

A revision of the Heteropteryginae (Insecta: Phasmida: Bacillidae) of Borneo, with the description of a new genus and ten new species

P.E. Bragg

Bragg, P.E. A revision of the Heteropteryginae (Insecta: Phasmida: Bacillidae) of Borneo, with the description of a new genus and ten new species.

Zool. Verh. Leiden 316, 31.iii.1998: 1-135, figs 1-150.— ISSN 0024-1652/ISBN 90-73239-61-3.

P.E. Bragg, 51 Longfield Lane, Ilkeston, Derbyshire, DE7 4DX, U.K.

Key words: Phasmida; Heteropteryginae; distribution; ecology; Borneo; new genus; *Spinodares*; new species; *Dares*; *Datames*; lectotypes.

The three tribes of Heteropteryginae Kirby, 1896 occurring in Borneo are nocturnal, and ground dwelling species, easily found in both primary and secondary rainforest. The subfamily is reviewed, with keys and redescriptions of all Bornean species; one new species of a predominantly Bornean genus is described from the Philippines. Lectotypes have been selected for a number of species. The eggs of 17 species are described and illustrated. Distribution maps are given for all species. Many of the species have been collected by the author and reared in the United Kingdom; some observations on their natural history and behaviour are included.

In the tribe Heteropterygini the synonymy has been re-examined with a revision to the status of several taxa. The five syntypes of *Haaniella grayii* (Westwood) were found to belong to two different species. In the tribe Datamini new terms are introduced for the spines and tubercles. A new genus, *Spinodares*, is described with *S. jenningsi* spec. nov. as the type species. All recorded Bornean specimens of *Dares* Stål, 1875 have been re-examined and the synonymy revised. Seven new species of *Dares* are described, six from Borneo: *D. kinabaluensis*, *D. mjobergi*, *D. multispinosus*, *D. murudensis*, *D. navangensis*, *D. planissimus*, and one from Palawan: *D. philippinensis*; this is the only record of the tribe Datamini from the Philippines. *Acanthoderus otys* Westwood, 1859 has previously been placed in the genus *Dares* Stål, 1875, it is found to belong in *Datames* Stål, 1875 with *Pylaemenes infans* Redtenbacher, 1906 as a new junior synonym; the female is described for the first time from a specimen in the Nationaal Natuurhistorische Museum, Leiden (RMNH). Two new species of *Datames* are described, one with three subspecies: *D. muluensis*, *D. borneensis borneensis*, *D. b. sepilokensis* and *D. b. waterstradti*. Of the twelve new taxa described eight are represented in the RMNH collection.

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Introduction

The Heteropteryginae Kirby, 1896 is the only subfamily of the Bacillidae which occurs in Borneo. Members of this subfamily are easily recognisable by their general body form, although a few species of Necrosciinae Brunner, 1893 (Heteronemiidae Rehn, 1904) have a superficial resemblance. The insects are flightless, nocturnal, and are not found in urban areas.

The last comprehensive treatment of the species belonging to this group was by Redtenbacher (1906). Since that date Rehn & Rehn (1938) have produced a monograph of Obrimini Brunner, 1893 of the Philippines and Günther (1944) produced a revision of the genus *Haaniella* Kirby, 1904. Between 1932 and 1944 Günther produced several papers describing new taxa and synonymising various species. Much of Günther's work on the group is found to be flawed, species were incorrectly synonymised and specimens misidentified; in many cases the errors have been demonstrated by captive breeding.

This paper deals with the Bornean members of the Heteropteryginae and includes some observations on some extralimital species. All Bornean species are redescribed in more detail than the original descriptions and new terminology is introduced specifically for the Datamini Rehn & Rehn, 1938. Observations on the ecology, behaviour and general biology are included in the comments which follow the description of each taxon.

Material

Due to the habitat and behaviour of these insects, few specimens are present in museums. Some type material has been examined for all the species. Previously recorded material has been re-examined where possible and material from various other museums has also been examined. Much of the examined material has been collected by myself and various companions during the past seven years. Some of the material has been reared in the U.K. A number of new taxa are described, most of these are represented in the Nationaal Natuurhistorisch Museum, Leiden, Netherlands.

Material has been examined from the following museums and institutes (with the acronyms indicated): BMKB, Brunei Museum, Kota Batu, Brunei; BMNH, Natural History Museum, London, United Kingdom; BPBM, Bernice P. Bishop Museum, Honolulu, Hawaii, USA; DCMD, Derby City Museum, Derby, United Kingdom; MHNG, Museo Civico de Storia Naturale "Giacomo Doria", Genova, Italy; MNHN, Museum National d'Histoire Naturelle, Paris, France; NHMN, Nottingham Natural History Museum, Wollaton Park, Nottingham, United Kingdom; NHMW, Naturhistorisches Museum, Wien, Austria; NHRS, Naturhistoriska Riskmusset, Stockholm, Sweden; NMSC, National University of Singapore, Singapore; OXUM, Oxford University Museum, Oxford, United Kingdom; RMNH, Nationaal Natuurhistorisch Museum, Leiden, Netherlands; SFDK, Sarawak Forestry Department, Kuching, Sarawak, Malaysia; SMSM, Sarawak Museum, Kuching, Sarawak, Malaysia; SMTD, Staatliches Museum für Tierkunde, Dresden, Germany.

In addition to museums and institutes, material has been examined from the following private collections: C.L. Chan, Kota Kinabalu, Sabah; P. Jennings, Derby, United Kingdom; O. Zompro, Kiel, Germany; F. Seow-Choen, Singapore.

Specimens from my personal collection have individual accession numbers, these are indicated by the initials PEB, followed by a hyphen, then the specimen number: e.g. PEB-1234. In the case of my own collection the specimens were collected by myself unless otherwise indicated.

Data is grouped by locality, and then given in the following format: sex (museum) collector, date.

In some cases the data labels give only the collector's initials; H.M.P. is probably H.M. Pendlebury, the others are unknown to me.

Distribution

Borneo is treated as four political areas: Brunei, Kalimantan (Indonesia), Sarawak (Malaysia) and Sabah (Malaysia); the latter two were separate countries until the formation of Malaysia in 1963. Historically Sarawak was part of Brunei, but became separate in various stages between 1841 and 1905. Sabah was known as British North Borneo from 1881 until 1963. Kalimantan was part of the Dutch empire, as Dutch Borneo, or just Borneo, until Indonesian independence in 1949. Locality labels reading "Brunei" and dated before 1905 could refer to what is now Sarawak, or even Sabah if dated before 1881. Most of the material from Borneo appears to have been collected after 1890, the exceptions being material described by Westwood and de Haan.

The original descriptions for many species give only "Borneo" or "Sarawak", or "North Borneo" as the locality; for most species there are no subsequent records. For a few species two or three localities have been recorded; however in several cases these are based on misidentified material.

The diverse nature of the ethnic groups and languages (English, Malay, various Chinese dialects, and various Dayak dialects) in use in Borneo means that place names and even mountains may have several different names; names differ on different maps. Spellings are frequently variable, the terminal endings "h" and "k" appear to be interchangeable, as do vowels, double consonants may become single (e.g. Semenggoh = Semenggok = Semongok; Simunjan = Simunjon). These changes also

apply to spellings of rivers, Rejang and Rajang are both used for the largest river in Sarawak, Mahakam and Mahakkam are both used for the largest river in Kalimantan. The traditional shifting cultivation means that names of villages present a further problem, the village may move but retain the original name. In addition to these problems, some specimen labels, particularly in the Sarawak Museum are handwritten and in a poor state of preservation.

Distribution maps have been plotted using longitude and latitude as indicated below.

 BRUNEI

Badas, swamp forest	E 114° 25'	N 004° 34'
Bandar Seri Begawan, Kota Batu	E 114° 57'	N 004° 53'
Kuala Belalong	E 115° 09'	N 004° 32'
Rampayoh, waterfall trail	E 114° 28'	N 004° 22'
Sungai Liang Forest Reserve (Kpg Sungai Liang)	E 114° 30'	N 004° 41'
Teraja, waterfall trail	E 114° 25'	N 004° 17'

KALIMANTAN

Boegan (see Long Bagoen)		
Boentok (= Buntok)	E 114° 50'	S 001° 44'
Long Bagoen (= "Boegan" = Long Bagun)	E 115° 13'	N 000° 36'
Long Bloe Oe (= Bluu)	E 114° 27'	N 000° 43'
Martapura	E 114° 49'	S 003° 27'
"Midden-O Borneo" [of Siebers]	E 116° 30'	N 001° 30'
Oeloe Kelai [upper River Kelai]	E 117° 00'	N 001° 50'
Pengaron	E 115° 03'	S 003° 18'
Poetoes Sibau (= Putussibau)	E 112° 56'	N 000° 51'
Pontianak	E 109° 20'	S 000° 02'
Ratu Miri, logging camp	E 113° 35'	S 000° 40'
Samarinda	E 117° 08'	S 000° 30'
Sambas	E 109° 18'	N 001° 22'
Sintang	E 111° 30'	N 000° 05'
Tabang	E 116° 01'	N 000° 34'

SABAH

Batu Putih	E 117° 56'	N 005° 26'
Bettotan [plotted at Sandakan]	E 118° 06'	N 005° 51'
Kallang	E 115° 59'	N 005° 07'
Kampung Madziang	E 116° 10'	N 005° 55'
Keningau	E 116° 09'	N 005° 20'
Kiau	E 116° 25'	N 006° 02'
Kimannis Logging Road (Kimannis to Keningau)	E 116° 00'	N 005° 30'
Kota Kinabalu	E 116° 04'	N 005° 57'
Kunak	E 118° 15'	N 004° 41'
Lok Kawi	E 116° 03'	N 005° 51'
Long Pa Sia	E 115° 43'	N 004° 24'
Marai-Parai (Marak-Parak)	E 116° 45'	N 006° 19'
Mendolong [approximate position]	E 115° 45'	N 005° 00'
Mostyn	E 118° 11'	N 004° 40'
Mt Kinabalu, near Park HQ	E 116° 33'	N 006° 00'

Mt Silam	E 118° 10'	N 004° 58'
Papar	E 115° 56'	N 005° 44'
Penampang	E 116° 06'	N 005° 54'
Poring Hot Springs	E 116° 43'	N 006° 03'
Sandakan	E 118° 06'	N 005° 51'
Sepilok, Forest Reserve	E 117° 57'	N 005° 50'
Sukau, Managgol River	E 118° 17'	N 005° 32'
Tawau	E 117° 54'	N 004° 15'
Tenom	E 115° 56'	N 005° 07'
Trus Madi (Mt Trus Madi)	E 116° 31'	N 005° 33'
Ulu Dusun	E 117° 45'	N 005° 46'
Ulu Mayog	E 116° 17'	N 005° 52'
SARAWAK		
20 km upstream of Kapit	E 113° 01'	N 002° 01'
2 km E of Serian, Rangan waterfall	E 110° 34'	N 001° 09'
6 km West of Sri Aman	E 111° 27'	N 001° 10'
Bako N.P.	E 110° 27'	N 001° 43'
Baki [plotted at Kapit]	E 112° 56'	N 002° 01'
Batang Lupar (Batang Lupar) [plotted at Sri Aman]	E 111° 27'	N 001° 14'
Batu Lawi	E 115° 15'	N 003° 50'
Bau, near Wind Cave	E 110° 08'	N 001° 24'
Bengoh	E 110° 16'	N 001° 14'
Bidi (= Gunung Buan Bidi)	E 110° 06'	N 001° 24'
Bintulu	E 113° 03'	N 003° 10'
Kuching	E 110° 21'	N 001° 33'
Kuching, 5th Mile	E 110° 20'	N 001° 29'
Kuching, 10th Mile (= Batu 10)	E 110° 19'	N 001° 25'
Lambir Hills N.P.	E 114° 02'	N 004° 12'
Lingga	E 111° 10'	N 001° 21'
Lio Match	E 115° 12'	N 003° 10'
Matang [treated as Mt Serapi]	E 110° 11'	N 001° 35'
Mt Api (Gunung Api)	E 114° 43'	N 004° 06'
Mt Dulit	E 114° 10'	N 003° 22'
Mt Gadin	E 109° 40'	N 001° 45'
Mt Mulu [summit]	E 114° 56'	N 004° 03'
Mt Mulu trail	E 114° 55'	N 004° 02'
Mt Santubong	E 110° 20'	N 001° 44'
Mt Sebakam	E 110° 17'	N 001° 15'
Mt Serapi	E 110° 11'	N 001° 35'
Mt Sunana	E 110° 17'	N 001° 15'
Niah N.P.	E 113° 43'	N 003° 52'
Pelagus logging camp	E 113° 00'	N 002° 15'
Penrissen (= Mt Penrissen)	E 110° 13'	N 001° 07'
Sadong hill (= Gunung Sadong)	E 110° 48'	N 001° 22'
Sarikei	E 111° 31'	N 002° 07'
Saribas (= Betong)	E 111° 35'	N 001° 25'
Simunjan (= Simunjon)	E 110° 45'	N 001° 23'
Tarum	E 111° 28'	N 001° 34'
Trusan	E 115° 16'	N 004° 47'

Records for the rivers Rajang, Baram, and Kapuas have not been plotted as they are long rivers and there is no indication of whereabouts on the river the material was collected; records for the River Purulon in Sabah have been omitted because more precise data is available in that area. Several places near Mt Kinabalu have not been located: Kabayau, Kamborangah, Kenokok, Lumu Lumu; in these cases the data is plotted at Mt Kinabalu summit if there are no other records in the surrounding area. Simatan probably refers to Semitau (E 111°57' N 000°33') but records for this locality have been excluded from the maps because of the uncertainty. Entawa, Gunung Sari, Dahan, Bungal have not been located.

Distribution maps are provided for all species. Because of the number of misidentified specimens which have been encountered, only records for examined specimens, have been included. Specific localities are indicated by a single dot, general localities, such as "Midden O-Borneo" which was given by Siebers, are indicated by a large open circle. Records limited to the country only have been omitted. Records which give only the name of a river are plotted as open circles near the mid-point of short rivers but are omitted for long rivers (e.g. Kapuas, Rajang). Records for the upper Mahakam from Dr Nieuwenhuis's expeditions in the 1890s are plotted as open circles at Long Bloe Oe which was the expedition's base; these are omitted if there is also a specific record for Long Bloe Oe.

Terminology

Wherever possible existing terminology has been used. The eggs are described using the standard terminology of Clark (1976). The term poculum is used for the male genital operculum in preference to subgenital lobe; when describing the insects, the use of operculum is restricted to the female. In two tribes, Heteropterygini and Obrimini, an ovipositor is formed by the elongation of the lamina supraanalis (eleventh tergite) and the operculum (seventh sternite); this is termed an oviscapt as it is analogous to the oviscapt which occurs in several groups of Diptera (by elongation of seventh tergite and seventh sternite).

Rehn & Rehn (1938) proposed names for the major spines (acanthotaxy) in the Obrimini, and suggested that the terminology could be modified to apply to all spiny phasmids. As in the tribe Obrimini, the spines and tubercles, and their relative sizes are very useful for distinguishing species in the Datamini. Consideration was given to the use of the same terms proposed for the Obrimini but this was found unsuitable for use with Datamini, mainly because of the highly tuberculate nature of some species, and the inappropriate notation used for the head, pronotum, and abdominal segments; in addition some of the spines named by Rehn & Rehn (1938) on the mesonotum or metanotum do not occur in the Datamini or would require redefining. Where appropriate, terminology has been adopted from Rehn & Rehn (1938) and where no suitable equivalent existed new terms are defined. Where homology between structures in Datamini and Obrimini is uncertain, new terms have been defined to avoid ambiguity with terms used by Rehn & Rehn (1938). In the following list terms used by Rehn & Rehn (1938) are indicated by (R&R) after the term. The typical range of size occurring in the Datamini is indicated. No new terms are proposed for spines on the Heteropterygini; where it is necessary to refer to specific spines on the Heterop-

terygini, the position has been described, or the closest term has been selected from those used for Obrimini or Datamini.

Acanthotaxy of the Datamini

Head (fig. 1)

Supra-antennals (R&R) = a pair just behind the base of the antennae. Usually absent in Datamini, if present they lie in front of the eyes and can be large.

Inter-orbitals = a pair of spines lying between the compound eyes (usually small or absent).

Pre-occipitals = spines, tubercles or a carinae on a line between the eye and the anterior occipitals. There may be a single pair or several spines or tubercles, or they may be absent. These may be homologous with Rehn and Rehn's supra-orbitals.

Lateral coronals (R&R) = a pair of spines on the postero-lateral angle of the head; always small in Datamini.

Occipitals (R&R) = in the Datamini the occipital region is often swollen and the occipital spines or tubercles clearly fall into three categories.

Anterior occipital = a pair of small to very large spines at the front of the swollen region.

Posterior occipital = a pair of small to very large spines at the back of the head. Possibly homologous with Rehn & Rehn's median coronals.

Central occipital = a single small to medium spine at centre of the anterior and posterior occipitals.

Pronotum (fig. 2)

Anterior pronotals = a pair of spines lying just behind the anterior margin, close to the centre-line (tubercles only in Datamini).

Pre-median pronotals = a pair of tubercles lying just in front of the median transverse groove.

Post-median pronotals = a pair of tubercles lying immediately behind the median transverse groove.

Posterior pronotals = a pair lying close to the posterior margin (tubercles only in Datamini).

Postero-lateral pronotals (R&R) = small spines or tubercles on the postero-lateral angle of the pronotum.

Mesonotum (fig. 3)

Antero-lateral mesonotals (R&R) = a pair of small spines or tubercles on the antero-lateral angle of the mesonotum.

Anterior mesal mesonotals (R&R) = a closely spaced pair of spines or tubercles near the anterior margin, close to the mid-line.

Anterior marginal mesonotals = a pair of quite widely spaced minute to very large spines or tubercles on the anterior margin of the mesonotum, sometimes absent. [Perhaps homologous with Rehn & Rehn's anterior mesal mesonotals but they are usually widely spaced and are on, or very close to, the anterior margin].

Posterior mesonotals (R&R) = spines or tubercles on the postero-lateral region of the mesonotum.

Posterior mesonotal mounds = a swollen area on the postero-lateral region of the mesonotum; sometimes spines are present on the mounds, particularly in males.

Posterior mesal mesonotals = a pair of spines or tubercles on posterior margin close to centre-line [similar to Rehn & Rehn's inter-posterior mesonotals, but much closer to the centre-line].

Metanotum (fig. 4)

Posterior metanotal mounds (R&R) = a swollen area on the postero-lateral region of the metanotum; sometimes with spines, particularly in males.

Posterior mesal metanotals = a pair of spines or tubercles on or near the posterior margin, close to the mid-line. [possibly homologous with Rehn & Rehn's first paired posteriors]

Abdomen (fig. 5)

First paired posteriors (R&R) = a pair on the posterior margin, near to the mid-line.

Second paired posteriors (R&R) = a pair on the posterior margin, more widely spaced than first paired posteriors; generally about mid-way between the first paired posteriors and the lateral margin.

Antero-laterals (R&R) = spines or tubercles on the anterior corners of the notum (rare in Datamini).

Postero-laterals (R&R) = spines or tubercles on the posterior corner of the notum.

Medio-lateral = spines or tubercles more or less in the middle of the lateral margin.

Mesopleuron (fig. 6)

Medio-lateral (R&R) = a single spine in the middle of the lateral margin of the mesopleuron. In Datamini this is minute or absent in females, and minute to small in males.

Metapleuron (fig. 7)

Metapleural (R&R) = a spine near middle of the metapleuron.

Laterals (R&R) = spines or tubercles on the anterior half of the ventro-lateral margin.

Supra-coxals (R&R) = spines or tubercles on the posterior half of the ventro-lateral margin, above the coxa.

Measurements

Unless otherwise indicated, measurements for each species are taken from the specimens with the longest and the shortest body length. Measurements were made using a mm ruler and are measured to the nearest 0.5 mm. However with some small species measurements were made to the nearest 0.1 mm using a binocular microscope fitted with an eyepiece graticule. The latter method was used for the shorter body lengths and the tarsi for most of the smaller species. For some species or individuals where measurement with a ruler was difficult because of leg position, the lengths of tibiae, and femora were also measured using a graticule.

Measurements of eggs were taken from randomly selected eggs (excluding any obviously deformed eggs), and were made using a graticule.

Drawings

Drawings of eggs, and selected portions of the insect body were made with the aid of a Wild M3 or M4 binocular microscope fitted with a drawing tube. Drawings of whole insects were made using a "Paxiscope" print projector (manufactured by Braun) to project an image of a set specimen onto the drawing paper, the main features of the insect were traced and the drawings completed using a binocular microscope.

Keys and diagnostic characters

It is intended that the keys presented here will be of use to both field ecologists and taxonomists. Keys are designed to use only external morphological characters which may be seen with the naked eye or with the aid of a hand lens. In some cases the keys refer to eggs, these may be helpful for confirmation but are not essential.

The presence of wings, an oviscapt, and spines on the pronotum is used to distinguish tribes. The genera and species are distinguished mainly by the arrangement of spines and tubercles. Diagnostic characters are not listed separately under the individual species headings but are used in the composition of the keys. In cases where confusion between species is possible a note is made in the comments section for the species.

Rearing in captivity

Most of the species which I have collected have subsequently been reared and have established sustainable cultures. Rearing has been useful in clarifying the synonymy in several cases, particularly with *Haaniella* and *Dares*. Specimens were reared in cages 60 cm tall, 30 cm wide and 30 cm deep of standard construction (Bragg, 1989). They were maintained at high humidity and bramble was used as the main food-plant. Scientific names for all foodplants used for rearing are given in table 1.

Biology and ecology

All members of the subfamily are nocturnal. In captivity the insects generally rest on the ground during the daytime, usually under leaves or under pieces of bark. In the wild, on Mt Serapi in Sarawak, *Epidares nolimetangere* (de Haan, 1842) was found to hide in the roots of small plants during the daytime, and at Bengoh I was told by the local people that *Haaniella grayii* may be found under logs and in tree stumps.

Most species of Heteropteryginae will feed on a wide variety of plants after capture, however, these plants may not form part of their normal diet. Table 2 lists the few identified plants which specimens have been observed feeding on before capture. Various species have been found feeding on a variety of other plants but these have not been identified.

Heteropterygini and Obrimini have an oviscapt and eggs are laid into the soil. Two species of Datamini have been observed to use the fore legs to bury the eggs (Abercrombie, 1992). Eggs become dehydrated and fail to hatch unless kept in a very

humid atmosphere or kept buried in a damp substrate. Eggs which are kept in a very wet substrate become waterlogged and fail to hatch. Eggs of Heteropteryginae can be hatched in about seven months if kept at 20-25°C but may take up to two years if unheated, this suggests that the eggs undergo diapause in cool conditions.

Heteropteryginae occur in a wide range of habitats in Borneo. Representatives of all three tribes have been found in both secondary and primary forest and with the exception of swamp forest, the subfamily has been found at every lowland site where more than 30 minutes were spent collecting. Two areas of swamp forest have been searched and no specimens found. In two nights at Simunjan specimens were found in dry areas near the swamp forest but not in the swamp area; in 12 nights at Kelambenkari no specimens were found. The absence of the subfamily from swamp forest is probably due to the eggs being laid in the ground, immersion for several days or weeks would cause the eggs fail to hatch. *Epidares nolimetangere* (de Haan) is particularly successful in areas of secondary forest, on Mt Serapi it is very common along the roadside, and is very common on the fringes of farmland at Bengoh. All three tribes have been found at about 1000 m, but only *Haaniella scabra* (Redtenbacher) has been found at 1500 m on Mt Kinabalu. No Heteropteryginae have been found at 3300 m on Mt Kinabalu although a few Heteronemiidae have been collected there.

Parasitic mites are common in the genus *Haaniella*, it is unusual to find specimens without mites (Bragg, 1993a). A mite was also found on a female *Dares ulula* (Westwood). Mermithid larvae (Nematoda: Mermithidae) have been found in *Haaniella echinata* (Redtenbacher) and *H. saussurei* Kirby. The larvae emerged from adult specimens within a few days of capture.

Spermatophores have been observed in two of the tribes (Bragg, 1991a, 1991f), Heteropteryginae: *Haaniella grayii* and *H. saussurei* and Obrimini: *Aretaon asperrimus* (Redtenbacher). As spermatophores have been recorded in a wide range of subfamilies (Bragg, 1991a) it is probable that this is also the method of sperm transfer in the tribe Datamini.

Bacillidae Brunner, 1893

Members of this family are distinguished from other families of Phasmida by having a sunken areola on the underside of the apices of the middle and hind tibiae, and by having a median segment which is shorter than the metanotum. The Heteropteryginae is the only subfamily of the Bacillidae which occurs in Borneo. Members of this subfamily are easily recognisable by their general body form, although a few species of Necrosiinae (Heteronemiidae) have a superficial resemblance.

Heteropteryginae Kirby, 1896

Heteropteryginae Kirby, 1896: 472; Rehn, 1904: 89; Kirby, 1904a; Karny, 1923: 234; Günther, 1953: 546, 551; Bradley & Galil, 1977: 198.

Distinguished from other Bacillidae by having antennae longer than the fore femora, and either the prosternum has two adjacent wart-like structures, or, in winged species, the apical area of middle and hind tibiae each have a small spine.

All members are strongly built, with relatively short legs and bodies for phasmids. The metanotum and median segment are fused but usually easily distinguished; the metasternum and median segment are fused and only distinguishable with difficulty, if at all. The bodies and legs are often armed with strong spines, or the body is verrucose. Eggs lack a capitulum.

Key to tribes of Heteropteryginae of Borneo

1. Males and females always winged, usually short wings, but may be full length
 tribe **Heteropterygini**
- Wingless 2
2. Female with oviscapt, male with spines on pronotum. [Pronotal foramen at anterior margin of pronotum; anterior mesosternal plate without raised median sensory area. Apex of tibiae armed with spine; lamina supraanalis of female obvious and clearly separated from 10th abdominal segment; oviscapt present]
 tribe **Obrimini**
- Female without oviscapt, male without spines on pronotum. [Pronotal foramen removed by more than its length from anterior margin of pronotum; anterior mesosternal plate with raised median sensory area. Apical area of tibiae without spines. Lamina supraanalis of female not visible] tribe **Datamini**

Comments.— The members of this subfamily are basically ground dwelling; most seem to hide in leaf litter during the day; eggs are buried in soil or leaf litter. Most of the Bornean species have been successfully reared in captivity, and, as might be expected for insects of limited mobility, most eat a wide variety of foodplants.

The distribution of the Heteropteryginae includes Indo-China, the Malay peninsula, Philippines, Borneo, New Guinea, Fiji, Indonesia, and Madagascar. One tribe, the Anisacanthini, contains only two genera and is restricted to Madagascar; the other three tribes are all represented in Borneo. The Obrimini are poorly represented in Borneo which appears to be the western limit of the tribe which extends eastward as far as New Guinea and Fiji (fig. 9); of the few species which do occur in Borneo most appear to be restricted to the north-east of the island. The Datamini are well represented in Borneo which is more or less in the centre of the recorded distribution of the tribe (fig. 10). The Heteropteryginae are also well represented; records for the tribe are restricted to the Malay peninsula, Borneo, Sumatra, Java and Sulawesi (fig. 8).

Heteropterygini Kirby, 1896

Heteropteryginae Kirby, 1896: 472.

Heteropterygini Günther, 1953: 551; Bradley & Galil, 1977: 199.

Body broad and short, not stick-like. Head and body usually spiny. Female abdomen dorsoventrally compressed; male abdomen slender and cylindrical. Lamina supraanalis and operculum elongated to form an oviscapt. Wings and elytra present, usually much shorter than body length. All femora with four distinct carinae; carinae usually spiny. The eggs lack a capitulum.

Two genera, *Heteropteryx* and *Haaniella* are represented in Borneo. Observations on a third genus, *Miroceramia*, from Sulawesi are also included in this section.

Key to the genera of Heteropterygini

1. Thorax and tibiae not equipped with spines; hind wings of female distinctly longer than elytra. [Recorded only from Sulawesi] *Miroceramia* Günther
- Undersides of tibiae with large distinct spines. Thorax almost always equipped with at least a few distinct spines. In resting position, hind wings of females do not project from under elytra 2
2. Wings of male reaching end of abdomen, longer than elytra; body of male brown. Female with wings covering third abdominal segment; body of female green or yellow *Heteropteryx* Gray
- Males and females both with short wings, covering no more than first three abdominal segments in Bornean species; bodies of males and females brown
..... *Haaniella* Kirby

Haaniella Kirby, 1904

Haaniella Kirby, 1904a: 444; Kirby 1904b: 397; Dohrn, 1910: 401; Karny, 1923: 234; Rehn, 1938: 367; Günther, 1944: 68; Bradley & Galil, 1977: 199. Type species: *Haaniella muelleri* (de Haan) [*Phasma* (*Heteropteryx*) *mülleri* de Haan, 1842] by original designation.
Heteropteryx Redtenbacher 1906: 168; Giglio-Tos, 1910: 14 (not *Heteropteryx* Gray, 1835).

Description.— Broad, heavy body, not stick-like. Pronotum trapezoidal, slightly longer than wide; mesonotum almost rectangular, 1-2 times longer than wide; metanotum shorter than wide. Back of head rounded and spiny. Pronotum, mesonotum, prosternum, mesosternum, metasternum, abdominal sternites, and all femora and tibiae spiny. Exposed areas of upper side of abdomen often with spines or tubercles. Lateral margins of thorax and abdomen with numerous small spines. Spines on males generally larger than corresponding spines on females. Wings completely covered by elytra; wings and elytra short, more or less oval, covering only a few abdominal segments. Antennae much longer than fore legs. Bodies of females and males predominantly brown. Abdomen of male slender and cylindrical. Anterior of female abdomen wide, narrowing towards posterior. Femora thickened, particularly hind femora. All femoral carinae armed with spines. Hind tibiae armed with large spines (larger than femoral spines) on underside; middle and fore tibiae, and dorsal side of hind tibiae, with (usually very distinct) spines. Lamina supraanalis elongated and distinct in females, very short or not visible dorsally in males. Praeopercular organ of females usually a small swelling with two spines. Fifth tarsomere about as long as first four together.

Bornean species (only): Lateral margins of abdominal tergites 2-7 armed with 7 (very rarely 6 or 8) minute lateral pointing spines [*H. muelleri*, from West Malaysia, has only 4 (rarely 3 or 5) such spines, and only on segments 2-6].

Key to species of the genus *Haaniella*
(Measurements in brackets refer to captive-reared specimens)

1. Lamina supraanalis of females not serrated or toothed, often only superficially indented, terminating as a blunt fork or a double point. Even in adult insects front wings do not overlap when in resting position. Hind tibia with large, more or less straight, triangular spines of similar size.
Three species, none from Borneo: *H. muelleri* (de Haan), *H. parva* Günther, *H. jacobsoni* Günther; there are several subspecies of *H. muelleri* (see Günther, 1944).
- Lamina supraanalis of females serrated, with 4-8 teeth, sometimes very small. When in resting position, front wings of adults always overlap each other with at least middle section of their hind edges. Hind tibia with conspicuous, usually curved, spines which increase in length towards apices of tibiae; small spines between these spines. All species in this group occur in Borneo 2
2. Mesonotum with two pairs of similarly sized spines; one pair just behind anterior margin and second pair near middle of mesonotum. Abdominal terga with with central pair of spines; spines very large on segments 2-4 of males, may be present only as small spines on few terga of females 3
- Mesonotum with only one pair of medium or large spines, just behind anterior margin; no similar sized pair near middle of mesonotum, only a few small spines. Abdominal tergites without obvious paired spines in centre 4
3. Between bases of elytra, just in front of posterior margin of mesonotum, four spines of similar size on common base. Body length: male 75-95 mm, female 101-138 mm *Haaniella grayii* (Westwood)
- Between bases of elytra, just in front of posterior margin of mesonotum, only two spines of similar size on common base (occasionally with two very much smaller spines). Body length: male 61-76 mm, female 86-102 mm
..... *Haaniella dehaanii* (Westwood) **stat. rev.**
4. Mesonotum with large pair of spines on anterior of lateral margin; spines clearly much larger than subsequent laterals, and of similar size to anterior marginals. Pronotum usually with obvious posterior pronotal spines, in addition to large pre-median pronotals. Eggs barrel shaped 5
- All spines on lateral margins of mesonotum of equal size. Pronotum with only small or hardly perceptible posterior pronotal spines. Second to sixth abdominal segments of male of similar breadth. Eggs lemon shaped. Large species: male 83-90 mm, female 125-136 mm *Haaniella saussurei* Kirby
5. Abdominal segments 3-7 with numerous minute spines all of similar and more or less in rows. Wings of female cover only the first two abdominal segments. Abdominal segments of male gradually taper from second to sixth segment. Body length of male (72-) 76-92 mm, female (90-) 92-134 mm
..... *Haaniella echinata* (Redtenbacher)
- Abdomen rugose dorsally, not spinose, except on the lateral margins. Wings of female usually cover first three abdominal segments. Spines on underside of abdomen relatively large, almost as long as largest spines on mesonotum. Small species: male 45-58 mm, female 60-76 mm
..... *Haaniella scabra* (Redtenbacher) **stat. rev.**

Comments.— There are eight species in the genus, five occur in Borneo and all five are endemic. For distinguishing the Bornean species of *Haaniella*, the following spines are significant (see fig. 11): relative size of the anterior and subsequent spines on the lateral margin of the mesonotum (fig. 11, B), number of pairs of spines on the mesonotum (fig. 11, C), presence of spines on the posterior half of the pronotum (fig. 11, A), number of spines between the bases of the elytra (fig. 11, D), large spines on the abdomen (fig. 11, E).

All species seem to prone to parasitic mites to the extent that it is very rare to find a specimen without mites. A survey of four Bornean species in 1991 found mites on 63 of the 64 specimens examined, the exception being a first instar nymph (Bragg, 1993a). The mites are reddish-brown in colour and are usually found in the abdominal pits but may be found on the antennae, legs and dorsal surface of the body. Parasitism by endoparasites has been reported in a female *H. echinata* from Brunei - the specimen contained a 54 cm long Mermithid larva (Bragg, 1993a: 40). In addition, a mermithid larva was taken from an adult female *H. saussurei* (PEB-2166) in 1994.

All can be reared in captivity (although *H. scabra* is proving difficult) and feed on a wide variety of plants. Standard cages are used with a large container (20 cm × 15 cm, and 6-12 cm deep) of damp "Vermiculite" being provided for egg laying. Eggs take 8-18 months to hatch (temperature dependent) and it is assumed that they undergo a long diapause if kept cool (ambient room temperature in United Kingdom). There is clear evidence of a reduction in mean size of *H. echinata* when reared; there is no apparent reduction in size with *H. grayii*; insufficient data is available for the other species.

Mating takes place immediately after the female has undergone the final ecdysis, before she has had time to eat her old skin (she may do this during mating). Mating is initially frequent but becomes rarer as the female ages. It is possible that males are more strongly attracted to the large females rather than small ones; when two females (lengths 109 mm and 138 mm) were kept with one male mating appeared to be more frequent with the larger female. Fertilization is brought about by transfer of spermatophores, this has been observed in 3 species in the genus, *H. muelleri*, *H. saussurei* and *H. grayii* (see: D'Hulster, 1990; Bragg, 1991a; 1991f). The spermatophores are spherical, white and about 3 mm in diameter. During mating the end of the male abdomen just covers the praeopercular organ and the male's claspers grip the organ (from observation of *H. grayii*).

All but one of the Bornean species are large and, at least until recently, they were widely used as a source of food by the indigenous tribes; they are still eaten in the region around Kapit.

Haaniella dehaanii (Westwood, 1859)

Heteropteryx De Haanii Westwood, 1859: 83, pl. 3.7 (♀). Holotype, ♀ (BMNH, 48-40), Borneo.

Haaniella dehaanii; Kirby, 1904b: 398.

Heteropteryx de Haani; Redtenbacher, 1906: 169.

Heteropteryx dipsacus Redtenbacher, 1906: 170. Lectotype [here selected], ♀ (MCSN), Sarawak, Borneo, coll. G. Doria, 1865-1866. Batan Lupar, 1867, leg. O. Beccari. Paralectotype, ♂ (MCSN), Sarawak, Borneo, coll. Doria & Beccari. **Syn. nov.**

Haaniella grayi dehaanii; Günther, 1944: 71.

Haaniella grayi dipsacus; Günther, 1944: 71.

Haaniella dehaani; Bragg, 1992a: 5 [not a subspecies of *H. grayii*].

Material.— **Borneo**: Locality unknown: ♀, holotype, *H. dehaanii* (BMNH, 48-40) [no date, acquired 1848]; ♀ (PEB-1760), ♂ (PEB-1761), bred by Kim D'Hulster, 1992; ♀ (PEB-2043), captive reared, 1994; ♀ (PEB-2044), mounted with eggs, captive reared, 1994; eggs (PEB-1411), bred by Kim D-Hulster, 1991; eggs (PEB-1778), laid by PEB-1760, captive reared 1992; eggs (PEB-2045), removed from body of PEB-2044, captive reared 1994.— **West Borneo**: Locality unknown: ♂ (BMNH, 86-44) [no date].— **Sarawak**: Locality unknown: ♀, lectotype, *H. dipsacus* (MCSN), O. Beccari, 1867. Batan Lupar: ♂, paralectotype, *H. dipsacus* (MCSN), Doria & Beccari. Mt Serapi, 90 m: ♀ (PEB-1595), 2 ♂♂ (PEB-1593; PEB-1594), ♀ nymph (PEB-1597), ♂ nymph (PEB-1598), nymph (PEB-1599), 05.viii.1992; 2 ♂♂ (PEB-296; PEB-297), 19.viii.1991; eggs (PEB-299; PEB-300), Paul Jennings, 13.viii.1990; egg (PEB-1596), laid by PEB-1595, 05.viii.1992; 2 ♀♀ nymphs (PEB-298; PEB-1208), 19.viii.1991. Mt Serapi [altitude unknown]: ♀ nymph (PEB-295), viii.1989. Penrissen, 4400 [ft ?]: ♀ nymph (RMNH) [label badly faded, may not be Penrissen].

Adults.— Colour variable (tending to darken with age), body generally mid to dark brown, but may be light brown or almost black; large spines frequently green, particularly in males. Basal half of male elytra brown, apical half white with brown veins; female elytra usually brown but basal half may be light brown to cream. Measurements of males given in table 3, females in table 4.

Head armed with eight medium spines arranged in longitudinal rows: two inner rows of two spines and two outer rows of two spines.

Pronotum with one small to medium spine on each corner of fore margin; one large pair, close to centre line, just in front of mid point; one medium, widely spaced pair just in front of hind margin.

Mesonotum with one widely spaced pair of large spines just behind fore margin; one large pair close to mid point; one anterior pair of minute spines and one posterior pair of large spines on common base between bases of elytra; anterior spine on lateral margin large, remainder small. Mesopleuron triangular, with row of medium to small spines on ventral margin and large spine just in front of centre of hind margin. Metapleuron with row of medium to large spines on ventral margin and large spine in centre.

Metanotum and median segment without spines; metanotum with slightly raised mound in centre.

Centre of abdominal tergites 2-6 of male with one pair of spines, large on tergite 2 decreasing to small on tergite 6. Females with small pairs of spines at centre of tergites 3-5. Tergites 2-7 with minute spines on lateral margins and dorsally with randomly placed minute spines.

Prosternum spineless. Mesosternum with two or three pairs of medium spines near centre of lateral margins; one minute pair on margin by each coxa; randomly scattered minute spines, particularly on hind half. Metasternum with one minute central pair of spines on hind margin, two pairs of small to medium spines on lateral margins, and one minute spine near base of each coxa. Median sternite with one medium pair of spines on hind margin. Abdominal sternites 2-4 (occasionally 5th) with four longitudinal rows of medium to minute spines, each row consisting of two spines per sternite decreasing in size towards the rear, spines of outer rows all minute. Few randomly scattered minute spines may be present on abdominal tergites 2-6.

Elongated lamina supraanalis of female terminates in 6-8 triangular teeth and projects beyond operculum (figs 12-14). Operculum with distinct central longitudinal carina and apical notch. Praeopercular organ consists of minute spineless swelling. Tenth segment of male with notch in apex. Poculum deep, apex rounded, with downward curving rim. Cerci of male and female short, slightly flattened with blunt point at apex.

All femoral carinae, except for ventro-posterior of fore femora, armed with at least few medium spines; ventro-posterior of fore femora and all hind femoral carinae with small to minute spines; other carinae rarely with small or minute spines. Dorsal carinae of all tibiae with minute spines. Ventral carinae of fore and middle tibiae with small spines. Ventral carinae of hind tibiae with small spines basally, increasing to large (straight or slightly curved) spines apically; with minute spines between others.

Egg.— (figs 31-32). Barrel shaped, with rounded ends; mid brown; densely setose. Capsule with very short setae, slightly longer at opercular end and on operculum. Micropylar plate "X" shaped with micropyle between arms at polar end. Operculum almost circular, convex. Typical measurements from Mt Serapi: length 10.0 mm, height 7.2 mm, width 6.5 mm. Material from unspecified area typically: length 9.0 mm, height 6.2 mm, width 5.6 mm.

Comments.— Having collected this species on Mt Serapi, and examined the type specimens of *dehaanii* and *dipsacus*, it is clear that they are the same species. The curvature of the spines in *dipsacus*, and the straight spines of *dehaanii* is a variable feature within the population on Mt Serapi. There are differences in the relative size of the legs, the specimens of *dipsacus* have legs which are relatively longer in both sexes. The largest male is the paralectotype of *dipsacus* with 77 mm; my wild caught males range from 69-75 mm (n = 4), the legs of the longest specimen are relatively short compared to the type of *dipsacus* (e.g. fore femur 18.5 mm : 20 mm) while the antennae are longer (60 mm : 55 mm). Females range from 89.0-99.5 mm but the lectotype of *dipsacus* (98 mm) has much longer legs than other specimens so data for this specimen is given in the table. The smallest adults examined are reared, male 63 mm, female 89 mm; as the largest female is also reared (99.5 mm) there is no indication that rearing reduces the size.

As previously noted (Bragg, 1992a), *H. grayii* and *H. dehaanii* are sympatric on Mt Serapi and no intermediate forms have been found, they are therefore treated as distinct species. Although not uncommon on Mt Serapi, they appear to be restricted to a small area; with one exception, all specimens collected by myself and companions were collected along one path near the base of the mountain (the exception was collected along the roadside near to the junction with the path); *H. grayii* also occurred along this path. The paralectotype of *H. dipsacus* is labelled "Batan Lumar", presumably Batang Lumar, the river flowing through Sri Aman.

Foodplants include bramble, oak, and pyracantha.

Haaniella echinata (Redtenbacher, 1906)

Heteropteryx echinata Redtenbacher, 1906: 171 pl. 6.10 (♂) & 6.11 (♀); Giglio-Tos, 1910: 14; Syntypes, ♂♂ & ♀♀ (NHMW, 284) (ZMHB) (ZMAS) (M. Burr) Borneo.

Haaniella echinata; Rehn, 1938: 368; Cocking, 1986: 7; Harman, 1987: 380-382, figs. 1(♂), 2(♀) & 3(egg); Hausleithner, 1991: 219; Schulten, 1995: 96, figs. 58 (♀), 59 (♂ & ♀).

Haaniella echinata echinata; Günther, 1944: 71.

[not *Haaniella saussurei* (Redtenbacher, 1906); **erroneous synonym** by Rehn, 1938: 368].

[not *Haaniella scabra* (Redtenbacher, 1906); **erroneous synonym** by Günther, 1944: 72].

[not *Haaniella echidna* Rehn, 1938; **erroneous synonym** by Günther, 1944: 72].

Material.— **Borneo**: Locality unknown: ♀ nymph (BMNH, 94-138), ♂ nymph (BMNH, 1905-100), ♂, ♀ (BMNH) 1888 [no accession data]; ♀ (BMNH, 56-44), ♀ nymph (SMSM-120).— **Brunei**: Locality unknown: 3 ♀♀, 5 ♀♀ nymphs, 5 ♂♂ (OXUM), Waterstradt van der Poll, bought Janson, 1909. Badas, swamp forest: ♀ (PEB-2163), mounted with egg, 31.x.1994; ♂ (PEB-2165) [No large central spines on rear of pronotum], 31.x.1994. Temburong District, Kuala Belalong, 100 m: ♀ (PEB-499), viii.1991; ♀ (PEB-192), 3 ♂♂ (PEB-191; PEB-500; PEB-964), viii.1991; ♀ (BMKB, PEB-966), collected as nymph and reared to adult, viii.1991; ♀ (BMKB, PEB-962), ♂ (BMKB, PEB-965), 3 ♀♀ nymphs (BMKB, PEB-960; BMKB, PEB-967; BMKB, PEB-968), ♂ nymph (BMKB, PEB-969), viii.1991; eggs (BMKB, PEB-1106), 02.viii.1991. Teraja, waterfall trail: ♀ nymph (PEB-2164), 03.xi.1994.— **Kalimantan**: Oeloe Kelai: ♀ nymph (RMNH), Midden O. Borneo Expedition, Kapt. Buyo, ix-x.1925. [Illegible] Balekpapan Road: ♀ (RMNH), vii.1912. Central E Borneo: ♀ (RMNH), H.C. Siebers, 14.ix.1925; ♀ nymph (RMNH), H.C. Siebers, 07.ix.1925.— **Sabah**: Locality unknown: ♂ (BMNH, 88-122), 2 ♀♀, ♂ nymph (BMNH, 1917-96); 2 ♀♀, 2 ♀♀ nymphs (RMNH), N. Borneo Expedition, Mohari, 1912; ♀ (PEB-257), ♂ (PEB-258) bred by Neil Hubbard, 1988; ♀ (PEB-2046) original PSG stock, captive reared 1994; ♂ (PEB-1472) captive reared 1992; ♂ nymph (PEB-1029) captive reared 1992; 2 nymphs (PEB-259; PEB-260) original PSG culture, captive reared 1991; eggs (PEB-1410) bred by Neil Hubbard, 1989. Mt Kinabalu, Poring Hot Springs, 760 m: ♀ (PEB-273), 31.vii.1990; eggs (PEB-272) removed from body of PEB-273, 31.vii.1990. Kabayau 600 ft (near Kinabalu): ♂, ♀ (RMNH), 09.v.1929 [From H.M. Pendlebury collection]. Sepilok: ♀ (PEB-1684), 22.viii.1992; ♂ (PEB-1683), 24.viii.1992. Ulu Dusun: 2 ♂♂ (BMNH, 1982-387), A. Harman, 1977; ♀ (J. Cocking), J. Cocking, 04.vi.1984. Bettotan (near Sandakan): ♀ nymph (RMNH), C.B.K. & H.M.P., 21.viii.1927. Long Pa Sia: ♂ (RMNH), Singar Bin Baru, xi-xii.1987. Bungai: ♀ (BMNH, 1955-354), ex FMS collection.— **Sarawak**: Locality unknown: ♀, ♂ (BMNH, 1917-59), 2 ♀♀ nymphs (BMNH, 56-44), 2 ♂♂ nymphs, ♀ nymph (BMNH, 87-14), 2 ♀♀ (PEB-1806; PEB-1807), captive reared 1992; 3 ♂♂ (PEB-1808; PEB-1809; PEB-1810), captive reared, 1992. Rajang River: ♀ (BMNH, 87-14), 20 km upstream of Kapit: ♀ (PEB-261), ♂ (PEB-274), collected as mating pair, 07.viii.1990; 2 ♂♂ (PEB-275; PEB-478), 07.viii.1990; egg (PEB-509), laid by PEB-261, 07.viii.1990. Pelagus Logging Camp, 40 km from Kapit: ♀ (PEB-477), ♂ (PEB-1211), collected as a mating pair, 08.viii.1990; eggs (PEB-479), laid by PEB-477. Kapit area: eggs (PEB-1890), viii.1990; ♂ (PEB-2047), 1st generation captive bred, 1994. Trusan: ♀ (BMNH, 1955-354), ex FMS collection. Mt Dulit: ♂ (BMNH, 1933-254), foot of Mt Dilit (junction of Tinjar and Lejok rivers). Lio Matah: ♀ nymph (SMSM-119), G.M. [no date]. Niah: ♀ (SFDK), 26.ii.1979. Batu Niah: 3 ♂♂ (BMNH, 1982-387), A. Harman, xii.1980; ♀, 2 ♂♂ (BMNH, 1982-387), A. Harman, xi-xii.1980. Niah NP: ♀ (PEB-1632), ♂ (PEB-1634), ♀ nymph (PEB-1737), 17.viii.1992; eggs (PEB-1633), laid by PEB-1632. Lambir Hills NP: ♀ (PEB-1620), ♂ (PEB-1619), 18.viii.1992. Baram: ♂ (BMNH, 92-24) [acquired 1892]. Mulu NP, Hidden valley, camp 6: ♀ nymph (BMNH, 1982-206), P. Chapman, 20-28.iii.1978.

Additional material in the collection of C.L. Chan, all examined to confirm species, only localities were recorded: **Brunei**: Beliat district, Rampayah waterfall trail; Sungai Liang Forest Reserve; Kuala Belalong.— **Sabah**: Poring Springs; Sepilok; Ulu Dusun; Penampang; Tenom district, Sungai Purlon, 300 m; Ulu Mayog; Kallang; Lahar Datu, Mt Silam, 2200 ft; Keningau, Apin Apin; Batu Putih; Sipitang district, Mendolong, SFI area, 800 m.— **Sarawak**: Mulu NP, Gunung Mulu trail.

Adults.— Colour variable (tending to darken with age), body generally mid to dark brown, plain or mottled; large spines frequently green, particularly in males; coxa-trochanter joint often blue-green. Male elytra brown, often with white diagonal stripe running from near base on leading edge to near apex of hind edge, although

other patterns do occur; female elytra usually brown but occasionally with some white markings; both sexes frequently with large black spot just behind middle of leading edge. Measurements of males given in table 3, females in table 4.

Back of head armed with two transverse rows of four medium spines; in front of these may be a row of two or four smaller spines; some minute spines may also be present.

Pronotum with one small to medium spine on each corner of fore margin; one large pair, close to centre line, just in front of mid point; one medium, widely spaced pair just in front of hind margin; one small to medium pair just in front of hind margin, not far from centre line (latter pair serves to distinguish this species); transverse row of four spines at front of posterior half (similar to those at rear) rarely present.

Mesonotum with one transverse pair of large spines just behind fore margin; group of four medium to large spines on common base between bases of elytra (anterior pair of this group may be shorter than posterior pair); anterior spine on lateral margin large, remainder small. Mesopleuron triangular, with row of medium to small spines on ventral margin and large spine just in front of centre of hind margin.

Metapleuron with row of medium to large spines on ventral margin and large to very large spine in centre. Metanotum and median segment without spines; metanotum with central tuberculate swelling (group of 4 spines in nymphs).

Abdominal tergites 2-7 with row of 6-8 (usually 7) minute spines on lateral margins, dorsally with randomly placed minute spines (sometimes with double row along centre-line).

Prosternum spineless. Mesosternum with three pairs of medium spines near centre of lateral margins; one small pair on margin by each coxa; randomly scattered minute spines, particularly on hind half. Metasternum with one small central pair of spines on hind margin, three medium spines on each lateral margin, and one small spine near base of each coxa; occasionally with few randomly scattered minute spines. Median sternite with one medium pair of spines on hind margin. Abdominal sternites 2-7 with four longitudinal rows of medium to small spines, each row consisting of two spines per sternite decreasing in size towards rear; few randomly scattered minute spines may be present between inner rows. Elongated lamina supraanalis of female truncated, with 4 minute teeth, not projecting beyond operculum. Operculum with distinct central longitudinal carina and rounded, downward curving apex (figs 15-17). Praeopercular organ consists of one pair of spines on swollen base. Tenth segment of male with indented apex; lamina supraanalis usually visible as small pointed lobe, not projecting beyond lateral apices of tenth segment. Poculum deep, apex rounded, with downward curving rim. Cerci of male and female short, slightly flattened with rounded point at apex.

All femoral carinae, except for ventro-posterior of fore femora, armed with at least few medium spines; all femoral carinae with small to minute spines. Dorsal carinae of all tibiae with minute spines. Ventral carinae of fore tibiae with small or minute spines; ventral carinae of middle tibiae with small spines. Ventral carinae of hind tibiae with small spines basally, increasing to large curved spines apically; with minute spines between others.

Egg.— (figs 27-28). Barrel shaped, with rounded ends; mid brown; densely setose. Capsule with medium-long setae, generally obscuring surface details; length 9.5 mm,

height 6.0 mm, width 5.5 mm. Micropylar plate basically "X" shaped, arms at polar end have bend near apex; with micropyle between arms at polar end. Operculum almost circular, convex, lacking capitulum.

Comments.— This is a common and quite widespread species. At Pelagus logging camp in 1990 I was told by a local Iban man that they are eaten by the Iban people. The specimens recorded by Giglio-Tos (1910) from Samarinda are not included on the distribution map as I have not checked these specimens.

H. echinata is quite easy to rear in captivity although not as easy as *H. grayii*. There is a remarkable difference in the size of captive-reared specimens: they are much smaller than wild-caught specimens. Captive males 68-77 mm, wild males 84-94 mm; captive females 91-97 mm, wild females 109-134. Foodplants include bramble, flowering currant, hawthorn, ivy, oak, pyracantha, raspberry, rose, and silver birch.

Haaniella grayii (Westwood, 1859)

Heteropteryx grayii Westwood, 1859: 82. pl. 30.2 (♂), & 30.3 (♀). Lectotype [here selected], ♀ (OXUM, 529, 3/4, 1830-73), Borneo; Paralectotypes [all are *H. saussurei*]: 2 ♂♂, ♀ (OXUM, 529), ♂ (BMNH, 58-66), Borneo [BMNH specimen has two pairs of anterior mesonotals].

Heteropteryx grayi; Sharp, 1895: 262; Redtenbacher, 1906: 170.

Heteropteryx australe Kirby, 1896: 472; Kirby, 1904b: 398. Lectotype [here selected], ♂ (BMNH, 73-12) Australia; Paralectotype, ♀ (BMNH, 73-12) Australia. [synonymised by Günther, 1944: 71].

Haaniella grayii; Kirby, 1904b: 397.

Haaniella grayi; Günther, 1932a: 66; Rehn, 1938: 368.

Haaniella grayi grayi; Günther, 1935b: 124; Günther, 1943: 150; Günther, 1944: 71; Bragg, 1990: 157; Bragg, 1991f: 8.

[not *Haaniella grayi dehaani* (Westwood, 1859); **erroneous synonym** by Günther, 1944: 71].

[not *Haaniella grayi dipsacus* (Redtenbacher, 1906); **erroneous synonym** by Günther, 1944: 71].

Material.— **Borneo**: locality unknown: ♀, lectotype, *H. grayii* (OXUM, 529, 3/4, 1830-73); ♂ nymph (OXUM), Wallace [no date]; 2 ♀♀ (RMNH).— **Western Borneo**: ♂ (RMNH), "Australia" [Locality suspect]; ♂, lectotype, ♀ paralectotype *H. australe* (BMNH, 73-12).— **Kalimantan**: Sungai Ratu Miri, Ratu Miri logging camp: ♀ (PEB-2421), collected as nymph, 19.viii.1993; ♂ (PEB-2420), collected as nymph, 22.viii.1993 [died xi.1994]. Kapoeas: ♂ nymph (RMNH), Borneo expedition Dr Nieuwenhuis, 1894. Mahakkam: 2 ♂♂, ♂ nymph, ♀ (RMNH), Borneo expedition Dr Nieuwenhuis, 1894. Upper Mahakkam: 2 ♂♂, 4 ♂♂ nymphs, ♀, 9 ♀♀ nymphs (RMNH), Borneo expedition Dr Nieuwenhuis, 1894. Long Bloe Oe: 2 ♂♂, 3 ♀♀, 4 ♂♂ nymphs, 6 ♀♀ nymphs (RMNH), Borneo expedition Dr Nieuwenhuis, 1898; ♂, 7 ♂♂ nymphs, 4 ♀♀ nymphs (RMNH), Borneo expedition Dr Nieuwenhuis, xi.1898; ♀ (RMNH), Borneo expedition Dr Nieuwenhuis, 1894. Boegen: ♂, 2 ♀♀ nymph (RMNH), Borneo expedition Dr Nieuwenhuis, 1894. Gunung Sari, 95 m: ♂ (RMNH), A.M.R. Wegner, 21.viii.1956. Bengen River, Tabang: 2 ♂♂ nymphs (RMNH), A.M.R. Wegner, 04.x.1956; ♂ nymph (RMNH), A.M.R. Wegner, 26.x.1956. Sambas: ♀ (RMNH), Dr Bosscha, 1891. Sintang: ♀ (RMNH), Guedhuis Borneo Expedition, ix.1891. Simatan: 2 ♀♀ (RMNH), J.v.Veldhuijzen (Borneo expedition) [no date]. Central E Borneo: 2 ♂♂ (RMNH), H.C. Siebers, 31.viii.1925; nymph (RMNH), H.C. Siebers, 10.viii.1925.— **Sarawak**: locality unknown: ♀, ♀ nymph (BMNH, 1931-570), C.J. Brooks, 1909; ♀ (BPBM), T.C. Maa, 1958-1959. Mixed localities (reared material): 2 ♀♀ (PEB-480; PEB-1202), ♂ (PEB-1212), ♀ nymph (PEB-1201), 2 ♂♂ nymphs (PEB-1218; PEB-1222), 1989; ♀ (PEB-1842), ♂ (PEB-1843) collected as nymphs, viii.1991; ♀ (PEB-1917), ♂ (PEB-1943), ♂ nymph (PEB-1913), 1993; 2 ♀♀ (PEB-2042; PEB-2426), 1994; eggs (PEB-482), captive reared, 1989; ♀ nymph (PEB-1219), captive reared from eggs laid viii.1989, died i.1991; nymph (PEB-1217), 1st generation captive reared, i.1991; nymph (PEB-2048), captive reared 1994. Bau: ♂ (BMNH, 1931-150), J.M. Bryan, vi.1912. Bau, near Wind Cave: ♀

(PEB-1541; PEB-1538), 08.viii.1992; egg (PEB-1542), from PEB-1541, 08.viii.1992. Kpg Bengoh: ♂ (PEB-481), ♀ nymph (PEB-1204), 27.vii.1989. Dahan: ♂, ♀ nymph (BMNH, 1931-150), J.M. Bryan, xii.1913. 2 km E of Serian, Rangkap waterfall: ♀ (PEB-2342), 2 ♂♂ (PEB-2340; PEB-2341), 09.xi.1994. Mt Matang: ♂ (SMSM-114), 1909. Mt Serapi, 600 ft: ♂ (SMSM-526), P.E. Bragg, 05.viii.1992; ♀ (SFDK), P.E. Bragg, 04.viii.1992; ♂ (SFDK), P.E. Bragg, 05.viii.1992. Mt Serapi, 90 m: 3 ♂♂ (PEB-288; PEB-290; PEB-293), 19.viii.1991. Mt Serapi, 120 m: ♂ (PEB-1209), 2 ♀♀ nymphs (PEB-1206; PEB-1216), 26.vii.1991. Mt Serapi, 150 m: ♀ (PEB-287), ♂ (PEB-1210), eggs (PEB-1412), 27.vii.1991. Mt Serapi, 240 m: ♂ (PEB-289), 26.vii.1991. Mt Serapi, 260 m: ♂ nymph (PEB-1221), 26.vii.1991. Mt Serapi, 300 m: ♀ nymph (PEB-1207), 26.vii.1991. Mt Serapi (unspecified altitude): 3 ♂♂ (PEB-286; PEB-1213; PEB-1214), 3 ♀♀ (PEB-1198; PEB-1199; PEB-1200), 2 ♀♀ nymphs (PEB-1203; PEB-1220), 13.viii.1990; ♂ (PEB-292), ♀ (PEB-294), nymph (PEB-291), 19.viii.1991; ♀ (PEB-1027), ♀ nymph (PEB-1028), viii.1991; egg (PEB-1205), laid viii.1989, hatched ii.1991; ♀ (PEB-1427), ♀ nymph (NHWC, PEB-1786), viii.1991; 2 ♀♀ (NMWC, PEB-1785; PEB-1881), collected as nymphs, viii.1991. Mt Santubong: ♀ (SMSM-527), P.E. Bragg, 31.vii.1992.— **No data:** ♀, ♂ nymph (RMNH), ♀ (SMSM-115).

Adults.— Colour variable (tending to darken with age), body generally mid to dark brown, but may be light brown or almost black; large spines frequently green, particularly in males. Basal half of male elytra brown, apical half white with brown veins; female elytra usually brown but basal half may be light brown to cream. Measurements of males given in table 3, females in table 4.

Head armed with ten medium spines arranged in longitudinal rows: two inner rows of two spines and two outer rows of three spines (there may also be one or two pair of small spines in front of middle rows).

Pronotum with one small to medium spine on each corner of fore margin; one large pair, close to centre line, just in front of mid point; one medium, widely spaced pair just in front of hind margin.

Mesonotum with one widely spaced pair of large spines just behind fore margin; one large pair close to mid point; one group of four large spines on common base between bases of elytra; anterior spine on lateral margin large or medium, remainder small. Mesopleuron triangular, with row of medium to small spines on ventral margin and one large spine just in front of centre of hind margin. Metapleuron with row of medium to large spines on ventral margin and one large spine in centre.

Middle of metanotum with slightly raised mound with four tubercles (in nymphs a group of 4 spines on common base, like those on mesothorax). Median segment without spines. Centre of abdominal tergites 2-5 of male with one pair of spines, large on tergite 2, decreasing to small on tergite 5. Females with small pairs of spines at centre of tergites 3 and 4. In both males and females all except anterior pair of abdominal spines may be absent on one or both sides. Tergites 2-7 with row of minute spines on lateral margins, dorsally with randomly placed minute spines.

Prosternum spineless. Mesosternum with two pairs of medium spines near centre of lateral margins; one small pair on margin by each coxa; randomly scattered minute spines, particularly on hind half. Metasternum with one small central pair of spines on hind margin, two pairs of large to medium spines on lateral margins, and one small spine near base of each coxa. Median sternite with one medium pair of spines on hind margin.

Abdominal sternites 2-6 with four longitudinal rows of medium to small spines, each row consisting of two spines per sternite decreasing in size towards rear; few randomly scattered minute spines may be present between inner rows. Female: elon-

gated lamina supraanalis terminates in 6-10 distinctly triangular teeth and projects beyond operculum (figs 18-20); operculum with distinct central longitudinal carina and apical notch; praeopercular organ consists of minute spineless swelling. Male: tenth segment with notch in apex; poculum deep, apex rounded, with downward curving rim. Cerci of male and female short, slightly flattened with truncated apex.

All femoral carinae, except for tventro-posterior of fore femora, armed with at least few medium spines; all femoral carinae with small to minute spines. Dorsal carinae of all tibiae with minute spines. Ventral carinae of fore and middle tibiae with small spines. Ventral carinae of hind tibiae with small spines basally, increasing to large (curved or slightly curved) spines apically; with minute spines between others.

Egg.— (figs 29-30). Barrel shaped, with rounded ends; mid brown; densely setose. Micropylar plate "X" shaped with micropyle between arms at polar end. Operculum almost circular, convex, lacking capitulum. Surface texture and size shows regional variation. Sarawak material typically with long setae, obscuring all surface details; length 9.2 mm, height 7.0 mm, width 6.0 mm. Kalimantan material with extremely short (almost imperceptible) setae, longer on operculum and around the rim of operculum, with all surface details clearly visible; length 8.3 mm, height 6.5 mm, width 5.7 mm.

Comments.— OXUM and BMNH contain a total of five specimens which are marked as Westwood's types, these consist of two distinct species, a fact that has previously been unnoticed; in addition the illustrated male (Westwood, 1859: fig 30.2) is not present in either collection. The paralectotypes are a species which was subsequently described by other authors based on other material: *H. saussurei* Kirby, 1904, and *H. saussurei* (Redtenbacher, 1906). Redtenbacher's (1906: 168) and Günther's (1944: 69-71) keys correctly distinguished the taxa; the use of the name *grayii* was restricted to the species illustrated by Westwood (figs 30.2 & 30.3). The lectotype of *grayii* is selected with reference to Westwood's illustrations and agrees with Redtenbacher's and Günther's treatment of this species.

This species is common in the five areas of Sarawak from which I have collected it. The specimens from Ratu Miri in Kalimantan were collected as nymphs and reared in captivity. They are noticeably smaller than both wild caught and reared specimens from Sarawak; however this may be due to them being reared under different conditions (a much smaller cage).

The indigenous people (Bidayuh Dayaks) at Bengoh informed me that they eat the eggs of this species (Bragg, 1990). After boiling in water for about 30 seconds the shell is removed and the egg eaten. The eggs are about the same size as a peanut, and the taste is similar to that of the yolk of a hen's egg.

This species is quite easy to rear in the standard conditions for the tribe. Food-plants include bramble, elder, eucalyptus, flowering currant, hawthorn, ivy, oak, pyracantha, raspberry, and rose.

Haaniella saussurei Kirby, 1904

Haaniella saussurei Kirby, 1904b: 397. Holotype, ♀ (MHNG) Sunda islands. [n.sp. based on *Heteropteryx grayi* var. *Saussure*, 1869: 310 (not Westwood, 1859).]; Bragg, 1991a: 76, fig 1 (spermatophore); Bragg, 1991b: 17, fig 1 (spermatophore); Bragg, 1992c: 297, fig 2 (egg).

Heteropteryx saussurei Redtenbacher, 1906: 171. Syntypes: ♀ ♀ (NHMW, 285), (HNHM - destroyed),

(MCSN) Borneo. [homonym & objective synonym, synonymised by Bragg, 1992c: 297].

Haaniella echinata saussurei (Redtenbacher, 1906); Günther, 1944: 70.

Haaniella echidna Rehn, 1938: 369, pl. 14 (♂). Holotype, ♂ (ANSP, Hebard Type 1294), Sadong, Sarawak, Borneo; Paratype, ♂ (MCZC) same data. [Synonymised by Bragg 1992c: 297].

Haaniella echinata echidna; Günther, 1944: 70.

[not *Haaniella echinata* (Redtenbacher, 1906); **erroneous synonym** by Rehn, 1938: 368].

Material.— **Borneo**: ♂ (BMNH, 58-66) [paralectotype of *H. grayii*].— **Brunei**: Unknown locality: ♀ (OXUM), Waterstradt van der Poll, bought Janson, 1909; ♀ (OXUM), Waterstradt van der Poll, bought Janson, 1909 [Numbered 601. This is an exceptionally small specimen (84 mm)].— **Sarawak**: Unknown locality: 2 ♂♂, 1 ♀ (OXUM, 529) [paralectotypes of *H. grayii*]; ♂ nymph (OXUM), Wallace. Tarum (near Debak): ♀ (PEB-2166), ♂ (PEB-2168), ♀ nymph (PEB-2167), 25.x.1994. Sarikei: ♂ (SMSM-116), 01.i.1949; ♀ (SMSM-117), S. Tiga, 09.ii.1900. Kuching: nymph (SMSM-118), ♀ (SFDK), 22.i.1977. Kuching, 4.5 mile: ♀ (PEB-1475), reared from nymph, viii.1991; ♂ (PEB-1537), 28.vii.1992; ♀ nymph (PEB-1844), 29.vii.1992; ♂ (PEB-269), 25.vii.1991. Kuching, 10th mile, Timber research centre: ♀ nymph (SFDK), 1975. Bako NP, 50 m: 3 ♀♀ (PEB-266; PEB-267; PEB-474), ♂ (PEB-475), reared from nymphs, 01.i.1988; ♂ (PEB-268), 20.viii.1989; eggs (PEB-262; PEB-264), removed from body, 01.i.1988; eggs (PEB-476), laid by females collected 01.i.1988; eggs (PEB-1403), removed from body of captive reared specimen, 1990; 4 nymphs (PEB-263; PEB-265; PEB-270; PEB-271), 1st instar, 1st generation captive reared, 1991. Simunjan: ♀ (not preserved), P.E. Bragg, 17.viii.1991.— **No data**: ♀ nymph (OXUM), ex Saunders collection.

Adults.— Colour variable (tending to darken with age), body uniformly mid to dark brown; large spines may be green, particularly in males; coxa-trochanter joint often green. Male elytra dark brown basally, lighter brown apically, often with white patch near mid point of leading edge, veins dark brown or black; female elytra usually brown but occasionally with some white markings, occasionally with large black spot just behind middle of leading edge. Measurements of males given in table 3, females in table 4.

Back of head armed with 10-12 small to medium spines, usually more or less in three transverse rows of four; some minute or small spines may also be present just behind line between eyes.

Pronotum with one small spine on each corner of fore margin; one large to medium pair, close to centre line, just in front of mid point; one small to medium, widely spaced pair just in front of hind margin; (no small or medium spines just in front of hind margin near centre line).

Mesonotum with pair of medium spines just behind fore margin; group of four spines (medium in ♀♀, large in ♂♂) on common base between bases of elytra; all spines on lateral margins small and of more or less equal size. Mesopleuron triangular, with row of medium to small spines on ventral margin and one medium spine just in front of centre of hind margin.

Metapleuron with row of medium to large spines on ventral margin and one spine (medium in females and large in males) in centre. Metanotum and median segment without spines (metanotum without central swelling in adults but with group of 4 spines in nymphs).

Tergites 2-7 with row of 6-8 (usually 7) minute spines on lateral margins, and dorsally with randomly placed very minute spines (sometimes with double row along the centre-line in males).

Prosternum spineless. Mesosternum with three pairs of small or medium spines near centre of lateral margins; one small pair on margin by each coxa; randomly scattered minute spines, particularly on hind half. Metasternum with one small central pair of spines on hind margin; three medium and one or two small spines between mid and hind legs; and one small spine near base of each coxa; occasionally with few randomly scattered minute spines. Median sternite with one medium pair of spines on hind margin. Abdominal sternites 2-7 with four longitudinal rows of medium to small spines, each row consisting of two spines per sternite decreasing in size towards rear; few randomly scattered minute spines may be present. Elongated lamina supraanalis of female with strong longitudinal carina, apex truncated with 4 minute teeth (magnification may be required), not projecting beyond operculum (figs 21-23). Operculum curves downward, with distinct central longitudinal carina, and blunt point at apex. Praeopercular organ consists of one pair of spines on swollen base. Tenth segment of male with slightly indented apex; lamina supraanalis visible as small pointed lobe which projects beyond tenth tergite. Poculum deep, apex rounded, with downward curving rim. Cerci of male and female short, slightly flattened with rounded point at apex.

All femoral carinae, except for ventro-posterior of fore femora, armed with at least few medium spines; all femoral carinae with small to minute spines. Dorsal carinae of all tibiae with minute spines. Ventral carinae of fore tibiae with small or minute spines; ventral carinae of middle tibiae with small spines. Ventral carinae of hind tibiae with small spines basally, increasing to large curved spines apically; with minute spines between others.

Egg.— (figs 35-36). Lemon shaped; brownish grey; sparingly setose. Capsule with short setae; length 12.0 mm, height 7.0 mm, width 6.0 mm. Micropylar plate basically "X" shaped with opercular arms curving towards each other at apices; micropyle between arms at polar end. Operculum almost circular, conical, lacking capitulum.

Comments.— The distribution of this species appears to be limited to costal or near costal areas of Sarawak. The basic shape of the egg is different to all other Bornean *Haaniella* but similar to the West Malaysian *H. muelleri* (de Haan). This species should be as easy to rear as the rest of the genus; the original culture died out because the eggs were kept too wet. Foodplants include bramble, eucalyptus, hawthorn, ivy, oak, raspberry, and rose.

One of the OXUM specimens is exceptionally short (84 mm) and has a very finely spinose mesonotum. The praeopercular organ, operculum and arrangement of the major spines place it with this species. The body had been eviscerated so eggs were not available for examination.

The paralectotypes of *H. grayii* deserve particular mention here. The BMNH specimen has two pairs of anterior mesonotal spines; the mesonotal spines are both clearly anteriors, the spines on the lateral margin of the mesonotum are all of a similar size and the abdomen lacks any large spines. One of the OXUM paralectotypes (labelled as 1/4) has two small posterior mesonotal spines but otherwise agrees with the description of *H. saussurei*. The remaining two paralectotypes fully agree with the description of *H. saussurei*.

Haaniella scabra (Redtenbacher, 1906)

Heteropteryx scabra Redtenbacher, 1906: 171; Rehn, 1938: 369. Syntypes, ♂♂, ♀♀ (NHMW, 286) (coll. Schulthess-Rechberg) (coll. Rolle) (ZMAS), Borneo, Kinabalu.

Haaniella grayi scabra; Günther, 1932b: 313; Günther, 1935b: 124.

Haaniella echinata scabra; Günther, 1944: 72.

Material.— **Sabah**: Trus Madi, 4000-6000 ft: ♂ (NMWC, NMW 1976.9.Z), xi.1968 [A.E. Gardner collection]. Mt Kinabalu, Lumu Lumu, 5500 ft: ♀ (RMNH), 08.iv.1929 [From H.M. Pendlebury collection]; ♂ nymph, ♀ nymph (RMNH), 11.iv.1929 [From H.M. Pendlebury collection]; ♀ nymph (RMNH), 16.iv.1929 [From H.M. Pendlebury collection]. Mt Kinabalu, Kiau, 3000 ft: ♀ (RMNH), 02.v.1929 [From H.M. Pendlebury collection]. Mt Kinabalu, Kenokok, 3300 ft: ♀ nymph (RMNH), 23.iv.1929 [From H.M. Pendlebury collection]; ♂ nymph (RMNH), 26.iv.1929 [From H.M. Pendlebury collection]; Mt Kinabalu NP: 5 ♀♀, 2 ♂♂ (BMNH, 1982-387), A. Harman, 10-19.i.1981. Mt Kinabalu NP, near HQ, 1580 m: 3 ♀♀ (PEB-277; PEB-278; PEB-483), 4 ♂♂ (PEB-279; PEB-281; PEB-284; PEB-484), 3 ♀♀ nymphs (PEB-280; PEB-282; PEB-283), 30.vii.1990; ♀ (PEB-285), collected as penultimate instar nymph, 30.vii.1990; 2 ♀♀ (PEB-2116; PEB-2117), viii.1992 [Died vii.1994], ♂ (PEB-1698), 30.viii.1992; eggs (PEB-1413), removed from body of ♀ collected 30.vii.1990; 2 ♀♀ (PEB-2049; PEB-2050), died ii.1994, collected viii.1992; ♀ (PEB-1915), viii.1992; ♀ (PEB-1960), died vii.1993, collected viii.1992; ♂ (PEB-1961), died vi.1993, collected viii.1992.

Additional material in the collection of C.L. Chan, all examined to confirm species, only localities were recorded: **Sabah**: Mari-Parai, Mt Kinabalu; Mt Kinabalu, near Park HQ.

Adults.— Body uniformly mid to dark brown. Male elytra brown at base and apex, often with broad white band across middle; female elytra brown; both sexes often with large black spot just behind middle of leading edge. Measurements in tables 3 and 4 taken from my own collection only.

Back of head armed with 10 medium spines, in four longitudinal rows, two inner rows of three, and two outer rows of two spines; some minute or small spines may also be present on sides of head and between eyes.

Pronotum with one medium spine on each corner of the fore margin; one large (♂) or medium (♀) pair, close to centre line, just in front of mid point; just in front of hind margin one medium pair on lateral margin and one small pair near centre-line; there may also be few scattered minute spines.

Mesonotum with one pair of medium (♀) or large (♂) spines just behind fore margin; group of two medium and two minute spines (medium in ♀♀, large in ♂♂) on common base between bases of elytra; anterior spine on lateral margin small but much larger than remainder which are minute. Mesopleuron triangular, with row of medium to small spines on ventral margin and one medium (♀) or large (♂) spine just in front of centre of hind margin.

Metapleuron with row of small to medium spines on ventral margin and spine (medium in females and large in males) in centre. Metanotum and median segment without spines; metanotum with small bituberculate central swelling (with a pair of spines in nymphs).

Tergites 2-7 with row of 6-8 (usually 7) minute spines on lateral margins. Dorsally, abdominal tergites spineless; anterior tergites smooth, posterior scabrous. Prosternum spineless. Mesosternum with three pairs of small spines, and few scattered

spines near centre of lateral margins; one minute spine or tubercle on the margin by each coxa; randomly scattered minute spines, particularly on hind half. Metasternum with one minute central pair of spines on hind margin; three or four minute spines between mid and hind legs; one minute spine near base of each coxa; occasionally with few randomly scattered minute spines. Median sternite with small pair of spines on hind margin.

Abdominal sternites 2-7 with four longitudinal rows of small spines, each row consisting of two spines per sternite decreasing in size towards rear; however, as front and rear spines on each segment are not perfectly in line, spines may appear to be in 8 rows. Praeopercular organ consists of one pair of spines on swollen base. Apex of lamina supraanalis of female truncated, with 2-8 minute teeth (magnification may be required), not projecting beyond operculum (figs 24-26). Operculum curves downward, with distinct central longitudinal carina, and blunt point at apex. Tenth segment of male with slightly indented apex; lamina supraanalis usually visible as small blunt lobe which does not project beyond tenth tergite. Poculum deep, apex rounded, with downward curving rim. Cerci of male and female short, flattened, with rounded apex.

All femoral carinae, armed with at least few small spines (smaller on ventro-posterior carina of fore femora). Dorsal carinae of all tibiae with minute spines or tubercles. Ventral carinae of fore and mid tibiae with minute spines in females and small to minute spines in males. Ventral carinae of hind tibiae with small spines basally, increasing to medium straight or slightly curved spines apically.

Egg.— (figs 33-34). Barrel shaped, with rounded ends; mid brown; densely setose. Capsule with short setae; length 6.0-7.0 mm, height 5.0-5.1 mm, width 4.5-4.8 mm. Micropylar plate "X" shaped with micropyle between arms at polar end. Operculum almost circular, convex, lacking capitulum.

Comments.— The locality of Labuan recorded by Rehn (1938: 369) is suspect because it is an island, and all of it is at a very low altitude (maximum 97 m), the other localities are very high mountains (some of the highest points in Borneo).

In contrast to the other Bornean species in this genus, and *H. muelleri* from West Malaysia, this species has proven difficult to rear in captivity. Wild caught stock of *H. scabra* has been successfully maintained in the same conditions as other *Haaniella* species for two years. Half grown nymphs have been successfully raised to adult, eggs have been laid, successfully incubated and hatched; however the newly hatched nymphs almost always die within two weeks of hatching. Eggs from my stock were distributed to several PSG members: Kim D'Hulster in Belgium raised two males to adult, and I currently have two half grown females; these are the only survivors from a total of about 300 eggs. Foodplants include bramble, hawthorn, ivy, oak, pyracantha, raspberry, and rose.

Possible *Haaniella grayii* × *H. echinata* hybrid

Material.— **Sarawak:** ♂ (BMNH, 87-14).

Description.— Pre-median pronotal spine large on left, absent on right; one pair of large posterior pronotal spines. Mesonotum with one large pair of anterior prono-

tal spines, without median pair, posterior with group of four spines on common base. Anterior of lateral margin of mesonotum with one large spine. Abdomen with one pair of large spines on segments 3-6, but lacking left spine on segment 4.

Comments.— The presence of posterior pronotals and absence of median mesonotals are typical of *H. echinata*. The spines on the abdomen are typical of *H. grayii*. It is likely that this specimen is a hybrid.

Heteropteryx Gray, 1835

Heteropteryx Gray, 1835: 13, 32; Westwood, 1859: 81; Kirby, 1890: 571; Brunner von Wattenwyl, 1893: 98; Rehn, 1904: 89; Kirby, 1904b: 396; Karny, 1923: 234; Bradley & Galil, 1977: 198. Type species: *Heteropteryx dilatata* (Parkinson), by monotypy.
Leocrates Stål, 1875b: 48; Redtenbacher 1906: 166; Giglio-Tos, 1910: 13. Type species: *Leocrates graciosa* (Westwood), by monotypy.

Description.— Broad, heavy body, not stick-like. Head, thorax and legs all spiny; underside of thorax and abdomen spiny; upper side of abdomen of female spiny where not covered by wings. Wings of males body length, elytra almost as long; wings and elytra of female oval, reaching to end of third abdominal segment. Antennae much longer than fore legs. Bodies of females brightly coloured (green or yellow), males brown. Back of head raised and swollen; with numerous medium to large spines. Female abdomen with spines on lateral margins. Abdomen of male with lateral lobe-like expansions on some segments, large in nymphs but reduced in adults. All femoral carinae armed with strong spines. Hind tibiae armed with large spines on underside (larger than femoral spines); middle and fore tibiae, and upper side of hind tibiae, with distinct spines.

Comments.— This is a monotypic genus with quite a wide distribution.

Heteropteryx dilatata (Parkinson, 1798)

Phasma dilatatum Parkinson, 1798: 190, pl. 18, figs 2-5; Shaw, 1798: pl. 347 (♀, dorsal) & 348 (♀, ventral, & egg); Shaw, 1806: 124, pl. 45 (♀, dorsal) & 46 (♀, ventral, & egg); Audinet Serville, 1838: 281. Holotype, ♀ (Location of type not known) Asia.
Heteropteryx dilatata; Gray, 1835: 32; Westwood, 1859: 82; Westwood, 1874: 173, pl. 32.1 (♀); Rehn, 1904: 89; Kirby, 1904b: 397; Karny, 1923: 234; Günther, 1935b: 124; Loser & Schulten, 1981: 23-27; Carlberg, 1989: 165-173; Brock, 1989: 207-211; Brock, 1994: 33, pl. NN, figs 9 & 10 (gynandromorph); Seow-Choen et. al., 1994: fig. page 7 (♂ & yellow ♀); Chan & Lee, 1994: 5-6, 1 fig. (egg) & 2 pls (♂; ♀); Seow-Choen, 1995: 49, colour-fig. 1 (gynandromorph); Schulten, 1995: 100, figs. 61 (♀), 62 (♀), 63 (♀ & egg); Seow-Choen, 1996: 122, fig 1 (gynandromorph); Brock, 1997: 109, fig 1 (♀), pl. 97K figs 5 & 6 (♀), pl. 97L fig 7 (♂ nymph), pl. 97L fig 8 (♂).
Diapherodes dilatata; Burmeister, 1838: 574.
Heteropteryx hopei Westwood, 1864: 16. Holotype, ♀ (OXUM, 488), locality not known. [Synonymised by Westwood, 1874: 173].
Phasma (Eurycantha) graciosa Westwood, 1848: 16, pl. 7.3 (♂). Holotype, ♂ (OXUM, 526), Prince of Wales's Island. [Synonymised by Kirby, 1904b: 397].
Heteropteryx castelnaudii Westwood, 1874: 174, pl. 32.3 (♂ nymph). Holotype, ♂ nymph (OXUM, 527), Tringany. [Synonymised by Günther, 1935b: 124].
Heteropteryx rollandi Lucas, 1882: xxxii. Holotype, ♀ (Location of type not known), Malacca. [Synonymised by Kirby, 1904b: 397].

Leocrates dilatatus; Redtenbacher, 1906: 166.

Leocrates castelnaudi; Redtenbacher, 1906: 167; Giglio-Tos, 1910: 13.

Heteropteryx dilatatus; Miller, 1939: 48.

Material.— **West Malaysia**: locality unknown: ♀ (PEB-132), reared 1989; ♀ (PEB-138), yellow form, reared by Fred Giles 1991; ♀ (PEB-144), purchased from pet shop 1988; ♂ (PEB-133), reared 1989; ♂ (PEB-136), reared 1990; 2 ♀ nymphs (PEB-135; PEB-146), reared 1989; ♀ nymph (PEB-137), 1st instar, reared 1987; ♂ nymph (PEB-1948), penultimate instar, reared 1993; ♂ nymph (PEB-142), reared 1987; eggs (PEB-139; PEB-147), reared 1989. Pahang: ♀ (BPBM), Tanam Camp, 18 mile Railway Track, Rompin Mining Co., 16.xii.1960.— **Sarawak**: Mt Serapi, 150 m: ♂ (PEB-143), 26.vii.1991; ♀ nymph (PEB-145), 19.viii.1991. Matang: ♂ (SMSM-112), vi.1900. Entawa: 2 eggs (SMSM-113), 05.x.1911 [assumed ♀ is on public display].

Female.— Body and legs, dorsally light green, ventrally mid green; wings pale pink, with only tips green; elytra light green. Female rarely bright yellow (see Seow-Choen et al., 1994: fig, page 7). Museum specimens frequently dull green or even brownish green. Body length 143-151 mm (measurements from my own specimens only). Head greatly swollen at rear; spinose: lateral coronals medium, supra-orbital series consisting of two medium spines, anterior and posterior occipitals large, with one small pair of spines anterior to anterior occipitals. Antennae much longer than fore legs; unarmed; at least 28 segments.

Pronotum spinose: anterior lateral pronotals small; one small to medium pair of lateral pronotals near posterior margin; posterior pronotals small to medium. Prosteronum with 6 small spines.

Mesonotum with 2-4 medium lateral mesonotals; medium anterior mesonotals, usually with 2 pairs of spines near middle of mesonotum; with one spine at base of elytra; with one pair of medium spines at centre of hind margin. Mesopleura with numerous small to medium laterals and one medium mesopleural spine. Mesosternum with numerous small spines.

Metanotum unarmed. Metapleura with small to medium laterals and one small mesopleural spine. Metasternum with numerous small spines.

Abdominal tergites 1-7 with (usually 5) small spines on lateral margins; 1-4 otherwise unarmed. 5-8 with small latero-anteriors and small medials. 7-8 with minute first paired posteriors. Segments 9-10 unarmed. Lamina supraanalis slender, elongated, as long as 9-10 combined, projecting beyond end of operculum; apex with "V" shaped notch.

Sternites 2-6 of with two transverse rows of 4 small spines; 7th with anterior row of 4 spines, posterior with praeopercular organ consisting of small transverse lobe with pair of small spines; operculum elongated, narrowing at posterior, with longitudinal median carina, apex truncated.

Anterior coxae armed with two small spines; middle and hind with 5-6 small spines. Femora laterally compressed, particularly middle and hind. Apices of all femora with spine on dorsal, anterior and lateral surfaces; all carinae armed with small and medium spines. Tibiae with small spines on all carinae; posterior tibiae with medium to large spines on ventral carinae, these become longer apically. Tarsomeres 1-4 of equal length, combined length equal to 5th tarsomere.

Male.— Uniformly mid brown, elytra mid brown with pale yellow leading edge;

with pale band at apex and usually pale band near base. Costal region of wings pale brown with dark veins; anal fan pink with brown veins, strongly pink basally, fading apically. Body length 87-98 mm (measurements from my specimens only).

Head greatly swollen at rear; spinose: lateral coronals medium, supra-orbital series consisting of two medium spines, anterior and posterior occipitals large, with one small pair of spines anterior to anterior occipitals. Antennae much longer than fore legs; unarmed; at least 25 segments.

Pronotum spinose: anterior lateral pronotals small; one small to medium pair of lateral pronotals near posterior margin; posterior pronotals small to medium; pre-median pronotals small. Prosternum with 6 small spines.

Mesonotum with 2-4 minute lateral mesonotals, small anterior mesonotals, one spine at base of elytra, one pair of medium spines at centre of hind margin, except in my bornean specimen (PEB-143). Mesopleura with numerous small to medium laterals and one medium mesopleural spine. Mesosternum with numerous small spines.

Metanotum unarmed. Metapleura with small to medium laterals and one small mesopleural spine. Metasternum with numerous small spines.

Abdominal tergites unarmed except for minute spines on lobe-like expansions of lateral margins. Lamina supraanalis just visible dorsally.

Sternites 2-6 of with two transverse rows of 4 small spines; 7th with two pairs of minute spines; 8 unarmed; poculum deep, apex rounded; cerci long, slender.

Anterior coxae armed with two small spines; middle and hind with 5-6 small spines. Femora laterally compressed. Apices of all femora with spine on dorsal, anterior and lateral surfaces; all carinae armed with small and medium spines. Tibiae with small spines on all carinae; posterior tibiae with medium to large spines on ventral carinae, these become longer apically. Tarsomeres 1-4 of equal length, combined length equal to 5th tarsomere.

Nymphs.— Uniformly brown, females take on green colouring of adults few instars before becoming adult.

Egg.— (figs 37-38). Barrel shaped, with convex ends, ventral surface straight; mid grey; length 8.5 mm, height 5.5 mm, width 5.0 mm. Micropylar plate "X" shaped with micropyle between arms at polar end. Operculum setose; almost circular, slightly convex; lacking capitulum.

Comments.— This is a well known species. Live and dead specimens are frequently offered for sale at entomological exhibitions and even some pet shops. It has been reared in captivity in the United Kingdom, and readily available for over ten years. Captive-reared and imported stock originates from the Cameron Highlands, West Malaysia. Foodplants include bramble, hawthorn, ivy, oak, pyracantha, raspberry, and rose.

This is one of the few Bornean species which occurs outside Borneo, having been recorded from West Malaysia, Sumatra and Java. I have only encountered three live specimens in Borneo, all on Mt Serapi; SMSM has some specimens (without data) on public display in cases of stuffed birds, in addition to the specimens marked "Entawa" in their phasmid collection (I have been unable to locate Entawa). As a spectacularly coloured and large species it is one likely to have been taken to museums by collectors in the past; as there are relatively few specimens (none in BMKB and FRCS, and none from Borneo in OXUM) this species is probably not common in Borneo. It was

originally recorded from Borneo (unspecified area) by Rehn (1904: 89); Chan and Lee's record for Sarawak (1994: 5) is based on my material.

The yellow coloration of the females appears to be caused by a recessive allele. In captivity the coloration appeared spontaneously (presumably by mutation) in stock reared by Mr Fred Giles of Leicester (personal communication). Eggs from yellow specimens produced some yellow offspring, but never in a ratio higher than one yellow to three green. Yellow forms are known to occur in West Malaysia.

Miroceramia Günther, 1934

Miroceramia Günther, 1934: 283. Type species: *Miroceramia pterobrimus* Günther, 1934, by original designation.

Miroceramia westwoodii (Bates, 1865) comb. nov.

Heteropteryx westwoodii Bates, 1865: 345. Holotype, ♀ (OXUM, 528) Sulawesi, Menado, Wallace.

Haaniella westwoodii; Kirby, 1904b: 398; Günther, 1944: 71.

Heteropteryx westwoodii; Redtenbacher, 1906: 169.

Miroceramia pterobrimus Günther, 1934: 284, fig 1 (♂). **Syn. nov.** Holotype, ♂ (SMTD) East Sulawesi, ii.1910.

Haaniella westwoodii; Günther, 1944: 71.

Material.— **Sulawesi**: Menado: ♀, holotype *Heteropteryx westwoodii* (OXUM, 528). Piroe: ♀ (BPBM), F. Muir, ii.1909. Manusela NP, Wae Mula Plain: ♂ (BMNH, 1987-262), Operation Raleigh, M.J.D. Brendell, 23.viii.1987. Mansela, 2500 ft: ♀ (BMNH, 1932-116) Pratt, 1919.

Comments.— The female of this species from Sulawesi, has previously been included in *Haaniella*. It clearly differs from the other members of *Haaniella* and belongs in *Miroceramia*. There can be little doubt that it is synonymous with *M. pterobrimus*. The body length of the BPBM specimen is 73 mm. The BMNH male has a note on the label by M.T.D. Brendall stating "This insect stridulates from the wing bases".

Obrimini Brunner, 1893

Obrimi Brunner von Wattenwyl, 1893: 98.

Obriminidae Bruner, 1915: 228.

Therameninae Karny, 1923: 232.

Obrimini Redtenbacher, 1906: 36; Rehn & Rehn, 1938: 405; Günther, 1953: 552; Bradley & Galil, 1977: 199.

Pronotal foramen at anterior margin of pronotum. Head and body spiny in all Bornean species. Female abdomen may be dorsoventrally compressed or cylindrical. Lamina supraanalis and operculum elongated to form an oviscapt. Wings and elytra absent. Apex of tibiae armed with one small spine (this may be difficult to distinguish). Eggs cylindrical in Bornean species. [Rehn & Rehn's statement that "the posterior femora are usually at least half as long as the abdomen" (1938: 401) is not the case in females of most Bornean species, although it appears to be true for most males].

Key to Obrimini

1. Front of mesonotum with raised triangular region. Antennae not reaching beyond ends of fore legs. Body length less than 50 mm *Hoploclonia* Stål
- Mesonotum without distinct raised triangular area. Antennae reaching beyond thends of fore legs. Body length of females up to 85 mm *Aretaon* Rehn & Rehn

Comments.— The distribution of the tribe includes Borneo, Philippines, Moluccas, New Guinea, Fiji, and Sri Lanka. There are no records from Sulawesi. The only specimen recorded from Sri Lanka is the holotype of *Theramenes olivacea* (Westwood, 1859), as this species has since been recorded from the Talaur Islands (Redtenbacher, 1906: 38) it is possible that the Sri Lanka record is in error. One monotypic genus occurs on Fiji.

Borneo is the western limit of the tribe (excluding *T. olivacea*) and has few species. The Philippines have a large number of species and the two genera in Borneo are well represented in the Philippines. It seems likely that this tribe has only recently entered Borneo from the Philippines, this is supported by the distribution of the tribe within Borneo; most are restricted to north east Borneo (i.e. close to the Philippines), others are recorded only from the northern coast.

Aretaon Rehn & Rehn, 1938

Aretaon Rehn & Rehn, 1938: 419; Bradley & Galil, 1977: 199. Type species *A. asperrimus* (Redtenbacher) [*Obrimus asperrimus* Redtenbacher, 1906] by original designation.

Number of species in the genus: 3.

Number of species recorded from Borneo: 2.

Description.— Generally relatively broad, strongly spinose. Occiput with six or more spines. Pronotum with strong prominent anterior spines; posterior pronotals laterally displaced and smaller than anteriors. Prosternum transverse with inter-coxal raised sensory areas. Mesonotum with strong anterior spines; females with either median pair of spines or crown of four spines, males with median unarmed or with one pair of spines; posterior spines strongly composite. Metanotum with posterior spines strongly composite. Median segment and all abdominal terga with posterior mesal spine or foliaceous dentation. Abdominal terga of at least female slightly expanded laterally.

Comments.— The generic description has been slightly modified from that given by Rehn & Rehn (1938) to take account of variation in captive reared specimens of *Aretaon* (*Aretaon*) *asperrimus*. Rehn & Rehn described two subgenera:

Aretaon (*Aretaon*) Rehn & Rehn, 1938: 421.

Aretaon (*Trachyaretaon*) Rehn & Rehn, 1938: 422.

Only *A. (Aretaon)* is recorded from Borneo.

Description of the subgenus *Aretaon* Rehn & Rehn, 1938.— Granulose with numerous large spines. Occiput with 6-8 spines arranged in two rows. Pronotum lacking inter-posteriors. Middle of mesonotum with paired medials. Metanotum lacking anterior mesals. Dorsal carinae of femora with serrated teeth.

Comments.— The status of the two described species is unclear; there is a reasonably strong possibility that they are simply variations of a single species (Bragg, in Jennings, 1992: 26). The type specimens of *A. muscosus* (Redtenbacher) are all immature and the features used to distinguish the two species change as the insects develop into adults. The following key (from Rehn & Rehn, 1938: 420) serves to distinguish the two forms.

Key to the subgenus *Aretaon*

1. Dorsal carinae of anterior tibiae relatively smooth, with only few low tubercles; abdominal tergites 1-5 with one large posterior mesal spine *Aretaon (Aretaon) asperrimus* (Redtenbacher)
- Dorsal carinae of anterior tibiae with basal half serrated; abdominal tergites 1-8, especially 4-8 with medio-longitudinal subtriangular area cut off by lateral and posterior spines or by lobe-like serrations *Aretaon (Aretaon) muscosus* (Redtenbacher)

Aretaon (Aretaon) asperrimus (Redtenbacher, 1906)

Obrimus asperrimus Redtenbacher, 1906: 41, pl. 1.4 ♀, & 1.5 ♂; Dohrn, 1910: 398; Günther, 1935b: 123.

Syntypes, ♂ ♂ ♀ ♀ (NHMW, 37), (coll. Bolivar), (ZMAS), (coll. Staudinger), Kina Balu, Borneo.

Aretaon (Aretaon) asperrimus (Redtenbacher); Rehn & Rehn, 1938: 421.

Aretaon asperrimus (Redtenbacher); Bragg, 1991a: 76-80; Bragg, 1991b: 18-21; Jennings, 1992: 26-30; Bragg, 1995b: 4-5; Schulten, 1995: 103, figs. 64 (♂ & ♀), 65 (eggs & ♀).

Material.— **Sabah:** Mt Kinabalu: ♀, ♀ nymph (OXUM), van der Poll, bought Janson, 1909. Mt Kinabalu, 2800-3100 ft: ♂ (SMSM-57), 15.ix.1913. Kinabalu Park, Poring Hot Springs, 760 m: ♀ (PEB-1689), 21.viii.1992; 3 ♀ ♀ (PEB-163; PEB-164; PEB-170), 31.vii.1990; 3 ♀ ♀ (DCMD, PEB-1468; NHMN, PEB-1469; NMWC, PEB-1470), captive bred 1992; 3 ♂ ♂ (PEB-165; PEB-168; PEB-169), 31.vii.1990; 2 ♂ ♂ (DCMD, PEB-171; PEB-172), 1st generation captive bred 1991; eggs (PEB-173), hatched 18.ii.1991, laid 31.vii.1990; eggs (PEB-174), hatched 12.ii.1991, laid 31.vii.1990; eggs (DCMD, PEB-175), 1991; 2 nymphs (DCMD, PEB-166; PEB-167), 1st instar, captive bred 1991; 2 ♀ ♀ (PEB-1814; PEB-1815); 2 ♂ ♂ (NHMN, PEB-1471; PEB-1887); ♀ nymph (PEB-1434), ♂ nymph (PEB-1435), captive bred 1992; 2 ♀ ♀ (PEB-1969; PEB-1970); 2 ♂ ♂ (PEB-1967; PEB-1968); ♀ nymph (PEB-1971); ♂ nymph (PEB-1972), captive bred 1993; 3 ♀ ♀ (SMSM-528; PEB-2094; PEB-2427), captive bred, 1994. Tawau, Quoin Hill: ♂, ♀ (BPBM), Y. Hirashima, 26-29.vii.1962.

Female.— Body granulose with simple, compound spines; legs and ventral surface setose. Colour darkens with age; older specimens almost uniformly dark brown, almost black; younger specimens brown with yellow markings on thorax and anterior of abdomen. Yellow markings variable, concentrated at posterior of pronotum and anterior of mesonotum, anterior of metanotum, and on first two abdominal terga. Body length 74-88 mm (measurements from my material only).

Head rectangular; supra-orbitals either large tubercles or small spines; supra-antennals in form of wide tubercles. Occiput with 6-8 small spines arranged in two rows, median coronals always present, in front of these is pair of simple spines, anterior to these there may be two distinct spines or two partly fused spines or a single spine. Lateral coronal spines small. Antennae longer than fore legs; segments becoming longer apically; basal segment with minute tooth on lateral margin.

Prothorax with deep transverse groove; with medium anteriors; medium posteriors widely spaced. Prosternum with two oval sensory areas between legs.

Mesonotum with medium anteriors, medium medians, compound posteriors, and very small antero-laterals; laterals present only as tubercles. Posteriors consist of one large spine with several small spines on and around base. Division between mesonotum and mesopleura indistinct. Mesopleura with small antero-lateral, 3-4 small laterals, small medio-lateral, two minute supra-coxals. Mesosternum with three pairs of tubercles.

Metanotum with compound posteriors, similar to posterior mesonotals. Metapleura with 2 small laterals, and two small and 2-4 minute supra-coxals. Metasternum with two pairs of tubercles.

Abdominal segments 2-8 wider than long, narrowing gradually; 9th with parallel sides; 10-11 narrowing to point. Median segment very indistinct, with one posterior mesal tubercle or small spine. Segments 2-5, and sometimes 6, with one small posterior mesal spine with laterally widened base, and small second paired posterior spines. Segments 2-4 with small postero-lateral spines; 5-7 with postero-laterals forming small lobe-like expansions. Segments 6-9 smooth, or with posterior mesal tubercles, or with posterior mesal lateral spines or lobes; if lobes these tend to increase in size towards posterior. If 6-9 armed with posterior mesal, then first and second posteriors also present as either small spines or tubercles. Lamina supraanalis as long as length of segments 9-10 combined; upward curving. Sternites 2-4 with two pairs of rather indistinct tubercles. Operculum long, slender, pointed; apical half with median longitudinal carina; apical third curving upwards.

All femoral carinae with small spines, on both anterior carinae of fore femora spines absent on basal half. Tibiae all with distinct ventro-medial carina. Anterior tibiae with minute spines or tubercles on both dorsal carinae, ventral unarmed. Middle and hind tibiae with minute spines or tubercles on all carinae although these may be very indistinct on dorsal carinae.

Male.— Body granulose with simple and compound spines; legs and ventral surface setose. Dorsal surface of body, and legs mid to dark brown with yellowish streaks; darkening with age; ventral surface yellowish. Thorax and anterior half of abdomen with median longitudinal yellow stripe; lateral margins of mesonotum and metanotum yellow. Tubercles and tips of spines black. Body length 47-54 mm (measurements from my material only).

Head rectangular; supra-orbital tubercles present; supra-antennals in form of wide tubercles. Occiput swollen, with 6-8 small spines arranged in two rows: median coronals simple, and in front of these, three spines on common base, anterior pair may be fused along most of their length. Lateral coronal spines small. Antennae longer than fore legs; segments becoming longer apically; basal segment with minute tooth on lateral margin.

Prothorax with deep transverse groove; with small anteriors and small widely spaced posteriors. Prosternum with two oval sensory areas between legs.

Mesonotum with medium anteriors, compound posteriors, and very small antero-laterals; laterals present only as tubercles. Posteriors consist of large spine with several small spines on and around base. Division between mesonotum and mesopleura indistinct. Mesopleura with small antero-lateral, 3-4 very small laterals, small medio-

lateral, one small supra-coxal; one medium mesopleural spine just above ventral margin. Mesosternum with three pairs of tubercles.

Metanotum with compound posteriors, similar to posterior mesonotals. Metapleura with few very small laterals, and two medium and one small supra-coxals. Metasternum with 3-4 pairs of tubercles.

Median segment very indistinct, with one small posterior mesal spine. Segments 2-6 slightly longer than wide; 2 a trapezium, 3-6 of even width; 7th widening; 8-10 more or less of even width. Segments 2-5 with one small posterior mesal spine, 5 may be only a tubercule; 6-8 with posterior mesal tubercles. Segments 2-7 with indistinct second paired posterior tubercles. Segments 2-5 with small postero-lateral tubercles. Apex of 10th segment indented, 11th a small triangle. Sternites 2-4 with two pairs of rather indistinct tubercles. Poculum densely setose; deep, rounded, posterior with distinct longitudinal carina; apex pointed, with flattened rim.

All femoral carinae with spines; on both anterior carinae of fore femora spines absent on basal half; ventral carinae of middle and hind femora with small to medium spines, rest minute to small. Tibiae all with distinct ventro-medial carina. Anterior tibiae dorsally with very indistinct rounded tubercles, ventrally unarmed. Middle and hind tibiae with minute spines or tubercles on all ventral carinae, dorsal carinae with very indistinct tubercles.

Nymphs.— Nymphs in later instars have more spinose legs than adults, particularly tibiae, size of spines reduced at final ecdysis. Nymphs tend to be more colourful than adults, often with various shades of brown and green. Yellow markings only appear at final ecdysis.

Egg.— (figs 39-41). Cylindrical, opercular end flat, polar end hemispherical; surface uniformly pitted with minute circular holes; uniformly mid grey. Typical dimensions: length 5.5 mm, height 2.8 mm and width 2.5 mm. Operculum circular, slightly convex, lacking capitulum. Micropylar plate "Y" shaped, with distinct median line. Stem of "Y" indented at opercular end; of variable width, covering up to one third of circumference. Arms of "Y" may circle polar end and fuse on ventral surface, or they may be shorter and remain distinct. In random sample of 10 eggs 40% had arms uniting on ventral surface.

Comments.— *Aretaon asperrimus* has been recorded from Luzon in the Philippines (Rehn & Rehn, 1938: 422) in addition to Borneo. This species is remarkably easy to rear in captivity. This is rather surprising considering the difficulties with *Hoploclonia* spp., the only other cultured members of the tribe. Foodplants include bramble, flowering currant, hawthorn, ivy, oak, pyracantha, raspberry, rose, and silver birch.

The male is frequently observed riding around on the back of the female, but without any signs of mating taking place. Aggression between males is not uncommon and has previously been reported by Roberts (1992), this appears to be competition for females, often with a second male attempting to dislodge a male from the back of a female. The first twelve minutes of the following attack illustrates the type of behaviour which is typically involved. A male which was mounted on a female (but not copulating) was approached by a second male; the second male climbed on the first and began rhythmically squeezing the abdomen of the first male with his hind legs while tightly holding on to the legs of the first with his middle and hind feet; at the same time the second was flicking the end of his abdomen. The female

began to walk across the foodplant. After three minutes the first male, still mounted by the second male, moved off the female. The second male continued this style of attack for a total of eight minutes; by this time the female had moved to another part of the cage. The second male then gripped the first crosswise, by the mesothorax. Twelve minutes after the initial attack, the first male escaped; the second male pursued and remounted the first male. The original rhythmic gripping and tail flicking was interspersed with standing upright, jerking the whole body and flicking the end of the abdomen; this continued for at least a further 23 minutes at which time observations were discontinued. It seems likely that the second male, having allowed the first male to escape, pursued the first male in mistake for the female which had already gone elsewhere.

The female begins to lay eggs about four to five weeks after becoming adult. The eggs are buried in the substrate and Jennings (1992) reports eggs being found in the tissue paper used to plug gaps between the food plant and water container. According to Jennings (1992), the eggs are laid at a rate of about one or two per 24 hours and take approximately 12 to 13 weeks to hatch when kept at 22-26°C, my own results showed 1.1 eggs per day over a 20 day period, and hatching took 80 days (13 weeks) at ambient temperatures (June-August).

Newly hatched nymphs are very lively and start to feed easily. At this stage there is little colour variation, a medium brown. Nymphs grow quite quickly, Jennings (1992) recorded twenty two days between the first and second instar. By the third instar it is easy to distinguish sexes by the presence of the ovipositor in the female. As the nymphs mature they become more colourful and show some variation. Jennings reports approximately 85% of nymphs surviving to adulthood, with males maturing more quickly than females and progressing through one instar less.

Aretaon muscosus (Redtenbacher, 1906)

Obrimus muscosus Redtenbacher; 1906: 41. Syntypes, ♂♂ ♀♀ (NHMW, 36), (ZMAS), (Staudinger), Borneo, Kinabalu; Günther, 1935b: 123.

Aretaon (Areton) muscosus; Rehn & Rehn, 1938: 422.

Areton muscosus; Bragg, in Jennings, 1992: 26.

Material.— **Brunei**: Temburong district, Kuala Belalong, 60 m: ♂ (PEB-508), S. Nyawa, viii.1991.— **Sabah**: Kinabalu: ♂ nymph, ♀ nymph, syntypes (NHMW). Murut territory: ♀, ♀ nymph (OXUM) [illegible - Higgins 1871, nymph 2/-, adult 5/-].— **Sarawak**: Bintulu, Similanjau Forest Reserve: ♂ (SFDK), 13.viii.1978.

Description.— As *A. asperrimus* but with additional spines: dorsal carinae of anterior tibiae with basal half serrated; abdominal tergites 1-8, especially 4-8 with medio-longitudinal subtriangular area cut off by lateral and posterior spines or by lobe-like serrations.

Comments.— The type specimens are nymphs; the type specimens of *A. asperrimus* are all adults. *A. muscosus* is distinguished by having more prominent spines, particularly on the front tibiae and the top of the abdomen. However, having reared *A. asperrimus* it is clear that nymphs of this genus are very spiny and these spines in particular are reduced when the insect becomes adult. It is therefore quite likely that

A. asperrimus and *A. muscosus* are the same species. This possibility was considered and rejected by Günther (1935: 123) but as he had not reared them he would not have known that the spines are reduced when the insects become adult. However, the situation is complicated by the variability of the spination; until further evidence is available, I consider it unwise to synonymise these two species. If the two species are distinct, PEB-508 which also has a pair of median mesonotals, probably belongs to this species. Rehn & Rehn (1938: 422) also recorded this species from Labuan.

Hoploclonia Stål, 1875

Hoploclonia Stål, 1875a: 8; Stål, 1875b: 50, 92; Stål, 1875c: 18; Kirby, 1904b: 399; Redtenbacher, 1906: 45; Rehn & Rehn, 1938: 464; Bradley & Galil, 1977: 199; Bragg, 1995a: 25. Type species: *Hoploclonia gecko* (Westwood) [*Acanthoderus gecko* Westwood], by monotypy.

Tisamenus Stål, 1875b: 50, 92; Kirby, 1904b: 399; Redtenbacher, 1906: 43. Type species: *Tisamenus serratarius* Stål, 1875, by subsequent designation, Kirby, 1904b: 399. Synonymised by Rehn & Rehn, 1938: 464.

Description.— Body generally short and stout; spinose or at least granulose. Head rectangular, longer than wide; armed with spines, tubercles, or crests. Basal segment of antennae flattened; antennae slightly shorter than fore legs. Mesonotum with elevated triangular area at anterior, usually armed with spines or teeth. Mesonotum and metanotum with some form of medio-longitudinal carina. Metanotum short and broad (although in males sometimes compressed by metapleura). Female with oviscapit.

The Bornean species may be distinguished from Phillipine species by the presence of a spine at the apices of all tibiae; according to Rehn & Rehn (1938: 464), some species from the Philippines have a spine on some tibiae but none have spines on all tibiae. In addition all Bornean species have a large more or less upright spiny structure on the pronotum, the arrangement of these spines is characteristic of the species. First and fifth tarsomeres long, the intermediate three short. Antennae reaching to about the apices of fore tibiae.

Key to males of the genus *Hoploclonia* (Bornean spp. only)

1. Abdominal segments without obvious spines. Pronotum with pair of large, double spines *Hoploclonia gecko* (Westwood)
- Spines present on at least abdominal segments 2-3 2
2. Pair of large, upright spines present on only abdominal segments 2 and 3, abdominal segment 4 unarmed *Hoploclonia abercrombiei* Bragg
- Obvious spines present on fourth abdominal segment as well as segments 2 & 3 ...
..... *Hoploclonia cuspidata* Redtenbacher

Key to females of the genus *Hoploclonia* (Bornean spp. only):

1. Large lateral pointing spine present on metapleura 2
- No large spine on metapleura *Hoploclonia cuspidata* Redtenbacher

2. Abdominal segments 2 and 3 each with pair of spines near centre line *Hoploclonia abercrombiei* Bragg
 - Third abdominal segment without spines; second segment spineless or with only one small pair of spines 3
3. Front of metanotum with central pair of spines arising from single base; second abdominal segment with pair of small spines *Hoploclonia apiensis* Bragg
 - Metanotum without any large spines; second abdominal segment spineless *Hoploclonia gecko* (Westwood)

Comments.— The genus *Hoploclonia* is predominantly a Philippine genus; 14 species are recorded from the Philippines, and four from Borneo; the Bornean species are endemic. Another species, *H. draconia* (Westwood), has been recorded from the Philippines on a number of occasions and only once from Borneo (Redtenbacher 1906: 45), examination of the bornean specimen showed it had been misidentified. Rehn & Rehn (1938) gave a detailed redescription of the genus and synonymised it with *Tisamenus* Stål. They also described eight new species and provided a key to the species from the Philippines but did not include the Bornean species.

Rehn & Rehn (1938) did mention the Bornean species *H. gecko* and *H. cuspidata* (1938: 466), saying "It seems quite probable that these two species may form a distinct species group". There is little doubt that these and the other two bornean species are closely related; the only distinguishing features are a few of the spines. The eggs of *H. apiensis* are unknown, the others are almost identical.

There is some evidence of a difference in geographical distribution for two of the species; specific locality records of *H. gecko* are limited to the western end of Sarawak and *H. cuspidata* has been found only in the north east of the island, in eastern Sarawak, Brunei and Sabah. The two other species are each known only from one locality.

Hoploclonia abercrombiei Bragg, 1995

Hoploclonia abercrombiei; Bragg, 1995a: 28, figs 2 (♂), 3d (♂), 7a (♀). Holotype, ♀ (BMNH, PEB-2162), Sarawak, Niah National Park, outside Great Cave, coll. I. Abercrombie, 27.x.1994. Paratypes: ♀ (PEB-2161), data as holotype; ♂ (PEB-1641), locality as holotype, coll. P.E. Bragg, 17.viii.1992; ♂ (BMNH, PEB-2159), data as holotype; ♂ (OXUM, PEB-2160), data as holotype.

Material.— **Sarawak:** Niah NP, outside Great Cave: ♀, holotype (BMNH, PEB-2162), ♀, paratype (PEB-2161), ♂, paratype (BMNH, PEB-2159), ♂, paratype (OXUM, PEB-2160), I. Abercrombie, 27.x.1994; ♂, paratype (PEB-1641), P.E. Bragg, 17.vii.1992; ♀ (PEB-2535), I. Abercrombie, 28.x.1994, died vi.1995.

Female.— Whole of body and legs mid to dark brown; tips of larger spines reddish brown; apical segment of antennae white. Centre of mid femora with pale patch; bases of all tibiae pale. Whole of dorsal surface and head rugose, sparingly setose, and granulose; thoracic sternites smooth, abdominal sternites rugose. Femora, tibiae and tarsi all setose; hind femora only very sparsely setose. Measurements given in table 5.

Head rectangular, with medium supra-orbital spines and numerous tubercles on top of head.

Pronotum with transverse median depression. Front half of pronotum occupied by pair of multiple spines which consist of row of three spines which decrease in size towards posterior; anterior spine pointed, others blunt (fig. 50). Middle spines of paratype almost as large as anterior spines. Two small blunt spines just behind transverse depression. Anterior prothoracic sclerite with two circular raised sensory areas between base of legs; posterior sclerite with two blunt spines.

Mesonotum a trapezium; anterior with raised triangular area running to about mid point of mesonotum. Anterior edge of triangular area with several small blunt spines or large tubercles, two anterior corners formed by cluster of spines; each cluster consists of one forward pointing medium spine, one laterally pointing very large broad-based spine and variable number of small or medium spines on sides and base of large spine. Three quarters of way from anterior margin, large rounded mound topped with pair of large spines. Mesopleura with four large lateral spines, and very large mesopleural spine close to dorsal margin. Mesosternum with row of three or four blunt spines on each side in front of mid legs.

Metanotum short, with pair of tubercles near hind margin. Metapleura with very large centrally positioned metanotal spine; with two to four small to medium, and one large supra-coxal spine. Metasternum with one or two blunt spines on each side.

Median segment short, with first paired posterior tubercles. Second and third abdominal segments with one pair of small anterior spines, and one pair first paired posterior of tubercles. Abdominal segments six to nine have one pair of medium to large first paired posterior tubercles. Abdomen tapers from segments two to seven, eighth and ninth segments of equal width. Tenth and eleventh abdominal tergites elongated and pointed, forming ovipositor with elongated operculum. First abdominal sternite with pair of tubercles; second abdominal sternite with one or two tubercles on each side. Operculum with longitudinal carina; apex curving downwards.

Fore femora curved and compressed near base, upper carinae armed with few blunt spines. All four carinae of middle and hind femora indistinct but armed with small spines. Apices of all tibiae have small spine on underside. Middle tibiae armed with two or three small spines on undersides; hind tibiae with three to five.

Male.— (figs 45 & 51) Coloration based on photographic transparency of living male taken *in situ* at time of capture.

Head, prothorax, anterior triangular area of mesonotum, pleural region, all sternites, and antennae, dark brown. Legs, mesonotum, metanotum, and abdominal terga, black. Major pleural sclerites of mesothorax and metathorax very dark brown, almost black. Yellowish-orange markings present: as bands at base of all tibiae, and as stripes along lateral edges of mesonotum and metanotum. Body only very slightly rugose, not granulose. Fore femora and all tibiae setose. Body length 38.0-39.6 mm; measurements of longest specimen as in table 5.

Head quadrangular; with two large supra-orbital spines, small lateral coronal spines and small median coronal spines; rest of armature limited to several minute spines or tubercles.

Pronotum quadrangular, slightly longer than wide, two very large upward pointing anterior pronotal spines (fig. 54), deep transverse indentation at mid point, four or five spine-like lateral pronotal tubercles. Prosternum with two raised granulose sensory areas between base of legs.

Mesonotum a long trapezium with narrow posterior margin. Front of mesonotum forming raised triangle which ends at about mid point of mesonotum. Mesonotum with small antero-lateral spines, anterior mesal tubercles; very large outward pointing anterior mesonotal spines, one large double spine one fifth of way from posterior margin. Mesopleura with four large lateral spines and one very large mesopleural spine. Mesosternum with one pair of tubercles near fore margin, followed by two pairs of spine-like tubercles.

Metanotum small, almost quadrangular, with three tubercles arranged transversely. Metapleura with very large metapleural spine near dorsal margin, and two medium and one small supra-coxal spine.

Median segment rounded at anterior and straight at posterior, without spines. Second and third abdominal segments each with one large pair of upright anterior spines. Abdomen tapers evenly to sixth segment, seventh segment slightly wider, eighth segment a trapezium much wider at posterior, ninth and tenth segments narrowing slightly. Poculum short and rounded. Cerci flattened, tapering to blunt points.

Carinae of all legs indistinct. Fore femora curved, with basal third narrow and with three spines on basal half of dorsoposterior carina. Dorsal surface of mid femora with four spines near base and tubercle near mid point. Dorsal surface of hind femora with four spines near base and two tubercles near mid point. Indistinct ventral carinae of mid and hind femora with tubercles and spines along their length, becoming larger towards apex, two apical pairs of spines powerful. Fore tibiae unarmed. Middle and hind tibiae with one pair of small spines on underside, one at mid point of tibia, other slightly towards apex.

Egg.— (figs 58-59). Capsule a short cylinder, rounded at polar end, flattened at opercular end. Capsule, micropylar plate and operculum greyish brown and densely covered with numerous short hairs, hairs longer at opercular end. Micropylar plate indistinct; "T" shaped, with arms extending from sides near to polar end and almost joining on ventral surface. Operculum round, almost flat, covered with short hairs and lacking capitulum. Single egg examined with following measurements: length 3.8 mm, height 3.0 mm, width 2.6 mm.

Comments.— When the first male of this species was found in 1992 it was assumed that it was the male of *H. cuspidata* as a female of the latter species was found less than 200 m away. However the uncertainty caused by several museum specimens of male *H. cuspidata* prompted a return visit to this site in 1994. On this visit two mating pairs of *H. abercrombiei* were collected, along with a male and a female. Mr Abercrombie managed to keep pair alive and has successfully bred this species which feeds on bramble and has proved easier to rear than *H. cuspidata* and *H. gecko*. The first egg hatched on 20.ii.1995, having been laid on 27.x.1994 (115 days). In addition a male of undetermined species was also collected at this site (*Hoploclonia* sp. 1, below).

Hoploclonia apiensis Bragg, 1995

Hoploclonia apiensis Bragg, 1995a: 35, figs 6, 7d. Holotype, ♀ (BMNH, BM1978-206) Sarawak, Mulu National Park, Gunung Api summit, crawling beneath the characteristic dense low vegetation, 26.iv.1978, RGS Expedition 1977-8, J.D. Holloway et al.

Material.— **Sarawak:** Mt Api: ♀, holotype (BMNH BM1978-206), J.D. Holloway et al. 26.iv.1978.

Female.— (figs 46 & 56) Specimen almost uniformly mid brown, lateral margins of mesonotum and metanotum pale brown. Measurements given in table 5. Dorsal surface of body and head rugose, sparingly setose, and sparingly tuberculate; ventral surface smooth, sternites of thorax setose. Femora, tibiae and tarsi all setose, fore legs densely setose.

Head rectangular, with two pairs of small spines just behind eyes and numerous tubercles on top and back of head.

Pronotum with transverse depression across mid point. Anterior pronotal spines fork into two equal sized branches (fig. 56). Pronotum with two small blunt lateral spines near posterior. Anterior prothoracic sclerite with two circular raised sensory areas between base of legs; posterior sclerite with two blunt spines.

Mesonotum a trapezium, with raised triangular area at front running to about mid point of mesonotum. Anterior margin of mesonotum forms anterior edge of triangular area, with large spine at each corner and two small spines near middle. Triangular area with second, larger, pair of spines just behind front pair. Posterior apex of triangular area with pair of spines arising from single swollen base. Mesopleura bearing five spines: one large spine near dorsal margin; and three medium and one small spine which occur at almost regular intervals from anterior margin, small spine posteriormost, below large spine. Anterior of mesosternum with row of two blunt spines on each side in front of mid legs.

Metanotum short; with pair of spines on swollen base at about mid point. Metapleura with two small and one medium supra-coxal spine, and large metapleural spine near dorsal margin.

Median segment short and unarmed. Second abdominal segment with pair of medium sized anterior spines. Abdominal segments six to nine with large first paired posterior tubercles. Abdomen tapers from segments two to six (seventh, eighth and ninth segments distorted during preservation). Tenth and eleventh abdominal tergites elongated and pointed, forming an ovipositor with elongated operculum. Operculum with longitudinal carina; apex curving downwards.

Fore femora curved and compressed near base, upper carinae armed with few spine-like tubercles. All four carinae of middle and hind femora indistinct but armed with small spines. Undersides of fore tibiae armed with few minute spines. Middle and hind tibiae armed small spines on undersides.

Comments.— The male and egg are unknown. The female may be distinguished from *H. cuspidata* by the presence of large metapleural spines and double spine on the pronotum; from *H. gecko* by the spines on the second abdominal segment; from *H. abercrombiei* by the absence of spines on the third abdominal segment; and from all three by the double spine on the metanotum.

Hoploclonia cuspidata Redtenbacher 1906

Hoploclonia cuspidata Redtenbacher 1906: 46; Bragg 1995a: 32, figs 1 (♀), 3b (♀), 4 (egg), 7c (♂). Holotype, ♀ (MNHN) North Borneo.

Hoploclonia draconia; Redtenbacher, 1906: 45 (not Westwood, 1848) [♂ specimen from Borneo only].

Material.— **Brunei:** locality unknown: ♂ (OXUM), Waterstradt van der Poll, bought Janson, 1909. Temburong district, Kuala Belalong, 100 m: ♀ (BMKB, PEB-983), P.E. Bragg & I. Abercrombie, 06.viii.1991; ♀ (PEB-1904), captive bred from PEB-983 by I. Abercrombie, 1992. Bandar Seri Begawan: 2 ♀♀ (BMKB), i.1968. Seria, Sungai Liang, Arboretum: 1 ♀ (C.L. Chan), K. Kosugi, vi.1986. Teraja, waterfall trail: ♀ (PEB-2536), I. Abercrombie, 03.xi.1994.— **Sabah:** Mayog: ♀ (C.L. Chan), 24.iv.1989; Long Pa Sia: 2 ♀♀ nymphs (C.L. Chan), J. Huisman. Mt Kinabalu: ♂ (NHMW), Staudinger. Crocker Range, above Kallang, Tenom: ♂, ♂ nymph (C.L. Chan), A. Lamb, 12.viii.1984.— **Sarawak:** Niah NP: ♀ (PEB-1906), 17.viii.1992; eggs (PEB-1805), laid by PEB-1906; Niah Caves, Gan Kira, on ground: ♂ (SMSM-10), HK.S., 19.v.1959.

Female.— (figs 47 & 52). Preserved specimens of Brunei origin mid brown, slightly darker on abdomen. Large and medium spines on body reddish coloured, as portions of all femora, particularly near bases. Specimen from Niah significantly darker than those originating in Brunei; dorsal surface of abdomen very dark brown, almost black, with little evidence of any red colouring on insect. No sign of yellow on margins of mesonotum and metanotum mentioned by Redtenbacher; probably a variable characteristic. Measurements given in table 5.

Whole of body and head rugose, sparingly setose, and granulose except for smooth ventral surface. Femora, tibiae and tarsi all setose, fore legs densely setose.

Head rectangular, with two small supra-orbital spines and numerous tubercles.

Pronotum with transverse depression across mid point. Front half of pronotum occupied by compound anterior pronotals consisting of row of three or four blunt ended spines which decrease in size towards posterior (fig. 52); these not symmetrical, on each of three specimens examined in detail one side with three spines while other with four. wo blunt spines just behind transverse depression.

Mesonotum a trapezium with raised triangular area at front running to about mid point of mesonotum. Anterior edge of triangular area with several small blunt spines or large tubercles, two anterior corners formed by large broad spine. Three quarters of way from anterior margin, large rounded mound topped with pair of tubercles. Mesopleura with four medium lateral spines, and one large mesonotal spine. Mesosternum with three pairs of tubercles.

Metanotum unarmed. Metapleural sclerite with two small and one medium supra-coxal spine; no metapleural spine present. Metasternum unarmed.

Median segment unarmed. Second abdominal segment with one pair of small anterior spines. Abdominal segments six to nine with first paired posterior tubercles. Abdomen tapers from segments two to six; seventh, eighth and ninth segments of equal width. Tenth and eleventh abdominal tergites elongated and pointed, forming ovipositor with elongated operculum.

Fore femora curved and compressed near base, upper carinae armed with few tubercles. All four carinae of middle and hind femora indistinct but armed with small spines. Fore tibiae armed with few minute spines on underside. Middle and hind tibiae armed small spines on under sides; five or six pairs on hind tibiae, three to four pairs on mid tibiae.

Male.— Similar to *H. abercrombiei* but differing in size, coloration and in number of spines on abdomen. Body length of OXUM specimen 32 mm, NHMW specimen 33 mm; full measurements of the NHMW specimen given in table 5.

Colour mid to dark brown, spines of thorax red-brown, sides of mesonotum very dark brown. Lateral margins of mesonotum and metanotum yellow.

Large anterior pronotal spines each with two tubercles or small spines near base on posterior face (fig. 53). Size of small spines variable.

Mesopleura with four small lateral spines on lower margin and one large mesopleural spine which is level with double spine of mesonotum; laterals of equal size and not evenly spaced, large gap between third and fourth spines.

Abdominal segments 2-4 with medium pair of anterior spines.

Spines on femora small but otherwise as in *H. abercrombiei*. All tibiae without spines, except for a minute apical spine on middle and hind tibiae.

Egg.— (figs 60-61). Capsule a short cylinder, rounded at polar end, flattened at opercular end. Capsule, micropylar plate and operculum greyish brown and densely covered with numerous short hairs which are longer at opercular end. Micropylar plate indistinct; elongated oval with two arms extending from sides near to polar end. Position of micropyle shown by black micropylar cup at polar end of plate. Operculum round, almost flat, covered with short hairs and lacking capitulum. Typical egg length 3.5-3.7 mm, height 2.8-2.9 mm and width 2.5 mm. Opercular angle difficult to measure due to egg being so short relative to curve of dorsal surface; however in region of -12° if a line passing through centre of operculum and centre of polar end taken as being parallel to micropylar plate.

Nymphs.— First instar nymphs 12 mm in length, black with reddish brown legs. Third instar female nymph 27 mm, legs clearly reddish, body not showing any obvious spines.

Comments.— Ian Abercrombie successfully reared two female specimens of *H. cuspidata* from eggs laid by the specimen collected in Brunei and has also found that this species can reproduce by facultative parthenogenesis (personal communication, 1993). He has subsequently established a sexual culture from the female collected in 1994 (PEB-2536). As with *H. gecko*, this species is difficult to rear in captivity.

Hoploclonia gecko (Westwood 1859)

Acanthoderus gecko Westwood 1859: 52, pl. 26.6 & 26.7. Lectotype, ♀, Borneo, Sarawak, (BMNH, 56.44).

Paralectotypes: 2 ♂♂, data as lectotype (BMNH, 56.44); 1 ♂, 1 ♀, Sarawak, coll. Wallace, 1858 (OXUM 494); 2 ♂♂, 2 ♀♀, Sarawak, (OXUM 494).

Hoploclonia gecko; Stål, 1875b: 92; Kirby, 1904b: 399; Redtenbacher, 1906: 46, fig 1.10 (♂); Rehn & Rehn, 1938: 466, footnote 74; Bragg, 1991c: 13-15; Bragg, 1992c: 298-299, figs 3 & 4; Bragg, 1995a: 27, figs 3a (♀), 3c (♂), [Lectotype designation]; Schulten, 1995: 105, figs. 66 (♀), 67 (egg).

Material.— **Sarawak**: locality unknown: ♀, lectotype (BMNH, 56.44); 2 ♂♂, paralectotypes (BMNH, 56.44); 2 ♀♀, 2 ♂♂, paralectotypes (OXUM 494); ♀, ♂, paralectotypes (OXUM 494), Wallace; 3 ♂♂, ♀ nymph (MCSN), S. Doria, 1865-66 [♀ has O. Beccari 1867 on underside of data label]; ♀ (OXUM), Wallace [no date]. Bako NP, 50 m: 4 ♀♀ (PEB-485; PEB-150; PEB-162; PEB-501), 2 ♂♂ (PEB-153; PEB-502), 20.viii.1991; ♂ (PEB-486), 19.viii.1989; eggs (PEB-487; PEB-155; PEB-158), 20.viii.1989; ♀ (PEB-149), ♂ (PEB-151), collected as mating pair, 01.i.1988; ♂ (PEB-152), nymph (PEB-148), captive reared, 1990; ♂ (NHMN, PEB-156), captive reared, 1991; ♂ (DCMD, PEB-157), captive reared, 1990; eggs (PEB-159), 01.i.1988. Santubong: ♀ (SMSM-4), v.1904. Mt Santubong, 100 m: 2 ♀♀ (PEB-1672; PEB-1673), 31.vii.1992. Mt Santubong, 300 m: ♂ (PEB-2141), 21.x.1994. Matang Road: ♀ (SMSM-1), 30.v.1900. Matang: ♂ (SMSM-2), xii.1898. Mt Serapi, 210 m: ♀ (PEB-154) 13.viii.1990. Mt Serapi: ♀ (PEB-1611), ♂ (PEB-1610), 05.viii.1992. Lingga: ♂ (SMSM-5), xi.1895. 10th mile: ♂ (SMSM-6), vi.1895.— **No data**: 2 ♂♂ (SMSM-7; SMSM-8); ♀ (SMSM-3); ♀ nymph (SMSM-9).

Female.— (figs 48 & 54). Mid brown, slightly darker on abdomen. Large and medium spines on body, and longitudinal carinae are reddish coloured. Whole of body and head roughly granulose, almost verrucose, except for ventral surface which is smooth; sparingly setose. Femora, tibiae and tarsi all setose, fore legs densely setose. Measurements given in table 5.

Head rectangular, with two small supra-orbital spines; rest of head armature consists of tubercles: gulars, occipital medials, median coronals, and lateral coronals.

Pronotum with transverse depression across mid point. Anterior pronotals consist of large forked spine, occasionally with two smaller spines on posterior (fig. 54); otherwise armed only with tubercles.

Mesonotum a trapezium with raised triangular area at front running to about mid point of mesonotum. Anterior of triangular area with only small anterior mesal spines or tubercles; anterior corners are formed by large laterally pointing broad spine which may have few small spines at its base. Three quarters of way from anterior margin is large rounded mound topped with one pair small or medium spines. Mesonotum otherwise armed only with tubercles. Mesopleura with large mesopleural spine, and row of small laterals. Mesosternum with four pairs of well rounded tubercles.

Metanotum and median segment both short and unarmed. Metapleura with one large metapleural spine, and three small and one medium supra-coxal spines.

Abdominal segments all without spines but with numerous small tubercles, 2-9 with obvious first and second paired posterior tubercles. Abdomen tapers from segments two to six; seventh, eighth and ninth segments of equal width. Tenth and eleventh abdominal tergites elongated and pointed, forming ovipositor with elongated operculum.

Fore femora curved and compressed near base; dorsoposterior carinae armed with small spines, especially near base, otherwise unarmed. All four carinae of middle and hind femora armed with small spines, particularly small on ventro-anterior carinae. Fore tibiae with few minute spines on each ventral carina. Middle and hind tibiae with small spines on ventral carinae.

Male.— (figs 49 & 55). Mesonotum, metanotum, abdominal nota and legs black; rest brown; with bright red, occasionally orange, medio-longitudinal stripe running from mesonotum to 4th abdominal segment; major spines red or reddish brown. Head and thorax granulose, abdomen smooth. Fore femora and all tibiae setose, middle and hind femora sparingly setose. Measurements given in table 5.

Head quadrangular; with two medium-large supra-orbital spines, small occipital medial spines, small median coronal spines, and small lateral coronal spines; with gulars present as tubercles.

Pronotum quadrangular, slightly longer than wide, with deep median transverse groove. Anterior pronotals consist of large forked spine (fig. 55), occasionally with tubercle on posterior; otherwise armed only with few tubercles. Prosternum with two raised granulose, almost circular, sensory areas between base of legs.

Mesonotum a long trapezium with narrow posterior margin. Front of mesonotum forming raised triangle which ends at about mid point of mesonotum. Mesonotum with very small anterior mesal spines, medium anterior laterals, very large outward pointing anterior mesonotals, post-median mesonotals present as large double spine

on swollen base. Lateral margins with few small tubercles. Mesopleura with large mesopleural spine, 4-5 small lateral spines. Mesosternum with three pairs of tubercles.

Metanotum a small trapezium, widest at anterior. Metapleura with extremely large metapleural spine near dorsal margin, and with two very small and one small supra-coxal spine.

Abdomen unarmed except for very small first paired posterior tubercles on median segment. Abdomen tapers very slightly to seventh segment, slightly wider, eighth segment a trapezium much wider at posterior, ninth and tenth segments narrowing slightly; apex of 10th with small rounded notch. Poculum rounded, with wide flattened rim. Cerci flattened, tapering to blunt points.

Fore femora curved, with basal third narrow; dorsoposterior carina with small spines on basal half, rest unarmed. Dorsal carinae of mid femora and hind femora with small spines, larger near base and becoming no more than tubercles near apices. Ventral carinae of mid and hind femora each with apical pair of small spines; ventro-posterior carina of hind femora with few minute tubercles near base. Fore tibiae unarmed. Middle and hind tibiae with few minute spines on ventro-posterior and ventro-medial carinae.

Egg.— (figs 62-63). A short cylinder, with polar end rounded, opercular end more or less flat, ventral surface longitudinally straight, dorsal surface longitudinally convex; setose, setae longer at opercular end; greyish brown. Typical dimensions: length 4.1-4.2 mm, height 2.9-3.0 mm, width 2.6-2.7 mm. Opercular angle difficult to measure due to egg being so short relative to its height and width; in region of -10° . Micro-pylar plate rather indistinct; "Y" shaped, with arms curving two thirds of way round polar end.

Comments.— All specimens have been found on the ground or no more than 30 cm above ground level. The egg is laid a few millimetres below ground level in damp soil. A breeding culture has been established (Bragg, 1991d) although this is a difficult species to maintain; nymphal mortality is high. Foodplants include bramble, eucalyptus, flowering currant, hawthorn, ivy, oak, pyracantha, raspberry, and rose.

Hoploclonia spec. 1.

Hoploclonia sp. 1; Bragg, 1995a: 38, fig. 7b (δ).

Material.— Sarawak: Niah NP, outside Great Cave: δ (PEB-2158), P.E. Bragg, 27.x.1994.

Comments.— This specimen has body proportions and spination similar to *H. abercrombiei*. The anterior pronotals (fig. 57) are branched like those of *H. gecko* and there is a single anterior spine on the left side of 4th abdominal segment, as if it is a *H. cuspidata* with a spine missing. It is possible that this is a variation of *H. abercrombiei*, or it may be a hybrid.

Hoploclonia spec. 2.

Hoploclonia sp. 2; Bragg, 1995a: 38.

Material.— **Sarawak:** Batu Lawi expedition: ♂ nymph (SMSM-11), 25.v.1911.

Comments.— This immature specimen has a pair of spines on the second abdominal segment, but not on any other abdominal segments. It is possible that the specimen may be a male of *H. apiensis* but only a cursory examination of this specimen has been possible.

Datamini Rehn & Rehn, 1938

Obrimini Redtenbacher, 1906: 38 [in part].

Datamini Rehn & Rehn, 1938: 401; Günther, 1953: 546, 551; Bradley & Galil, 1977: 198.

Description.— Body verrucose, broad and short, not stick-like. Prothoracic foramen not at fore margin of pronotum, but set back by about its own diameter. Female abdomen often dorsoventrally compressed but may be cylindrical. Lamina supraanal is not elongated, operculum not longer than 10th tergite. Antennae generally short, rarely reaching beyond legs in females and not much further in males.

Key to genera of the tribe Datamini

Orestes Redtenbacher, 1906 and *Woodlarkia* Günther, 1931 are not recorded from Borneo. *Woodlarkia* is not included in the following key; as Rehn & Rehn correctly stated (1938: 405, footnote 20) the published descriptions of the genus and sole species are inadequate for it to be placed in the key. The geographical distribution of the genus, Woodlark Island, is far from the other members of this tribe and suggests that the genus may be incorrectly placed in this tribe.

1. Antennae only slightly longer than length of fore femora (distinctly shorter than combined length of fore tibia and femur); abdomen of females of almost uniform width throughout. Without mesopleural or metapleural spines. Species all small (female less than 35 mm, male less than 30 mm) *Planispectrum* Rehn & Rehn
- Antennae long, usually reaching beyond end of tibiae; if antennae shorter than fore legs then abdomen of females narrow sharply at about the 6th segment. Adults usually larger than above 2
2. Back of head conically elevated, spinose or tuberculate, usually with four converging carinae 3
- Back of head not conically elevated, but may be swollen or flat; either smooth or tuberculate, or spinose but without distinct converging carinae 4
3. Abdomen armed with spines on posterior of lateral margins (and on central carinae); thorax and abdomen with definite central longitudinal carina *Pylaemenes* Stål
- Abdomen tuberculate, without spines on lateral margins; central longitudinal carina of thorax and abdomen obsolescent in most species *Datames* Stål
4. Back of head flat, may be tuberculate, but never swollen. (not recorded from Borneo) *Orestes* Redtenbacher
- Back of head swollen and usually tuberculate or spiny 5

5. First antennal joint armed with one or two spines on outside. First and second tarsomeres of hind leg about equal length. Body scabrous or tuberculate 6
 - First antennal joint not armed with spines. First tarsomere of hind leg about twice as long as the second tarsomere. Body granulose, not tuberculate
 *Epidares* Redtenbacher
6. Mesonotum with one large pair of spines projecting forwards, almost reaching front of pronotum. Large spines on mesopleura and metapleura of females
 *Spinodares* gen. nov.
- Females without large spines on mesonotum or mesopleura. If males have spines on front of mesonotum they project mainly upwards and slightly outwards or slightly forwards, rarely reaching as much as half way towards front of pronotum
 *Dares* Stål

Comments.— The distribution of the tribe (fig. 10) includes southern China, Vietnam, Cambodia region, the Malay peninsula, Borneo, Timor, Sulawesi, Moluccas, New Guinea and Palawan. The tribe has not previously been recorded from the Philippines; a new species described here is from Brooke's Point on the southern tip of the island of Palawan, the Philippine island which is closest to Borneo. All but two of the seven genera are represented in Borneo. Two genera, *Epidares* and *Spinodares* are endemic and *Dares* is predominantly Bornean.

The Datamini are a very distinctive tribe with no obvious closely related group. Within the Datamini *Pylaemenes* and *Datames* are clearly very closely related. The other genera do not show obvious close relationships although *Dares* and *Spinodares* have a number of similar features. The phylogeny of the tribe is unclear, the dendrogram (fig. 65) represents a possible relationship between the genera.

Dares Stål, 1875

Dares Stål, 1875b: 51, 93; Kirby, 1904b: 400; Redtenbacher, 1906: 53; Rehn & Rehn, 1938: 485; Bradley & Galil, 1977: 198. Type species: *D. validispinus* Stål by designation of Kirby (1904b: 400).

Description.— Body verrucose and tuberculate, males frequently with spines. Antennae reaching as far forward as apices of tibiae, longer in males. Basal joint of antennae with one tooth or spine on outer margin. Vertex swollen; tuberculate or spiny (males always with some spines). Anterior of lateral margins of pronotum expanded to cover pronotal foramen. Mesonotum and metanotum not parallel sided, and usually without raised median longitudinal carina (small slightly raised carina present in one species). Mesonotum and metanotum of males usually with pair of spines on hind margin. Abdomen of males cylindrical and not verrucose. Abdomen of females dorsoventrally compressed; anterior wide posterior narrow, segments 3-5 widest; segments 6 and 7 very short. Lamina supraanalis not visible dorsally. Anal segment short. Poculum deep, rounded, appears almost spherical. Operculum deep and rounded, with longitudinal carina. Cerci not visible dorsally and even ventrally usually difficult to see. Femora finely tuberculate, or dentate, rarely spinose; usually clearly quadrangular in females (exception *D. ulula*); more or less rounded in males. All tarsi of similar length. Egg spherical, densely or sparingly setose; operculum circular or almost circular.

Comments.— As Stål used the names of kings for several of the new genera which preceded *Dares*, e.g. *Tisamenus* and *Pylaemenes*, it is likely that *Dares* was based upon *Dareus*, a Persian king. Stål used the spelling *Dares* on both occasions and while it may have been a misspelling there is no direct evidence and therefore no justification for an emendation of the name.

The genus contains several nominal species which were described from single immature specimens. Most of the species in the genus were synonymised by Günther (1935a: 3) but captive rearing of some of these species has shown the synonyms to be erroneous. At least one species, *D. ulula*, shows considerable geographical variation; conversely, there is very little difference between the females of several species although the corresponding males may be very different. The holotype of *D. subcylindricus*, a non-Bornean species appears to be a female nymph, judging from a photograph (I have been unable to examine the specimen), the species is not included in the following keys.

With the following revision, the genus contains twelve species, ten are Bornean, and all species are endemic. The phenograms (figs 66 & 67) are based on examination of eight characters in the males and eleven in the females. Both phenograms show a similar relationship between the five species for which both sexes are known.

Key to species of the genus *Dares* (males)

1. Spines on fore margin of mesonotum 3
 - No spines on fore margin of mesonotum 2
2. Spines on metanotum at least as large as spines on metapleura. Species from Borneo *Dares validispinus* Stål
 - Spines on metanotum (if any) much smaller than those on metapleura. Species from Philippines *Dares philippinensis* spec. nov.
3. Abdominal segments with large tubercles or transverse carinae 4
 - Abdominal segments all smooth *Dares planissimus* spec. nov.
4. Abdomen without spines on lateral margins (if tubercles present on lateral margins they are anterior or mesal) 5
 - Spines on posterior of lateral margins of segments 2-8; additional spines on middle of lateral margins of some segments. Spines of mesonotum and metanotum branched *Dares multispinosus* spec. nov.
5. Abdominal tergites 6-8 smooth. (Abdominal tergites 4-5 with pair of quite large spine-like tubercles on posterior margin, rest smooth)
 - *Dares navangensis* spec. nov.
 - Abdominal tergites 6-8 with tubercles or transverse ridge 6
6. Posterior margin of abdominal tergites 6-8 with pair of quite large tubercles but without continuous transverse ridge. Second antennal segment clearly thicker than subsequent segments *Dares verrucosus* Redtenbacher
 - Posterior margin of abdominal tergites 6-8 with transverse ridge which may have two indistinct tubercles or several small tubercles. Second antennal segment only slightly wider than subsequent segments 7
7. Posterior margin of abdominal tergites 6-8 with one raised transverse ridge which has no more than two obvious but small tubercles on it. Mesopleura with dis-

- tinct spine. Large central occipital spine, posterior occipitals small *Dares ulula* (Westwood)
- Posterior margin of abdominal tergites 6-8 with irregular transverse ridge with four or more distinct tubercles. Mesopleura usually without distinct spine. Central occipital small, posterior occipitals medium to large *Dares breitensteini* Redtenbacher

Key to females of the genus *Dares*

1. Lateral margin of 3rd abdominal tergite armed with tubercles or teeth. (Anterior margin of mesothorax usually with two fairly obvious tubercles, teeth, or swellings) 3
- Lateral margin of 3rd abdominal tergite without any irregularities (spines, teeth or tubercles). [Fore margin of mesonotum with only small tubercles, or without tubercles.] 2
2. Antennae with 24 segments, body length about 4.5cm *Dares validispinus* Stål
- Antennae with 20 segments, body length 2.5cm *Dares murudensis* spec. nov.
3. Abdominal tergites 6-9 with obvious large or moderately large raised tubercles near lateral margins 4
- Abdominal tergites 6-9 with only very small tubercles, or without tubercles ... 5
4. Anterior occipital spines large, clearly much larger than tubercles on head; or, if anterior occipitals not large, head lacks pre-occipital ridge and any tubercles in this position stop well short of eye *Dares ulula* (Westwood)
- Anterior occipitals large tubercles or small spines, not much larger than other tubercles in region and tuberculate pre-occipital ridge present *Dares breitensteini* Redtenbacher
5. Body without any large spines 6
- Body with large spines on at least mesonotum and metanotum 7
6. Anterior margin of mesonotum with obvious blunt spines or large tubercles, antennae with 25 segments, species from Borneo .. *Dares verrucosus* Redtenbacher
- Anterior margin of mesonotum without obvious tubercles (only very small tubercles), antennae with 24 segments, species from Philippines *Dares philippinensis* spec. nov.
7. Head with large spines; metapleura with only small, blunt, supra-coxal spine, mesonotum and metanotum with much larger spines .. *Dares mjobergi* spec. nov.
- Head without any large spines but with large tubercles; metapleura with extremely large supra-coxal spine, at least as large as any other spines elsewhere on body *Dares kinabaluensis* spec. nov.

Dares breitensteini Redtenbacher, 1906

Dares breitensteini Redtenbacher, 1906: 55; Günther, 1943: 150. Lectotype [here designated], ♀ (NHMW, 58) Borneo, Paralectotypes: ♀, 2 ♂♂ (NHMW) Borneo.

Dares ulula; Günther, 1943: 150 [in part. Not *D. ulula* (Westwood, 1859)].

[not *Dares breitensteini*; Hausleithner, 1991: 220, fig. 2. **Misidentification** - see *D. verrucosus*].

[*Dares ulula* (Westwood, 1859); **erroneous synonym** by Günther, 1935a: 3].

[Not *Dares breitensteini*; Schulten, 1995: 94, fig. 56 (♀). **Misidentification** - see *D. verrucosus*].

Material.— **Borneo**: locality unknown: ♀, lectotype (NHMW, 58); 2 ♂♂, ♀, paralectotypes (NHMW).— **Kalimantan**: Mahakam: 2 ♂♂, ♀ nymph (RMNH), Borneo expedition of Dr Nieuwenhuis, 1894; ♀ nymph (RMNH), Borneo expedition Dr Nieuwenhuis, 1894. Bloe-oe: 2 ♀♀ (RMNH), Borneo expedition Dr Nieuwenhuis, 1898. Poetoes Sibau: 4 ♂♂, ♀ (RMNH), Borneo expedition Dr Nieuwenhuis, Büttikofer, vi.1894; ♂ (RMNH), Borneo expedition Dr Nieuwenhuis, 04.vii.1894. Boegan: ♂ nymph (RMNH), Borneo expedition Dr Nieuwenhuis, vii.1894.

Female.— Whole insect almost uniformly dark brown; verrucose, and densely setose dorsally and ventrally. Measurements given in table 7.

Antennae with 24-25 segments; basal segment flattened, with apical tooth on exterior margin; second segment with minute tubercle at base; 1-3 long, 4 & 5 and very short, 16th to penultimate short; 15th with small tooth on external margin, 17th slightly swollen. Head very tuberculate (fig. 83). Back of head slightly swollen, with row of large and medium tubercles running from eye to medium posterior occipital tubercle; anterior occipital tubercles indistinguishable from those in row; lateral coronal tubercles small; no central occipital; few tubercles between posterior occipital and lateral coronals.

Pronotum swollen at anterior, with transverse median groove; with anterior and pre-median, post-median and posterior pairs of medium tubercles; paralectotype with fifth pair of medium tubercles which lies between post-median and posterior pair.

Mesonotum with very large anterior marginal mesonotal tubercles; large antero-lateral pair of tubercles; posterior mesonotal mounds medium, with medium apical tubercle or with blunt medium spine and 1-3 medium tubercles; lateral margins with 3-4 medium tubercles. Mesopleura rugose, ventral margin with 4 medium tubercles. Mesosternum with two pairs of tubercles.

Metanotum with small posterior mesonotal mounds, lectotype with blunt medium spine and few small tubercles, paralectotype tuberculate but without distinct apical tubercle. Metapleura rugose; ventral margin with one small tubercle and one small to medium blunt supra-coxal spine. Metasternum with two pairs of tubercles.

Abdominal segments 2-9 with median longitudinal carina, indistinct on 2, distinct on remainder; on 3-6, carina with small or medium tubercles on lateral margins. Segments 1-9 with both first and second paired posterior tubercles; first pair small on 1-2 and 7, medium on 3, 6 and 8-9, large on 4-5; second pair small on 1-5, on 6-9 as large double tubercle (made up of two tubercles one behind other). Segment 3 with two medium and one small tubercle on margin and one medium anterior tubercle close to lateral margin. Segments 4-5 with anterior large lobe-like tubercle, one median large tubercle and one small posterior tubercle on lateral margin; and one large tubercle on anterior margin close to lateral margin. Segments 6-8 with anterior medium tubercles very close to lateral margins. Segment 9 with pair of widely spaced medium tubercles some distance behind anterior margin, and pair of medium tubercles between first and second paired posteriors. Segments 8-9 with posterior half of longitudinal carina high and pointed; carinae of segment 9 projects over segment 10. Tenth segment with median longitudinal row of three small tubercles; postero-lateral pair of medium tubercles; and three large tubercles on each side. Posterior margin of tenth segment with uneven, with indentation in centre. Abdomi-

nal sternites rugose; 2-5 with median pair of tubercles; 2-7 with small first posterior tubercles, generally indistinct but very distinct on 7. Operculum rugose, with two lateral longitudinal carinae; lateral surfaces convex; apex almost straight, only slightly curved, with down-curving rim.

Femora and tibiae setose. Dorsal carinae of femora with few rounded tubercles. Fore femora without spines. Ventro-posterior carinae of middle femora and both ventral carinae of hind femora each with two small spines near apex; middle femora with one small spine near apex of ventro-anterior carinae. Hind tibiae with one or two indistinct tubercles. Tarsomeres 1-4 of similar size.

Male.— (fig. 73). Head, body and femora rugose; legs setose. Base colour light to mid brown, with two dark longitudinal stripes along thorax and abdomen, interrupted and indistinct on abdomen; lateral margins of mesonotum and metanotum slightly yellowish; ventral surface light brown; larger spines on head and thorax occasionally reddish. Measurements given in table 6.

Antennae with 16+ segments (all examined specimens damaged); basal segment with tooth on external margin at apex; 13th with small or minute tubercle in centre of outer margin. Back of head slightly swollen; pair of medium to large anterior occipital spines; posterior pair of occipital medium to large spines or large tubercles; small central occipital spine; pair of broad, lateral coronal tubercles; small or minute spine between each anterior occipital and posterior occipitals.

Pronotum rugose, with median transverse groove. Anterior, pre-median, posterior pronotal tubercles present but indistinct; post median tubercles occasionally present; second pair of posterior pronotal tubercles present, and occasionally one postero-lateral pair.

Mesonotum with medium to large anterior marginal mesonotals; with small anterior lateral mesonotal tubercles; posterior mesonotal swellings with large spine, occasionally with double spine (either of equal size or one large and one small). Mesopleura with row of 5-6 tubercles on ventral margin. Mesosternum granulose or rugulose, with two pairs of tubercles.

Posterior metanotal swellings with large spine. Metapleura with stout medium, or large supra-coxal spine and small tubercle. Metasternum granulose or rugulose, with pair of tubercles.

Median segment without obvious tubercles. Second abdominal segment with first pair of posterior tubercles indistinct to medium. Segments 3-8 with first paired posterior tubercles, occasionally extremely large (almost like blunt medium spines) on 3-5; small pair of tubercles may be present just anterior to these (particularly on segments 4-7) and may merge at bases to form a carina. Second paired posterior tubercles clearly present on 6-8 and may be present on 5. Bases of tubercles merge, forming transverse carina on at least segments 6-8. Eighth segment with pair of posterior lateral tubercles. Ninth segment with short longitudinal carina or swollen tubercle on posterior margin. Tenth segment with pair of tubercles near anterior margin; apex with small indentation. Segments 2-4 narrowing slightly, 5-6 widening very slightly, 8th widening, 9th almost straight, 10th narrowing. Sternites rugulose. Eighth sternite with small first paired tubercles. Poculum deep, angular, irregularly tuberculate; apex rounded with down-curving rim.

Femora and tibiae setose; carinae indistinct. Apices of femora with blunt spine

dorsally. Fore femora with slight undulations on dorsoposterior carina but no tubercles, rest smooth. Middle and hind femora with few indistinct tubercles on both dorsal carinae; dorsoposterior of hind femora usually with one spine-like tubercle near base. Ventro-posterior carinae of middle and hind femora, and ventro-anterior of hind femora, each with two small spines near apices; ventro-anterior of middle femur with one small spine near apex. In addition to apical spines, hind femora usually with row of three very indistinct tubercles. Tibiae unarmed. Tarsomeres 1-4 of similar size.

Comments.— There is no certainty that the male and female type specimens are correctly associated as no specific localities are given. However the RMNH material consists of a female and two males which are known to have been collected on the same expedition and may therefore be from one locality. Without the RMNH material I would conclude that the sexes are not correctly associated and that the males were conspecific with *D. verrucosus* and the females conspecific with *D. ulula*. The RMNH material causes sufficient doubt for *D. briensteini* to be treated as distinct until more material becomes available to clarify the issue. The RMNH specimens are mentioned by Günther (1943: 150) who listed them as *D. ulula*.

Dares kinabaluensis spec. nov.

Material.— **Sabah:** Mt Kinabalu, Marai-Parai: ♀, holotype (C.L. Chan) C.L. Chan & W. Wong, ii.1985. The holotype is mounted with one egg in a gelatin capsule.

Female.— (fig. 77). Whole insect uniformly dark brown. Antennae with 20 segments; first armed with one tooth on outer edge; second widened. Head tuberculate and verrucose. Back of head with quadrangular swelling; top of swelling more or less flat with almost central longitudinal groove; anterior and posterior occipital tubercles medium. One or two small tubercles between eyes and anterior occipital tubercles. Lateral coronals large tubercles. Measurements given in table 7.

Pronotum tuberculate, wider than long, with transverse median groove; anterior, pre-median and post-median pronotal tubercles medium, posterior pronotal tubercles small. Lateral margin with small tubercle near posterior margin. Posterior margin with pair of tubercles near each lateral margin.

Mesonotum as wide as long; with two large anterior marginal spines and posterior mesonotal mounds small but with two large spines; small antero-lateral tubercles. Mesopleura roughly granulose; ventral margin with 4-5 small tubercles. Mesosternum with pair of rounded tubercles.

Metanotum almost twice as wide as long; medium posterior metanotal spines. Metapleura verrucose, with long slender upward curving supra-coxal spine. Metasternum with pair of rounded tubercles.

Median segment twice as wide as long. Abdominal tergites verrucose; with median longitudinal carina, indistinct at anterior becoming distinct at posterior. Segments 2-4 widening gradually, 5-6 narrowing, 7-9 of almost equal width. Segment 3 with one or two small tubercles near middle of the lateral margins; segments 4-5 with 2-3 large tubercles in similar position. Segments 1-7 with first paired posterior tubercles, small on 1-3 and 6-7, large on 4-5. Eighth segment with numerous tuber-

cles near lateral margins. Carina of 8th and 9th segments large, forking at hind margin. Middle of posterior of 9th segment elongated, projecting over half length of 10th segment. Hind margin of 10th segment with triangular notch in centre. Operculum verrucose, tuberculate at rear; apex rounded; with slight medio-longitudinal carina.

Femora and tibiae setose. Apices of all femora with spine on dorsal surface, projecting over joint. Dorsal carinae of all femora tuberculate, rounded on fore femora, angular on middle and hind. Ventral carinae of middle and hind femora each with few small tubercles; with two pairs of spines near apex. Ventral surface of fore femora with only few minute tubercles. All tibiae without any distinct tubercles. Tarsomeres 1-4 all of equal length.

Male.— Not known.

Egg.— (figs 90-92). Capsule almost spherical; roughly granulose, densely setose; uniformly dark brown. Setae tapering, apex only slightly curved (not hooked). Operculum almost round, narrowing dorsally. External micropylar plate "Y" shaped, stem near operculum, arms circling two thirds of way around polar end. Length 3.22 mm, height 2.93 mm, width 2.44 mm.

Dares mjobergi spec. nov.

Dares ulula Günther, 1935a: 3 [in part (not Westwood, 1859)].

Holotype, ♀ (NHRS), Kalimantan, Mt Tibang, 1400 m, Dr E. Mjöberg.

Female.— (figs 117-118). Base colour mid brown, with tubercles and larger spines yellowish-brown, with small patches of black on mesonotal and metanotal mounds. Densely verrucose and finely setose.

Antennae broken at 12th segment, densely setose; basal segment flattened and with apical spine on exterior margin; second segment only slightly wider than 3rd segment. Back of head slightly swollen; anterior occipitals large spines, posterior occipitals small spines, small lateral coronal spines on swollen base, without central occipital.

Pronotum with transverse median groove; with small anterior and pre-median paired tubercles and minute post-median and posterior pairs. Lateral margins extended at anterior to cover pronotal foramen.

Mesonotum with large, slender anterior marginal mesonotal spines. Posterior mesonotal mounds large with large spines; spines bearing tubercles such that spines almost appear to be branched. Mesopleuron with four small tubercles on ventral margin and small, blunt medio-lateral spine. Mesosternum with two pairs of swollen tubercles and numerous minute tubercles.

Metanotum with posterior mesonotal mounds large with large tuberculate spines (as on mesonotum); with minute pair of posterior mesal metanotal tubercles. Ventral margin of metapleura with 2-3 minute tubercles and one small supra-coxal spine. Metasternum with several tubercles.

Abdominal terga 2-9 with median longitudinal carina, very small except on 8-9; on posterior half of 9th carina expands dorsally and posteriorly (fig. 118). Segments 1-9 with first paired posterior tubercles, small 1-3 and 7-9, medium on 6, large and tri-

angular on 4-5. Second paired posterior tubercles present on 7-9. Lateral margins of segments 2-5 with tubercle or laterally compressed lobe: 2nd with one small tubercle, 3rd with large triangular tubercle, 4th with large triangular serrated spine-like lobe at apex, 5th with rounded lobe with small spine at apex. Segments 6-9 with postero-lateral tubercles. Tenth segment with three medium tubercles on anterior margin, with large postero-lateral pair of tubercles; margin indented between postero-laterals. Abdominal sternites 2-5 with posterior first and second paired tubercles and other randomly placed tubercles. Sternites 2-7 with longitudinal carina. Operculum with full length median longitudinal carina; apex rounded.

Both mid legs missing from specimen. Fore femur with several large tubercles on all carinae except ventro-anterior which has only one small tubercle; hind femur with spine-like tubercles on all carinae, ventral carinae with obvious spines at apices; lateral surfaces of hind femur tuberculate; apices of femora with spine on dorsal surface. Fore and hind tibiae with rounded tubercles. Tarsomeres 1-4 of similar size.

Male.— Not known.

Comments.— Both mid legs, the right hind tarsus and the antennae beyond the 12th segments are missing. It is possible that this is the female of *D. navanensis* but this seems unlikely because *D. mjobergi* is much smaller and it lacks a central occipital spine which is very obvious in the nymph of *D. navangensis*. Named after Dr Mjöberg with the spelling *mjobergi* used in preference to *mjoebergi*.

Dares murudensis spec. nov.

Material.— **Borneo**: Mt Murud, 7000-7200 ft: ♀, holotype (RMNH), Dr E. Mjöberg [no date].

Female.— (fig. 78). Head and body mid brown, dorsally and ventrally; scabrous, setose. Legs brown, setose. With distinct longitudinal carina on thorax and abdomen. Measurements given in table 7.

Antennae with 20 segments; basal segment flattened; first and second segments with one tooth on outer margin; 6-9 very short, apical segment three times longer than penultimate. Back of head with quadrate swelling; anterior, posterior and central occipital tubercles all medium; with medium lateral coronal tubercles.

Pronotum trapezoidal, almost flat; with median transverse groove; with medium anterior and posterior pronotal tubercles, and small pre-median and post-median tubercles.

Mesonotum with two large anterior marginal tubercles; two medium posterior mesonotal mounds, with an indistinct apical tubercle. Mesopleura scabrous with 3-4 small tubercles on the ventral margin. Mesosternum with two rounded tubercles.

Metanotum with indistinct longitudinal carina, posterior metanotal mound small, apically with indistinct tubercle. Metapleura scabrous with large supra-coxal tubercle. Metasternum with two indistinct rounded tubercles.

Abdominal segments rugose; with longitudinal median carina indistinct on segments 1-2, distinct on 3-9. Lateral margins of segments 2-3 uneven but without obvious tubercles; 4-5 laterally expanded by indistinct lateral pointing tubercles. Segments 3-6 with very small paired first posterior tubercles. Carina of 8th and 9th segments forked at posterior; 9th high and narrow. Tenth segment with pair of tubercles near anterior margin followed by short lateral carinae running to posterior mar-

gin; median carina little more than two elongated tubercles. Apex of 10th segment almost straight, without any obvious notch. Operculum scabrous, with median longitudinal carina.

All femoral carinae tuberculate (ventro-anterior carina of fore femora only sparingly tuberculate); ventral carinae of middle and hind femora each with pair of small spines or pointed tubercles at apex. Tibiae without tubercles. Tarsomeres 1-4 all of equal length.

Male.— Not known.

Egg.— Egg still in genital operculum spherical, granulose, mid brown, setose. Setae long, tapering, straight, with no curve or hooks at apices.

Comments.— This species is exceptionally small for *Dares*, similar in size to the two known species of *Planispectrum*. However it has longer antennae, and the abdomen has the typical *Dares* shape (broad anterior, narrow posterior).

Dares multispinosus spec. nov.

Dares ulula; Günther, 1943: 150 [in part (not Westwood 1859)].

Material.— **Kalimantan**: Mahakkam: ♂, holotype (RMNH), Borneo expedition Dr Nieuwenhuis, 1894.

Male.— (fig. 74). Head, and dorsal surface of thorax rugose, abdomen and all sternites more or less smooth. Colour basically yellow-ochre with some dark brown or black markings on dorsal surfaces of thorax and abdomen. Abdominal segments 2-6 with two discontinuous longitudinal black stripes; 7-8 mostly black. Apices of femora, all dorsal tubercles and spines on legs, and abdominal postero-lateral spines dark. Measurements given in table 6.

Antennae with 11+ segments (broken off) basal segment with apical spine on external margin. Head with pair of medium supra-antennal spines. Back of head slightly swollen; pair of large anterior occipital spines (both broken off); medium posterior pair and lateral coronal spines medium sized. No central occipital spine present.

Pronotum with large swollen pre-median pronotal tubercles; median transverse groove indistinct.

Mesonotum with very large, forward pointing, anterior marginal mesonotal spines, almost reaching front of pronotum. Posterior mesonotal swellings with large branched spines; two small spines branch off near base and two medium near apex. Anterior lateral mesonotal spines medium; 2-3 small lateral mesonotals on each margin; posterior lateral mesonotals small spines. Mesopleural spine medium; ventral margin of mesopleura with 2-3 small spines. Mesosternum with two pairs of rounded tubercles.

Metanotum with very large branched posterior metanotal spines; with one small and one medium branch near apices, and tubercle nearer base (number and size of branches probably a variable characteristic). Metapleura with one small and one medium-large supra-coxal spine. Metasternum without distinct tubercles.

Median segment rugose, first paired posterior tubercles small. Segments 2-6

with small to medium first paired posterior spines; 7-9 with first and second paired tubercles, small on 7-8, large on 9. Posterior half of ninth segment with high sharp longitudinal carina. Segments 2-9 with posterior lateral spines; 2-7 with medio-lateral spine, largest on 4-5. Segments 2-7 narrowing gradually and evenly, 8 widening greatly, 9-10 almost straight; apex of 10th with two lobe-like projections. Abdominal sternites 2-7 with first paired posterior tubercles; 8th with first and second paired posterior tubercles. Poculum deep, rounded, with three very large and several smaller tubercles; apex straight with down-curving rim.

Fore femora missing. Apices of femora with blunt spine dorsally. Femoral carinae indistinct; dorsal carinae of middle and hind femora each with three spines or large tubercles; ventral carinae each with 3-4 tubercles or spines (tubercles basally, spines apically). Tibiae with spines or tubercles dorsally. Tarsomere 4 shorter than 1-3 on middle leg (hind tarsi missing).

Female.— Not known.

Comments.- The holotype is quite badly damaged, having broken antennae, head spines, tarsi and no front femora, furthermore it is possible that it is not an adult specimen; however this male is so distinctive that there is no possibility of confusing this with any known species.

Dares navangensis spec. nov.

Dares ulula: Günther, 1935a: 3 [in part (not Westwood, 1859)].

Holotype, ♂ (NHRS), Kalimantan, Long Navang, Mjöberg; paratype, ♀ nymph (NHRS), same data.

Female nymph.— The specimen is a small nymph, head and thorax 9.5 mm, in poor condition; it lacks fore legs, antennae, right mid leg, all tarsi, and abdomen beyond the 6th segment; some of the thoracic spines are damaged.

Base colour of body dark brown, black around posterior mesonotal and posterior metanotal mounds; tubercles and spines light brown. Head and thorax verrucose, abdomen rugose; legs setose, body sparingly setose.

Back of head slightly swollen, with pair of large anterior occipital spines, posterior pair of medium occipital spines, medium central occipital spine and medium lateral coronal spines.

Pronotum with anterior slightly swollen, with median transverse groove and small pair of anterior pronotal tubercles. Lateral margin projects at anterior to cover pronotal foramen.

Mesonotum with large anterior marginal mesonotal spines; with large anterior lateral mesonotal tubercles and three small tubercles on lateral margins; posterior mesonotal mounds with large compound spine. Mesopleuron with small, broad supra-coxal spine and several small tubercles. Mesosternum granulose and rugulose, with two distinct pairs of tubercles.

Posterior metanotal mounds with large compound spines. Metapleura with large supra-coxal spine. Metasternum tuberculate.

Abdominal segments 1-6 with first paired posterior tubercles, small on 1-3 and 6, large and lobe-like on 4-5. Lateral margins of all segments without tubercles or spines. Abdominal sternites 2-6 with medium first paired posterior tubercles.

Fore legs and all tarsi missing. Femora and tibiae setose; carinae distinct. Apices of femora with one large spine dorsally. Dorsal carinae of middle and hind femora with rounded tubercles, dorso-posterior of hind femora with one spine-like tubercle. Ventral carinae of middle and hind femora each with two pairs of spines near apices, and with one large tubercle near mid-point of each carina.

Male.— (fig. 75). Head, and body rugose and setose. Specimen uniformly mid brown.

Antennae broken off; basal segment with spine on anterior of external margin as long as one quarter of basal segment. Back of head slightly swollen, with pair of very large anterior occipital spines, posterior pair of small occipital spines, central occipital tubercle and small lateral coronal spines.

Pronotum rugose, anterior with rounded swelling bearing pair of pre-median tubercles; with median transverse groove. Lateral margin projects at anterior to cover pronotal foramen.

Mesonotum with extremely large anterior marginal mesonotal spines; with anterior or lateral mesonotal tubercles and three small tubercles on lateral margins; posterior mesonotal mounds with very large spine, base of spine with numerous tubercles. Mesopleura with small, broad supra-coxal spine. Mesosternum granulose and rugulose, with one pair of tubercles.

Posterior metanotal mounds with very large spine (as large as posterior mesonotals). Metapleura with medium supra-coxal spine. Metasternum granulose, with very indistinct pair of tubercles.

Median segment usually unarmed. Segments 2-3 and 6-9 with almost imperceptible first pair of posterior tubercles, segments 8-9 with small second paired posterior tubercles; segments 4-5 with large, swollen, first paired posterior spines. Posterior half of 9th segment with longitudinal carina. Tenth segment with transverse row of three tubercles near middle of segment, lateral margins with two tubercles, apex of segment straight. Segments 2-4 narrowing slightly, 5-7 and 9 of uniform width, 8 much wider than 7 and widening slightly, 10th much longer than wide and narrowing. Sternites 2-7 with pair of indistinct posterior tubercles, 6-7 also with pair of anterior tubercles, 8th with longitudinal carina. Poculum deep, angular, angle with three large and numerous small tubercles, apex rounded with down-curving rim. Cerci dorso-ventrally flattened.

Femora and tibiae setose; carinae indistinct. Apices of femora with spine dorsally. Dorsal carinae of fore and middle femora smooth or with slight undulations but no distinct tubercles. Dorsal carinae of hind femora with few indistinct tubercles, dorso-posterior with small blunt spine near base. Fore femora ventrally unarmed. Ventral carinae of middle and hind femora each with two small spines near apices; ventro-posterior carinae also with small tubercle near mid point. Tibiae unarmed. Tarsomeres 1-4 of similar size.

Comments.— The paratype is a nymph with only the first six segments of the abdomen; the verrucose nature of the specimen, and distinct femoral carinae show it to be female.

The holotype lacks left hind leg, right mid tarsus and both antennae beyond basal segment.

Dares planissimus spec. nov.

Material.— **Kalimantan**: Boven Mahakkam: ♂, holotype (RMNH), Borneo expedition Dr Nieuwenhuis, 1894.

Male.— (fig. 71). Head and pronotum rugose, rest of body granulose. Colour basically yellowish brown. Lateral margins of mesonotum and metanotum, legs, and large spines yellow. Measurements given in table 6.

Antennae with 21 segments; basal segment with tooth on external margin at apex. Back of head slightly swollen; pair of medium anterior occipital spines, one medium posterior pair, one small central occipital spine; one pair of large lateral coronal tubercles.

Pronotum with median transverse groove; rugose, with only very small anterior and pre-median pronotal tubercles.

Mesonotum with small anterior marginal mesonotal spines; posterior mesonotal swellings with medium spine (no spine on right swelling). Ventral margin of mesopleura with four tubercles, posterior being larger than remainder. Mesosternum with two pairs of rounded tubercles.

Posterior metanotal swellings with medium spine. Metapleura with stout medium, and two small supra-coxal spines. Metasternum with pair of tubercles.

Median segment with minute first paired posterior tubercles. Segments 2-4 smooth; 5-10 rugulose; 7-8 with few irregular tubercles on hind margin. Ninth with irregular transverse posterior carina and small longitudinal carina; 10th with anterior paired tubercles. Segments 2-5 narrowing evenly, 6-7 of even width, 8-9 widening gradually, 10th narrowing with apex straight. Poculum deep, rounded and almost smooth.

Femora and tibiae setose. Apices of femora with blunt tooth dorsally. Fore femora with tubercles on dorsoposterior carinae, rest smooth. Middle and hind femora with tubercles on all carinae; dorsoposterior of hind femora with 1-2 spine-like tubercles. Middle and hind femora each with two small spines on apices of ventro-posterior carinae and ventro-anterior carinae. Tibiae without distinct carinae; dorsal surface of hind tibiae with few tubercles, rest smooth. Tarsomeres 1-4 of similar size.

Female.— Not known.

Comments.— Although the specimen bears a label in Günther's writing stating "*Dares ulula* Westw., K. Günther det." the specimen is not mentioned in the paper (Günther, 1943) which deals with the material from this expedition. The locality is difficult to read, it appears to say Baven but is probably Boven Mahakam, or upper Mahakam, presumably in the region around Long Bloe-oe.

Dares philippinensis spec. nov.

Material.— **Philippines**: Palawan Island, Brooke's point, Mainit Mountains, Mainit: ♀ holotype (C.L. Chan), ii.1983; ♀, ♂, ♂ nymph; paratypes, data as holotype. Brookes Point: ♀ nymph, paratype (BMNH, 1975-193), R. Rodriguez, 1974.

Female.— Whole insect uniformly dark brown; scabrous, and finely tuberculate. Antennae with 24 segments; basal segment flattened, with spine on anterior of exteri-

or margin; second segment widened but not toothed. Back of head slightly swollen, with row of 3 small tubercles running from eye towards medium anterior occipital tubercle; posterior occipital tubercles large; lateral coronal tubercles small; no central occipital. Measurements given in table 7.

Pronotum almost flat, with transverse median groove; with anterior and pre-median pairs of small or indistinct tubercles and indistinct post-median and posterior pairs of tubercles.

Mesonotum with two small anterior marginal mesonotal tubercles; posterior mesonotal mounds small, without obvious apical tubercle. Ventral margin of mesopleura with five small tubercles. Mesosternum with two pairs of tubercles.

Metanotum with very small posterior mesonotal mounds (not as high as posterior mesonotals); with small pair of posterior mesal metanotal tubercles. Ventral margin of metapleura with few small tubercles and one small blunt supra-coxal spine. Metasternum without tubercles.

Abdominal segments 1-3 and 6 with very small first paired posterior tubercles; segments 4-5 with large first paired tubercles. Segments 2-5 with longitudinal median carina, increasing from indistinct on 2 to very distinct on 5. Lateral margins of 3rd segment with small but distinct tubercle in middle; lateral margins of 4th and 5th segments with 1-2 small and one medium tubercle. Segments 6-8 with posterolateral tubercles. Segments 8-10 with numerous small tubercles, particularly near lateral margins. Eighth and 9th segments each with short median longitudinal carina running from the middle to posterior margin; carinae widen or slightly split at hind margin. Posterior margin of tenth segment with irregular wide indentation. Abdominal sternites rugulose; lateral surfaces of 6-7 tuberculate; 4-8 with small pair of first posterior tubercles. Operculum scabrous, with median longitudinal carina; apex slightly pointed. Cerci flattened with rounded apex.

Femora and tibiae setose. Dorsal carinae of femora with few rounded tubercles. Fore femora without spines; mid and hind femora each with two small spines on apex of ventro-posterior carinae and one or two small spines or tubercles near apex of ventro-anterior carinae. All tibiae without tubercles. Tarsomeres 1-4 of similar size.

Male.— (fig. 72). Head, thorax and abdomen scabrous, abdominal sternites rugulose. Colour basically mid brown. Two broad black longitudinal stripes run along thorax and abdomen, discontinuous because raised carinae and rugulose areas brown. Dorsal margin of metapleura black. Femora, tibiae and mesopleura brown with black mottling. Mesosternum with some black on lateral margins. Male nymph lacks any obvious black markings. Measurements given in table 6.

Antennae with 24 segments basal segment toothed as in female. Back of head slightly swollen; one pair of medium anterior occipital spines, one medium posterior pair, one small central occipital spine; one pair of lateral coronal tubercles.

Pronotum with median transverse groove; scabrous but without well defined tubercles.

Mesonotum with medium pointed posterior mesonotal swellings. Ventral margin of mesopleura with small spine below mesonotal swelling. Mesosternum with two pairs of rounded tubercles.

Metanotum with very small posterior metanotal swellings. Metapleura with medium supra-coxal spine. Metasternum without tubercles.

Median segment scabrous, first paired posterior tubercles minute. Segments 2-3 with minute first paired posterior tubercles; 4-6 with large first paired tubercles on swollen bases. Ninth segment with longitudinal carina widening and rising at hind margin. Segments 2-7 narrowing evenly, 8 widening greatly, 9-10 narrowing; apex of 10th rounded. Poculum deep, rounded posterior tuberculate.

Apices of femora with blunt tooth dorsally. Femoral carinae indistinct, with only few small tubercles on dorsal surfaces. Fore femora without spines; mid and hind femora each with two small spines on apex of ventro-posterior carinae and one or two minute spines on apex of ventro-anterior carinae. All tibiae smooth. Tarsomeres 1-4 of similar size.

Comments.— Male is similar to *D. validispinus*; female very similar to *D. verrucosus*.

Dares subcylindricus Redtenbacher, 1906

Dares subcylindricus Redtenbacher, 1906: 56. Holotype, ♀ nymph (NHMW, 55), Tonkin, Montes Manson.

Comments.— The unique holotype appears to be a female nymph (based on examination of a photograph). This is the only previously described non-Bornean species. NHMW were unwilling to lend the specimen by post so it has not been examined in detail and I am therefore unable to redescribe the species.

Dares ulula (Westwood, 1859)

Acanthoderus ulula Westwood, 1859: 53, pl. 26.1; Stål, 1875b: 94. Holotype, ♀ nymph (OXUM 500), Sarawak, coll. D. Wallace.

Dares ulula (Westwood); Kirby, 1904b: 400; Redtenbacher, 1906: 54; Günther, 1932a: 66 [specimen lost]; Abercrombie, 1992: 2; Abercrombie, 1995: 34.

Dares calamita Redtenbacher, 1906: 55. Holotype, ♀ (HNHM but lost), locality unknown. [synonymised by Günther, 1935a: 3].

Dares corticinus Redtenbacher, 1906: 56. Holotype, ♂ nymph (MNHN), Borneo, Chaper 1891 [synonymised by Günther, 1935a: 3].

[not *Dares ulula*; Günther, 1935a: 3. **Misidentified**].

[not *Dares ulula*; Günther, 1943: 150. **Misidentified**].

[not *Dares breitensteini*; Günther, 1935a: 3. **Erroneous synonym**].

[not *Dares otys*; Günther, 1935a: 3. **Erroneous synonym**].

[not *Dares validispinus*; Günther, 1935a: 3. **Erroneous synonym**].

[not *Dares verrucosus*; Günther, 1935a: 3. **Erroneous synonym**].

Material.— **Borneo**: locality unknown: ♂ nymph, holotype of *D. corticinus* (MNHN), Chaper, 1891.— **Federated Malay States**: locality unknown [assumed Sarawak or Sabah]: ♀, ♂ (BMNH, 1931-570), C.J. Brooks, 1909.— **Sarawak**: locality unknown: ♀ nymph, holotype of *D. ulula* (OXUM 500), D. Wallace. Mt Gadin, Lundu: ♂ (SMSM-53) [no date]. 2 km E of Serian, Ranchang waterfall: ♂ (PEB-2154), 09.xi.1994. 6 km West of Sri Aman: ♂ (PEB-203), 07.viii.1989. Bau, near Wind Cave: 2 ♂♂ (PEB-1548; PEB-1549), 4 ♂♂ nymphs (PEB-1550; PEB-1551; PEB-1552; PEB-1553), 08.viii.1992; ♂ (PEB-2153), 06.xi.1994. 20 km upstream of Kapit: nymph (PEB-209), 07.viii.1990. Pelagus river, Pelagus Logging Camp: ♀ (PEB-212), 08.viii.1990. Kpg Bengoh: ♂ (PEB-199; PEB-1398), 29.vii.1989; ♂ (PEB-202), 31.vii.1989. Saribos [= Betong]: ♂ (RMNH), 14.ix.1922. Mt Santubong, 100 m: ♀ (PEB-1670), 31.vii.1992. Mt Serapi, 90 m: ♂ (RMNH, PEB-189), 19.viii.1991. Mt Serapi, 120 m: ♀ (PEB-193), 12.viii.1989. Mt Serapi, 150 m: ♀ (PEB-194), 5 ♂♂ (PEB-195; PEB-196; PEB-197; PEB-200; PEB-204), eggs (PEB-207; PEB-1409), 12.viii.1989. Mt Serapi [altitude not recorded]: 2 ♀♀ (PEB-210; PEB-1399), 2

♂♂ (PEB-201; PEB-208), ♂ nymph (PEB-206), 13.viii.1990; ♀ (RMNH, PEB-1419), viii.1991; ♂ (PEB-1609), 05.viii.1992; eggs (PEB-1893), viii.1991; nymph (PEB-205), 1st instar, captive bred 1991. Niah NP, near Great Cave: 2 ♀♀ (PEB-2156; PEB-2588), ♂ (PEB-2149; PEB-2155), 28.x.1994; ♀ (PEB-1907), 2 ♂♂ (PEB-1642; PEB-1643), 17.viii.1992. Niah NP: ♂ (PEB-1885), collected as nymph, failed to shed skin properly, 17.viii.1992. Tarum (near Debak): ♀ (PEB-2157), 05.xi.1994; ♂ (PEB-2150; PEB-2152), ♀ nymph (PEB-2151) 25.x.1994. Matang: ♂ (SMSM-52), i.1903. Kuching: ♂ (SMSM-55), 27.ii.1899 [posterior mesonotal spines branched]; ♀ nymph (SMSM-51), 19.ii.1902; ♂ nymph (OXUM), 21.ii.1901 [Presented by R. Shelford]. Kuching, 4.5 mile: ♀ (PEB-1840), died i.1993, collected as adult viii.1991; ♀ (PEB-1886), died iv.1993, collected viii.1992; ♂ (PEB-1536), 28.vii.1992. Kuching, 5th Mile: ♀ (PEB-211), ♂ (PEB-198), 25.vii.1991. Bidi: ♀ nymph (BMNH, 1911-178), C.J. Brooks, 1907-1908.— **No locality:** ♂ (SMSM-54), i.190? [last figure of date illegible].

Female.— (fig. 80). Base colour very dark brown, densely overlaid by mid brown, with occasional yellowish patches; mesosternum and metasternum, and particularly tubercles, may be yellowish. Densely verrucose; densely setose dorsally, ventrally and on legs. Species shows considerable variation in size of tubercles and spines. Measurements given in table 7.

Antennae with 25 segments; basal segment flattened and with apical spine on exterior margin, occasionally slight swelling also present in middle of lateral margin of segment; second segment not flattened and if widened then only at base; segments 1-3 long, 4 & 5 very short; 15th with small swelling on external margin. Back of head slightly swollen; anterior occipitals vary from large tubercles to medium spines; posterior occipitals vary from large tubercles to small spines; lateral coronal tubercles large to very large; without central occipital. Head usually with following features: one medium tubercle to small spine between eye and anterior occipitals, one medium pair of post-antennal tubercles, several small to medium tubercles on each side of head in region between anterior occipital, posterior occipital and coronal.

Pronotum with transverse median groove; with at least medium anterior and pre-median paired tubercles and small post-median and posterior pairs, and often with other tubercles present. Pronotal margins with posterior and post-median tubercle.

Mesonotum with medium to large anterior marginal mesonotal spines which have medium tubercle on posterior near base. Posterior mesonotal mounds large with multiple tubercles, apically with medium spine or large tubercle. Ventral margin of mesopleura with 4 small tubercles. Mesosternum with two pairs of tubercles.

Metanotum with posterior mesonotal mounds medium to large with multiple tubercles, apically with medium spine or large tubercle; with small posterior mesal metanotal tubercles. Ventral margin of metapleura with 2-3 small tubercles and one small to medium supra-coxal spine. Metasternum with two pairs of tubercles.

Abdominal segments 1-9 with small median longitudinal carina, often with small tubercles on each side. Posterior half of carina on 9 high and widened at anterior. Segments 1-9 with both first and second paired posterior tubercles; first pair small to medium on 1-2 and 8-9, medium to large and often laterally widened on 3-7; second pair indistinct to small on 1-5, large to very large on 6-9, often double tubercle on 7-8. Segment 2 with 1-3 indistinct or small tubercles on lateral margin. Lateral margin of segments 3-5 with two medium to large tubercles and usually one small tubercle. Segments 6-10 with 3-4 tubercles on lateral margins. Tenth segment with medi-

um first paired anterior tubercles; with postero-lateral pair of small to medium tubercles; usually with several additional small or medium tubercles randomly distributed outside area between first paired anteriors and postero-laterals. Posterior margin of tenth segment smoothly indented between postero-laterals. Abdominal sternites 2-7 with median longitudinal carina; posterior first and second paired tubercles, indistinct at anterior increasing in size towards posterior. Operculum often with full length median longitudinal carina and often with two lateral carinae which diverge from anterior; rim rounded with slight point at apex.

Dorsal carinae of femora with large tubercles; ventral carinae with rounded tubercles although these may be indistinct on fore femora; apices of femora with blunt spine on dorsal surface. Fore femora without ventral spines. Ventral carinae of hind femora and posterior ventral of middle femur each with two small spines near apex; anterior ventral carina of middle femur with one small spine and one tubercle near apex. Tibiae all clearly tuberculate. Tarsomeres 1-4 of similar size.

Male.— (figs 68, 79 & 81). Head, and body rugose and setose. Base colour dark to mid brown. Thoracic nota and pleura with black between rugose areas; abdomen with broad black median longitudinal stripe which often takes form of black triangles on segments 2-6 (with apex to anterior). Mesonotum and metanotum with yellowish lateral margins and central longitudinal stripe; larger spines on head and thorax light brown, rarely yellowish. Legs mid brown to yellowish brown with row of minute black dots on lateral surfaces. Ventral surface of body light brown or ochre. Measurements given in table 6.

Antennae with 23 segments; basal segment with spine on anterior of external margin as long as one quarter of second segment; 13th with small tubercle in centre of outer margin; segments 14-23 much shorter than others. Back of head slightly swollen; pair of large to very large anterior occipital spines; posterior pair of small to medium occipital spines or large tubercles; large central occipital spine; lateral coronals either small blunt spines or large tubercles (fig. 81).

Pronotum rugose, anterior with rounded swelling; with median transverse groove. Usually without tubercles, if present indistinct.

Mesonotum with large to extremely large anterior marginal mesonotals; with small anterior lateral mesonotal tubercles; posterior mesonotal swellings with very large to extremely large spine. Mesopleura with small broad supra-coxal spine. Mesosternum granulose or rugulose, with two sometimes indistinct pairs of tubercles. Very rarely posterior mesonotal spines may be branched near apices.

Posterior metanotal swellings with large to extremely large spine. Metapleura with large to very large (rarely medium) supra-coxal spine. Metasternum granulose or rugulose, occasionally with pair of tubercles.

Median segment usually unarmed but occasionally with minute indistinct tubercles. Segments 2-9 with first pair of posterior tubercles, usually indistinct on 2 and 9, 3-4 and 8 small, 5-7 small to medium; segments 6-9 with small or minute second paired posterior tubercles; bases of tubercles swollen to form transverse carinae. Segments 2-8 occasionally with small to medium tubercle at anterior of lateral margins. Ninth segment with short longitudinal carina on posterior margin, often little more than large tubercle. Tenth segment usually unarmed, rarely with median transverse row of three indistinct tubercles; apex with minute or small "V" shaped

indentation. Segments 2-5 narrowing slightly, 6-8 widening, 9 almost straight, 10th narrowing. Sternites setose, usually smooth but occasionally with two transverse rows of shallow indentations; 8th rarely with pair of posterior tubercles. Poculum deep, angular, apex rounded with down-curving rim.

Femora and tibiae setose; carinae indistinct. Apices of femora with spine dorsally. Dorsal carinae of fore and middle femora smooth or with slight undulations but no distinct tubercles. Dorsal carinae of hind femora smooth or with few indistinct tubercles; usually with one small spine-like tubercle near base. Ventro-posterior carinae of middle and hind femora and ventro-anterior of hind femur each with two small spines near apices; ventro-anterior carinae of middle femur with one or two small spines near apex. Tibiae unarmed. Tarsomeres 1-4 of similar size.

Egg.— (figs 98-100 & 104). Capsule almost spherical, length 4.7 mm, height 4.5 mm, width 3.9 mm. Capsule, micropylar plate and operculum dark brown; very finely granulose; with few hairs, particularly on operculum. Hairs are short, white, slightly curved and taper to point; easily shed and usually only present on newly laid eggs (figs 98-100 show egg which has lost hairs). Operculum convex; almost circular, width 2.7 mm, height 2.6 mm; without capitulum. External micropylar plate detectable with magnification; extensive, covering about half surface of egg; in form of two wide bands circling operculum and polar end, joined by band along dorsal surface. External plate appears to correspond to internal plate (fig. 104).

Comments.— The holotype (and only type) of *D. calamita* Redtenbacher has been destroyed; the original description agrees with *D. ulula*. Examination of *D. corticinus* and comparison with PEB-209, a nymph of similar size does not contradict Günther's synonym, but with such small nymphs the matter is by no means certain. *D. corticinus* has smaller posterior mesonotal mounds, much smaller posterior metanotal mounds, and the apex of the abdomen is only very slightly indented. *Acanthoderus otys* Westwood belongs in *Datames*, although it was placed in *Dares* by Stål and all subsequent authors. *D. validispinus*, *D. verrucosus*, and *D. breitensteini* are all distinct species.

Günther recorded a female specimen from Serawai (Günther, 1932: 66) but the specimen cannot be found (Dr. H. Strümpel, ZMUH, personal communication, 1994). I have examined all other material which Günther recorded as *D. ulula* (Günther, 1935a: 3; 1943: 150) and found that none of the specimens were correctly identified. As Günther's records are clearly unreliable, the Serawai record has been omitted from the distribution map.

Branched mesonotal spines in the male have been observed in two specimens, one from Kuching (SMSM-55), and one specimen collected on Mt Santubong in 1994 which was kept by Mr Abercrombie for breeding but was not preserved when it died.

Foodplants include bramble, elder, hawthorn, oak, pyracantha, and raspberry. This species is very difficult to rear in captivity; the survival rate of nymphs is very low.

Dares validispinus Stål, 1875

Dares validispinus Stål, 1875b: 93; Kirby, 1904b: 400; Redtenbacher, 1906: 56; Günther, 1943: 150; Hausleithner, 1991: 220; Bragg, 1994: plate on page 241 (♀). Holotype, ♂ (NHMW, 53), Borneo.

Dares verrucosus Redtenbacher, 1906; [synonymised by Hausleithner, 1991: 220. However this applies to the 4 ♀♀ only].

[*Dares ulula*; Günther, 1935a: 3. **Erroneous synonym**].

Dares species 38; Brock, 1986: 8-10.

Material.— **Borneo**: locality unknown: ♂, holotype (NHMW); ♀ (BMNH, 94-138) [no date].— **Brunei**: locality unknown: ♂, ♀ nymph (OXUM), Waterstradt van der Poll, bought Janson 1909. Badas, swamp forest: ♂ (PEB-2144), 31.x.1994. Rampayah, waterfall trail: ♀ (PEB-2146), 03.xi.1994. Teraja, waterfall trail: ♀ nymph (PEB-2145), 03.xi.1994; Temburong District, Kuala Belalong, 100 m: 4 ♀♀ (PEB-190; BMKB, PEB-1466; BMKB, PEB-1467; PEB-1500), 2 ♂♂ (BMKB, PEB-186; PEB-504), eggs (PEB-1892), viii.1991; eggs (PEB-1914), laid in captivity, 1992; 3 nymphs (BMKB, PEB-961; BMKB, PEB-963; PEB-970), viii.1991; ♂ nymph (PEB-1883; PEB-1884), 3 ♀♀ nymphs (PEB-1919; PEB-1920; PEB-1921), 1st generation captive bred, 1992; nymph (PEB-1501), captive bred 1991; 3 ♂♂ (PEB-1956; PEB-1957; PEB-1958), 1st generation captive bred, 1993; nymph (PEB-2132), reared 1994, from stock collected 1991.— **Labuan**: 1 ♂ (RMNH).— **Sarawak**: locality unknown: ♀ (PEB-213), ♂ (PEB-214), eggs (PEB-215), reared by Mel Herbert, 1988. Trusan: ♂ nymph (SMSM-56), xi.1902. Lambir Hills NP: ♀ (PEB-1621), ♀ nymph (PEB-1622), 18.viii.1992. Batu Niah: 5 ♂♂, 15 ♀♀ (BMNH, BM 1982-387), A. Harman, xi-xii.1980; 2 ♂♂, 15 ♀♀ (BMNH, BM 1982-387), A. Harman, xii.1980. Niah NP: ♀ (PEB-1625), ♂ (PEB-1626), collected as mating pair, 16.viii.1992; ♀ (PEB-1963), ♂ (PEB-1962), collected as mating pair, 16.viii.1992; 3 ♀♀ (PEB-2077; PEB-2133; RMNH, PEB-2129), 3 ♂♂ (PEB-2128; PEB-2130; RMNH, PEB-2131), reared 1994 from stock collected 1992. Gunung Mulu NP, Camp 6, Hidden valley: 2 ♂♂ nymphs (BMNH, BM 1982-206), P. Chapman, 20-28.iii.1978; 2 ♂♂ (BMNH, BM 1978-11), 114° 56' E 004° 03' N, N.M. Collins, 14.iv.1978. Mulu NP, Gunung Mulu trail: ♀ (PEB-2147), ♂ (PEB-2148) C.L. Chan & Poon, 15.iii.1994.

Additional material in the collection of C.L. Chan, all examined to confirm species, only localities were recorded.— **Brunei**: Sungai Liang FR; Rampayah, waterfall trail.— **Sarawak**: Mulu NP, Gunung Mulu trail.— **Sabah**: Lok Kawi; Papar; Penampang, mile 9.

Female.— Base colour light to dark brown; with indistinct black markings on posterior mesonotal and metanotal mounds, on sides of anterior abdominal tergites, and small patches on legs; mesosternum and metasternum yellow-ochre. Body verrucose; minutely and sparingly setose dorsally, fore legs moderately setose. Measurements given in table 7.

Antennae with 24 segments (rarely 26: material from Rampayah only); basal segment flattened, with spine on exterior margin; second segment toothed or spined; 1-3 long, 17-23 very short; 14th with slight swelling on external margin. (Specimen PEB-2146 has 25 antennal segments; 15th swollen, 18-24 very short).

Back of head slightly swollen, with ridge running from eye to medium posterior occipital tubercule; ridge with 1-2 large tubercles at anterior; anterior occipital tubercles small or indistinguishable; lateral coronal tubercles large; no central occipital.

Pronotum with a transverse median groove; with medium anterior paired pronotal tubercles; pre-median, post-median and posterior paired tubercles small and indistinct; lateral margins with 3 small to medium tubercles.

Mesonotum with anterior marginal mesonotals varying from slight swelling to medium tubercles; medium antero-lateral pair of tubercles; with minute anterior mesonotal mounds with small apical tubercule; posterior mesonotal mounds small to medium with small to medium apical tubercule; lateral margins with 3-4 medium tubercles. Mesopleura verrucose, ventral margin with 4 small to medium tubercles. Mesosternum with two pairs of large tubercles.

Metanotum with minute to medium posterior mesonotal mounds usually with

small to medium apical tubercule; in specimens with medium sized mounds there may also be a pair of minute anterior mesonotal mounds with small apical tubercule. If present, posterior mesal metanotal tubercules indistinct. Metapleura verrucose; ventral margin with 2-3 small tubercules and one small blunt supra-coxal spine. Metasternum with 2 pairs of rounded tubercules which may be indistinct.

Abdominal segments 2-5 and 8-9 with median longitudinal carina, very indistinct or absent on 2-3, indistinct on 4-5; on 8-9 carina large but only present on posterior half. Carina of 9th segment with posterior either straight or with 4-5 posterior pointing tubercules; projecting over segment 10. Segments 1-10 with both first and second paired posterior tubercules; both pairs always very indistinct on segments 1-3; second pair indistinct to small 4-10; first pair large, widened and lobe-like on 4, medium tubercules to large widened lobes on 5, indistinct to medium on 6, indistinct to small on 7, small on 8-9, medium on 10. Lateral margins of segments 2-3 with slightly uneven or smooth, never with distinct tubercules. Lateral margins of segment 4 with at least one, and usually 3-4 medium tubercules. Lateral margins of segment 5 with at least two, medium or large tubercules, and often with 1-2 additional small tubercules. Segments 6-10 with postero-lateral tubercules and usually with few small tubercules on lateral margins. Segments 8-10 generally tuberculate near lateral margins. Posterior margin of tenth segment slightly indented, usually finely tuberculate. Abdominal sternites 4-7, and occasionally also 2-3, with small to medium first paired posterior tubercules, these increase in size towards posterior. Operculum with median longitudinal carina; posterior half of operculum very usually tuberculate, rarely smooth; apex very slightly pointed, rim not down-curving.

All dorsal carinae of femora with 3-4 tubercules, usually angular on middle and hind femora. Fore femora with tubercules rounded on posterior ventral carinae and indistinct on anterior ventral carina. Ventral carinae of middle and hind with blunt or pointed tubercules. Fore femora without spines. Ventral carinae of middle and hind femora each with two small spines near apex. Middle and hind tibiae all clearly tuberculate, fore tibiae usually clearly tuberculate. Tarsomeres 1-4 of similar size.

Male.— (fig. 70). Head, pronotum and 10th abdominal tergite rugose, rest of body granulose or smooth (smooth only recorded from one locality: Mulu). Base colour dark brown; rugose areas and granules are usually yellowish (except Mulu and Badas specimens) so the usual general appearance of the body is yellowish brown; lateral margins of mesonotum and metanotum yellow. Metasternum, mesosternum and most abdominal tergites yellow. Measurements given in table 6.

Antennae with 23 segments; basal segment with tooth on external margin at apex; 13th with small or minute tubercule in centre of outer margin. Back of head slightly swollen; pair of medium anterior occipital spines; posterior pair of occipital small spines or large tubercules; one medium central occipital spine; one pair of broad, lateral coronal tubercules.

Pronotum rugose, with median transverse groove; anterior half swollen with very indistinct anterior pronotal tubercules.

Mesonotum lacking anterior marginal mesonotals; with small anterior lateral mesonotal tubercules; posterior mesonotal swellings with medium large spine. Mesopleura with one medium mesopleural spine close to ventral margin. Mesosternum with two pairs of large pointed tubercules.

Posterior metanotal swellings with medium to large spine. Metapleura with stout medium supra-coxal spine. Metasternum with pair of tubercles.

Abdominal segments 1-3 and 7-9 without tubercles or spines; 4-7 with medium first paired posterior spines. Ninth segment with (usually high and pointed) longitudinal carina on posterior half; one pair of posterior lateral tubercles; second pair of anterior rounded tubercles. Tenth segment with median transverse row of 2-5 tubercles, pair of pointed tubercles on lateral margin, depression just before apex. Segments 2-4 narrowing slightly, 5-7 of even width, 8th greatly widened, 9th narrowing slightly, 10th narrowing, apex almost straight. Eighth sternite with first paired tubercles. Poculum deep, angular; with median transverse row of 3 large tubercles and more posterior row of 1-3 large tubercles, with several small tubercles in between; apex with wide indentation.

Femora and tibiae minutely setose; carinae indistinct. Apices of femora with blunt spine dorsally. Fore femora with slight undulations on dorsoposterior carina but no tubercles, rest smooth. Middle and hind femora with few indistinct tubercles on both dorsal carinae; dorsoposterior of hind femora usually with 1 spine-like tubercle near base. Ventro-posterior carinae of middle and hind femora, and ventro-anterior of hind femora, each with two small spines near apices; ventro-anterior of middle femur with usually two, or occasionally one small spine near apex. In addition to apical spines, hind femora usually with row of 3 small spines, and middle femora usually with 1-3 minute spines or tubercles on the ventro-posterior carinae. Tibiae unarmed. Tarsomeres 1-4 of similar size.

Egg.— (figs 87-89). Capsule almost spherical, length 3.2 mm, height 3.2 mm, width 3.0 mm. Capsule, micropylar plate and operculum dark brown with irregular greyish-brown spots; very finely granulose; sparingly setose. Setae 0.3 mm long, creamy-white, slightly curved, tapering; viewed under SEM they terminate in multiple branches. Operculum convex; almost circular, width 2.0 mm, height 2.4 mm; without capitulum. External micropylar plate detectable with magnification; "Y" shaped, covering about one sixth of capsule; with two arms almost circling polar end, body reaching to operculum; micropyle clearly visible between arms of "Y".

Comments.— I have confirmed, by captive rearing for several generations, that syntype females of *D. verrucosus* are the same species as *D. validispinus*. However the male nymph in the *verrucosus* syntype series is not the same species (it is a distinct species).

Foodplants include bramble, hawthorn, ivy, oak, pyracantha, raspberry, and rose. This species is easy to rear in captivity.

Dares verrucosus Redtenbacher, 1906

Dares verrucosus Redtenbacher, 1906: 55, pl. 1.17 (♂) & 1.18 (♀). Lectotype [here designated], ♂ nymph (NHMW, 52), Borneo, Banguay. Paralectotypes [All misidentified]: 2 ♀♀ (NHMW, 52) Borneo, Banguay; ♀ (NHMW) North Borneo; ♀ (NHMW, 52) Borneo, Kinabalu.

[*Dares ulula*; Günther, 1935a: 3. **Erroneous synonym**].

Dares validispinus; Hausleithner, 1991: 220 [this applies to ♀♀ only].

Dares species 69; Brock, 1986: 8-10.

Dares breitensteini Westwood, 1859 [sic]; Schulten, 1995: 94, fig. 56 (♀). **Misidentification**, and wrong author cited.

Material.— **Sabah:** Sandakan: ♂ nymph, lectotype (NHMW, 52). Murut territory: ♀ (OXUM) [illegible, 1871 2/-, specimen labelled *D. dayaka* sp. n. Type ♀, in Shelford's handwriting]. Keningau, 8th mile, c. 2500 ft: ♀ (C.L. Chan), E. Khoo, 04.iii.1986 [unusually short specimen]. Kinabatangan District, Sukau, Mananggol river: ♂ (PEB-2134) C.L. Chan, 08.iv.1994; Mostyn: ♀ (PEB-2585), coll. S. Mallet, 20.vi.1995. Sepilok Forest Reserve: ♀ (PEB-1753), 22.viii.1992, ♀ (PEB-1774), ♂ (PEB-1773), collected as mating pair, 22.viii.1992, eggs (PEB-1952) 1992, 5 ♀♀ (PEB-2123; PEB-2125; PEB-2126; PEB-2127; RMNH, PEB-2124), ♂ (PEB-2122), eggs (PEB-2097) reared 1994, from stock collected 1992; 3 nymphs (PEB-229; PEB-230; PEB-231), captive reared, 1987; ♀ (PEB-217), ♂ (PEB-225), eggs (PEB-1406), ♀ nymph (PEB-224), captive reared, 1988; ♀ (PEB-218), ♂ (PEB-222), ♀ nymph (PEB-223), ♂ (RMNH, PEB-227), captive reared 1989, ♀ (PEB-216), nymph (PEB-228), captive reared 1990; 4 ♀♀ (PEB-219; PEB-220; PEB-221; PEB-232), 2 ♂♂ (PEB-188; PEB-226), eggs (PEB-1020), captive reared 1991.

Additional material in the collection of C.L. Chan, all examined to confirm species, only localities were recorded.— **Sabah:** Sepilok; Kinabatangan district, Sukau, Mananggol River.

Female.— Dorsal and lateral surfaces, and legs uniformly dark brown; ventral surface light or dark brown. Whole of body verrucose; setose dorsally and ventrally. Measurements given in table 7.

Antennae with 25 segments; basal segment flattened and with one or two teeth on exterior margin; second segment toothed; 1-3 long, 4 & 5 very short. Head very tuberculate; 15th and 17th with swelling or tooth on external margin.

Head tuberculate. Back of head slightly swollen, with row of large and medium tubercles running from eye to medium or large posterior occipital tubercle, tubercles may merge to form irregular ridge; anterior occipital tubercles indistinguishable from those in row; lateral coronal tubercles medium; no central occipital; few tubercles between posterior occipital and lateral coronals.

Pronotum swollen at anterior, with transverse median groove; with anterior and pre-median, post-median and posterior pairs of medium tubercles; fifth pair of medium tubercles may be present between post-median and posterior pair. Lateral margins with 2-3 small to medium tubercles.

Mesonotum with anterior marginal mesonotals varying from slight swelling to very large tubercles; one medium antero-lateral pair of tubercles; posterior mesonotal mounds medium with small to very large apical tubercle; lateral margins with 3-4 medium tubercles. Mesopleura rugose, ventral margin with 4 small to medium tubercles. Mesosternum with at least two pairs of tubercles, often one or two more tubercles present.

Metanotum with small posterior mesonotal mounds, tuberculate with small to medium apical tubercle; with small, often indistinct, posterior mesal metanotal tubercles. Metapleura rugose; ventral margin with 2-3 small tubercles and one small blunt supra-coxal spine. Metasternum with 1-2 pairs of tubercles.

Abdominal segments 2-5 and 8-9 with median longitudinal carina, indistinct on 2-3, indistinct to small on 4-5, large on 8-9; carinae often with small tubercles on lateral margins. Posterior half of carina on 9 high, branched at posterior; projecting over segment 10. Segments 1-9 with both first and second paired posterior tubercles; first pair small on 1-3 and 6-9, medium to large and laterally widened on 4-5; second pair small on all segments, rarely medium on 8-9. Segment 2 often with small median tubercle on lateral margin. Lateral margin of segment 3 with one small to medium median tubercle, if medium, there may also be 1-2 small tubercles. Lateral margins

of segments 4-5 with at least three medium to large tubercles. Segments 6-10 with few tubercles on lateral margins. Segment 9 with pair of widely spaced medium tubercles some distance behind anterior margin, and with several small tubercles on posterior margin and close to lateral margins. Tenth segment with medium first paired, and small second paired anterior tubercles; with postero-lateral pair of medium tubercles; usually with several additional small or medium tubercles randomly distributed outside area between first paired anteriors and postero-laterals. Posterior margin of tenth segment slightly uneven, slightly indented. Abdominal sternites tuberculate, increasingly tuberculate towards posterior. Operculum very tuberculate; usually with anterior median longitudinal carina and often with two lateral carinae formed by row of tubercles; apex usually rounded, rarely almost straight, rim not down-curving.

Femora and tibiae setose. Dorsal carinae of femora with rough tubercles, ventral carinae with rounded tubercles; posterior dorsal carina of hind femur with spine or spine-like tubercle near base. Fore femora without spines. Ventral carinae of middle and hind femora each with two small spines near apex. Middle and hind tibiae all clearly tuberculate, fore tibiae usually clearly tuberculate. Tarsomeres 1-4 of similar size.

Male.— (fig. 69). Head, body and femora rugose, and occasionally granulose; legs setose. Base colour of dorsal and lateral surfaces light to mid brown, ventral surface ochre; with two wide longitudinal black stripes along thorax and abdomen; dorsal edge of mesopleura and metapleura black; lateral edges of mesosternum and metasternum black; basal half of middle and hind femora black, or at least with black longitudinal stripe. Lateral margins of mesonotum and metanotum yellowish; larger spines on head and thorax yellowish or light brown. Measurements given in table 6.

Antennae with 23 segments; basal segment with small tooth on external margin at apex; 13th with small or minute tubercle in centre of outer margin; 14-23 much shorter than others. Back of head slightly swollen; pair of medium to large anterior occipital spines; posterior pair of occipital medium to large spines or large tubercles; usually with small central occipital spine or tubercle; pair of broad, lateral coronal tubercles; rarely with small or minute spine between each anterior occipital and posterior occipitals.

Pronotum rugose, with median transverse groove. Anterior pronotal tubercles always present; pre-median, post median, and posterior tubercles occasionally present; occasionally one or two pairs of tubercles are present on lateral margins.

Mesonotum with small to medium anterior marginal mesonotals; with small anterior lateral mesonotal tubercles; posterior mesonotal swellings with large spine. Mesopleura with small to medium supra-coxal spine, occasionally with an anterior row of 4-5 minute tubercles on ventral margin. Mesosternum granulose or rugulose, with two pairs of tubercles.

Posterior metanotal swellings with medium spine. Metapleura with medium supra-coxal spine. Metasternum granulose or rugulose, occasionally with pair of small tubercles.

Median segment with minute indistinct tubercles, or without tubercles. Second abdominal segment with first pair of posterior tubercles indistinct to medium. Segments 3-7 with large first paired posterior tubercles. Eighth segment with widely

spaced first pair of posterior tubercles. Segments 2-7 with indistinct to medium tubercle in middle of lateral margin, if medium there may be a small tubercle on each side. Ninth segment with broad triangular longitudinal carina on posterior half; from base of anterior of carina transverse depression runs to lateral margin. Tenth segment with median transverse row of three small tubercles; apex straight or with minute indentation. Segments 2-6 narrowing slightly, 7 straight, 8th widening greatly, 9-10th narrowing. Sternites granulose or rugulose; 5-6 with two minute posterior tubercles; 7-8 with 2-4 small posterior tubercles. Poculum deep, angular, middle with short longitudinal carina and tubercle on each side; apex rounded with downward curving rim.

Femora and tibiae setose; carinae indistinct. Apices of femora with short blunt spine dorsally. Fore femora with slight undulations on dorsoposterior carina but no distinct tubercles, rest smooth. Middle and hind femora with few indistinct tubercles on both dorsal carinae; dorsoposterior of hind femora usually with one spine-like tubercle near base. Ventro-posterior carinae of middle and hind femora each with two small spines near apices; ventro-anterior carinae with one or two small spines or tubercles near apex. Tibiae unarmed. Tarsomeres 1-4 of similar size.

Egg.— (fig. 84-86). Capsule almost spherical, length 3.8 mm, height 3.8 mm, width 3.5 mm. Capsule, micropylar plate and operculum dark brown with irregular greyish-brown spots; very finely granulose; sparingly setose. Setae 0.3 mm long, creamy-white, slightly curved, tapering. Operculum convex; almost circular, width 2.3 mm, height 2.4 mm; without capitulum. External micropylar plate almost indiscernible even with magnification; "Y" shaped, covering about one sixth of capsule; with two arms almost circling polar end and body reaching to operculum; micropyle visible between arms of "Y".

Comments.— Although not adult, the male syntype is selected as the lectotype in order to avoid the necessity of erecting a new name; the synonym given by Hausleithner (1991: 220) is correct for the females but not for the male. The male and female are very similar to *D. breitensteini*; it is possible that *breitensteini* and *verrucosus* may be variations of a single species. Males differ in coloration (*D. verrucosus* has more black), spines on mesopleura and metapleura, and the abdominal segments. Females differ in size (*D. breitensteini* is much larger) and the tubercles on segments 6-9.

The locality given for the OXUM specimen, "Murut territory" lies in SW Sabah and is most likely to be between Tenom and the Sarawak border.

This species has been reared for about 10 years as PSG 69, the original stock was collected from Sepilok by Jonathan Cocking. It is a relatively easy species to rear, and can be maintained in a sweet jar with 4-5 cm of Vermiculite on the bottom. Food-plants include bramble, flowering currant, hawthorn, oak, pyracantha, raspberry, and rose.

Datames Stål, 1875

Datames Stål, 1875b: 51, 93; Rehn, 1904: 89; Kirby, 1904b: 400; Redtenbacher, 1906: 49; Rehn & Rehn, 1938: 485; Bradley & Galil, 1977: 198. Type species: *D. oilus* (Westwood, 1859) by designation of Rehn, 1904: 89.

Description.— Body roughly tuberculate, not spiny. Antennae about as long as fore legs, first segment with one or two teeth on outer edge. Rear of head with large four robust raised carinae. Margins of mesonotum and metanotum almost parallel. Mesonotum and metanotum with central longitudinal carina (although this may become indistinct in places); often with paired tubercles at ends of carinae which may be spine-like in males. Hind margins of abdominal segments with central longitudinal carina forking or ending as pair of tubercles, possibly as spines in males. Abdomen of male slim and cylindrical, female front half raised and swollen, hind half narrowing and flattened. Apex of abdomen dilated, anal segment rectangular or trapezoidal, lamina supraanalis absent. Femora quadrangular or almost cylindrical, with small teeth. Tibiae unarmed or with small teeth on upper surface.

Comments.— Most of the described species were synonymised by Günther, but several of these synonyms are probably wrong; Günther had not examined most of the type material. Records of *D. oileus* from Borneo are in error; only three species are found in Borneo, *D. otys* (Westwood), *D. borneensis* **spec. nov.** and *D. muluensis* **spec. nov.**, all are endemic.

Key to Bornean species of the genus *Datames*

1. First antennal segment armed with two spines on outer edge, second segment unarmed *Datames otys* (Westwood)
- First antennal segment armed with one spine on outer edge (second segment may be armed or unarmed) 2
2. Second antennal segment armed with one spine (fig. 101), posterior of mesonotum without spines. *Datames borneensis* **spec. nov.** 3
- Second antennal segment unarmed, posterior of mesonotum with a pair of spines *Datames muluensis* **spec. nov.**
3. Body length of male > 35 mm, female > 40 mm; abdominal segments 6-7 of female narrowing 4
- Body length of male < 35 mm, female < 40 mm; abdominal segments 6-7 not narrowing *Datames borneensis waterstradti* **subspec. nov.**
4. Antennae of male with 18 segments, female with 20; tibiae without tubercles, or with only few indistinct tubercles; metapleura without distinct spines (fig. 111) ..
..... *Datames borneensis borneensis* **spec. nov., subspec. nov.**
- Antennae of male with 22 segments, female with 22-24 segments; tibiae tuberculate; metapleura with distinct spines (fig. 110)
..... *Datames borneensis sepilokensis* **subspec. nov.**

Datames borneensis borneensis **spec. nov., subspec. nov.**

Datames oileus; Bragg, 1992c: 296 [not Westwood 1859].

Material.— **Sarawak**: Mt Serapi, 120 m: ♀, holotype (BMNH, PEB-176), 26.vii.1991. Paratypes: **Brunei**: Teraja, waterfall trail: ♂ (PEB-2137), 03.xi.1994.— **Sarawak**: Locality not recorded: ♂ (NHMW, PEB-2423), xi.1994; 3 ♀♀ (OXUM, PEB-2532; NHMW, PEB-2533; NHMN, PEB-2589), 2 ♂♂ (SMTD, PEB-2534; OXUM, PEB-2590) 1994. Mt Serapi, 100 m: ♂ (BMNH, PEB-1587), 05.viii.1992. Mt Serapi, 150 m: ♀ (PEB-488), 12.viii.1989. Mt Serapi, 240 m: ♀ nymph (PEB-178), 13.viii.1990; ♂ (BMNH, PEB-181),

26.vii.1991; ♂ (PEB-182), 13.viii.1990, ♂ nymph (BMNH, PEB-183), 26.vii.1991; ♂ (BPBM, PEB-489), 13.viii.1990. Matang: ♀ (SMSM-12), viii.1899; Mt Santubong, 100 m: ♀ nymph (BMNH, PEB-1862), very pale specimen when collected, almost white, 31.vii.1992. Kpg Bengoh: ♂ (BMNH, PEB-177), 31.vii.1989. Kpg Bengoh, Gunung Sebakam: ♀ (RMNH, PEB-180), egg (RMNH, PEB-490), removed from body of PEB-180, egg (BMNH, PEB-1408), 29.vii.1989. Kpg Bengoh, Gunung Sunana: ♀ (PEB-184), ♂ (BMNH, PEB-185), 30.vii.1989. 20 km upstream of Kapit: ♂ nymph (BMNH, PEB-179), 07.viii.1990. Bau, near Wind Cave: 4 ♂♂ (ZMHB, PEB-1557; MCSN, PEB-1558; NHRS, PEB-1559; BMNH, PEB-1836), ♂ nymph (BMNH, PEB-1722), eggs (PEB-1950; PEB-1560), 08.viii.1992; 1st instar nymph (PEB-1922), captive reared 1993; 3 ♂♂ (PEB-2138; NHMN, PEB-2139; RMNH, PEB-2140), 06.xi.1994. Bau: ♂ (SMSM-524), P.E. Bragg, 08.viii.1992. Lambir Hills NP: ♂ nymph (PEB-1623), 18.viii.1992. Niah NP: 2 ♂♂ (DCMD, PEB-1636; BMNH, PEB-1637), 17.viii.1992, ♂ (PEB-2135), 27.x.1994; ♂ (BMNH, PEB-2136), 28.x.1994.— **No data:** ♀ (SMSM-14).

Female.— (figs 101, 106, 108, 111). Body of almost uniform width throughout, abdominal segments 6-8 narrowing slightly. Whole body dark brown with small, lighter blotches; scabrous; tuberculate; very setose, but less so on ventral surface. Measurements are given in table 8.

First antennal segment flattened, with spine on outer edge, just before apex; second segment with spine on outer edge, close to middle of segment. Antennae with 20 segments, 1-3 and 20 long, 4 & 5 extremely short, 6-19 gradually increasing in length; segment 15 with minute tooth on outer edge.

Head more or less square, slightly narrower at front. A small carina links blunt supra-antennal spines and small inter-orbital tubercles. Back of head with swollen crest formed by four converging carinae; top of individual carinae may be continuous or broken at mid point by narrow gap, but in all cases carinae have gap just before they converge. Two blunt spines or large tubercles on each side of swollen crest, one at base, one half way up.

Pronotum, Mesonotum and Metanotum each with lateral margins built up into strong carinae.

Centre of pronotum with two longitudinal carinae, diverging towards rear, each with four blunt spines. Carinae with transverse break near centre.

Mesonotum with strong central carina, very high at front, decreasing in height towards rear; carina forks into two at front and rear margin.

Metanotum fused with median segment. Central carina runs along combined structure and forks at hind margin.

Abdominal segments 2-8 each with central carina which forks at anterior and posterior margins; carina of segment 4 forks widely and continues along margin for short distance; carina of 5th segment enlarged forming lobe, with posterior forks curving outwards through 180°. Segment 9 with prominent central carina, raised at rear. Segment 10 approximately rectangular but with serrated hind margin, usually with more or less triangular notch in centre of hind margin (fig. 108).

All femora and tibiae quadrangular. Base of fore femora curved and slightly constricted. Mid and hind femora with few large rounded swellings on upper carinae, some almost like blunt spines. First three tarsomeres almost quadrangular, fourth only half as long.

Mesosternum and metasternum smooth, only slightly setose, with few tubercles on mesosternum. Abdominal sternites slightly rugose, with central longitudinal cari-

na. Operculum rounded, rugose, with distinct central longitudinal carina and usually smaller and shorter longitudinal carina on each side.

Male.— (fig. 105). Body of uniform width throughout. Body and legs uniformly coloured very dark brown, occasionally mid brown. Body setose, legs densely setose. Measurements given in table 8.

Antennae as female but with 18 segments, spines present on segments 1, 2 and 13.

Head as in female, but carinae between supra-antennals and inter-orbitals may be absent; front carinae of head crest may be continuous or deeply divided such that front portion forms large blunt spine.

Lateral margins of pronotum, mesonotum and metanotum thickened and raised. Pronotum with four pairs of blunt spines arranged longitudinally. Mesonotum, metanotum and median segment with broad, raised carina; particularly high at front of mesonotum forming blunt peak there; widening at posterior of median segment.

Abdominal segments 2-6 with indistinct, wide central longitudinal carina. Abdominal segment 5 with posterior portion of carina raised and forked to form an inverted 'V' shaped lobe on hind margin. Segments 7-9 with noticeable longitudinal carinae forking at posterior margins. Tenth segment more or less rounded, with apical indentation and 1-2 notches on each side.

Legs as in female, but carinae may be indistinct, especially on tibiae.

Underside smooth, setose, as in female but lacking tubercles. 8th sternite short. Poculum rounded, with transverse indentation at anterior and three distinct longitudinal carinae at posterior.

Nymphs.— The newly hatched nymphs are a translucent fawn, turning to bright green within a few days; they become brown in the second instar. The length of a first instar nymph (PEB-1922) when freshly killed was found to be 17 mm, when dried the length was reduced to 16 mm.

Egg.— (figs 93-95 & 103). The following description is based on an egg from Bau and is slightly smaller than the egg briefly described from the Bako specimen (Bragg 1992: 297).

Capsule almost spherical, length 2.8 mm, height 2.6 mm, width 2.4 mm. Capsule, micropylar plate and operculum dark brown; very finely granulose; sparsely covered in 0.3 mm long setae which terminate in four hooks. Operculum convex; almost circular; lacking capitulum. External micropylar plate not visible to naked eye, not always detectable even with magnification. Internal plate open; with short, narrow median line; in form of letter 'T' with arms almost meeting at ventral surface and stem reaching operculum (fig. 103).

Comments.— This species is readily distinguished from other species in the genus by the antennae which have a spine on the outer edge of both the first and the second segments. Although other species have one or two spines on the first segment, none are described with spines on the second segment.

This species was originally assumed to be *Datames oileus* (Westwood) (Bragg, 1992: 297); this was based on Günther's work, he synonymised most species in the genus under the name *D. oileus* (1934: 343). As Westwood's type specimen is a nymph, a proper comparison was not undertaken when this species was first collected in Bako National Park. Having subsequently collected this species at different instars, a comparison became possible. It is worth noting that Günther's synonymy of

oileus is probably incorrect. This species is clearly distinct from all previously described species.

In the wild this species appears to have a diet restricted to only a few species of monocotyledons. Until 1992 it had only been found feeding on a small palm, *Daemonorops* sp., which gave little help in finding a suitable foodplant in the United Kingdom; in 1992 at Bau it was found feeding on a member of the Araceae and as this plant family occurs in Britain it became possible to maintain the species in the United Kingdom. Specimens from Bau have been kept in captivity for over two years, in humid conditions, feeding on a cultivated species of arum lily, on lords and ladies, and on tradascantia (all monocotyledons). Material collected was passed on to Mr Ian Abercrombie who is having some success rearing this species. He has reported (personal communication, 1994) that the nymphs have also eaten some bramble but only reluctantly, this contrasts with *Datames oileus* (Westwood) which readily feeds on bramble.

Datames borneensis sepilokensis spec. nov., subspec. nov.

Material.— **Sabah**: Bettotan, near Sandakan: ♀ holotype (RMNH), C.B.K. & H.M.P., 29.vi.1927 [ex F.M.S. Museums]. Paratypes: **Sabah**: Sepilok Forest Reserve: ♀ (C.L. Chan), C.L. Chan, 08.ix.1982; ♀ (C.L. Chan), C.L. Chan, 28.ix.1982; ♀, ♂ (C.L. Chan), C.L. Chan, F. Seow, K.M. Wong & A. Chung, 17.vi.1994; ♀, ♂ (F. Seow-Choen), F. Seow-Choen, C.L. Chan & A. Chung, 16.vi.1994. Sepilok Forest Reserve, Arboretum: ♂ (C.L. Chan), C.L. Chan, 23.viii.1992.

Female.— (figs 107 & 110). Body length 45.0-48.0 mm, full measurements given in table 8. Differing from *D. b. borneensis* in following respects: antennae of 22-24 segments, distinct blunt metapleural spine, distinct tubercles on dorsal carinae of all femora and tibiae, tenth abdominal segment almost triangular (fig. 110).

Male.— Body length 39.0-41.5 mm, full measurements given in table 8. Differing from *D. b. borneensis* in following respects: antennae of 22 segments, body generally more tuberculate, distinct blunt metapleural spine, distinct tubercles on dorsal carinae of all femora and tibiae (spine-like on hind femur).

Comments.— The mesonotum and median segment are almost distinguishable (unlike *D. b. borneensis*). The holotype bears a label which reads "*Datames oileus* Westw. H. Klante det."

Datames borneensis waterstradti spec. nov., subspec. nov.

Material.— **North Borneo**: ♀, holotype (RMNH), Mohari N. Borneo expedition, 1912. Paratypes: **North Borneo**: ♂ (RMNH), Mohari N. Borneo expedition, 1912; ♀, ♂ (RMNH), Waterstradt.

Female.— (figs 109 & 112). Body length 38.0-38.5 mm, full measurements given in table 8. Generally less carinate and tuberculate than *D. b. borneensis*. Abdominal segments 6 & 7 not narrowing, segments 8-10 narrowing very slightly. Antennae with 19 segments, apical segment orange-brown. Holotype uniformly dark brown; body of paratype light brown with mid brown longitudinal stripe along length of dorsal surface, legs mid brown.

Male.— Body length 32.0-33.0 mm, full measurements given in table 8. Body gen-

erally less carinate and tuberculate than *D. b. borneensis*, particularly noticeable on pronotum. Mohari's specimen uniformly dark brown; Waterstradt's specimen light brown with mid-brown legs.

Comments.— Klante labelled these specimens "*Datames waterstradti* n. sp." but does not appear to have published a description; he labelled Mohari's male "holotype" and Mohari's female "allotype". This species clearly differs in size from the other two subspecies. Antennae of all specimens except the holotype are broken. In both the female and the male, Mohari's is the longer specimen but has shorter legs than Waterstradt's specimen; the fore legs of Waterstradt's male are missing.

Datames muluensis spec. nov.

Material.— SARAWAK: Gunung Mulu National Park, ♀ Holotype (SFDK) F. Seow-Choen, I. Abercrombie, W. Fleming, Y.T. Lee, 21-23.xi.1996. Paratypes: ♂ (BMNH), ♂ (RMNH), ♂ (SMSM), ♂ (NMSC), ♂ (F. Seow-Choen), 3 ♂ (SFDK), data as holotype.

Female.— (fig. 121). Body and legs very dark brown; rugulose. Length 37.5mm, full measurements in table 8.

Antennae slightly shorter than fore legs, with 20 segments, 3-5 fused. First antennal segment flattened, with one blunt spine on the outer edge, second segment widened but without a distinct tooth. Head almost one-and-a-half times longer than wide; occipital region swollen, almost conical. Head armed with medium supra-antennal spines, medium inter-orbitals, one small pair of pre-occipital spines, small lateral coronals, medium anterior occipitals, medium posterior occipitals, medium central occipital; back of head with a small pair of spines between the lateral coronals and posterior occipitals.

Pronotum, mesonotum and metanotum each with the lateral margins thickened to form strong carinae; lateral margins of mesonotum raised and tuberculate. Pronotum a trapezium with anterior margin strongly indented; with small blunt anterior pronotals and pre-median spines on a raised mound, with a pair of strong carinae running from the post-median position to the small posterior pronotals; median transverse groove deep. Anterior third of mesonotum widening, posterior two-thirds narrowing; with a strong longitudinal carina; anterior and posterior margins of mesonotum with strong carinae, posterior with a small blunt pair of posterior mesal mesonotal spines. Metanotum with a broad longitudinal carina which continues on the median segment, forking at the posterior of the median segment. Metapleuron with one medium blunt supra-coxal spine. Left side of mesosternum with an indistinct rounded tubercule.

Abdominal segments 1-9 each with a central longitudinal carina; on segments 1-5 the carina forks at the posterior margins, on 6-8 the posterior terminates as two tubercles, carina of segment 9 prominent and raised at the posterior. Posterior margin of segments 1-9 slightly raised; 2-9 with small to medium postero-lateral tubercles. Segment 8 with second paired posterior tubercles; segment 9 with three pairs of tubercles on posterior margin. Segment 10 with three tubercles near the anterior margin; lateral margin with a laterally projecting tubercule; posterior margin slightly indented. Abdominal sternites rugulose. Operculum shallow, with a central longitudinal carina; apex rounded, anterior rugulose, posterior rugose.

Base of fore femora only slightly curved and slightly constricted. All femora quadrangular, tibiae almost quadrangular but lacking distinct carinae; femora and tibiae without tubercles or spines; apex of femora with a triangular lobe projecting over the joint. All tarsi short, combined length of tarsomeres 1-4 about as long fifth tarsomere.

Male.— (fig. 122). Coloration as in female. Length 32-33mm, full measurements in table 8.

Antennae as in female but with 18 segments, 13th with a minute tubercle on outer margin. Head armed as in female but with spines larger, anterior coronals clearly larger than the rest.

Pronotum with minute post-medial pronotal tubercles but without carinae running to posterior pronotals, otherwise as in female. Mesonotum of almost uniform width, one-and-a-half times longer than wide, with a strong longitudinal median carina; lateral margins with two rounded tubercles; with medium antero-lateral mesonotal spines, and a large pair of posterior mesal mesonotal spines. Mesonotum with lateral margins and central carina thickened. Metapleuron with large supra-coxal spine. Mesosternum without tubercles.

Abdominal segments 1-9 with indistinct central longitudinal carina which forking at posterior; 8th terminates as a pair of tubercles, 9th terminates as three tubercles and has large second paired posteriors, 8th and 9th with large postero-lateral tubercles. Tenth tergum with V-shaped notch in apex, lateral margins with large medio-lateral tubercles. Poculum deep, with downturned rim; posterior of poculum with longitudinal carina, posterior with three tubercles.

Legs as in female.

Egg.— Unknown.

Comments.— This species is named after the locality at which it was found.

Datames otys (Westwood, 1859) comb. nov.

Acanthoderus otys Westwood, 1859: 54, pl. 26.2 (♂). Holotype, ♂ nymph (OXUM 500), Borneo.

Dares otys (Westwood); Stål, 1875b: 94; Kirby, 1904b: 400; Redtenbacher, 1906: 56.

Pylaemenes infans Redtenbacher, 1906: 49. Holotype, ♂ (MNHN), Borneo, coll. R. Oberthur, 1898. **Syn. nov.**

Material.— **Borneo**: locality unknown: ♂ nymph, holotype of *Acanthoderus otys* (OXUM); ♂, holotype of *Pylaemenes infans* (MNHN).— **Kalimantan**: Martapura, Pengaron: ♂ (OXUM), van der Poll, bought Janson 1909. Central E Borneo: ♀ (RMNH), H.C. Siebers, 16.v.1925.

Female.— (fig. 120) Whole body mid brown with small lighter blotches and few dark brown markings on abdomen. Dorsal surface scabrous and tuberculate, ventral rugulose. Measurements given in table 8.

First antennal segment flattened, with twoblunt spines on outer edge, second segment unarmed, remainder missing.

Head more or less square, slightly narrower at front. Head armed with large supra-antennal spines, small inter-orbital spines, one medium pair of pre-occipital spines, small lateral coronals; back of head with swollen crest formed by four converging carinae, each with slight indentation just before they converge.

Pronotum, mesonotum and metanotum each with lateral margins thickened to form strong carinae. Lateral margins raised and tuberculate in posterior mesonotal and posterior metanotal regions.

Pronotum a trapezium with irregular lateral margins; blunt medium pre-median spines, small blunt posterior pronotal spines.

Mesonotum of uniform width; with strong longitudinal carina, very high at front, decreasing in height towards rear, front with two medium blunt spines; posterior with small blunt pair of posterior mesal mesonotal spines. Mesopleuron with three supracoxal tubercles.

Metanotum with broad longitudinal carina, with small blunt spine in middle of posterior margin. Metapleuron with one blunt supracoxal spine and two supra-coxal tubercles.

Median segment with medium-small first paired posterior spines. Abdominal segments 2-9 each with central longitudinal carina; on segments 2-5 carina forks at anterior and posterior margins, on 6-8 posterior end of carinae tuberculate; carina of segment 5 raised and posterior forks lobe-like; carina of segment 9 prominent and raised at posterior. Segments 2-9 with small to medium postero-lateral tubercles, segments 3-8 with small antero-lateral tubercles. Segments 8-9 with second paired posterior tubercles. Segment 10 with three tubercles near anterior margin; apex almost straight.

All femora and tibiae quadrangular. Base of fore femora curved and slightly constricted; dorsal carinae, particularly dorso-posterior, with two or three rounded swellings; ventro-posterior carina with small blunt tooth near apex, ventro anterior unarmed. Dorsal carinae of mid and hind femora with few lobe-like teeth; ventral carinae each with blunt spine and minute blunt spine near apices. All tarsi short, first four tarsomeres together about as long fifth tarsomere.

Mesosternum with five rounded tubercles, metasternum with two rounded tubercles. Abdominal sternites rugulose, 7th and operculum with central longitudinal carina. Operculum shallow and rounded, anterior rugulose, posterior rugose, with medium sized tubercle on each side of mid point.

Male.— (fig. 76). Body of uniform width, except for slight expansions of mesopleura and metapleura. Body and legs uniformly coloured light or mid brown. Body smooth and setose, legs densely setose (most of setae broken off on specimens examined). Measurements given in table 8.

Antennae of 23 segments; first segment with two spines on outer edge, one at anterior and one in middle. Second segment with blunt tooth near anterior. Segments 1-3 long, 4 and 5 very short.

Head square; anterior armed with four blunt spines: large pair of supra-antennals and small inter-orbital pair. Back of head raised, with distinct pre-occipital carinae; with numerous blunt spines: large anterior pre-occipitals (slightly curved in Redtenbacher's specimen), small pair of posterior pre-occipitals which may be partly fused with medium anterior occipitals, medium central occipital, small posterior occipitals, small lateral coronals and small median coronals.

Lateral margins of pronotum, mesonotum and metanotum thickened and raised. Lateral margin of pronotum with three rounded tubercles and pair of postero-lateral pronotal spines. Centre of pronotum with blunt spines: minute anterior pronotals,

small pre-median pronotals, minute post-median pronotals and small posterior pronotals.

Front of mesonotum with broad carina, greatly raised at front, becoming almost indistinct at rear. Carina with medium anterior mesal mesonotal spines, medium posterior marginal mesonotal spines, and few unevenly arranged tubercles. Lateral margins with blunt antero-lateral mesonotal spines, one or two upright small spines near hind margin, and with several irregularly placed tubercles. Mesopleura with expanded supra-coxal region with four spines and protruding spiracle. Mesosternum with anterior transverse carina; with three pairs of tubercles.

Metanotum with broad carina with pair of small blunt posterior mesal metanotal spines. Lateral margins of metanotum with several small tubercles, with pair of larger tubercles on each side near hind margin. Metapleura with expanded supra-coxal region bearing four blunt spines: anterior medium, followed by one large, one medium and posterior small. Metasternum with indistinct pair of tubercles.

Median segment with acentral swelling with posterior mesal swelling bearing pair of medium spines (in OXUM adult, one spine absent). Abdominal segments 2-10 rectangular, wider than long; with indistinct central longitudinal dorsal carina. Segments 2-10 with postero-lateral tubercles; these increase in size towards rear becoming spine-like on segments 8-10. Carina of segments 2-7 with first paired posteriors: indistinct tubercles on 2-4 and 7, medium spines on 5, and small spines on 6. Segments eight and nine with transverse carina on hind margin; carinae with small first, and large second paired posterior tubercles. Tenth segment with first and second paired anterior tubercles; with a rounded apical indentation and deep indentation in posterior of lateral margin. Poculum rounded, with transverse row of three large tubercles; hind margin down curving. Cerci short, apices rounded and swollen and slightly flattened.

All femora and tibiae quadrate; fore femora slightly curved at base. All femora with blunt spine at apex of dorsal surface. Fore femora with few rounded tubercles on dorsal carinae. Dorsal carinae of middle and hind femora with rounded tubercles and two or three blunt spine-like tubercles. Ventral carinae of femora armed with spines on underside near apices, each carinae of fore femora with one spine, middle and hind each with two spines. Dorsal carinae of all tibiae with few well rounded tubercles. Tarsi short; tarsomeres 1-4 of almost equal length.

Comments.— The female described here is presumed to belong to this species, but it is quite possible that it represents a distinct species.

In the male there are no spines on the lateral margins of the abdomen, other than the short, blunt, spine-like tubercles on segments 8-10; in the female there are only blunt tubercles, too short and fleshy to be regarded as spines. In contrast, both male and female specimens of *Pylaemenes spinivestris* (Bates) and *P. coronatus* (de Haan) clearly have spines of equal size on each of segments 2-9. The position of dorsal tubercles of male *D. borneensis* and *D. otys* corresponds to the spines in *Pylaemenes* spp. so there is clearly a close relationship between the genera.

A male *Datames*, collected in Singapore (PEB-2142), was compared to the *D. otys* with the following differences being noted. The specimen from Singapore has no spines or even medium tubercles on the hind margin of the metanotum or median segment, only two spines on the metapleura, only one true spine on the metapleura

(plus two bulges), all abdominal tubercles are smaller (except the dorsal spines on 5th segment).

Epidares Redtenbacher, 1906

Dares (*Epidares*) Redtenbacher, 1906: 53. Type species: *E. nolimetangere* (de Haan, 1842) [= *Phasma* (*Acanthoderus*) *noli me tangere* de Haan], by present designation.

Epidares; Bradley & Galil, 1977: 198; Bragg, 1992c: 296.

Description.— Body granulose, not tuberculate. Abdomen of male cylindrical, female with anterior half of abdomen much wider than posterior half. Spine formation on head and thorax similar in males and females. Antennae longer than fore legs; first antennal joint not armed. First tarsomere of hind leg at least twice length of tarsomere 2, 3 or 4. Generally similar to *Dares*.

Comments.— Redtenbacher placed two species in this group, however both type specimens of *Dares* (*Epidares*) *haematacanthus* Redtenbacher are lost and there are no other known specimens of this species. It is extremely unlikely that the two type localities for *E. haematacanthus*, "British North Borneo and New Guinea", are both correct; if the correct locality is New Guinea then the species was probably described in the wrong subfamily. If *haematacanthus* does belong in the Datamini it is the only species which has spines on the pronotum; on this basis it seems more likely that it belongs in either Obrimini or in Eurycanthinae.

Key to species of the genus *Epidares*

1. Pronotum with two spines *Epidares haematacanthus* (Redtenbacher)
- Pronotum without spines *Epidares nolimetangere* (de Haan)

Epidares haematacanthus (Redtenbacher, 1906)

Dares (*Epidares*) *hämatacanthus* Redtenbacher, 1906: 54. Syntypes: ♂ (ZMUH, but lost), Sabah; ♂ (ZMHB, but lost), New Guinea.

Comments.— Both syntypes are lost. There are no other known examples. It is very unlikely that both of the localities given by Redtenbacher are correct.

Epidares nolimetangere (de Haan, 1842)

Phasma (*Acanthoderus*) *noli me tangere* de Haan, 1842: 135, pl. 14.6 ♂, & 14.7 ♀. Lectotype [here selected], ♀ (RMNH), Pontianak, Kalimantan. Paralectotype, ♂ (RMNH), Pontianak, Kalimantan.

Acanthoderus nolimetangere; Westwood, 1859: 50.

Tisamenus nolimetangere; Kirby, 1904b: 399.

Dares (*Epidares*) *nolimetangere*; Redtenbacher, 1906: 54.

Dares nolimetangere; Günther, 1935a: 2; Herbert, 1990: 24-25.

Daris nolimetangere; Günther, 1943: 150. [Misspelling]

Epidares nolimetangere; Bragg, 1991d: 265-267; Bragg, 1992b: 4; Bragg, 1992c: 296, figs 1a & 1b; Abercrombie, 1992: 2; Abercrombie, 1995: 34; Schulten, 1995: 95, fig. 57 (♀), pl. 6 (♂ & ♀).

Material.— **Federated Malay States:** locality unknown: ♀, ♂, 2 ♀♀ nymphs, ♂ nymph (BMNH, 1931-570), C.J. Brooks, 1909.— **Borneo:** locality unknown: ♀ (OXUM), ex. Saunders collection.— **Kalimantan:** Pontianak: ♀, lectotype, ♂ paralectotype (RMNH). Martapoera, Pengaron: 3 ♀♀ (OXUM) van der Poll, bought Janson 1909; Long Bloe-oe: 3 ♂♂, ♂ nymph (RMNH), Borneo expedition Dr Nieuwenhuis, 1898. Mahakam: 3 ♂♂, ♀ (RMNH), Borneo expedition Dr Nieuwenhuis, 1894. Upper Mahakam: 2 ♂♂, ♀ (RMNH), Borneo expedition Dr Nieuwenhuis, 1894. Sintang: ♀ (RMNH), Goedhuis Borneo expedition, ix.1891. Poetoes Sibau: 2 ♂♂, 1 nymph (RMNH), Büttikofer, vi.1894.— **Sabah:** Mt Kinabalu, 2700-3100 ft [this locality suspect]: ♂ (SMSM-28), 28.ix.1913.— **Sarawak:** locality unknown: ♂ nymph (OXUM), Wallace, 1858, ♀, nymph (BMNH, 1928-193), C.J. Brooks, 2 ♀♀, 2 ♂♂, 2 nymphs (OXUM), Wallace [no date]; ♀, ♂ (BMNH, 56-44) [Wallace-type label]; ♀ (BMNH, 58-66); ♂, ♀, ♀ nymph (BMNH, 1931-570), C.J. Brooks, 1909; ♂ (RMNH); ♂ nymph (PEB-2425), captive reared 1994; 2 nymphs (PEB-254; PEB-255), captive reared 1990. Mixed stock from Kpg Bengoh & Bako NP: ♀ (PEB-187), captive reared 1990; eggs (PEB-1407), captive reared 1991. Bako NP, 100 m: ♀ nymph (PEB-1288); eggs (PEB-1317; PEB-1319), 01.i.1988; ♀ nymph (PEB-1289), 1st generation captive reared, 1989; nymph (PEB-1320), captive reared 1988; 1st instar nymph (PEB-256), 1st generation, from stock collected 01.i.1988. Penrissen: ♂ (SMSM-26), v.1899; 2 ♂♂, ♀ (RMNH) [data labels very faded, unable to read date]. Mt Santubong, 100 m: ♂ (PEB-1671), 31.vii.1992. Mt Santubong (altitude not recorded): ♀ (PEB-2424), 21.x.1994. Santubong: ♀, nymph (BMNH, 1931-150), J.M. Bryan, vii.1913. 2 km E of Serian, Rangan waterfall: ♂ (PEB-2143), 09.xi.1994. Dahan: ♀ (BMNH, 1931-150), J.M. Bryan, i.1914; ♂, ♀ nymph (BMNH, 1931-150), J.M. Bryan, xii.1913; ♀ nymph (BMNH, 1931-150), J.M. Bryan, x.1911. Sadong: ♀ (SMSM-20), Naysmith [no date]. Mt Gadin, Lundu: ♀ (SMSM-22), 1924. Kpg. Bengoh: ♀ (SMSM-15), P.E. Bragg, 30.vii.1989; ♂ (SMSM-31), P.E. Bragg, 29.vii.1989; 13 ♀♀ (PEB-233; PEB-235; PEB-244; PEB-245; PEB-1279; PEB-1280; PEB-1282; PEB-1283; PEB-1284; PEB-1286; PEB-1287; PEB-1307; PEB-1315), 17 ♂♂ (PEB-240; PEB-242; PEB-246; PEB-1290; PEB-1291; PEB-1292; PEB-1296; PEB-1297; PEB-1298; PEB-1300; PEB-1301; PEB-1302; PEB-1303; PEB-1304; PEB-1308; PEB-1312; PEB-1321), ♀ nymph (PEB-251), 29.vii.1989; 5 ♂♂ (PEB-1293; PEB-241; PEB-1305; PEB-1313; PEB-1316), 30.vii.1989; ♂ nymph (PEB-1295), 30.vii.1989; ♂ (PEB-1294), ♀ nymph (PEB-252), ♂ nymph (PEB-253), 01.viii.1989. Kuching: ♀ (SMSM-23), 16.ii.1899. Kuching, 4.5 mile: ♀ (PEB-1534), ♂ (PEB-1535), 28.vii.1992. Kuching, 5th Mile: ♀ (PEB-249), ♂ (PEB-248), 18.viii.1991; ♀ (PEB-250), 25.vii.1991. Bau: ♀ (BMNH, 1931-150), J.M. Bryan, xii.1913. Bau, near Wind Cave: 3 ♂♂ (PEB-1554; PEB-1555; PEB-1556), 08.viii.1992. Mt Serapi, 3000 ft: ♀ (SFDK), 12.xii.1981. Mt Serapi, 150 m: 4 ♀♀ (PEB-234; PEB-1278; PEB-1281; PEB-1285), ♂ (PEB-238), 12.viii.1989; ♂ (PEB-247), 14.viii.1989. Mt Serapi (altitude not recorded): 9 ♂ (PEB-236; PEB-237; PEB-239; PEB-243; PEB-1299; PEB-1306; PEB-1309; PEB-1310; PEB-1311), 12.viii.1989; ♂ (PEB-1322), 13.viii.1990; 2 ♂♂ (PEB-1607; PEB-1608), ♀ nymph (PEB-1606), 05.viii.1992; ♀ (PEB-1314), captive reared, 1990; ♂ (PEB-1464), ♀ nymph (PEB-1465), captive reared 1992; ♂ (PEB-2612), reared by G. Ramel, 1995 [specimen lacks abdominal spines]. Mt Matang, 445 ft: ♀ (SMSM-19), 10.xii.1909. Matang, 500 ft: ♂ (SMSM-33), E. Naysmith, vi.1893. Matang, 2800-3000 ft: ♂ (SMSM-25), ii.1902. Matang, 3200 ft ♀ nymph (SMSM-39), 02.viii.1909. Mt Matang, 3600 ft: ♂ (OXUM), Dayak collector, vi.1900 [presented by R. Shelford 1900]. Matang: 2 ♀♀ (SMSM-16; SMSM-21), 3 ♂♂ (SMSM-27; SMSM-30; SMSM-34), viii.1899; ♀ (SMSM-17), 03.xii.1913; ♀ (SMSM-18), ♂ (SMSM-35), 6 nymphs (SMSM-40 to SMSM-45), vii.1903; ♂ (SMSM-24), viii.1897; ♂ (SMSM-29), xii.1897; ♂ (SMSM-32), vii.1899; ♂ nymph (SMSM-36), viii.1899 [left abdominal spine missing]; ♀ nymph (SMSM-37), xii.1898. Matang Road: nymph (SMSM-38), 28.iii.1912.— **No data:** 3 ♀♀ (SMSM-48; SMSM-49; SMSM-50), 2 ♀♀ nymphs (SMSM-46, SMSM-47).

Female.— (fig. 114). Head scabrous; mesothorax and metathorax densely granulose; rest smooth. Abdomen and legs setose. Coloration variable with age; older specimens almost uniform mid brown; younger specimens with orange longitudinal stripe along the thorax and anterior half of the abdomen, orange tips to large spines, and orange on the margins of the mesonotum and metanotum. Measurements are given in table 9.

Antennae with 25 segments; 3rd much longer than 1-2; basal segment only slightly flattened and unarmed. Segment 15 with a small tubercle on middle of the external margin. (Female occasionally with 27 segments, in which case 17th has the tubercle: e.g. PEB-234).

Head with a pair of large pre-occipital tubercles; medium anterior occipital spines; small posterior occipital tubercles; small lateral coronal tubercles.

Pronotum with median transverse groove; small anterior, and pre-median pronotal tubercles. Anterior with prominent lobe-like projections over the pronotal foramen.

Mesonotum with large, slender, forward pointing anterior marginal mesonotal spines; medium antero-lateral mesonotal tubercles; 3-4 small tubercles on the lateral margin; a small pair of tubercles on the posterior margin. Posterior mesonotal mounds large, with a large spine and three large tubercles; rarely the large spine is a large double spine (e.g. PEB-2424). Mesopleural spine large, with 2-3 tubercles near the base. Mesopleura with 3-4 tubercles on the ventral margin. Mesosternum granulose, otherwise unarmed.

Posterior metanotal mounds large, with a large spine and 3-4 tubercles near the base; rarely the large spine is a large double spine (e.g. PEB-2424). Metapleura with a large supra-coxal spine and 3-4 tubercles. Metasternum granulose, otherwise unarmed.

Median segment unarmed, or occasionally with small first paired posterior tubercles. Second and third abdominal segments with medium second paired posterior spines; 3rd with small second paired posterior spines. Segments 3-4 with small medio-lateral spines; 8 with tubercle on hind margin; 9th with median longitudinal carina. Segments 2-5 occasionally with 1-3 small tubercles on the lateral margins. Segments 1-4 wide, rest narrow; 5-6 very short. Apex of 10th segment with deep notch. Sternites 6-7 with large tubercles on posterior margins. Operculum elongated, with median longitudinal carina; posterior half rounded; apex a blunt point.

Femora and tibiae rounded. Anterior femora unarmed. Mid and hind femora with two pairs of small spines near the apex of the ventral surface. Hind femora with a small blunt spine on the postero-dorsal carina.

Male.— (fig. 113). Males occur in two colour forms. Typical male coloration is light to mid brown with small dark green patches on the pronotum, posterior mesonotal and posterior metanotal mounds and lateral margins of abdominal segments. Specimens from Mt Serapi are green; the only light brown portions are: the anterior of the mesonotum, the tips of all large spines, most of the mesosternum and metasternum, a narrow longitudinal stripe on the abdomen, and the legs. The size of the green patches on the typical form varies but does not approach the green form. Measurements are given in table 9.

Head scabrous; mesothorax and metathorax densely granulose; rest smooth. Abdomen and legs setose.

Antennae with 23 segments; 3rd much longer than 1-2; basal segment only slightly flattened and unarmed. Segment 13 of male with a small tubercle on middle of the external margin; 14-23 much shorter than the rest.

Head with large anterior occipital spines; small posterior occipital tubercles; small lateral coronal tubercles.

Pronotum with median transverse groove; unarmed. Anterior with prominent lobe-like projections over the pronotal foramen.

Mesonotum with extremely large, slender, forward pointing anterior marginal mesonotal spines; posterior mesonotal spines very large; antero-lateral mesonotal tubercles small. Rarely the posterior mesonotals may have two additional smaller spines near the base (e.g. PEB-1299). Mesopleural spines very large. Mesosternum granulose, otherwise unarmed.

Posterior metanotal spines very large. Occasionally the posterior metanotals have small spines near the base; rarely the metanotals are double spines (e.g. PEB-1299). Occasionally with a small pair of posterior mesal metanotal tubercles. Metapleura with a very large supra-coxal spine. Metasternum granulose, otherwise unarmed.

Median segment unarmed. Second abdominal segment with large first paired posterior spines; 3rd occasionally with small first paired posterior tubercles; 9-10 with slight medio-longitudinal carina; 10th with small anterior second paired tubercles; rest unarmed. Segments 2-7 narrowing, 8 widening, 9-10 of even width. Eighth abdominal sternite with a median longitudinal carina. Poculum deep, rounded, with a down curving rim.

Femora and tibiae rounded. Anterior femora unarmed. Mid femora with 1-2 pairs of small spines near the apex of the ventral surface. Hind femora with a small blunt spine on the postero-dorsal carina, near the base; with 2-4 small spines on the ventral surface near the apex.

Nymphs.— Nymphs of both sexes can have very bright yellow markings and in some specimens yellow can be the predominant colour in the second to fourth instars. Penultimate instar female nymphs have a longitudinal yellow stripe on the thorax and anterior half of the abdomen. The sexes are easily distinguished in the third instar onwards by presence of spines on the third abdominal segments in the females.

Egg.— (fig. 42-44). Capsule an elongated sphere, length 3.9 mm, height 2.9 mm, width 2.7 mm. Capsule, micropylar plate and operculum dark brown with irregular greyish-brown spots; granulose; densely setose. Setae 0.6 mm long, light brown, curved, with an apical hook. Operculum convex; almost circular, width 1.9 mm, height 2.2 mm; without capitulum. External micropylar plate indiscernible, micropylar cup near polar end. Internal plate in the form of a "Y", covering about one sixth of capsule; with the two arms almost circling the polar end and the body reaching to the operculum; an open plate with a short, extremely narrow median line.

Comments.— Endemic to Borneo. Very common in parts of North West Borneo, particularly in (non-intensive) agricultural areas. Population densities are the highest observed for any phasmid in Borneo. In 1991 seven specimens were located in a measured 30 m² area of roadside verge on Mt Serapi (0.23m⁻²). The observed numbers on this and subsequent occasions were apparently much lower than in previous years, this is probably due to an increase in the frequency of cutting of the verges and an increase in the width of the cut area.

The colour form of the male depends on the population from which they originate. Populations breed true, and captive rearing under identical conditions indicates that there is little or no environmental effect on the colour forms. A crossbreeding experiment is in progress (typical female × green male).

The spination is subject to variation. Females may have branched posterior meso-

notals and posterior metanotals. Rarely males may lack spines on the second abdominal segment, one specimen in the Sarawak Museum (SMSM-36) has a spine on the right but lacks the left spine; I have examined one (PEB-2612) of two specimens reared from typical Mt Serapi stock (reared by Mr Gordon Ramel of Devon, U.K.) which lack both spines. Males which lack these spines have minute tubercles in these positions.

Specimens have been found with moss growing on their backs (e.g. PEB-247). Investigations on Mt Serapi have shown that this species hides in leaf litter and plant roots during the day, at the base of the previous night's foodplant.

The species is easy to rear (Herbert, 1990). Foodplants include bramble, elder, hawthorn, oak, pyracantha, raspberry, rose, and silver birch. Abercrombie (1992; 1995) has reported rather surprising egg laying behaviour, the female digs a hole in the substrate, then the egg is flicked over the head, caught on the antennae, then buried.

Defence is passive, the strong body spines offer good protection, to the extent that putting ones hand on one can result in bleeding, without any apparent damage to the insect. However, although very common on Mt Serapi and at Bengoh, this species is not immune to predators. In captivity they were eaten by *Chalcides ocellatus* (Forskol), a Mediterranean skink (Bragg, 1991d), similar sized skinks are commonly seen in daytime on Mt Serapi. An adult male *E. nolimetangere* was placed in a cage containing two adult (c. 25 cm) skinks which had not been fed for ten days; the skinks were accustomed to being fed weekly, often on other species of phasmids. The phasmid was eaten almost immediately, with no parts of the body left unconsumed. Skinks are diurnal and rely mainly on their eyesight to spot moving prey; as *E. nolimetangere* is nocturnal and remains immobile when disturbed during the daytime, they are probably overlooked by skinks. If they are noticed, the skinks would probably be deterred by the spines and seek softer food. The captive conditions; confined habitat, diet predominantly based on phasmids, and enforced hunger probably accounts for the eagerness with which the *E. nolimetangere* were attacked.

Orestes Redtenbacher, 1906

Orestes Redtenbacher, 1906: 47; Rehn & Rehn, 1938: 484; Bradley & Galil, 1977: 198. Type species: *O. verruculatus* Redtenbacher, 1906, by monotypy.

Comments.— The genus is monotypic and not recorded from Borneo. The holotype (and only specimen) is probably not adult. There is an adult female specimen in NHMW which probably belongs to this genus.

Planispectrum Rehn & Rehn, 1938

Platymorpha Redtenbacher, 1906: 46. [preoccupied by *Platymorpha* Jacoby, 1888 (Coleoptera)]. *Planispectrum*; Rehn & Rehn, 1938: 484 [n.n. for *Platymorpha* Redtenbacher, 1906: 46, preoccupied by *Platymorpha* Jacoby, 1888 (Coleoptera)]; Bradley & Galil, 1977: 198; Bragg, 1993b: 44. Type species: *P. cochinchinensis* (Redtenbacher) [*Platymorpha cochinchinensis* Redtenbacher 1906] by original designation.

Platyphasma; Uvarov, 1940: 116 [n.n. for *Platymorpha* Redtenbacher, 1906: 46, preoccupied by *Platymor-*

pha Jacoby, 1888 (Coleoptera)]; Bradley & Galil, 1977: 198. Type species: *P. cochinchinensis* (Redtenbacher) [*Platymorpha cochinchinensis* Redtenbacher 1906] by indication. Name rejected as a junior objective synonym.

Description.— Body flattened, pitted with depressions. Antennae short, hardly longer than fore femora, always shorter than the total length of the legs; at least the first antennal segment is toothed. Vertex with serrated tubercles or teeth. Pronotum trapezoidal. Mesonotum dilated at rear; metanotum angular. Lateral margins of thorax and abdomen may be toothed or unarmed; metapleura without a large lateral spine. Abdominal segments very short and wide. Anal segment of female truncated, lamina supraanalis not longer than the operculum. Cerci short and more or less hidden. Operculum swollen and rounded, apex with a rounded lip. Legs very short and unarmed.

Key to species of the genus *Planispectrum*

1. Margins of thorax and abdomen with spiny teeth. Antennae with 20 segments, the first two segments both toothed ... *Planispectrum cochinchinensis* (Redtenbacher)
- Margins of thorax and abdomen unarmed. Antennae with 14 segments, the first is toothed, the second unarmed *Planispectrum bengalensis* (Redtenbacher)

Comments.— Only *Planispectrum bengalensis* is recorded from Borneo. This appears to be the only Bornean member of the Datamini which is not endemic.

Planispectrum bengalensis (Redtenbacher, 1906)

Platymorpha bengalensis Redtenbacher, 1906: 46, Lectotype, ♀ (NHMW, 43), Bengalen. Paralectotypes: ♀ ♀ Bengalen (MNHN), and Java (MNHN).

Planispectrum bengalensis (Redtenbacher); Bragg, 1993b: 44, fig. 9 (♀) [Lectotype designation]; Zompro, 1995: 257, figs. 1 (♂) & 2 (♀).

Material.— “Bengalen”: ♀, lectotype (NHMW, 43).— **Sabah**: Crocker Range, 16 miles NW of Kenin-gau, 1400 m: ♀ (C.L. Chan) S. Nagai, 24.i.1983.— **Sarawak**: Matang: ♀ (OXUM) viii.1899; Santubong: ♀ (SMSM-58) ii.1900; Baki (near Kapit): 2 ♀ ♀, ♂ (O. Zompro) N. Naidenow, 14.viii.1994.— **Singapore**: ♀ (BMNH, BM 94-231) [specimen acquired in 1894].

Female.— (fig. 115). The following description of the female is based on the specimen from OXUM, and those in the collection of Oliver Zompro. Measurements are given in table 10.

Colour uniformly light to dark brown. Dorsal and ventral surfaces, and legs setose and scabrous. Body almost as high as wide; lateral surfaces almost vertical, dorsal and ventral surfaces almost horizontal. Width of body variable, OXUM specimen is narrower than all other specimens; the difference is due to the pleurae being vertical in the OXUM specimen and sloping outwards in others.

Antennae with 13-14 segments (difficult to tell if 13th is one or two segments). Basal segment with tooth on outer margin.

Head with large supra-antennal tubercles, occasionally with large inter-orbital

tubercles. Pre-occipitals, anterior and posterior occipitals forming a line of large tubercles on a swollen ridge. Central occipital absent. Lateral coronals medium or indistinct.

Pronotum a trapezium with anterior margin slightly indented. Median transverse groove shallow. Anterior and pre-median tubercles small, post-median and posterior indistinct. A pair of small tubercles mid way between the posteriors and the lateral margin.

Mesonotum square, almost flat; with median longitudinal carina; with small anterior marginal mesonotal tubercles. Mesopleura unarmed. Mesosternum with two pairs of indistinct tubercles.

Combined metanotum and median segment slightly wider than long; almost flat; with median longitudinal carina. Carina splits at the posterior of median segment. Mesonotal-metanotal, and metanotal-median segmental joints both indistinct. Metapleura unarmed. Metasternum unarmed.

Abdominal segments three times wider than long; 2-8 with median longitudinal carina which is divided at both anterior and posterior margins to form an 'X'; 9 with short median longitudinal carina. Anterior of carina on segment 5 distinctly swollen. Posterior-lateral tubercles indistinct to small on 2-7, medium on 8-9. Ninth segment with small second paired posterior tubercles and small second paired anterior tubercles; 10th with small second paired posterior tubercles. Abdominal sternites scabrous, unarmed. Operculum rounded, longer than wide, with median longitudinal carina; apex almost straight.

Legs short. Femora all with four indistinct carinae; unarmed except for very indistinct tubercles on the dorsal carinae. Tibiae unarmed. Tarsal segments 1-4 indistinct and short.

Male.— (fig. 116). Measurements as in table 10. Colour as in female. Generally form as in the female but much more slender. The specimen may not be adult.

Antennae 14 segments, basal segment toothed. Head tuberculate: supra-antennals large, lateral coronals medium, posterior occipitals medium, anterior occipitals large, inter-orbitals large.

Mesonotum, and the combined metanotum and median segment slightly longer than wide (mesonotum 3.8 mm long, 3.2 mm wide). Pronotum, mesonotum, metanotum and median segment otherwise as in female. Thoracic pleura and sterna unarmed.

Abdominal segments 2-5 narrowing, 6-10 of almost constant width (twice as wide as long). Segments 1-9 with indistinct central carina which forks at the posterior margin. Lacking distinct tubercles except for second paired posteriors on ninth segment, and two pairs on the tenth segment. Tenth segment with an indented apex. Poculum rounded, slightly longer than deep, with a rounded rim.

Legs as in female.

Comments.— This is the only species recorded from Borneo, having been recorded from Sabah and Sarawak (Bragg, 1993b) in addition to Singapore and the type locality of Bengalen. The only known male is that in the collection of Oliver Zompro.

Pylaemenes Stål, 1875

Bradley & Galil, 1977: 198. Type species: *P. coronatus* (de Haan) [*Phasma* (*Pachymorpha*) *coronatus* de Haan, 1842] by designation of Kirby, 1904b: 400.

Description.— Body scabrous, roughly tuberculate and spiny. Body of female slightly flattened. First antennal segment with 1-3 teeth on the outer margin. Occiput conically elevated, tuberculate and spinose. Margins of mesonotum and metanotum almost parallel. Mesonotum and metanotum with a strong central carina and strong carinae on the lateral margins; the mesonotum and metanotum have a distinct slope from the central carina to the lateral margins. Metapleura with a large spine just in front of the coxae. Abdomen of males slim and almost cylindrical, those of female sloping down from the central longitudinal carina. The hind margin of each segment is armed with a spine on the lateral margin and a pair of spines on the central carina; the exception being the median segment which lacks the lateral spines. The apex of the abdomen of the males is dilated laterally by the widened terga and ventrally by the rounded and swollen poculum. Operculum long, quite deep, carinate. Middle and hind femora armed with spines or tubercles on the carinae; fore femora either clearly armed or almost smooth.

Comments.— *P. coronatus* (de Haan) and *P. infans* Redtenbacher were recorded from Borneo (Redtenbacher, 1906); the latter belongs in *Datames*, and the former was incorrectly recorded. Three nominal species remain in the genus, none occur in Borneo.

Key to species of the genus *Pylaemenes*

1. Lateral abdominal spines projecting and oblique 2
- Lateral abdominal spines large and upright *Pylaemenes spinivestris* (Bates)
2. Antennae with about 27 joints *Pylaemenes coronatus* (de Haan)
- Antennae with 18 joints *Pylaemenes occipitalis* (Kaup)

Pylaemenes coronatus (de Haan, 1842)

Phasma (*Pachymorpha*) *coronatus* de Haan, 1842: 137, pl. 14.4 (♂), & 14.5 (♀). Syntypes: ♂ (RMNH) Java; ♀ (RMNH) Amboina.

Acanthoderus coronatus; Westwood, 1859: 51.

Pylaemenes coronatus; Kirby, 1904b: 400; Redtenbacher, 1906: 48, pl. 1.13 (♀) & 1.14 (♂).

Comments.— Redtenbacher mistakenly indicated that this species was described from Borneo by de Haan. Westwood recorded this species from Borneo; a specimen collected by Wallace, the specimen (in BMNH, 63-8) is actually from Boroo; the label is hand written and it is likely that Westwood mis-read the label. As with many of Wallace's specimens, this specimen was purchased through Stevens as a group of "Coleoptera, 5 Orthoptera and 11 various"; all other specimens of this species in BMNH are clearly labelled from other localities and the only one accessioned before Westwood's publication in 1859 is (BMNH, 55-8) from Ceram. Redtenbacher described *Pylaemenes infans* from Borneo (Redtenbacher 1906: 49) but this species belongs in *Datames*, as a junior synonym of *D. otys* (Westwood).

Spinodares gen. nov.

Description.— Distinguished from *Dares* by the presence of large mesopleural spines, large metapleural spines and extremely large anterior marginal mesonotals in the female. Similar in general body proportions to *Datames* and *Pylaemenes* but distinguished from both by the absence of a conical mound of carinae on the top of the head, from *Datames* by the presence of the large spines, and from *Pylaemenes* by the absence of spines on the abdomen. The eggs are more or less cuboidal, those of *Datames* and *Dares* are spherical. The genus is named *Spinodares* in recognition of the similarity to *Dares* and the large spines which distinguish it from that genus. Type species: *Spinodares jenningsi* **spec. nov.**

Spinodares jenningsi spec. nov.

Material.— **Sarawak**: Pelagus River, Pelagus logging camp: ♀ and 2 eggs, holotype (BMNH, PEB-160) P.E. Bragg, 08.viii.1990. Paratypes (same locality): 2 eggs, paratype material (PEB-161) laid by holotype, viii.1990, 2 ♀♀ (PEB-2622; P. Jennings), ♀ nymph (P. Jennings) P. Jennings, 08.viii.1990, ♀ (P. Jennings), 8 ♀ nymphs (OXUM; RMNH; BMNH; 5 in collection of P. Jennings) reared by P. Jennings, 1990.

Female.— (figs 82 & 119). The coloration of the insect is based on the preserved specimens and a photographic transparency which was taken in situ when the holotype was collected.

Whole of body and legs a mixture of mid and dark brown, the lighter colour being mainly on the raised portions. An orange-brown line runs along the mesothorax, metathorax and anterior half of the abdomen. Sides of body almost parallel, only slightly narrowing along the posterior half of the abdomen. A central longitudinal carina runs along the mesonotum, metanotum and abdomen. Upper surface of body rugulose and tuberculate, particularly at the lateral edges of the nota, close to the central longitudinal carina is relatively smooth. Underside of body slightly tuberculate in parts. Measurements are given in table 11.

Antennae reach beyond the end of the tarsi; basal joint flattened, with a blunt spine on the outer edge; composed of 25 segments, the anterior 10 being half or one third of the length of the rest.

Head almost square. With small supra-antennal tubercles; a large pre-occipital tubercle; large anterior occipital spines, each with a posterior tubercle at the base; small blunt posterior occipital spines; large lateral coronal tubercles.

Pronotum scabrous; fore margin curved, hind margin straight and wider than the front; with deep median transverse groove; anterior, pre-median, post-median and posterior tubercles all small.

Mesonotum three times longer than pronotum, almost rectangular; a raised area at the fore margin gives rise to two extremely large spines at the front, with some large outward pointing tubercles just behind; the spines project forwards and the tips are almost level with the concave portion of the fore margin of the pronotum (fig. 82). With two pairs of large posterior mesal mesonotal tubercles, and 3-4 tubercles on the lateral margins. The longitudinal carina becomes more prominent towards the rear. Mesopleura with a large mesonotal spine, with two tubercles at the base; with

small medio-lateral spine. Mesosternum with two pairs of tubercles at the anterior.

Metanotum with very distinct longitudinal carina; carina slightly forked at the posterior margin. Metapleura with one extremely large, and two small supra-coxal spines; the largest spine is between the two smaller spines.

Median segment almost indistinguishable from metanotum; carina branching and terminating as large first paired posterior tubercles. Abdominal segments strongly rugose; twice as wide as long. Segments 2-4, and 6-7 with the longitudinal carina dividing just before the hind margin, and rejoining at the margin, to form a hollow triangular structure. On segment 5 this structure is greatly enlarged, forming a three flanged lobe. The carina rises at the hind margin of segment 8 to form a small triangular pyramid. Segment 9 has the posterior half of the carina enlarged to form a lobe like tubercle. Segment 10 is almost a trapezium, narrower at the rear, with the posterior margin being slightly indented. Abdominal sternites 2-7 with small first paired anterior tubercles. Operculum deep and well rounded, twice as long as wide, not quite reaching the end of segment 10; with a longitudinal carina; posterior half with numerous tubercles.

Femora and tibiae all without distinct carinae; all dorsal femoral carinae with distinct tubercles; dorsal surface of all tibiae with tubercles. The anterior left leg of the holotype lacks tubercles, it is assumed that the specimen lost the leg and regenerated it at some stage; the tarsus has only four segments which supports this assumption). Apices of all femora with a blunt spine on the upper surface. Fore femora slightly curved along the basal half, ventral surface unarmed. Middle and hind femora with 3-4 spines on the ventral surface near the apices. Tarsal segments all short.

Egg.— (figs 96-97 & 102). Capsule dark brown, approximately cuboidal, twice as long as wide; with three large concave areas on each lateral surface. Whole surface evenly and finely granulose; with numerous hairs which swell at the apices, hairs most numerous at the polar and capitular ends, very few on the lateral surfaces. Length 3.7 mm, height 2.2 mm, width 1.6 mm. Operculum oval, without capitulum, almost flat, with some hairs on the surface. External micropylar plate indistinguishable, micropylar cup at the polar end of the dorsal surface, with a narrow median line. Internal plate open; large, in the form of a letter 'H' with a central extension running from the micropylar cup to the operculum (fig. 102). The plate more or less corresponds to the raised areas of the capsule.

Comments.— The specimens collected all survived several weeks in the United Kingdom, feeding on bramble. Mr Jennings succeeded in keeping one alive for 12 months and hatched a number of eggs, raising a number of nymphs to their penultimate instar; one went on to become adult but died about two weeks later; these specimens are all designated as paratypes.

Acknowledgements

I thank the staff who have kindly loaned material from the following museums: BPMB, MCSN, MNHN, NHMW, and RMNH. Material from Kuala Belalong was collected as part of the Royal Geographical Society / Universiti Brunei Darussalam Rainforest Expedition. Collection of material in 1992 was done with the aid of a small grant from the Royal Entomological Society of London. I thank my companions who

assisted with the collection of material on my visits to Borneo: Ian Abercrombie, Chan Chew Lun, Paul Jennings, Jenny Hands, Mel Herbert, Paul Inglis, Lee Yong Tsui, and Patrick van der Stigchel. I also thank the individuals who loaned specimens: Chan Chew Lun, Gordon Ramel, Francis Seow-Choen, and Oliver Zompro.

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Received: 21.iv.1997

Accepted: 4.xi.1997

Edited: C.H.J.M. Fransén

Table 1. Names of foodplants used for rearing Heteropteryginae.

Common name	Scientific name	Family
Arum lily	<i>Zantedeschia</i> spec.	Araceae
Bramble	<i>Rubus</i> spec.	Rosaceae
Dog Rose	<i>Rosa canina</i> Linnaeus	Rosaceae
Elder	<i>Sambucus nigra</i>	Caprifoliaceae
Eucalyptus	<i>Eucalyptus gunnii</i> Hooker	Myrtaceae
Firethorn	<i>Pyracantha</i> spec.	Rosaceae
Flowering currant	<i>Ribes</i> spec.	Grossulariaceae
Hawthorn	<i>Crataegus monogyna</i> Jacq.	Rosaceae
Ivy	<i>Hedera helix</i>	Araliaceae
Lords and Ladies	<i>Arum maculatum</i>	Araceae
Oak	<i>Quercus</i> spec.	Fagaceae
Privet	<i>Ligustrum ovalifolium</i>	Oleaceae
Raspberry	<i>Rubus idaeus</i> Linnaeus	Rosaceae
Rhododendron	<i>Rhododendron ponticum</i>	Ericaceae
Rose	<i>Rosa</i> spp.	Rosaceae
Rosebay Willowherb	<i>Epilobium angustifolium</i>	Onagraceae
Silver birch	<i>Betula pendula</i>	Betulaceae

Table 2. Native foodplants of some Heteropteryginae.

Phasmid species	Plant family	Plant species
<i>Dares validispinus</i>	Dioscoreaceae	<i>Discorea</i> sp.
<i>Datames borneensis</i>	Araceae	unidentified
	Arecaceae (Palmae)	<i>Daemonorops</i> sp.
<i>Epidares nolimetangere</i>	Melastomataceae	<i>Clidemia hirta</i>
	Araceae	unidentified
<i>Haaniella grayii</i>	Nepenthaceae	<i>Nepenthes ampullaria</i>
	Zingiberaceae	unidentified
	Gleicheniaceae (fern)	<i>Dicranopteris linearis</i>

Table 3. *Haaniella* males.

<i>Haaniella</i> ♂♂	<i>dehaanii</i>	<i>echinata</i>	<i>grayii</i>	<i>scabra</i>	<i>saussurei</i>
Total	63-75	68-94	78-95	51.5-57.0	82.0-92.0
Antennae	47-55	54-69	65-75	38.5-36.5	>62-69.5
Head	5.0-6.5	6.5-8.0	6.0-8.0	5.0	7.0-7.5
Pronotum	7.0-8.0	7.0-10.0	7.5-9.5	6.0	8.5-9.0
Mesonotum	9.0-13.0	10.0-14.0	12.0-14.0	7.5	12.0-14.0
Metanotum & Median segment	10.0	10.0-12.5	12.0-13.0	7.0	11.5-12.5
Elytra	11.0-? (damaged)	15.5-18.0	13.0-15.0	12.0	15.5
Fore femora	16.0-20.0	18.5-22.5	20.0-22.5	13.0	20.5-22.5
Fore tibiae	18.5-22.0	20.0-25.5	23.0-27.0	14.5-15.0	21.5-23.5
Fore tarsi	6.0-8.0	7.0-8.0	8.0-9.5	5.0	7.0-8.5
Mid femora	13.0-19.0	15.0-18.0	17.0-19.5	11.0-11.5	17.5-19.5
Mid tibiae	16.0-20.0	17.0-21.0	19.0-21.0	12.0-13.0	17.5-19.5
Mid tarsi	5.0-8.0	6.0-9.0	8.0-9.5	5.0-	7.0-9.0
Hind femora	19.5-28.0	21.0-27.0	26.0-29.0	16.5-17.0	25.0-26.5
Hind tibiae	23.5-32.0	25.0-32.0	29.0-32.5	19.0	27.0-29.0
Hind tarsi	6.5-9.0	8.0-11.5	8.5-11.5	6.0	9.0-10.5
Longest specimen	<i>H. dipsacus</i> Type	PEB-1634	PEB-289	PEB-279	PEB-268
Shortest specimen	PEB-1761	PEB-1810	PEB-2420	PEB-284	PEB-2168

Table 4. *Haaniella* females.

<i>Haaniella</i> ♀♀	<i>dehaanii</i>	<i>echinata</i>	<i>grayii</i>	<i>scabra</i>	<i>saussurei</i>
Total	89-98.0 (*99.5)	91.0-135.0	102-143	70-76	127-132 (**)
Antennae	43->50	54.0-71.0	60.5-80.0	36.0-40.5	74
Head	8.5-10.0	9.5-12.0	10.0-12.0	6.5-7.5	12.0-11.0
Pronotum	9.5	9.5-15.0	9.5-13.5	7.5-8.0	12.5
Mesonotum	12.0-16.0	12.5-18.5	13.5-23.0	8.5-9.0	17.5-18.5
Metanotum & median segment	12.5-16.0	13.5-17.5	13.0-18.0	10.0	17.5
Elytra	17.0-22.0	24.0-29.0	20.5-27.0	17.0-19.0	27.0-26.0
Fore femora	17.5-22.0	19.0-24.5	20.5-28.0	14.0	25.0
Fore tibiae	20.0-26.0	22.0-29.5	22.0-31.5	16.0-16.5	29.0-27.0
Fore tarsi	7.0-8.0	9.0-10.0	8.5-11.5	6.0	11.0-10.5
Mid femora	17.0-20.0	18.0-23.0	19.0-24.0	12.0	20.0-21.5
Mid tibiae	18.0-23.0	20.5-26.0	19.0-27.0	13.5-14.0	24.5-23.0
Mid tarsi	7.0-8.0	9.0-10.0	8.0-11.0	5.0	10.5-10.0
Hind femora	25.0-30.0	26.0-34.0	26.5-34.5	18.0-19.0	31.5-33.0
Hind tibiae	29.0-36.0	29.0-37.0	29.0-42.0	21.5-22.0	38.0-37.0
Hind tarsi	8.0-10.0	10.0-12.5	10.0-14.0	6.0	14.0-13.0
Longest specimen	<i>H. dipsacus</i> Lectotype	PEB-477	PEB-1538	PEB-277	PEB-2166
Shortest specimen	PEB-1760	PEB-2046	PEB-2421	PEB-2117	PEB-474

* Measurements of *H. dipsacus* Lectotype are given although one reared specimen is slightly longer.

** OXUM (84 mm) specimen excluded.

Table 5. *Hoploclonia* spp. Measurements of male *H. abercrombiei* are from the largest specimen only; measurements of female *H. cuspidata* are from the largest specimen; measurements of *H. gecko* are from my own material only.

	<i>H. abercrombiei</i>		<i>H. apiensis</i>	<i>H. cuspidata</i>		<i>H. gecko</i>	
	♂	♀	♀	♂	♀	♂	♀
Total	39.6	54-56	48.5	32-33	47-50	32-34	42-49
Antennae	18.7	20-21	19	17	16.2	17.0-17.5	15-16
Head	2.8	5	5.5	3.5	4.1	3.2-3.5	3.7-3.8
Pronotum	4.0	4.5	4	3.5	4.1	2.8-3.1	3.6-3.9
Mesonotum	8.8	10-10.5	7	6.5	9.2	7.0-7.5	9.0-9.2
Metanotum	3.1	3-3.5	3	3	3.1	2.6-2.9	3.1-3.4
Median Segment	2.8	3	3	2	2.8	2.3	2.2-2.4
Fore femora	10.7	11.5-12	12	9.5	10.4	8.5-9.5	10.5-11.0
Fore tibiae	10.2	12-12.5	12.5	10	9.7	9.0-10.0	10.0
Fore tarsi	3.8	4-4.5	5	3.5	3.3	3.4-3.7	3.5-3.7
Mid femora	8.3	10-10.5	11	8.5	8.6	8.0-8.5	8.5-9.0
Mid tibiae	9.8	10.5-11	11	9	9.2	8.5-9.0	8.5-9.0
Mid tarsi	3.5	3.5-4	4.5	3.5	3.5	3.1-3.3	3.0-3.4
Hind femora	11.7	14	14.5	10.5	12.5	10.5-11.0	11.5-12.0
Hind tibiae	14.2	14-16.5	15.5	12	13.1	12.0-12.5	12.0-13.0
Hind tarsi	3.8	4-4.5	5.5	4.0	4.1	3.5-3.7	3.7-4.2

Table 6. Sizes of *Dares* males.

<i>Dares</i> ♂♂	<i>breitensteini</i>	<i>multispinus</i>	<i>philippinensis</i>	<i>planissimus</i>	<i>ulula</i>	<i>validispinus</i>	<i>verrucosus</i>
Total	40	30	34	37.5	35-43	35.5-41.0	3.2-3.8
Antennae	>16.5	>10.1	15.5	>14.0 (regen.)	23-29	18.5-20.5	16.5-17.0
Head	2.9	2.4	2.7	3.2	3.2-3.7	3.5-3.7	2.7-2.9
Pronotum	4.0	2.2	3.4	2.9	3.2-3.6	3.2-3.7	3.3-3.7
Mesonotum	7.0	5.6	6.8	6.5	6.5-7.5	7.0-8.5	5.5-6.6
Metanotum	4.4	3.3	4.2	4.4	3.9-5.0	4.4-5.1	3.5-4.1
Median Segment	2.3	1.9	2.0	2.1	2.0-2.4	1.9-2.1	2.0-2.1
Fore femora	9.5	missing	8.5	8.0	9.5-13.0	7.5-8.5	8.0-8.5
Fore tibiae	9.5	missing	7.5	6.5	9.0-12.0	6.0-8.0	7.5-8.0
Fore tarsi	4.1	missing	3.3	3.3	3.5-4.5	3.6-4.3	3.0-3.1
Mid femora	8.0	8.5	7.0	6.5	8.0-10.0	7.0-8.0	7.0-8.0
Mid tibiae	7.5	8.0	6.0	5.0	7.0-9.0	5.0-6.5	6.0-6.5
Mid tarsi	3.6	3.7	3.2	3.4	3.5-4.5	3.5-4.1	2.8-3.2
Hind femora	10.0	10.0	9.5	8.0	9.5-12.5	8.0-9.0	8.5-9.5
Hind tibiae	10.0	10.0	8.5	7.0	10.0-13.0	7.5-9.0	8.0-9.0
Hind tarsi	4.1	>2.0	3.5	3.8	4.0-5.0	3.9-4.5	3.2-3.4
Longest specimen	NHMW	Holotype	Adult paratype	Holotype	PEB-1548	PEB-1957	PEB-227
Shortest specimen	-	-	-	-	PEB-197	PEB-1963	PEB-226

Table 7. Sizes of *Dares* females.

<i>Dares</i> ♀♀	<i>breitensteini</i>	<i>kinabaluensis</i>	<i>murudensi</i>	<i>philippinensis</i>	<i>ulula</i>	<i>validispinus</i>	<i>verrucosus</i>
Total	52.5	32.0	26.0	(43.5)-44.0	44.0-51.0	41.5-48.0	41.5-46.5
Antennae	c. 19.0	12.0	9.2	16.0	21.5-24.5	16.0	15.0-16.0
Head	5.0	3.5	3.0	3.4	4.0-5.0	3.6-5.0	3.9-4.2
Pronotum	5.0	3.2	2.2	4.2	4.0-4.8	4.0-4.1	4.3-4.6
Mesonotum	10.0	5.5	4.0	8.3	7.6-9.0	7.8-8.8	7.0-7.7
Metanotum	5.6	3.2	2.8	4.9	5.2-6.4	4.3-5.1	4.2-4.5
Median Segment	3.0	2.9	1.4	2.5	2.5-2.6	2.3-2.4	2.3-2.5
Fore femora	11.0	7.3	5.1	9.0	10.5-12.0	8.0-9.0	8.0-9.0
Fore tibiae	10.5	6.7	4.5	8.5	10.5-12.0	7.5-8.0	7.5-8.0
Fore tarsi	4.8	3.3	2.5	3.6	4.5-5.0	3.8-4.5	3.2-3.4
Mid femora	9.5	6.8	4.9	8.0	8.5-11.0	7.0-8.0	7.5-8.0
Mid tibiae	9.0	6.1	4.5	7.0	8.5-10.0	6.0-7.0	6.5-7.5
Mid tarsi	4.5	3.0	2.5	3.5	4.5-5.0	4.3-4.6	3.5-3.6
Hind femora	12.0	8.5	6.3	10.0	11.0-13.0	9.0-10.0	9.5-10.0
Hind tibiae	13.0	8.0	6.4	9.5	11.5-13.0	8.5-9.5	9.0-9.5
Hind tarsi	5.5	3.5	2.8	4.1	5.0-5.5	4.5-5.0	3.5-3.7
Longest specimen	Lectotype	Holotype	Holotype	Holotype	PEB-2156	PEB-190	PEB-219
Shortest specimen	not measured	-	-	Paratype	PEB-193	PEB-2147	PEB-221

Table 8. Measurements of Bornean *Datames*. N.B. *D. b. waterstradti*: shorter female specimen has longest legs.

Lengths (mm)	<i>D. b. borneensis</i>		<i>D. b. sepilokensis</i>		<i>D. b. waterstradti</i>		<i>D. muluensis</i>		<i>D. otys</i>	
	female	male	female	male	female	male	female	male	female	male
Total	48.5-54.5	43.0-49.0	45.0-48.0	39.0-41.5	38.0-38.5	32.0-33.0	37.5	32-33	43	36-39
Antennae	14-15.5	14.0	12.0-12.5	11.0	9.5	?	16	15	?	13.0
Head	4.0-4.5	2.5-3.0	4.0-4.5	2.5-3.0	3.0	2.0	4.0	3.0	3.5	3.0
Pronotum	4.0-5.0	3.5-4.0	3.5-4.5	3.0	3.0	2.5	3.0	2.5	3.5	2.5-3.0
Mesonotum	10.5-12.0	10-11.5	9.0-10.0	9.0	8.5	7.0-8.0	8.0	6.5	9.0	8.0-8.5
Metanotum	7.0-8.0	7.0-8.0	6.0-7.0	6.0-6.5	6.0	5.5	4.5	4.4	4.0	4.0
Median segment										
Fore femur	8.0-9.5	8.0-8.5	8.0	6.0-6.5	7.0	6.0	9.0	8.5	8.0	8.0-8.5
Fore tibia	8.0-9.5	7.0-7.5	7.5-8.0	5.5-6.0	6.5-6.0	5.5	8.5	8.5	7.0	7.5
Fore tarsus	3.5-4.0	3.0	3.0-3.5	2.5-3.0	2.5	1.5	3.5	3.0	3.0	3.5
Mid femur	8.0-9.0	7.0-7.5	7.0	5.5-6.0	6.5	5.5-6.0	8.0	7.0	7.0	7.0-7.5
Mid tibia	7.0-8.0	5.5-6.5	6.0-6.5	5.0-5.5	6.0-5.5	5.0-5.5	8.0	7.0	6.0	6.0-6.5
Mid tarsus	3.5-4.0	3.0-3.5	3.5	2.5-3.0	2.5	2.0	3.5	3.0	3.0	3.0-3.5
Hind femur	9.5-11.5	8.5-9.0	9.0-9.5	6.5-7.5	8.5	6.5-7.5	10.0	9.0	9.0	7.5-8.0
Hind tibia	8.0-9.5	7.5-8.0	8.0-8.5	6.0-7.0	8.0-7.0	5.5-7.0	10.0	9.5	8.0	7.0-7.5
Hind tarsus	4.0-4.5	3.0-3.5	4.0	3.0	3.0	2.5	3.5	3.0	4.0	3.0-3.5
Longest specimen	PEB-2533	PEB-181	C.L. Chan	C.L. Chan	Holotype	Mohari's	SFDK	SFDK	RMNH	NHMW
Shortest specimen	PEB-184	PEB-177	C.L. Chan	Seow-Choen	Paratype	Waterstradt's	-	SFDK	-	OXUM

Table 9. Measurements of *Epidares nolimetangere* (de Haan).

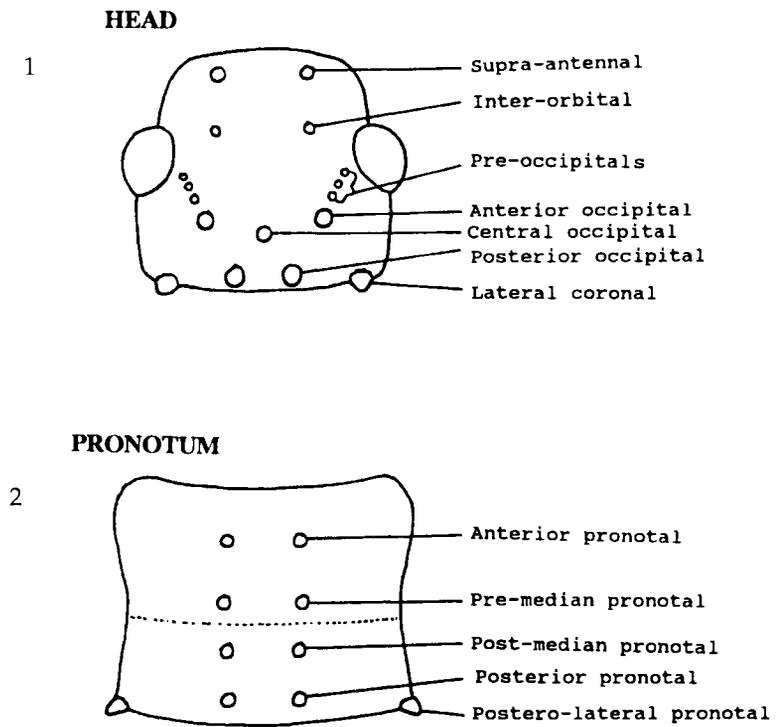
Length (mm)	♂	♀
Total	33.5-39.0	35.5-44.0
Antennae	26.0-31.5	22.5-25.5
Head	3.2-3.5	3.9-4.1
Pronotum	2.5-2.6	3.0-3.4
Mesonotum	8.0-9.5	8.0-9.4
Metanotum	4.5-5.1	5.0-5.8
Median segment	1.8-2.4	1.7-2.0
Fore femur	11.0-13.0	10.5-11.5
Fore tibia	11.0-13.0	11.0-11.5
Fore tarsus	4.4-5.0	3.9-4.1
Mid femur	9.5-10.5	9.5-10.0
Mid tibia	9.5-10.5	9.5-10.0
Mid tarsus	3.7-4.7	3.7-3.9
Hind femur	11.5-13.0	12.0-12.5
Hind tibia	12.5-14.5	13.5-14.0
Hind tarsus	4.7-5.2	5.1-5.3

Table 10. *Planispectrum bengalensis* (Redtenbacher), measurements of OXUM ♀, & Zompro ♂ to 0.1 mm.

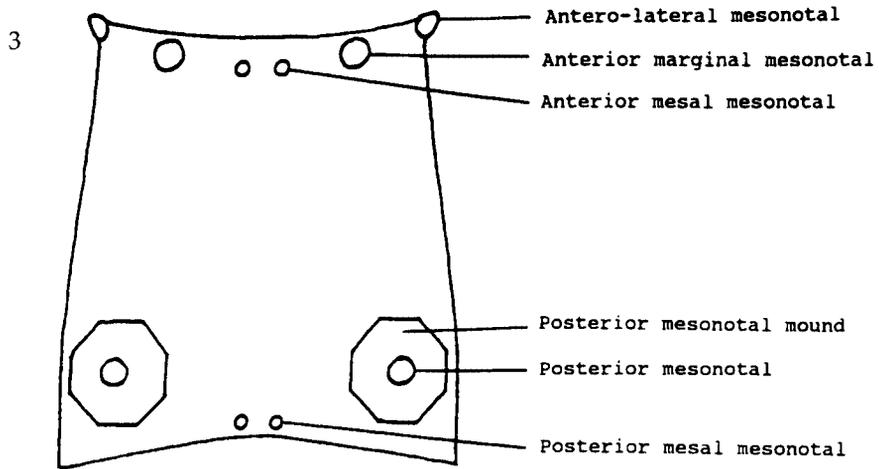
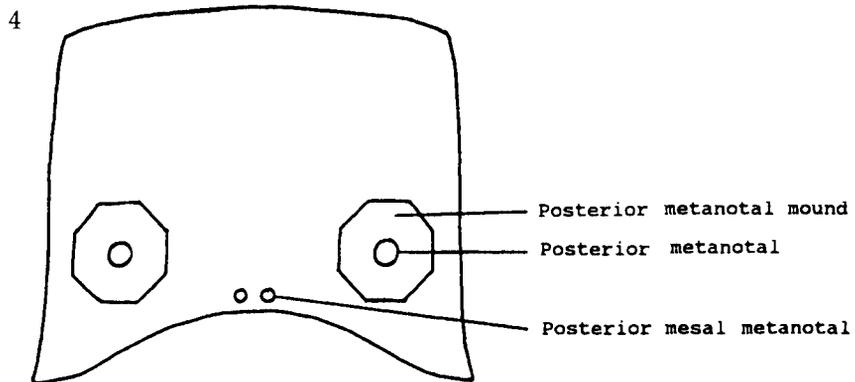
Lengths (mm)	Female	Male
Total	23.6	19.0
Antennae	5.5	4.3
Head	2.1	1.7
Pronotum	2.6	2.1
Mesonotum	4.5	3.8
Metanotum	2.9	2.0
Median Segment	0.3	1.2
Fore femora	4.5	3.3
Fore tibiae	3.7	3.0
Fore tarsi	1.7	1.3
Mid femora	3.9	3.3
Mid tibiae	3.7	2.8
Mid tarsi	1.6	1.4
Hind femora	5.0	4.5
Hind tibiae	4.3	3.5
Hind tarsi	1.6	1.5

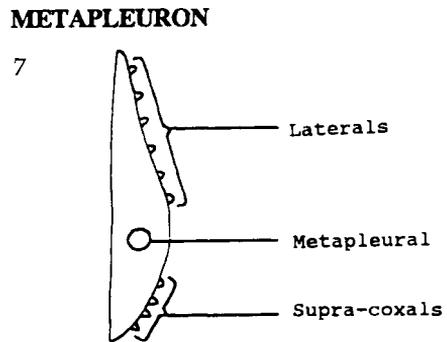
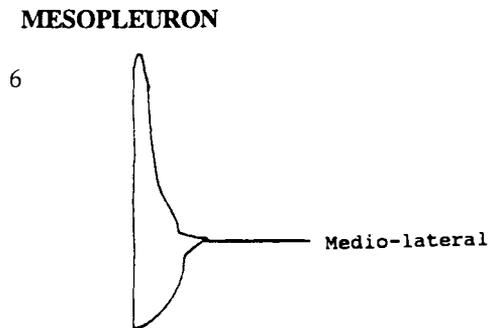
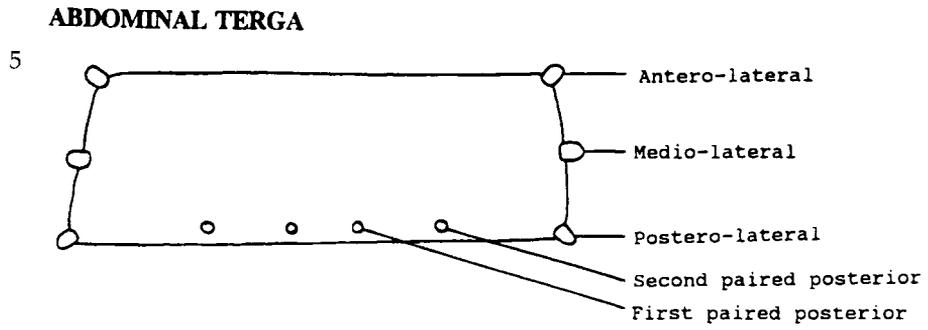
Table 11. *Spinodares jenningsi* **gen. nov., spec. nov.**, measurements taken from holotype; adult paratypes are all the same size.

Length (mm)	female holotype
Total	42.5
Antennae	17.5
Head	3.5
Pronotum	3
Mesonotum	8.5
Metanotum & Median segment	6.5
Fore femur	8.5
Fore tibia	8
Fore tarsus	3
Mid femur	7.5
Mid tibia	7
Mid tarsus	3
Hind femur	9.5
Hind tibia	9
Hind tarsus	3.5

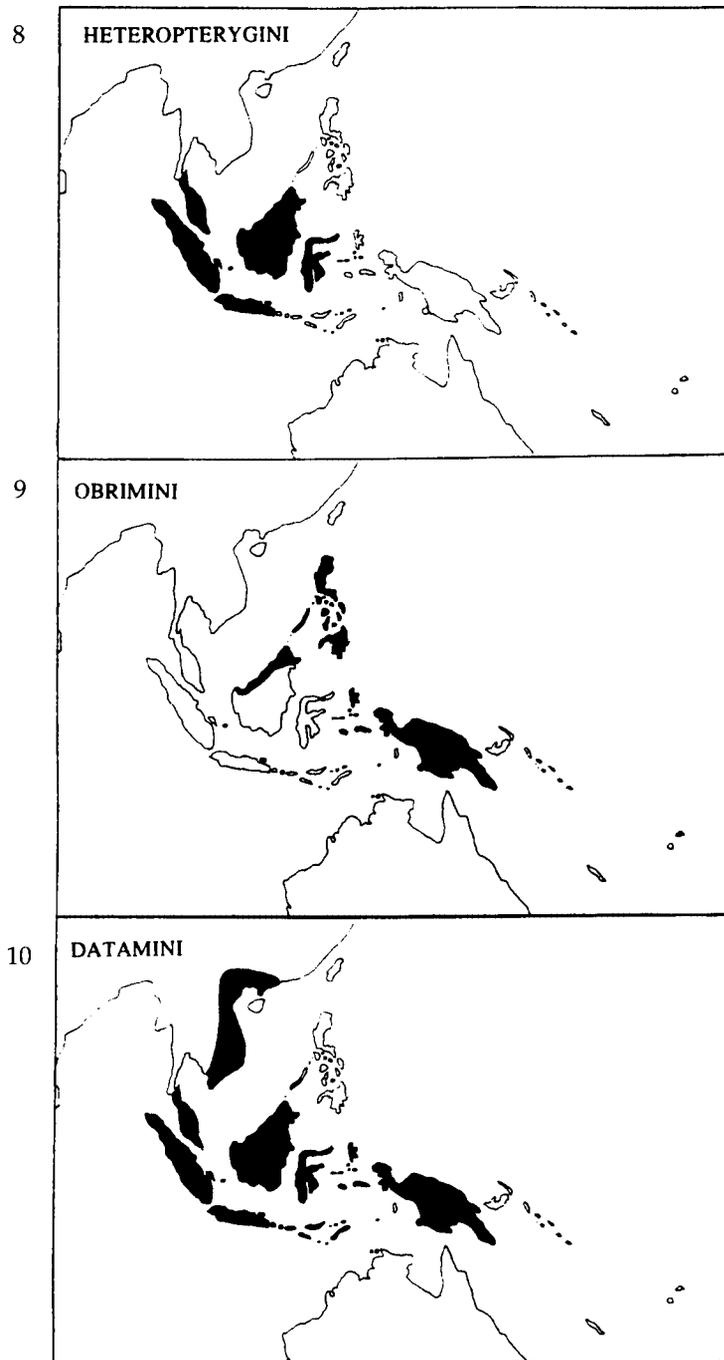


Figs. 1-2. Acanthotaxy of the head and pronotum of *Datamini*.

MESONOTUM**METANOTUM**Figs. 3-4. Acanthotaxy of the mesonotum and metanotum of *Datamini*.



Figs. 5-7. Acanthotaxy of the abdomen, mesopleuron and metapleuron of *Datamini*.



Figs. 8-10. Distribution of Heteropteryginae, Obrimini and Datamini.

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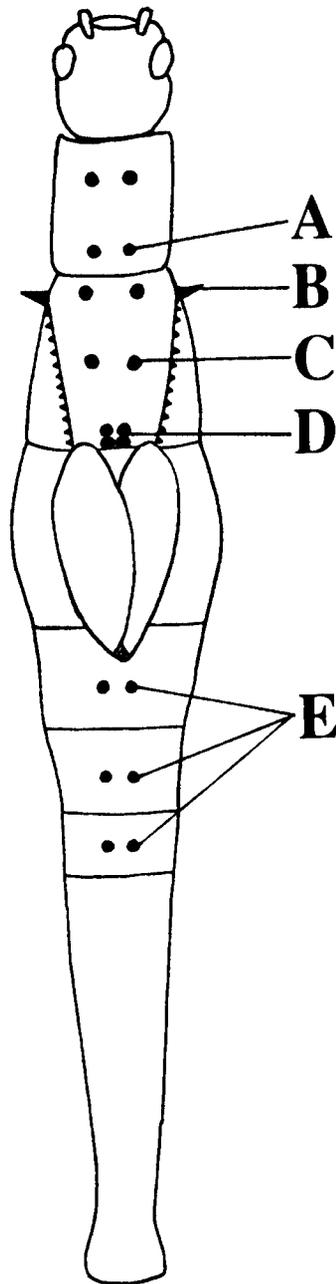
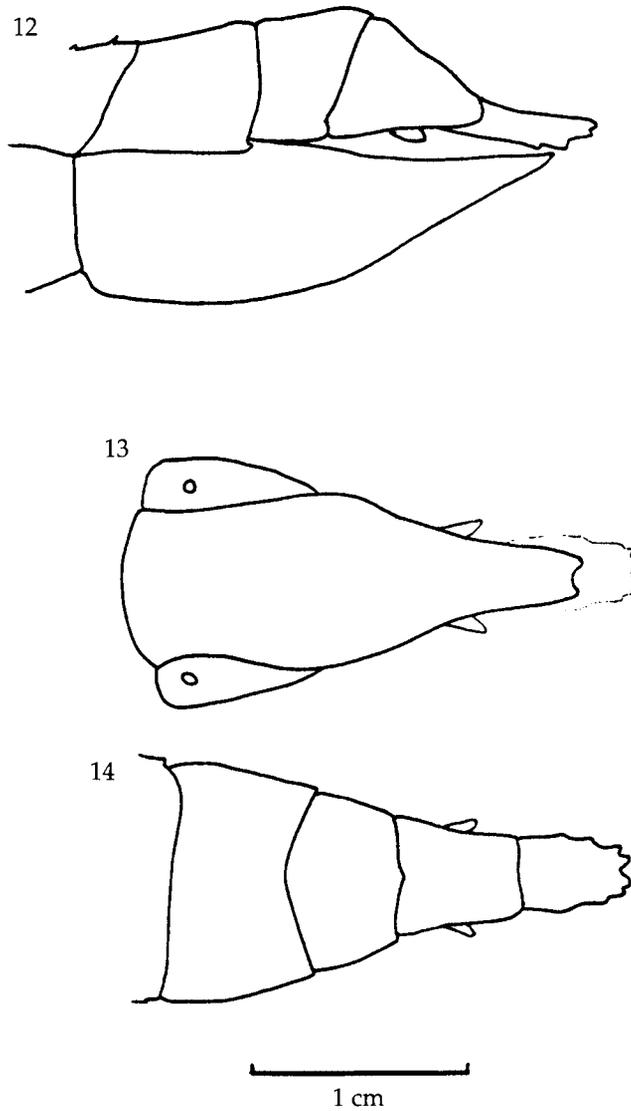
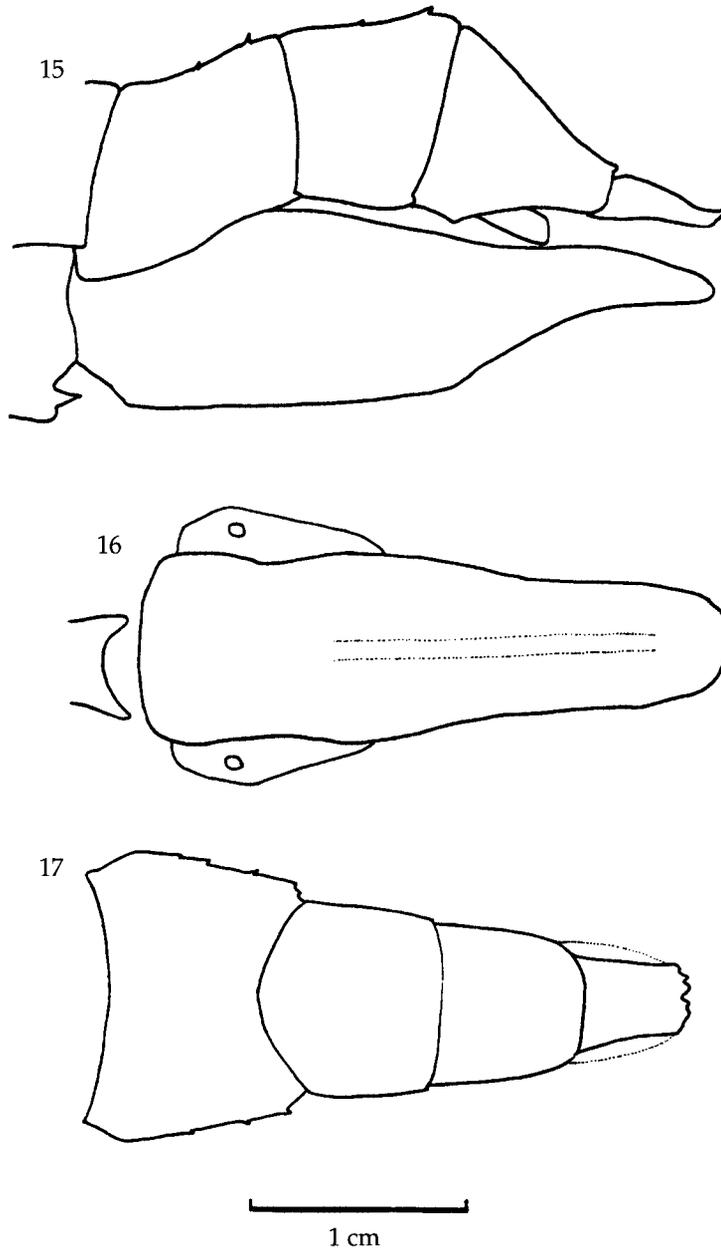


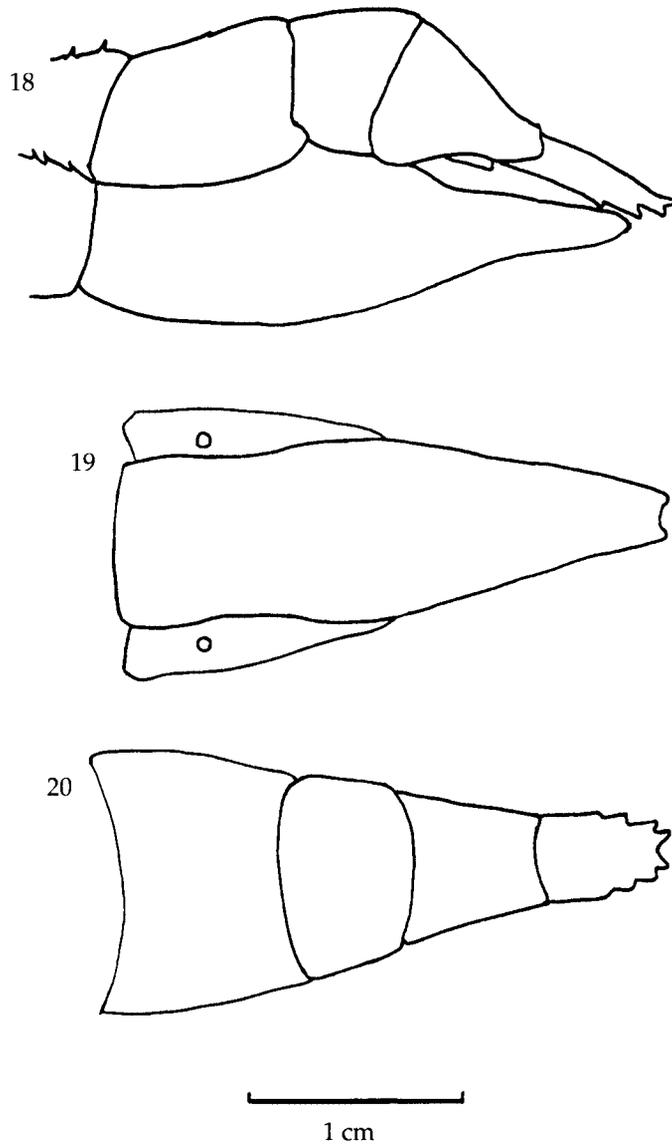
Fig. 11. Spines used to distinguish the species of *Haaniella*.



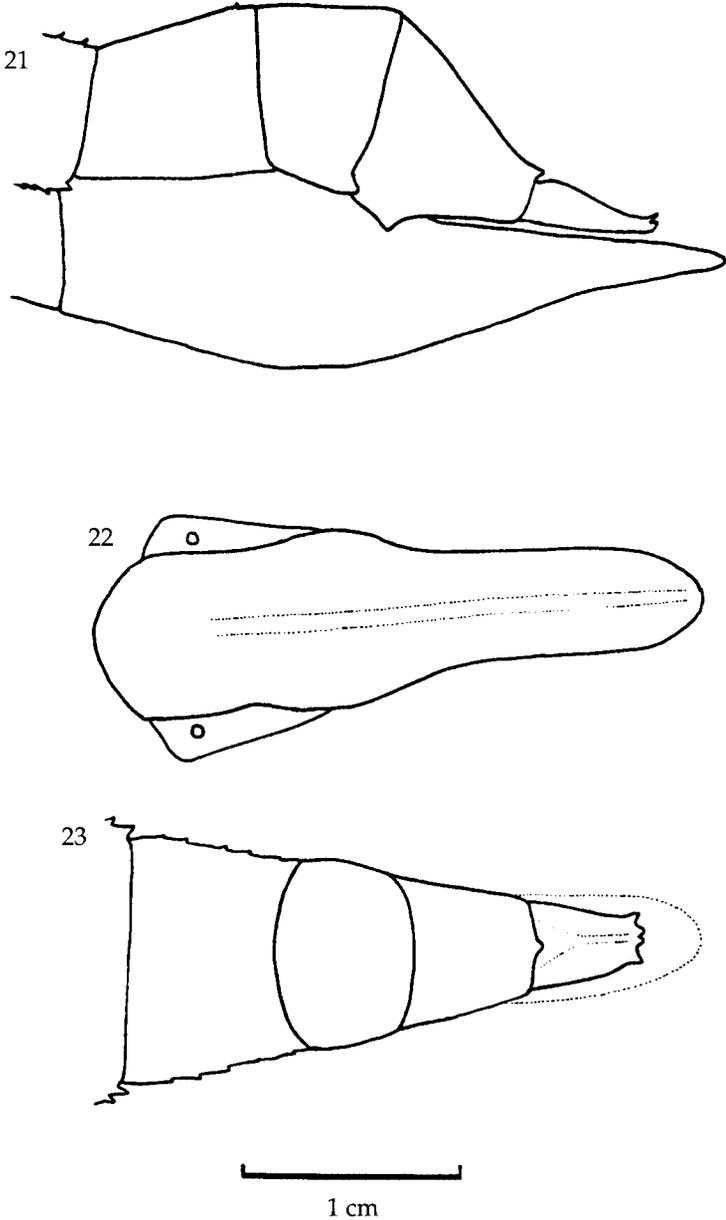
Figs. 12-14. *Haaniella dehaanii* (Westwood), apex of female abdomen: 12, lateral; 13, ventral; 14, dorsal.



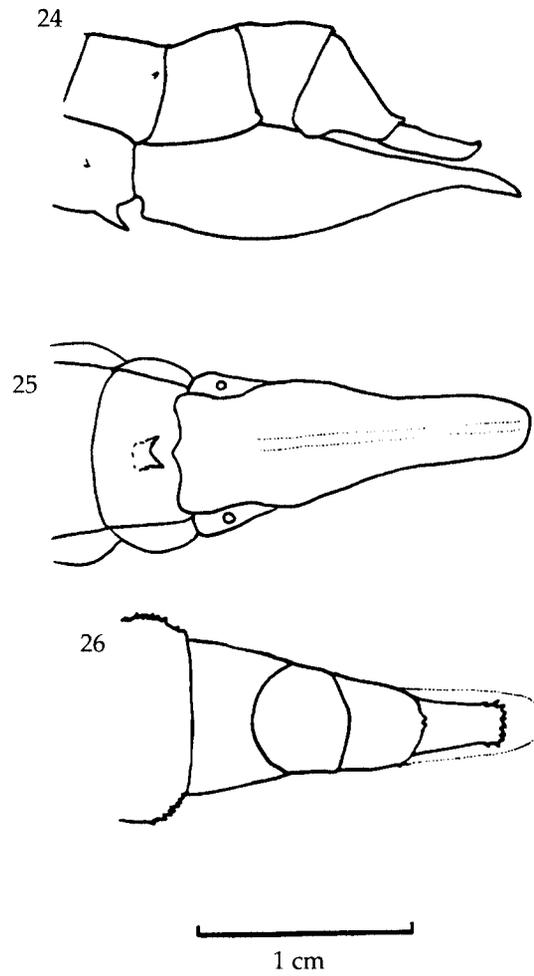
Figs. 15-17. *Haaniella echinata* (Redtenbacher), apex of female abdomen: 15, lateral; 16, ventral; 17, dorsal.



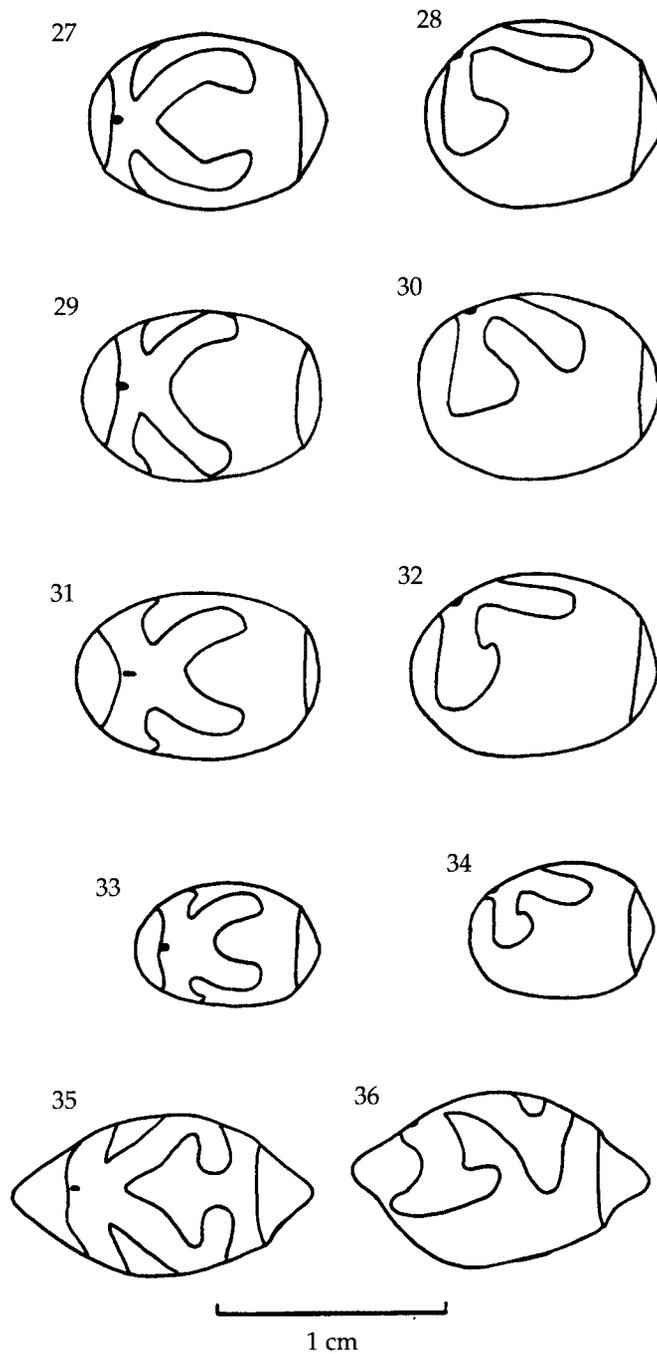
Figs. 18-20. *Haaniella grayii* (Westwood), apex of female abdomen: 18, lateral; 19, ventral; 20, dorsal.



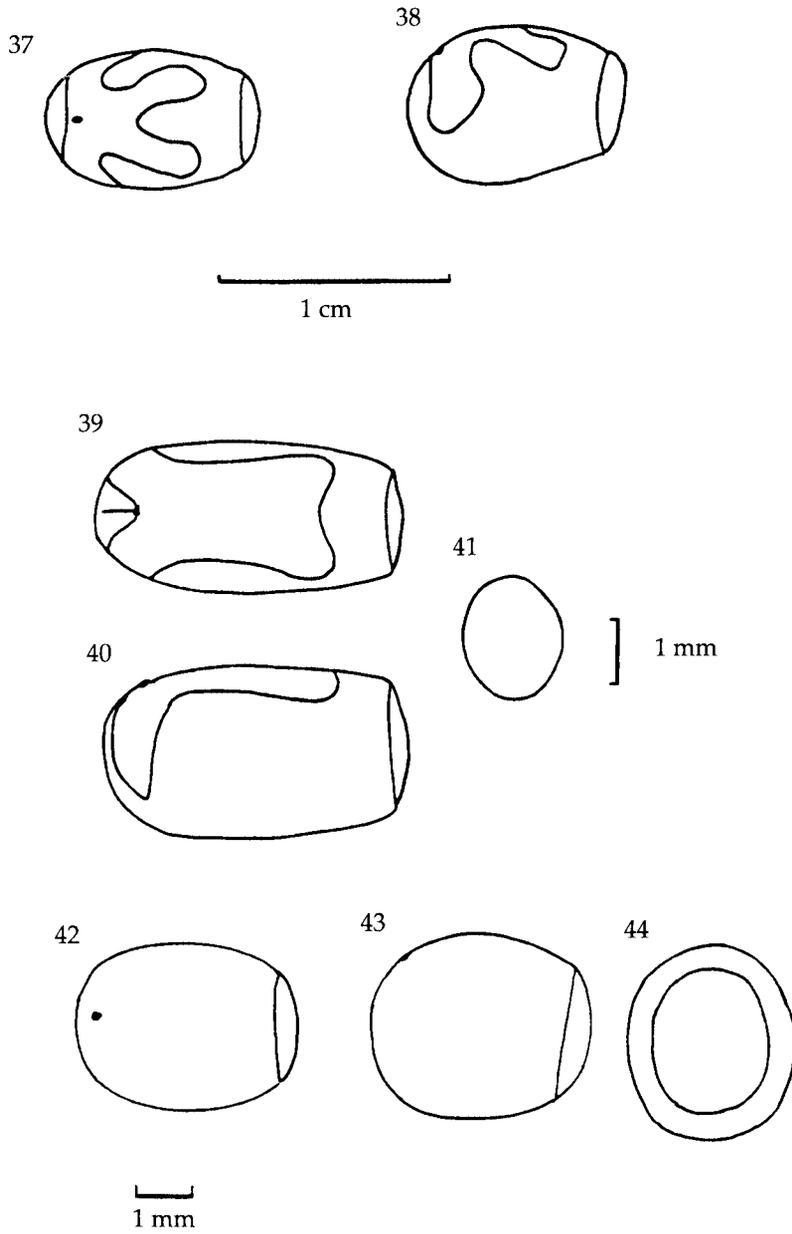
Figs. 21-23. *Haaniella saussurei* Kirby, apex of female abdomen: 21, lateral; 22, ventral; 23, dorsal.



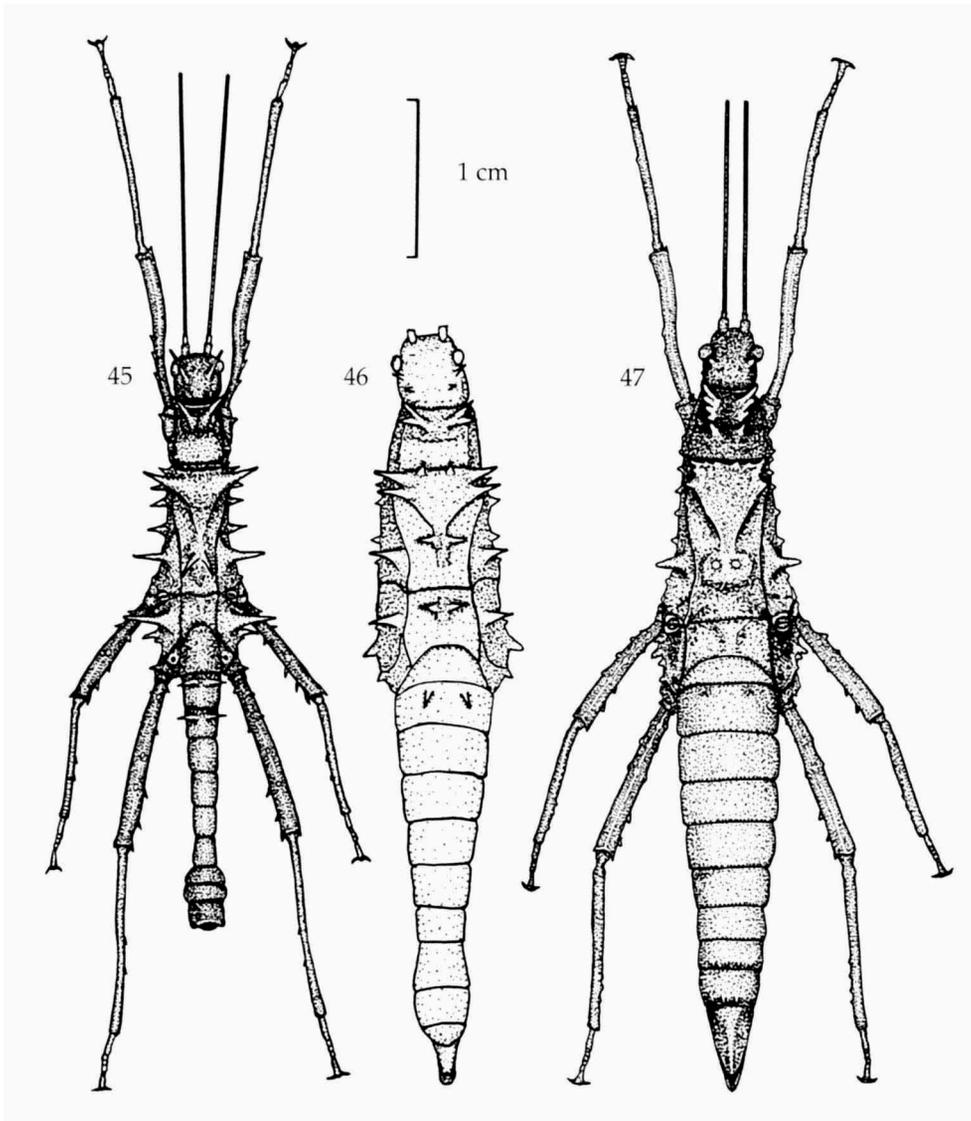
Figs. 24-26. *Haaniella scabra* (Redtenbacher), apex of female abdomen: 24, lateral; 25, ventral; 26, dorsal.



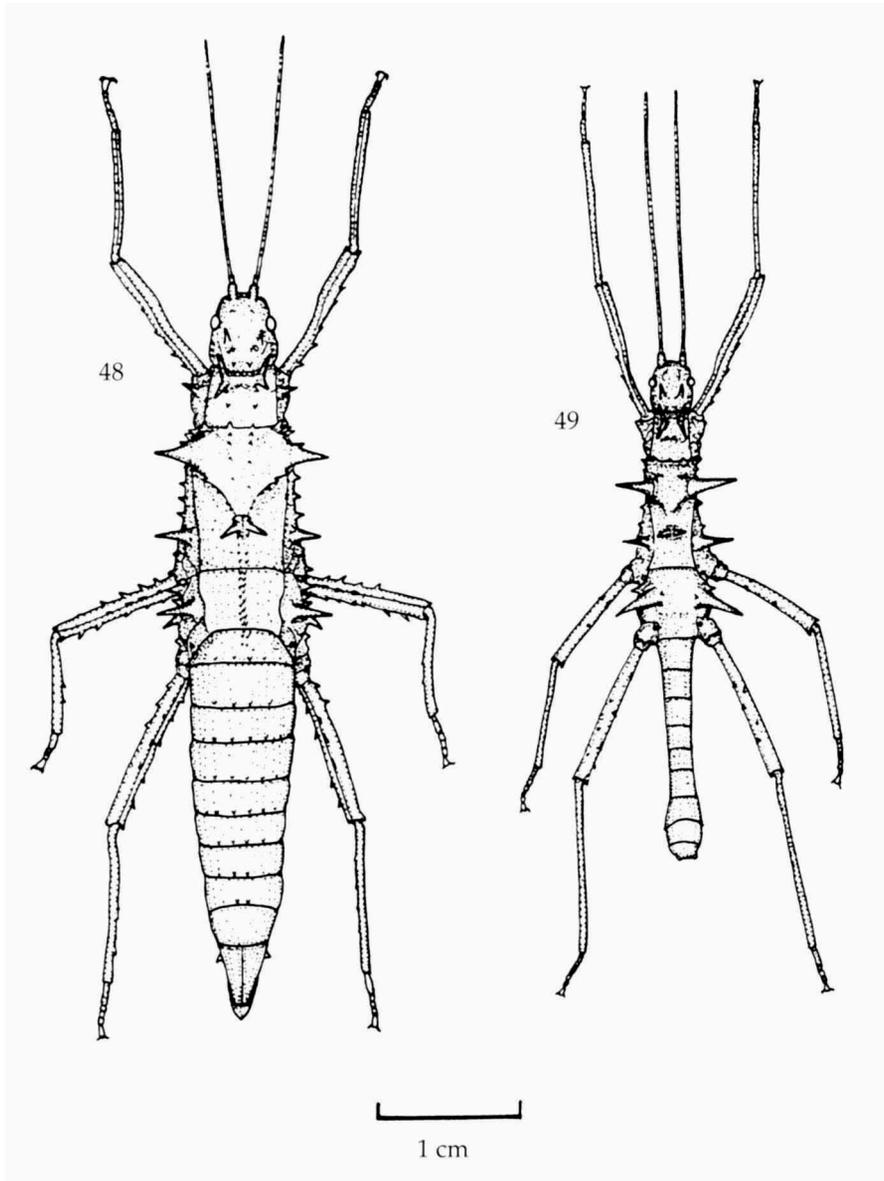
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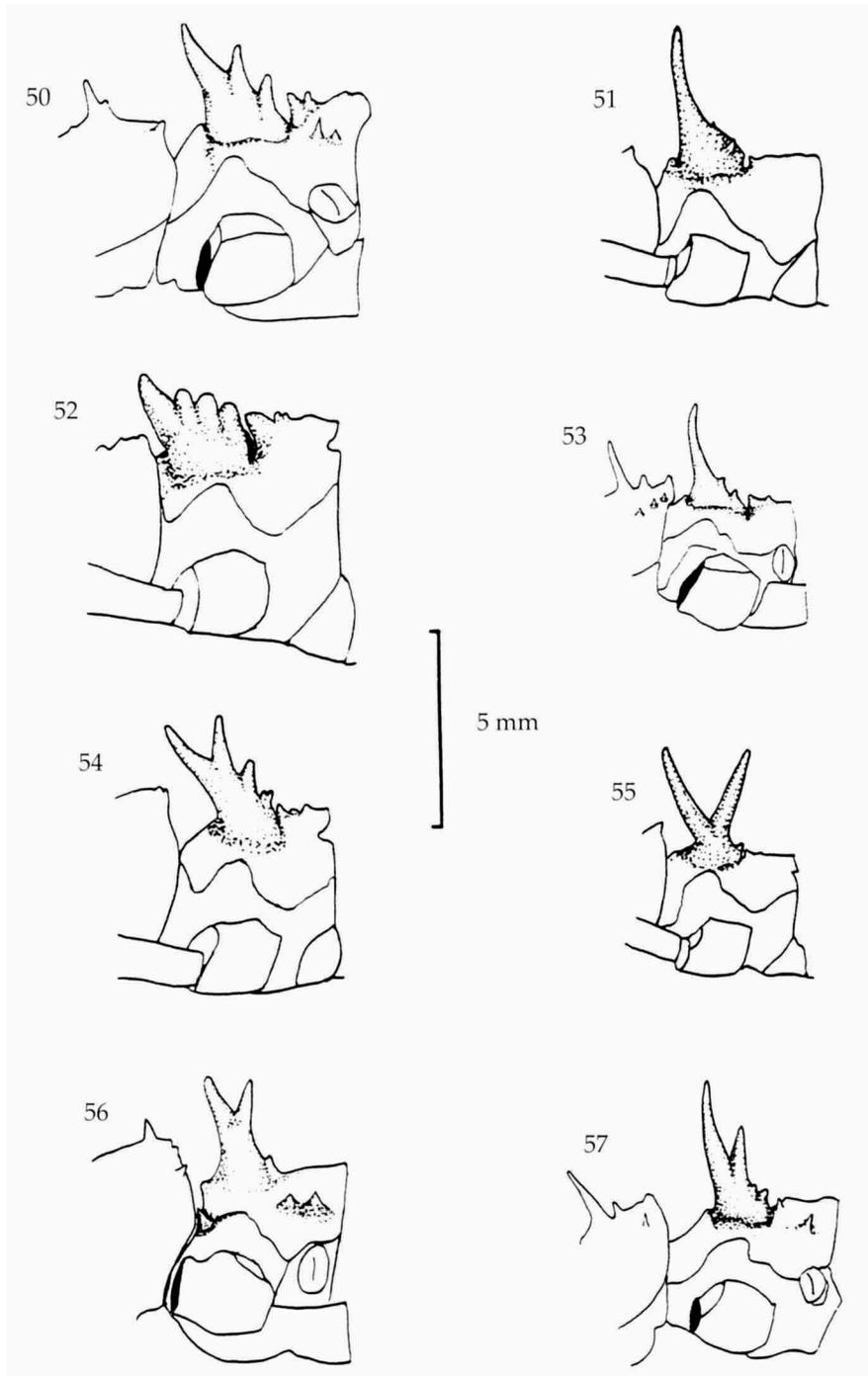
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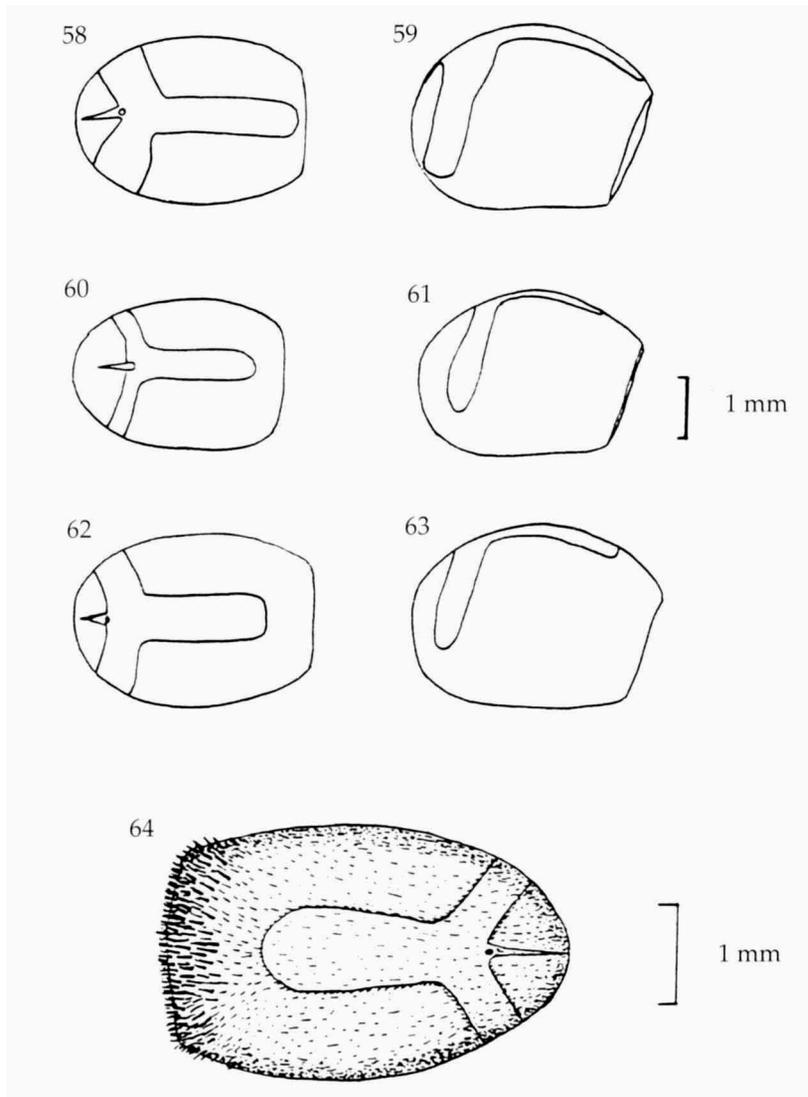
Figs. 45-47. *Hoptoclonia*: 45, *H. abercrombiei* Bragg, male; 46, *H. apiensis* Bragg, female holotype (legs omitted); 47, *H. cuspidata* female.



Figs. 48-49. *Hoploclonia gecko* (Westwood): 48, female; 49, male.



Figs. 50-57. *Hoploclonia*, pronotal spines: 50, *H. abercrombiei* Bragg, female; 51, *H. abercrombiei* male; 52, *H. cuspidata* female; 53, *H. cuspidata* Redtenbacher, male; 54, *H. gecko* (Westwood), female; 55, *H. gecko* male; 56, *H. apiensis* Bragg, female holotype; 57, *H. sp.1*, male (PEB-2148).



Figs. 58-64. *Hoploclonia* eggs: 58-59, *H. abercrombiei* Bragg; 60-61, *H. cuspidata* Redtenbacher; 62-63, *H. gecko* (Westwood); 64, *H. gecko*, dorsal view showing surface details.

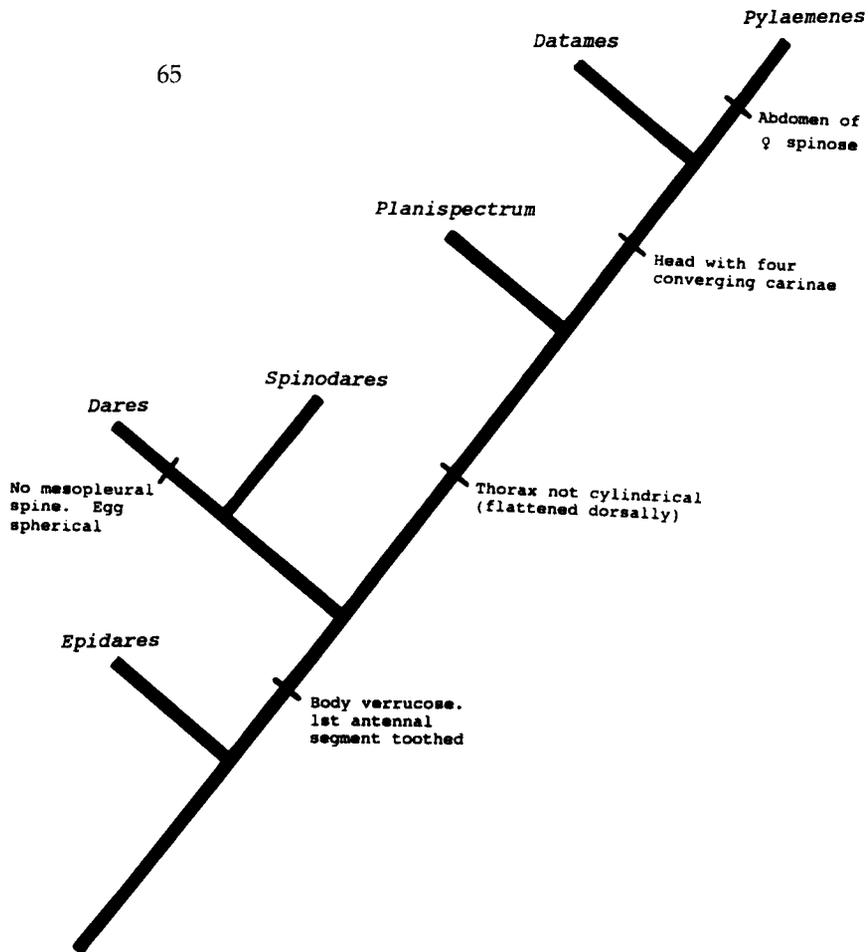
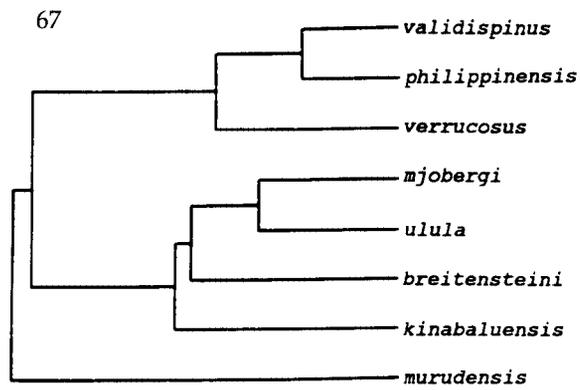
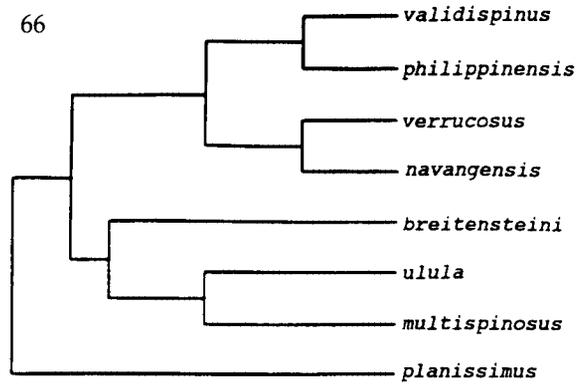
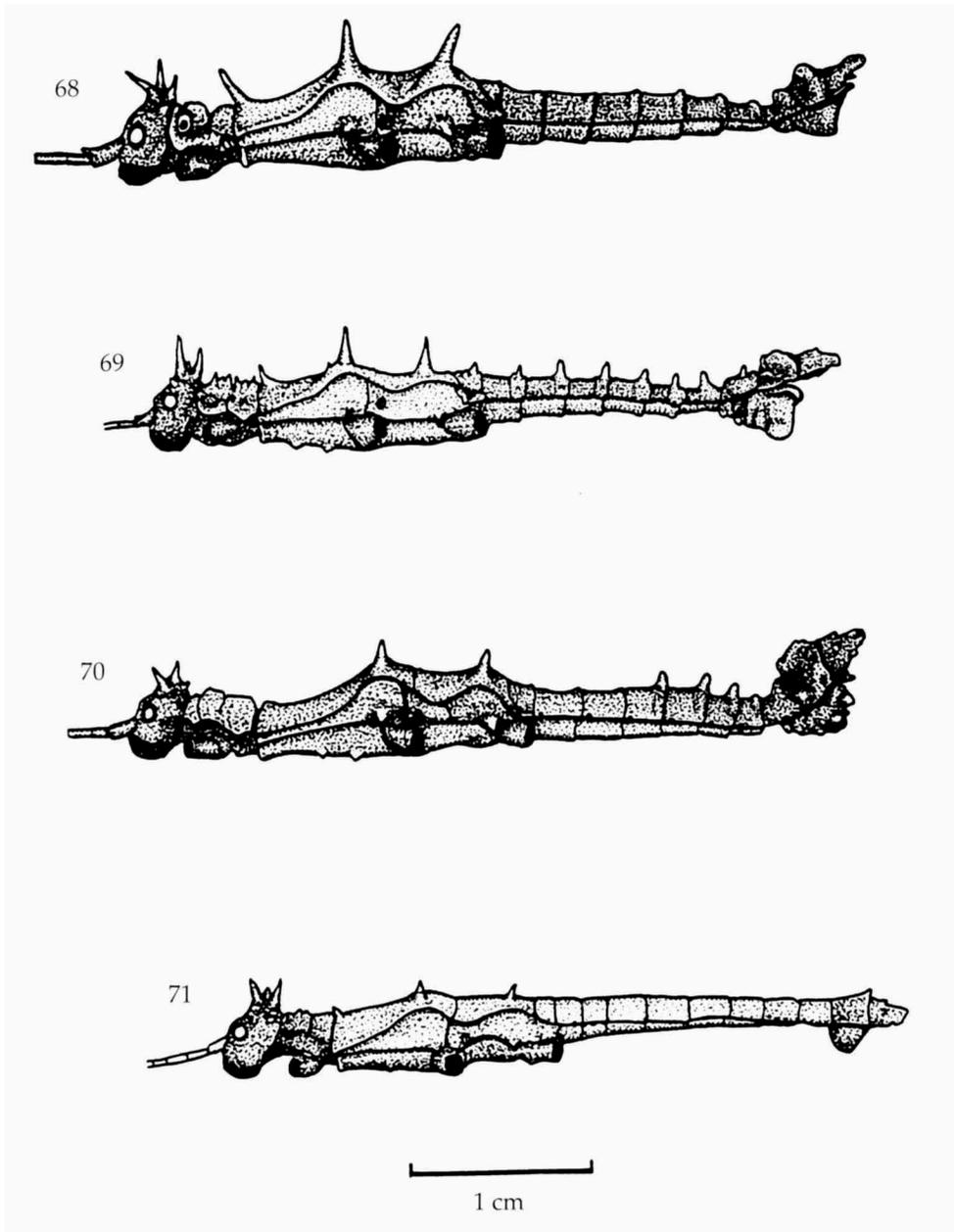


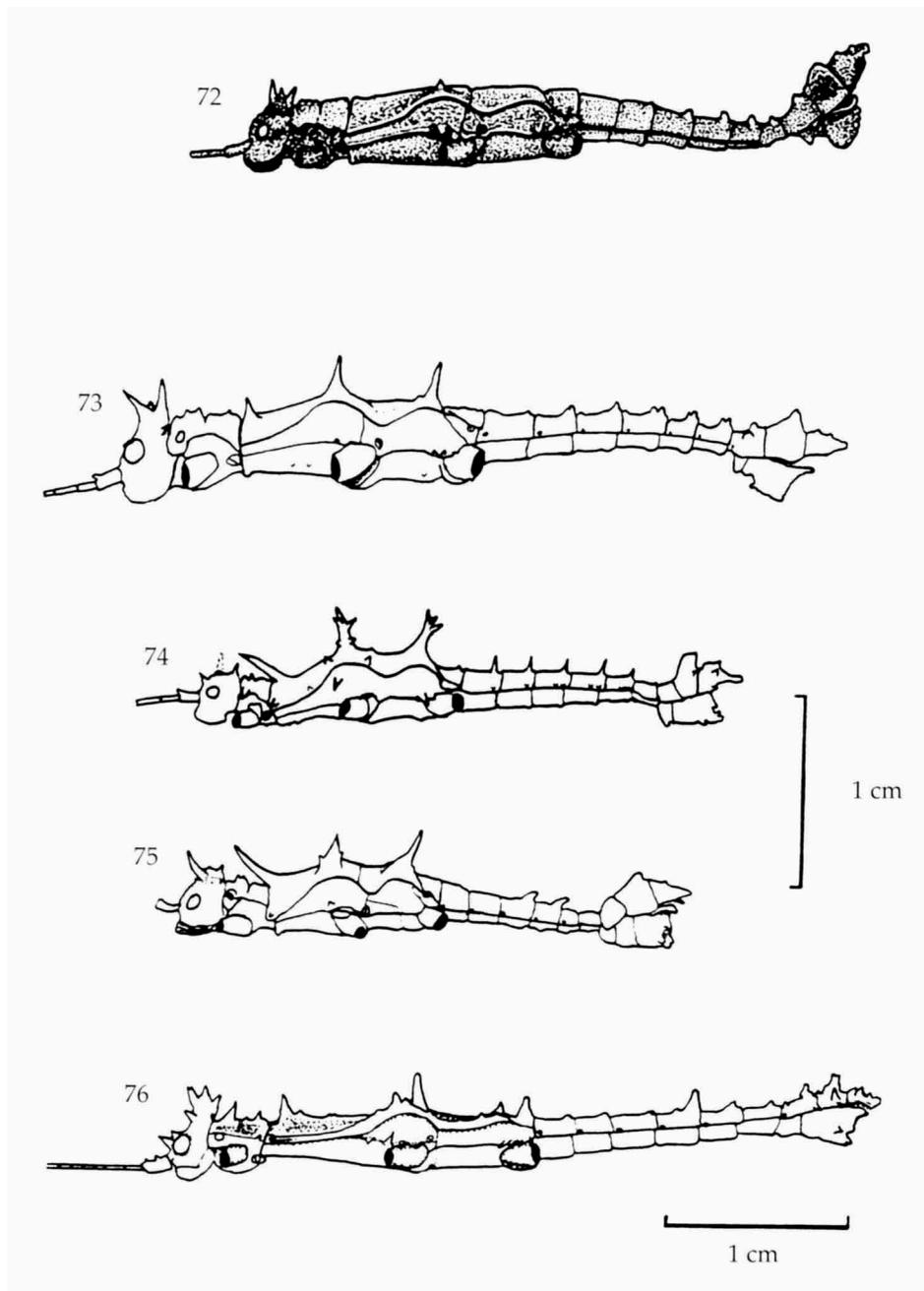
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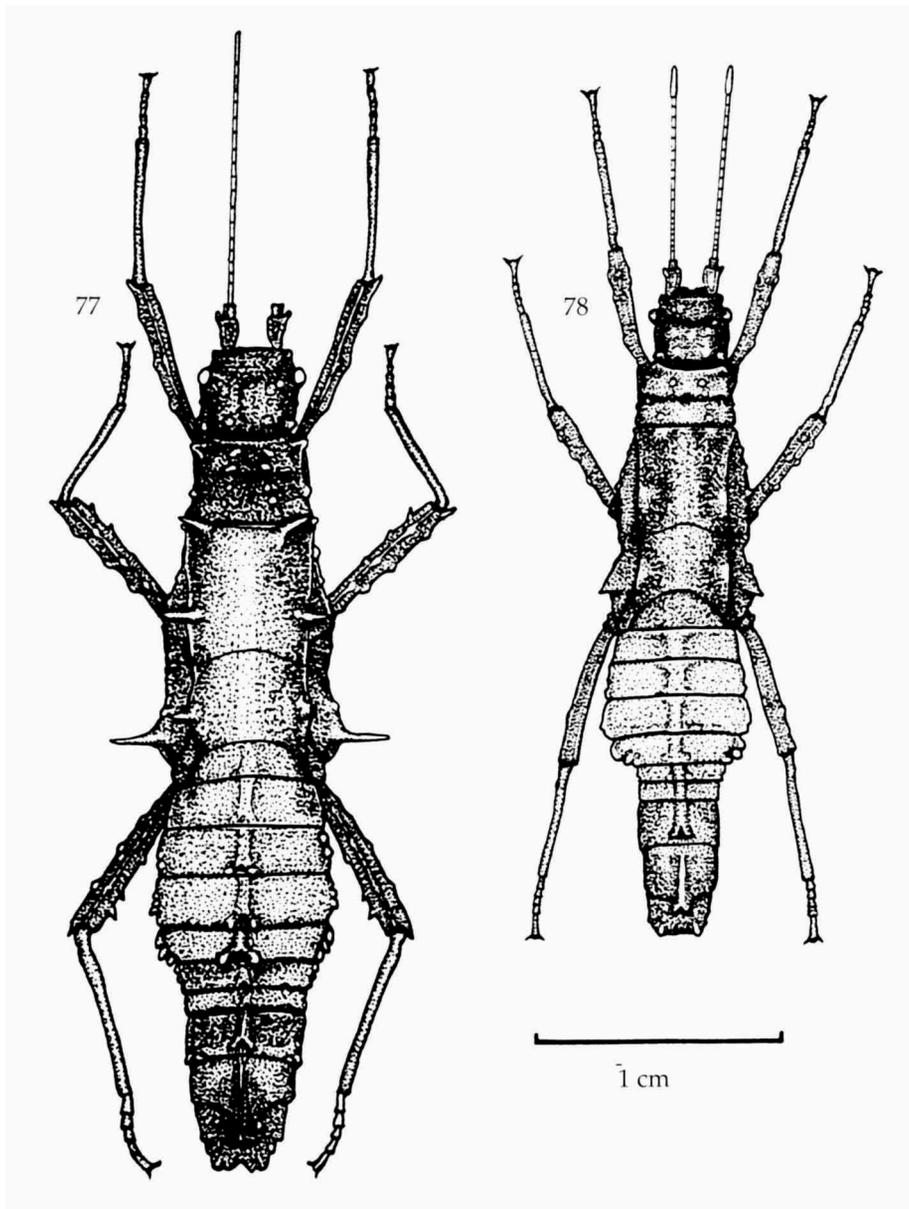
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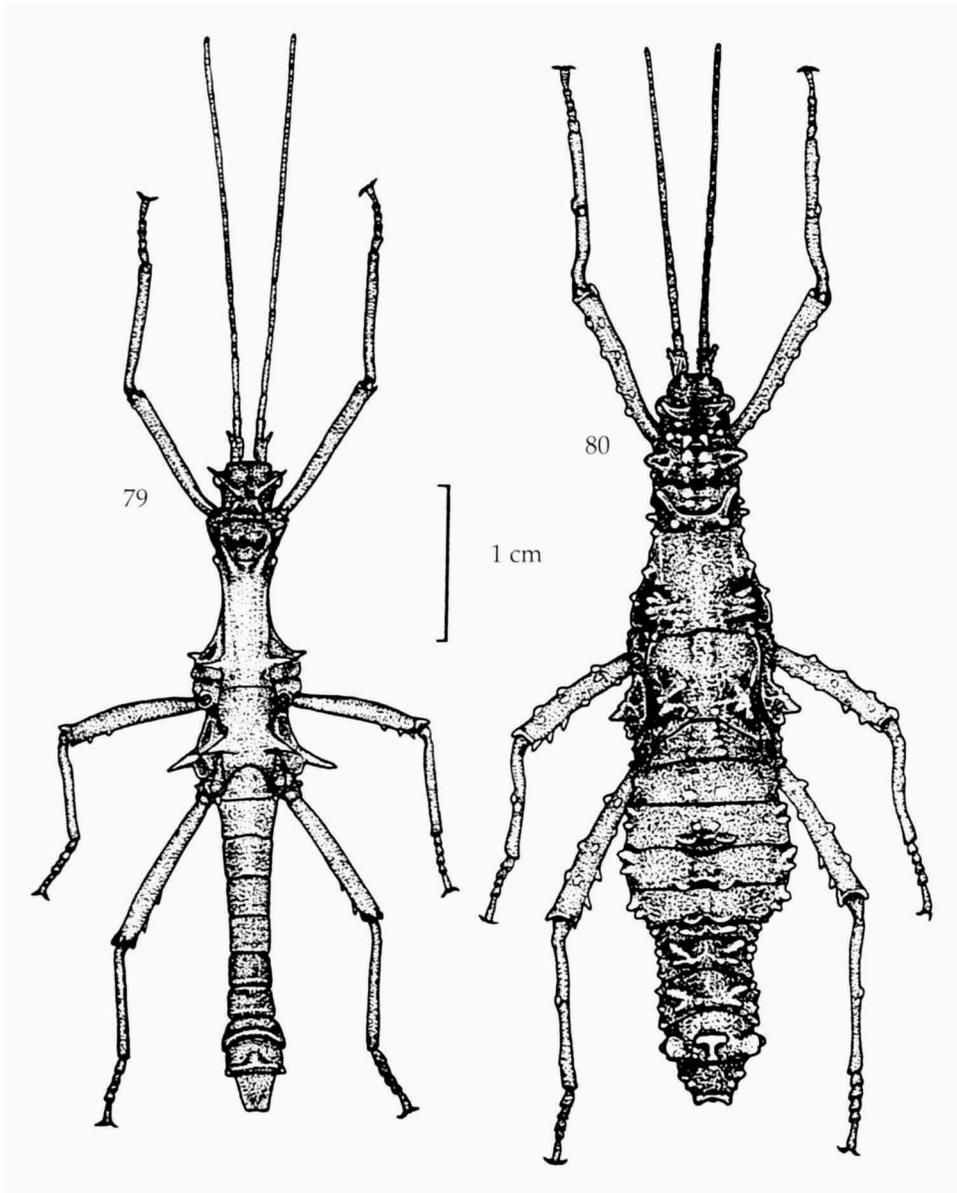
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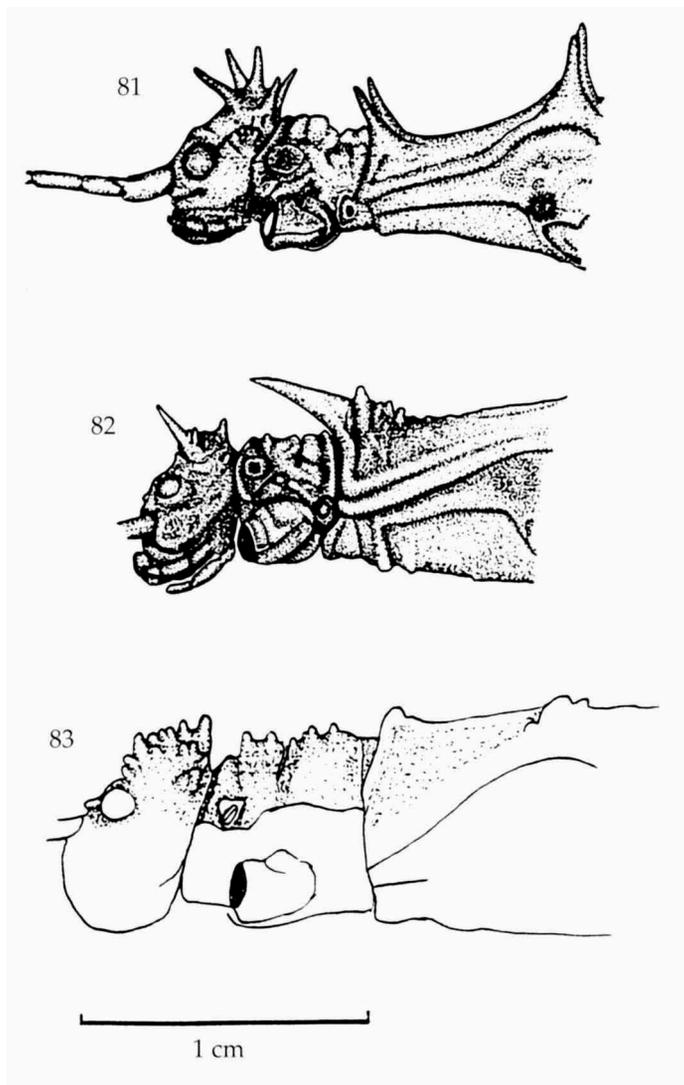
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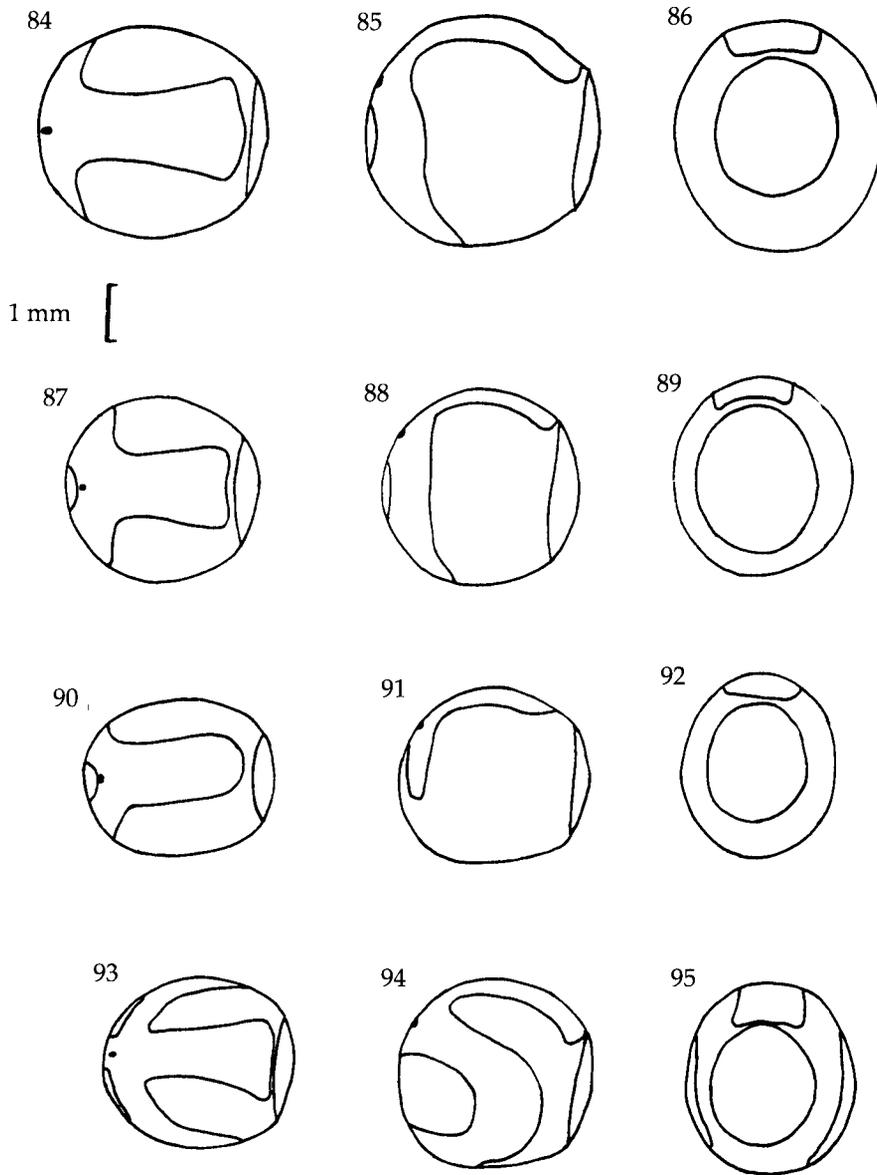
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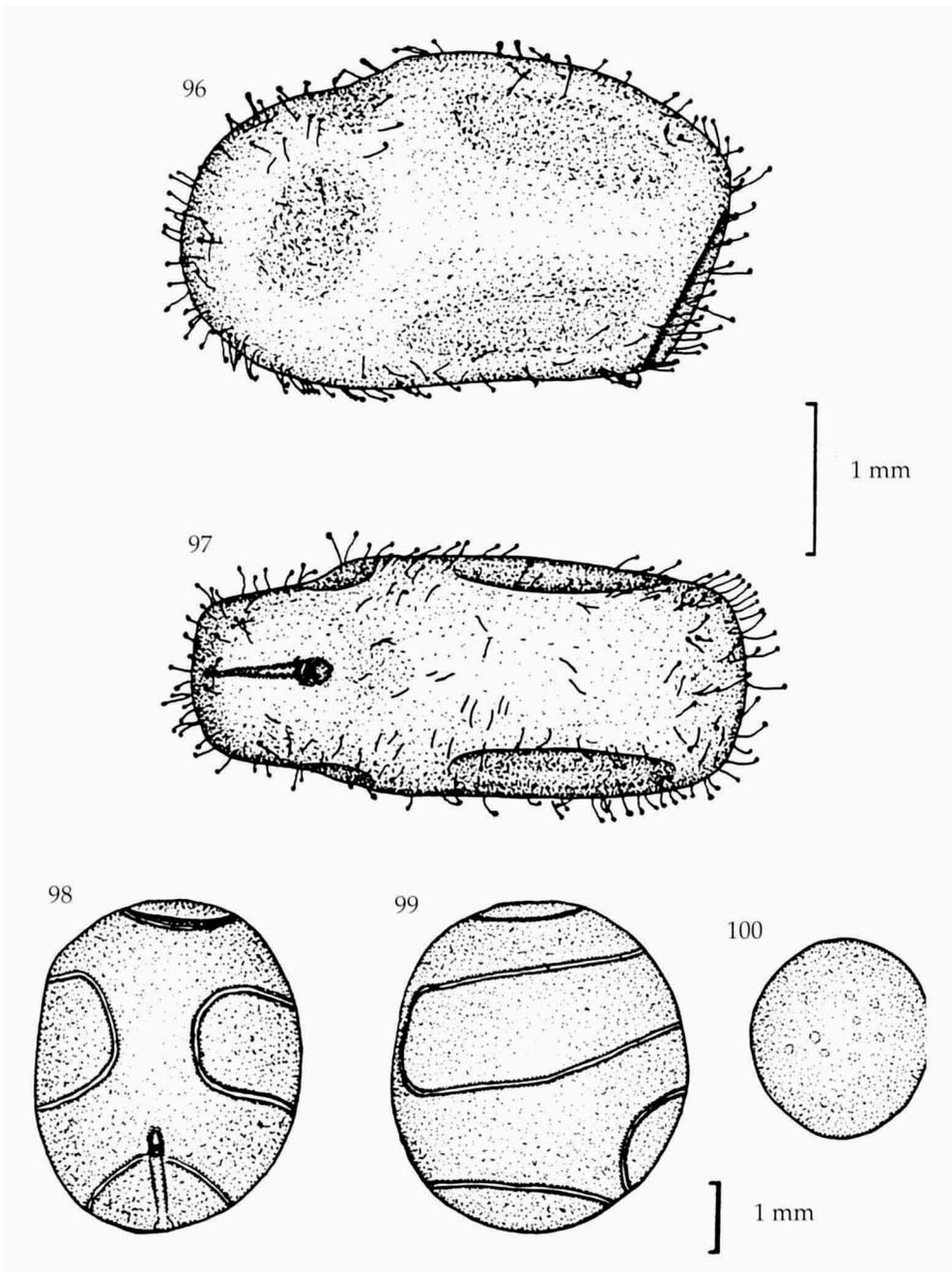
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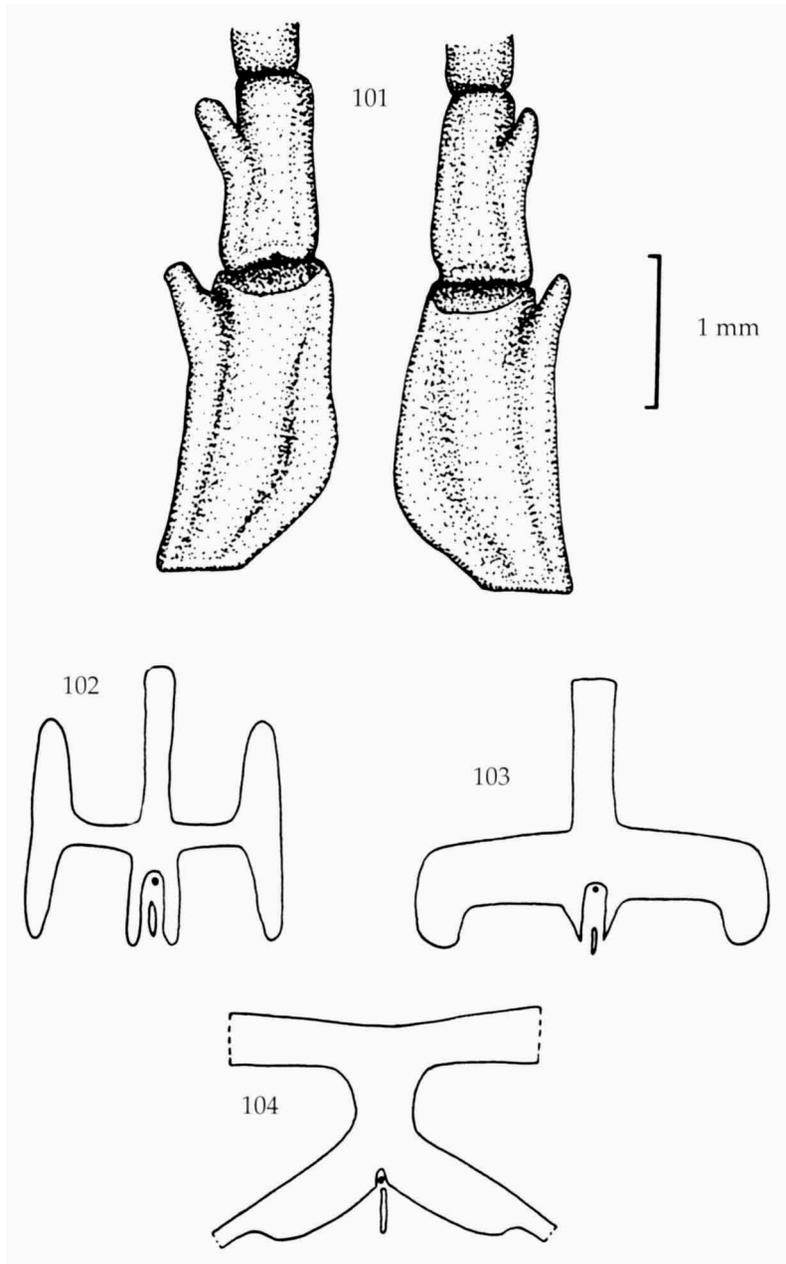
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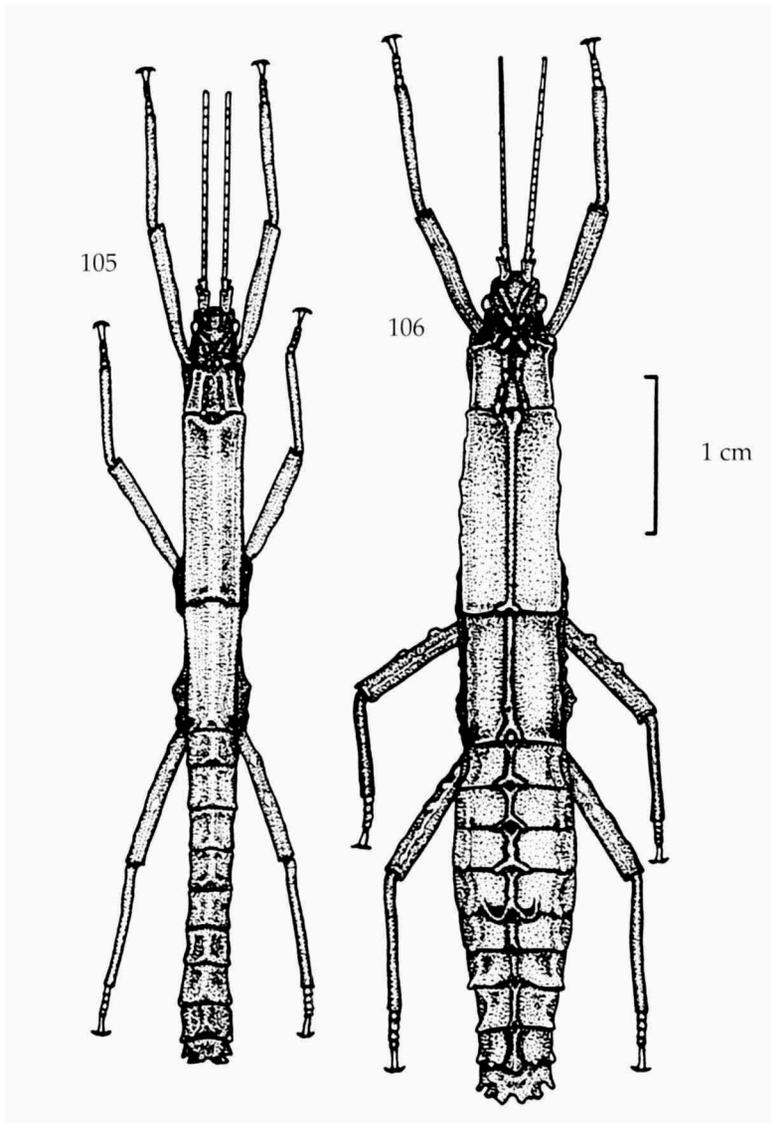
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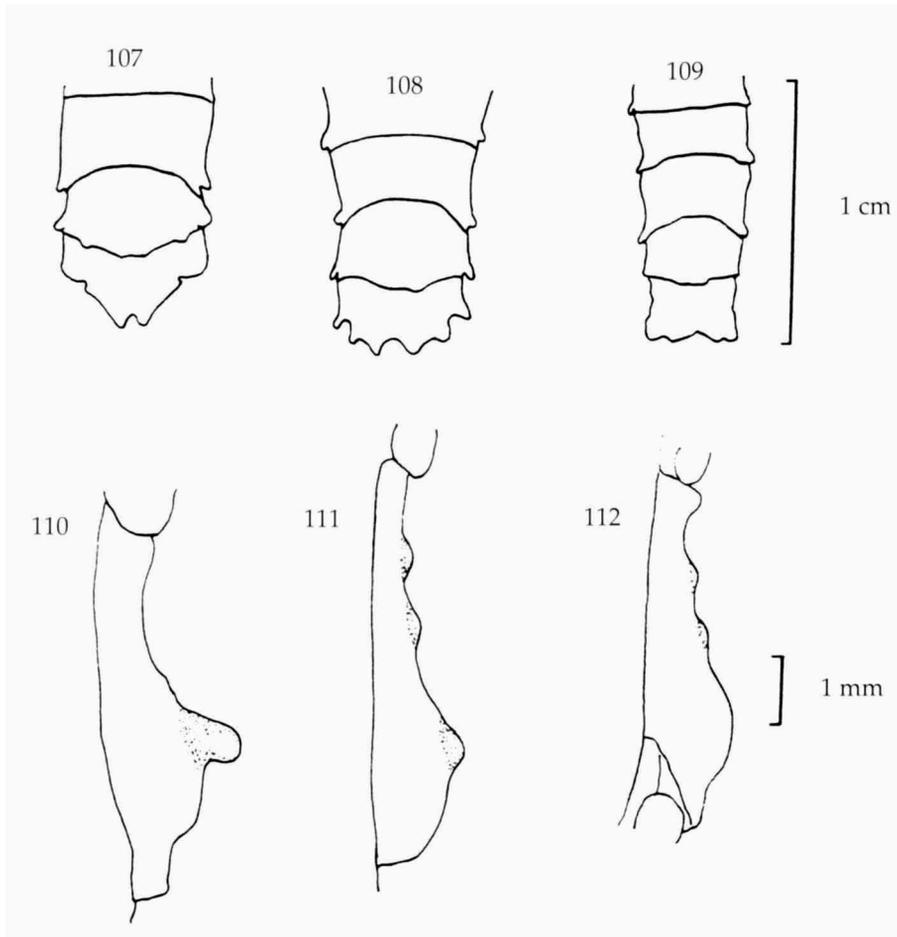
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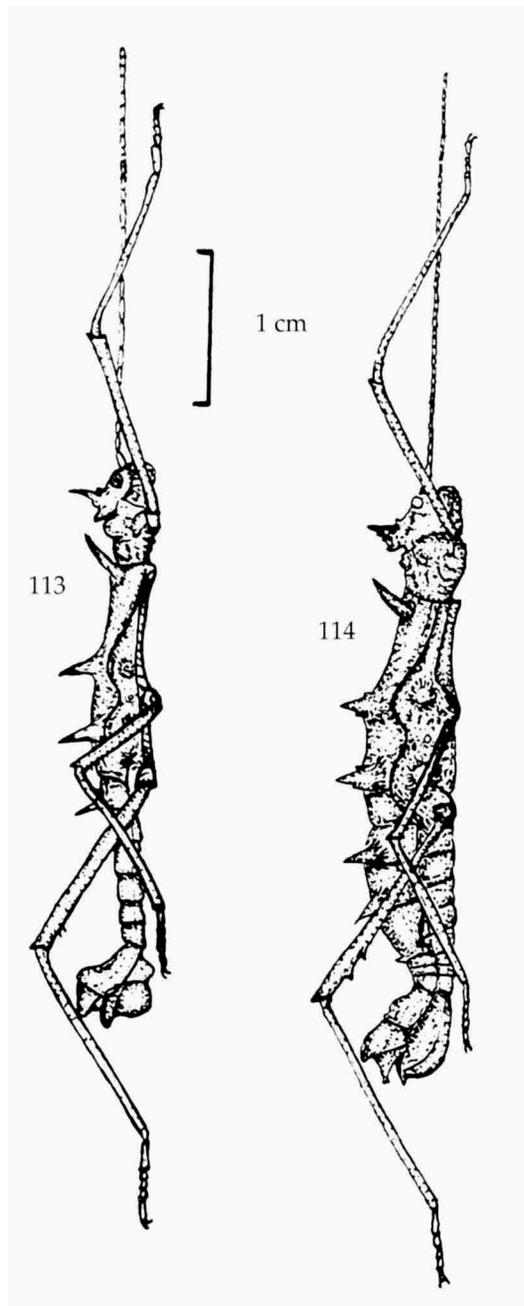
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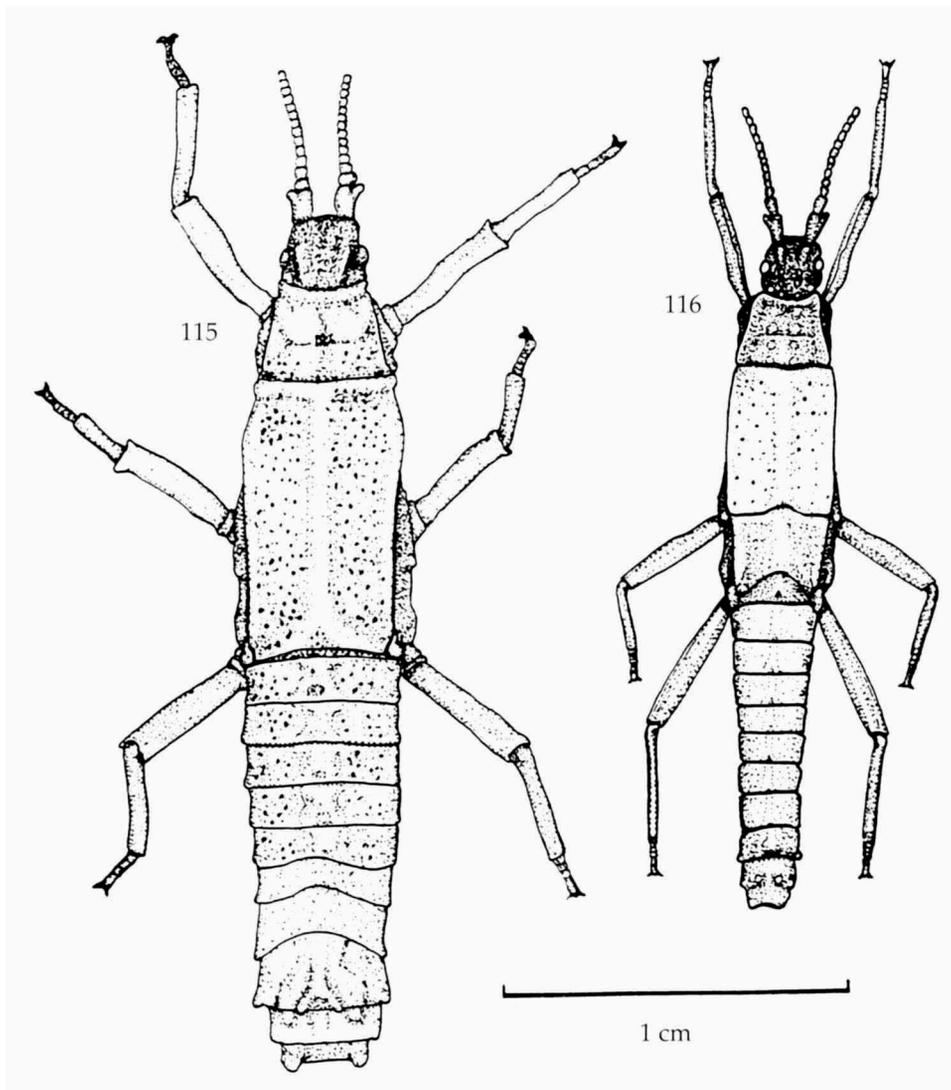
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Figs. 115-116. *Planispectrum bengalensis* (Redtenbacher): 115, female; 116, male.

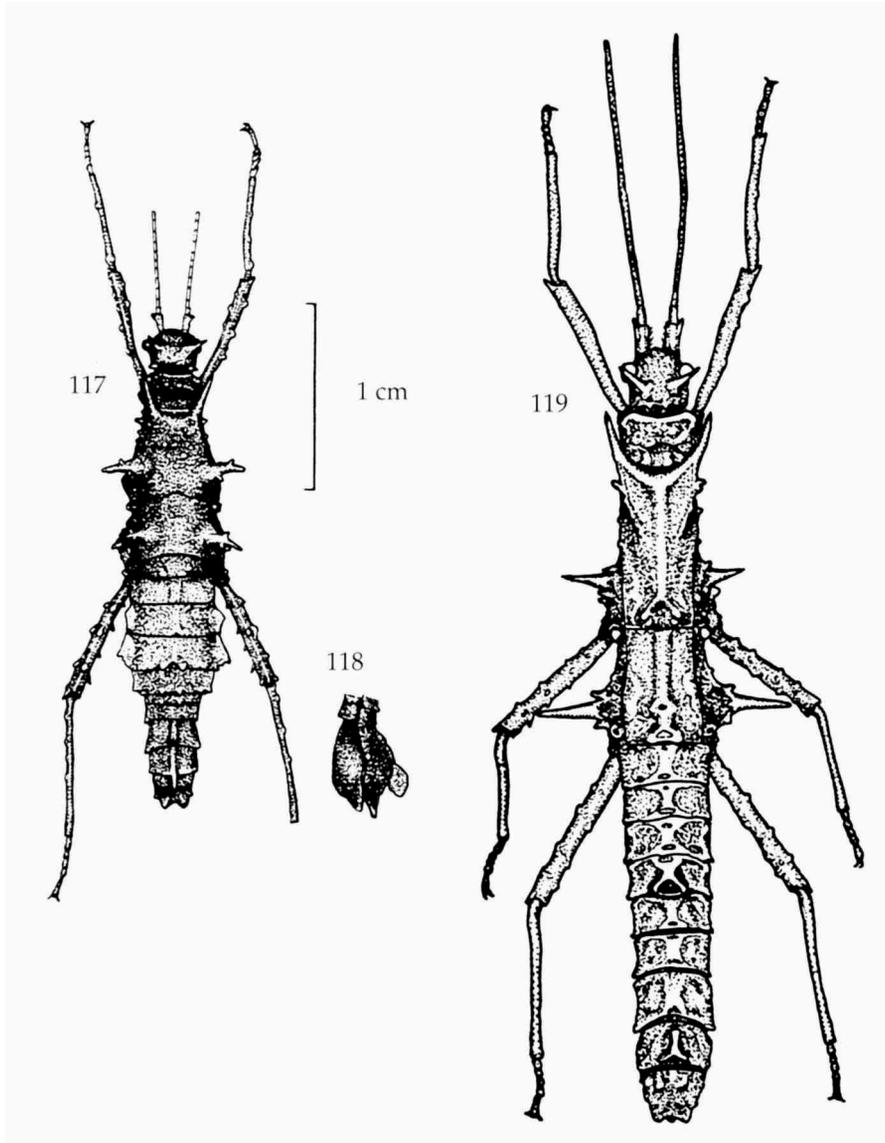
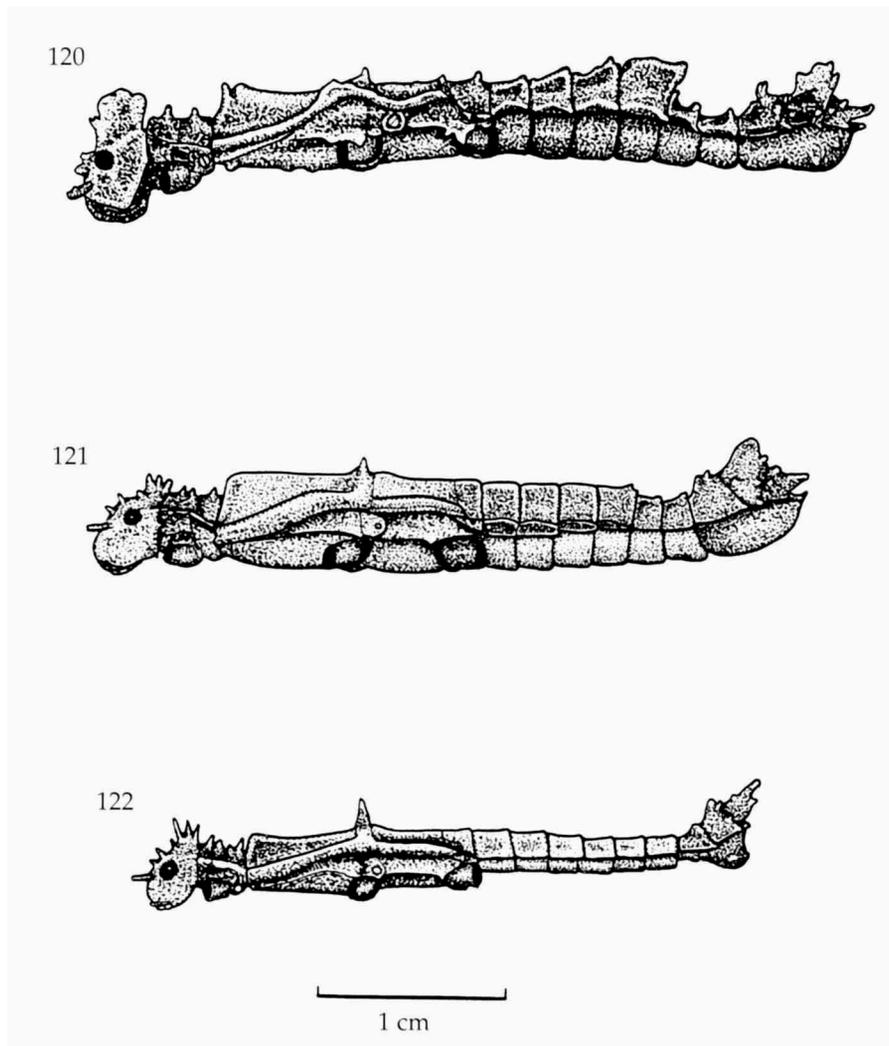


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Figs. 120-122: 120. *Datames otys* (Westwood), female, lateral view (RMNH specimen); 121. *Datames muluensis* spec. nov., female, lateral view; 122. *Datames muluensis* spec. nov., male, lateral view.

Figs. 123-149. Distribution maps: dots indicate specific localities, open circles show vague localities.

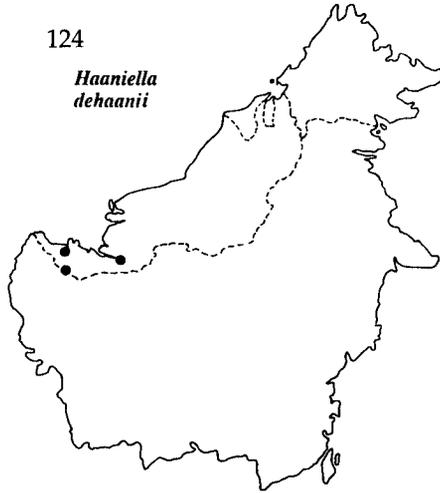
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Heteropteryx dilatata



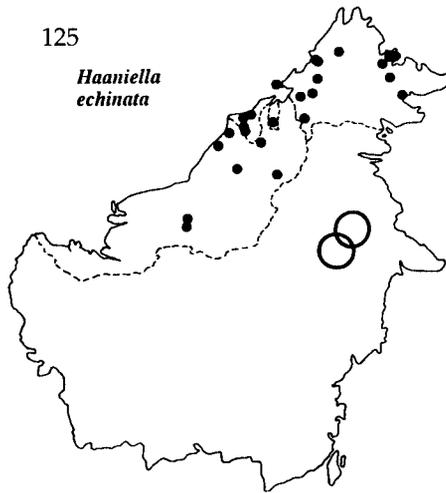
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Haaniella dehaanii



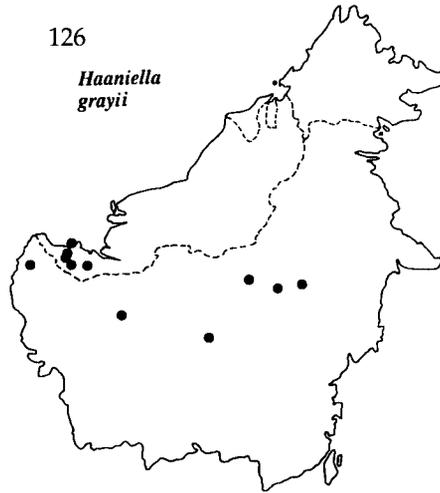
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Haaniella echinata



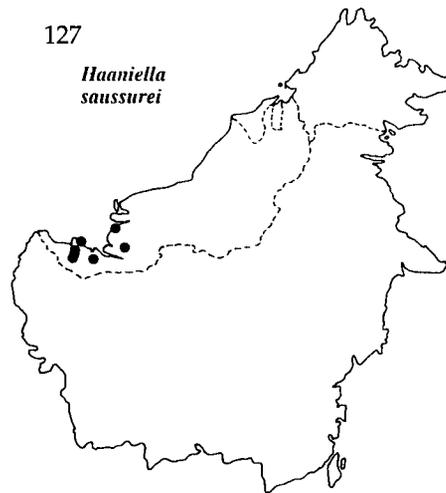
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Haaniella grayii



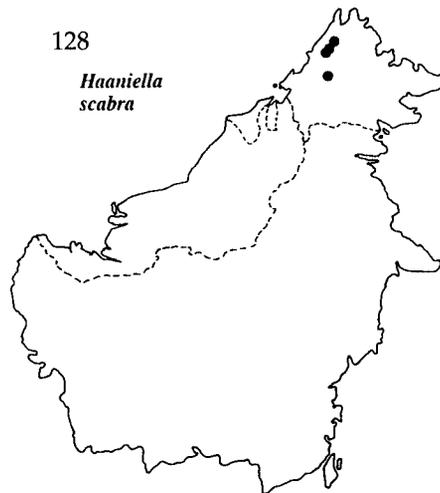
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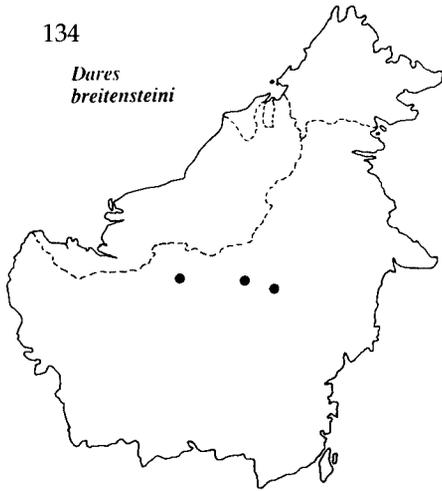
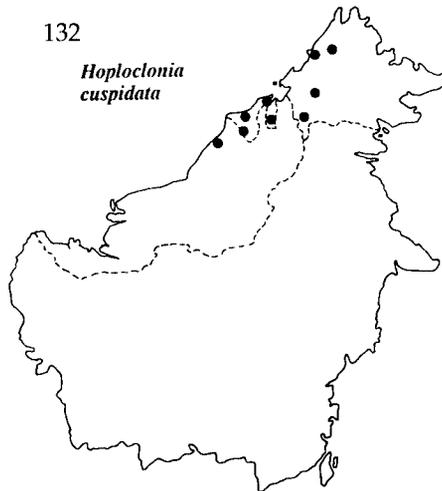
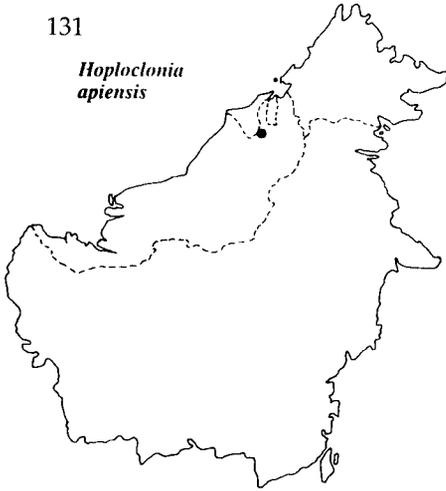
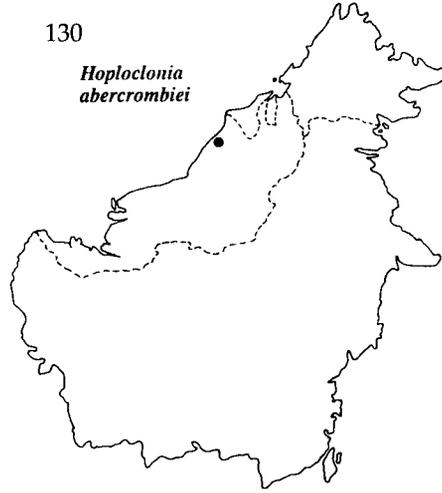
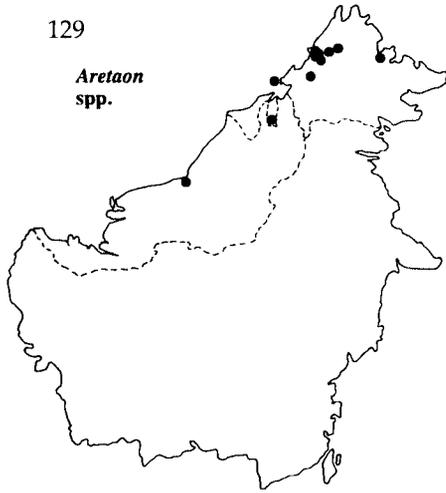
Haaniella saussurei



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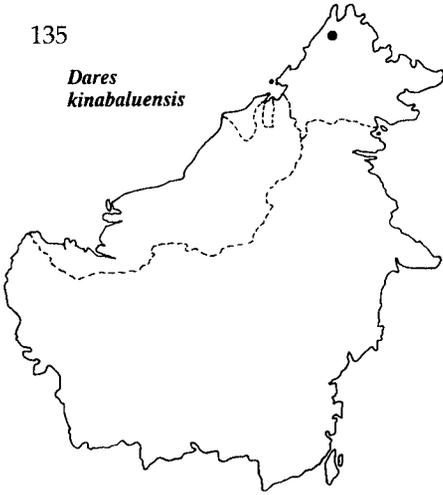
Haaniella scabra





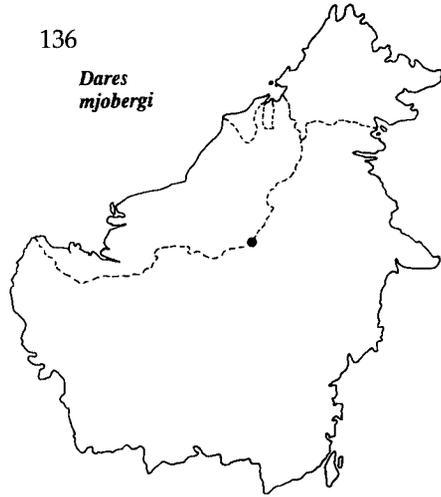
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*Dares
kinabaluensis*



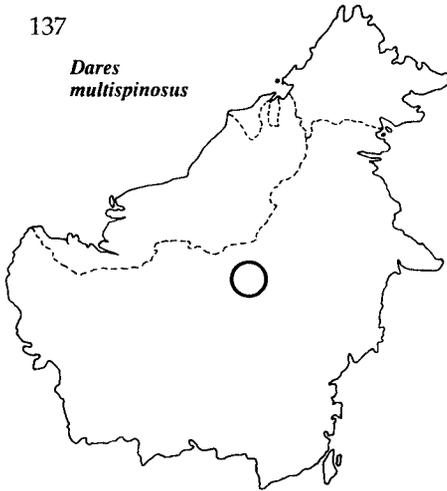
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*Dares
mjobergi*



137

*Dares
multispinosus*



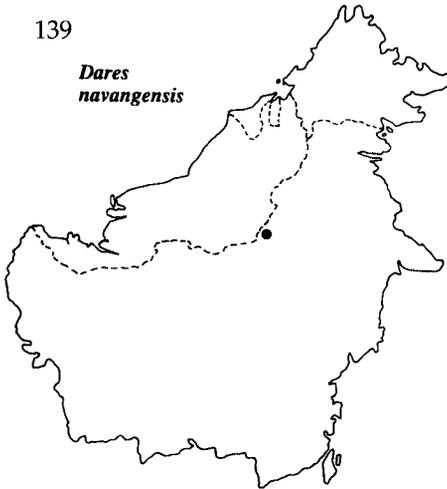
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*Dares
murudensis*



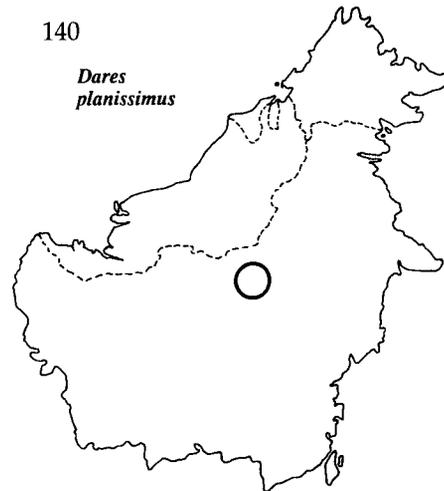
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*Dares
navangensis*



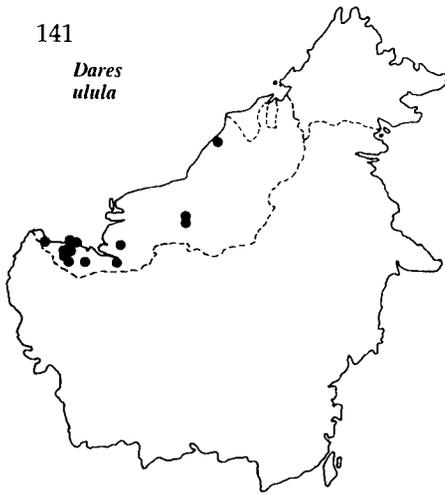
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*Dares
planissimus*



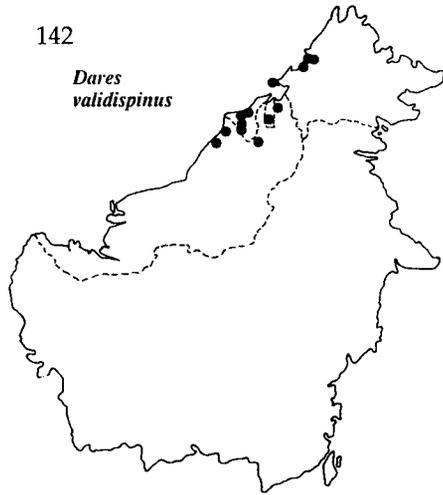
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*Dares
ulula*



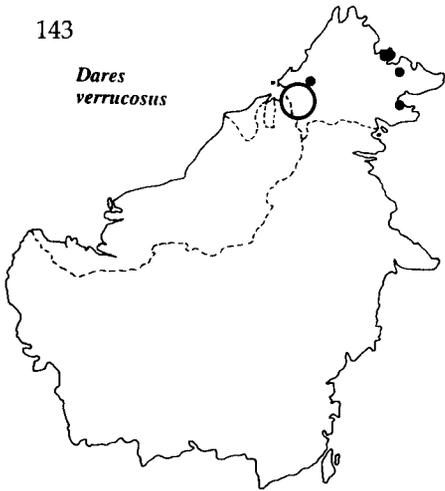
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*Dares
validispinus*



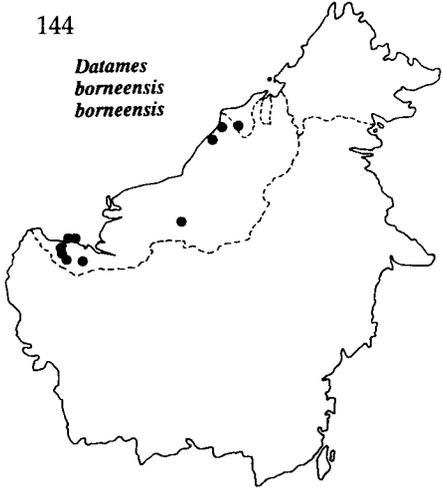
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*Dares
verrucosus*



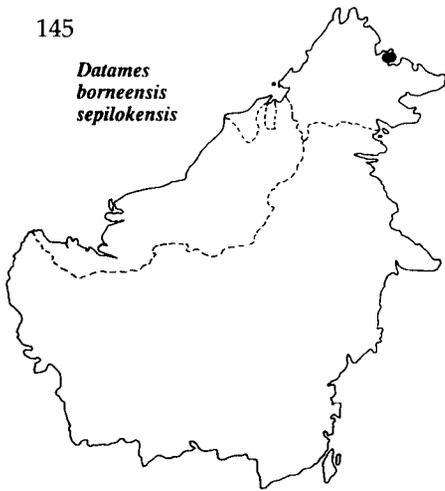
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*Datames
borneensis
borneensis*



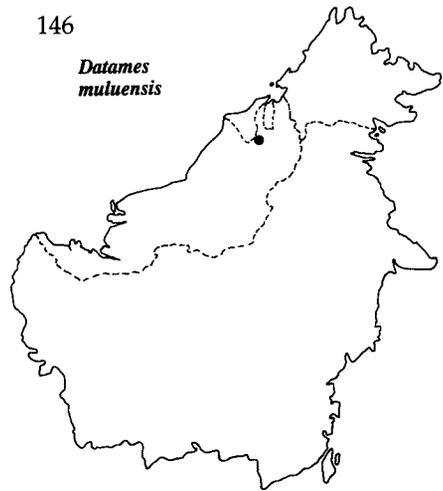
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*Datames
borneensis
sepilokensis*



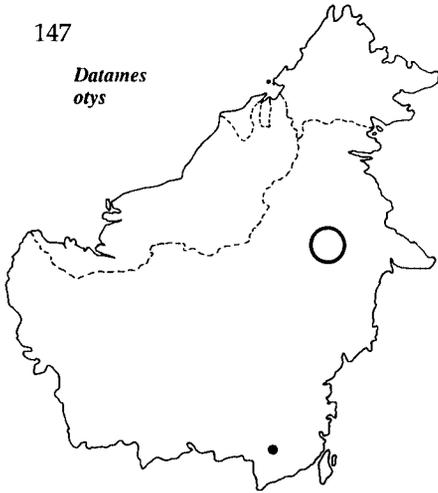
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*Datames
muluensis*



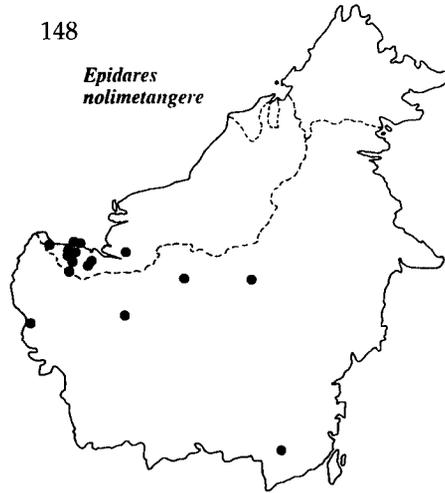
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*Datames
otys*



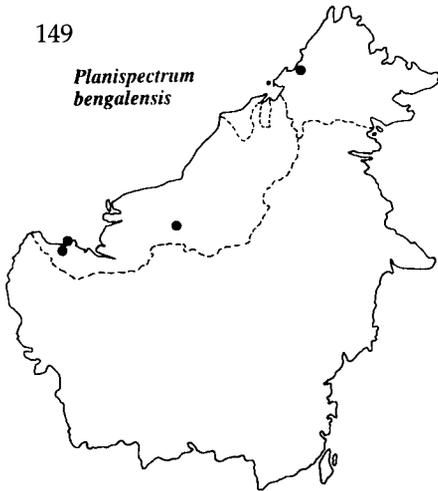
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*Epidares
nolimetangere*



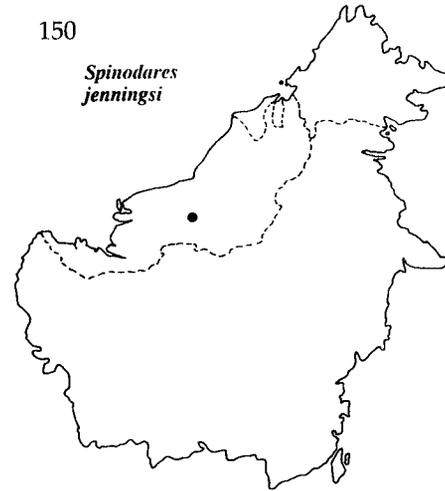
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*Planispectrum
bengalensis*



150

*Spinodares
jenningsi*



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<i>echinata</i> (<i>Haaniella</i>)	18	<i>Orestes</i>	82
<i>Epidares</i>	78	<i>verruculatus</i>	82
<i>haematacanthus</i>	78	<i>otys</i> (<i>Datames</i>)	75
<i>nolimatangere</i>	78	Parasites	

Mermithid larvae	12	<i>scabra</i> (<i>Haaniella</i>)	26
Mites	12	<i>sepilokensis</i> (<i>Datames borneensis</i>)	73
<i>philippinensis</i> (<i>Dares</i>)	58	Spermatophores	12
<i>Planispectrum</i>	82	<i>Spinodares</i>	86
<i>bengalensis</i>	83	<i>jenningsi</i>	86
<i>planissimus</i> (<i>Dares</i>)	58	<i>subcylindricus</i> (<i>Dares</i>)	60
<i>Platymorpha</i>	82	<i>Tisamenus</i>	37
<i>Platyphasma</i>	82	<i>ulula</i> (<i>Dares</i>)	60
<i>pterobrimus</i> (<i>Miroceramia</i>)	31	<i>validispinus</i> (<i>Dares</i>)	63
<i>Pylaemenes</i>	84	<i>verrucosus</i> (<i>Dares</i>)	66
<i>coronatus</i>	85	<i>verruculatus</i> (<i>Orestes</i>)	82
Rearing	11	<i>waterstradi</i> (<i>Datames borneensis</i>)	73
<i>rollandi</i> (<i>Heteropteryx</i>)	28	<i>westwoodii</i> (<i>Miroceramia</i>)	31
<i>saussurei</i> (<i>Haaniella</i>)	23		