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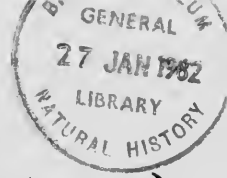
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# Bulletin of the British Museum (Natural History)



The taxonomy, biology and medical importance of *Simulium amazonicum* Goeldi (Diptera: Simuliidae), with a review of related species

A. J. Shelley, R. R. Pinger &  
M. A. P. Moraes

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# The taxonomy, biology and medical importance of *Simulium amazonicum* Goeldi (Diptera: Simuliidae), with a review of related species

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## Synopsis

The taxonomy of the species in the *Simulium amazonicum*-group is discussed and keys for the identification of adults and pupae are given. *S. quadrifidum* Lutz is resurrected from synonymy with *S. amazonicum* Goeldi, and *S. nitidum* Malloch is newly synonymized with *S. metallicum* Bellardi. A complete redescription of adults, pupae and larvae of *S. amazonicum* is provided, together with details of its distribution, biology and medical importance in Brazil.

## Introduction

The discovery during the last decade of several foci of onchocerciasis in the Brazilian Amazon (Moraes *et al.*, 1979) has led to renewed interest in the region's black-flies. However, considerable difficulty continues to be experienced in identifying Simuliids from this area, as well as from the tropical rain forests of neighbouring countries, because of the lack of keys and inadequate and confused species descriptions. The inchoate state of the taxonomy of South American *Simulium* s.l. has inevitably led to the misidentification of both vector and nuisance species, the most important examples being *S. amazonicum* Goeldi and *S. sanguineum* Knab. The former species is now firmly entrenched in the literature as nominally a vector of *Mansonella ozzardi* in Brazil (Cerqueira, 1959) and more recently, but almost certainly erroneously, of *Onchocerca volvulus* both in Brazil (Rassi *et al.*, 1975) and in Venezuela (Rassi *et al.*, 1977). It is said to have a vast distribution in Central and South America (Pinto, 1932; Vargas, 1945; Vulcano, 1967) and numerous reports have been published on its morphology and biology based on a scanty original description and without reference to type-material. In contrast, *S. sanguineum*, though with a similarly wide putative distribution (Pinto, 1932; Vargas, 1945; Vulcano, 1967), has received less attention, being regarded simply as a biting nuisance. However, recent work in Brazil (Shelley *et al.*, 1979) has shown that a species morphologically closer to *S. sanguineum* than to *S. amazonicum* is the vector of *O. volvulus*, and that although *S. amazonicum* is undoubtedly a vector of *M. ozzardi* (Shelley *et al.*, 1980) its distribution in Brazil is more localized than previously supposed.

Because of the potential importance of human onchocerciasis in the Amazon basin, a region of Brazil destined for future development, a taxonomic study of the black-flies in this part of Brazil has become essential. The redescription of *S. amazonicum* and the key to adults and pupae of species in the *S. amazonicum*-group given here are necessary first steps to this end. Some of the species in this group are the most common and persistently aggravating man-biting black-flies in South America, both in the tropical rain forests and adjacent savanna zones, and taxonomic resolution of this troublesome group of species is a prerequisite for a better understanding of the epidemiology of human onchocerciasis and mansonelliasis, especially in Amazonia and circum-jacent areas.

## Material studied

Most of the material examined for this paper is deposited in the Oswaldo Cruz Institute, Rio de Janeiro and the British Museum (Natural History), London. The majority of the *S. amazonicum*-group species examined in the Lutz collection of Simuliidae at the Oswaldo Cruz Institute lacked complete data. Reference is made only to specimens identified by us as species in the *S. amazonicum*-group or to those that have been previously confused with *S. amazonicum*. Collection data for these were found either on the label or, where a specimen only bears a number, in the card index of the Lutz Simuliid collection. These specimens have been relabelled and extra information, extrapolated from Lutz's publications, has been added where possible. Reared specimens of *S. amazonicum*-group species collected by us and used in this study have been deposited in the Oswaldo Cruz Institute and British Museum (Natural History). Although account has been taken of the numerous female specimens, in the collections of these two institutions, that have been collected from human bait, they are not referred to here due to the present difficulty in reliably separating some of the species of the *S. amazonicum*-group on one stage alone.

The following abbreviations are used for depositories of specimens referred to in this paper.

- AMNH American Museum of Natural History, New York, U.S.A.
- BMNH British Museum (Natural History), London, U.K.
- INPA Instituto Nacional de Pesquisas na Amazônia, Manaus, Brazil.
- IOC Instituto Oswaldo Cruz, Rio de Janeiro, Brazil.
- MLP Museo La Plata, La Plata, Argentina.
- MNHN Muséum National d'Histoire Naturelle, Paris, France.



NM Naturhistorisches Museum, Bern, Switzerland.  
 USNM United States National Museum, Washington, D.C., U.S.A.

### Acknowledgements

For financial assistance we thank the Ministério da Saúde (SUCAM), the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) of Brazil, and the UNDP/World Bank/WHO under their Special Programme for Research and Training in Tropical Diseases. We acknowledge the following specialists for their assistance in providing specimens: Dr S. Coscarón, MLP, Argentina; Dr F. C. Thompson, USNM, U.S.A.; Dr M. A. Tidwell, Centro Internacional de Entrenamiento e Investigaciones Médicas, Colombia and Dr H. D. Volkart, N. M., Switzerland. Dr L. B. Calheiros facilitated field visits, during which we were assisted by Messrs. A. P. A. Luna Dias and W. Arouck. Dr R. W. Crosskey kindly read through the manuscript and offered helpful suggestions during the course of the work.

### The *S. amazonicum*-group of species

Shortly after Goeldi's description (1905) of *S. amazonicum* it was already clear that it was difficult to recognize this species reliably. Lutz (1910) observed variability in female scutal patterns that he thought was caused by the different methods of preservation used and by the existence of two similar species which he went on to describe (Lutz, 1917). Similar difficulties were encountered by Cerqueira & Nunes de Mello (1964) who used material that was a mixture of at least three species (see below for evidence for this) in their redescription of *S. amazonicum*. To explain the difficulties involved in identifying *S. amazonicum*, exacerbated by Cerqueira & Nunes de Mello's confused description, it became customary for many entomologists in South America to refer to the *S. amazonicum* species complex, applying the term to any man-biting black-fly collected in the Brazilian Amazon or neighbouring countries that possessed a silver scutum with three black vittae and whose pupae showed a four- or six-filamented gill. Following recent investigations in Brazil and Colombia no sound evidence has been discovered to suggest that *S. amazonicum* is a complex in the strict sense used for *S. damnosum* (World Health Organization, 1977), but it is now known that several closely similar but nevertheless morphologically separable species occur which, for reasons of their homogeneity, form a natural species-group, the *S. amazonicum*-group. Some species within this group are only reliably separable when combinations of characters found in both adults and pupae are used.

**DIAGNOSIS.** *Female, male.* Sc bare.\* Pleural membrane and katapisternum bare. Scales on legs. Eyes dark red or black. *Female.* Fronto-ocular triangle absent. Cibarium armed with two or three rows of teeth. Scutum silver or grey pruinose with three velvet-black vittae, one median and 1 + 1 sublateral. Tarsal claws without teeth (except *S. quadrifidum*). Abdominal tergites 1–5 velvet-black, second segment silver pruinose; tergites 6–9 shiny black. Paraprocts broadly rectangular, cerci semi-oval with concave inner surfaces. Genital fork long and slender with 1 + 1 anterior processes. *Male.* Scutum silver or grey pruinose with three velvet-black vittae, either distinctly separate, or coalescing posteriorly to form an anchor-shaped mark, or coalescing along almost entire length leaving 1 + 1 indistinct silver submedian pruinose bands. Abdominal tergites velvet-black with silver pruinose areas particularly obvious on segments 2 and 6–8. Distimere subtriangular, shorter than subquadrangular basimere, with one apical or subapical spine (except *S. chaquense* which has two). Ventral plate broadly triangular, slightly concave ventrally, with many setae and spines.

*Pupa.* Cocoon usually slipper-shaped (except *Simulium* sp. (Madeira) which is shoe-shaped) with or without reinforced rim and median projection. Pupal gill with four, six or eight filaments usually shorter than pupa. *Onchotaxy.* Tergites three and four with 4 + 4 simple hooks; tergites 7–9 with spine combs on anterior margins. Sternite four with 1 + 1 hooks, sternites 5–7 with 2 + 2 hooks; posterior sternites with antero-lateral groups of spiny cuticular processes on each segment.

\* Coscarón (1971) describes Sc of ♀ *S. chaquense* with 4–5 hairs but the ♀ paratype in the BMNH collection has a bare Sc. Further examination of the type-material in MLP has shown that the Sc is bare (Coscarón, pers. comm.).

The *S. amazonicum*-group contains, according to our studies, the following species.

*S. amazonicum* Goeldi, 1905

? *S. tallaferoae* Ramírez Pérez, 1971

*S. chaquense* Coscarón, 1971

*S. minusculum* Lutz, 1910

? *S. roraimense* Nunes de Mello, 1974

*S. quadrifidum* Lutz, 1917 sp. rev.

*S. sanguineum* Knab, 1915

*Simulium* sp. (Barbacoas). Unidentified species from Barbacoas, Venezuela.

*Simulium* sp. (Madeira). Unidentified species from the R. Madeira, Brazil.

Previous reference has been made (World Health Organization, 1979; Shelley *et al.*, 1980) to *S. delponteianum* Wygodzinsky as a member of the *S. amazonicum*-group. It is now thought preferable not to include this species in the group at this stage due to its different eye colour and form of the male distimere. Similarly, *S. quadrivittatum* Loew and *S. haematopotum* Malloch are not at present included in the group due to differences in their morphology, despite their superficial resemblance to some of the *S. amazonicum*-group species.

### Keys to the species of the *S. amazonicum*-group

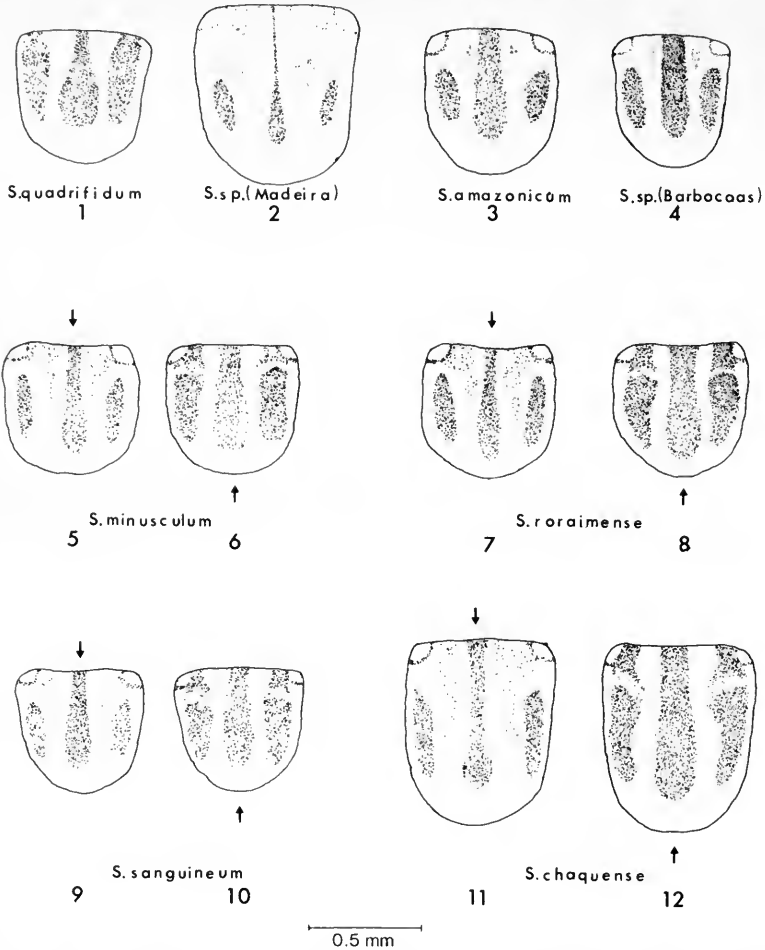
Separate keys are given for females, males and pupae even though it is not usually possible to identify to species when only one stage is available. This arrangement has been used for the sake of clarity, an accurate identification usually only being possible on reared material and using a combination of keys. As the keys have been based mainly on reared material from the Brazilian Amazon this must be borne in mind when they are used for identifying material collected outside this area. They are necessarily preliminary due to the difficulty in obtaining sufficient numbers of immature stages of the anthropophilic members of the group. However, they do provide a basis for more detailed future works and help to clarify the previous confusion surrounding *S. amazonicum* and its relatives.

Although most of the species in this key are clearly separable, future investigation is needed for the element denoted *S. minusculum*. In this paper it is assumed that the circumstantial association of six-filamented pupae with *S. minusculum* females by Lutz (1917) is correct, since females reared by the authors from six-filamented pupae appear conspecific with the *S. minusculum* syntypes. *S. roraimense* is regarded for the purposes of the key as a separate species even though it may only be separated from *S. minusculum* in the male by the absence of posterior merging of the scutal vittae. The variability of this character within *S. minusculum* and *S. roraimense* and hence its validity for separating these two species needs to be investigated. This character is already known to be variable in *S. sanguineum* (Tidwell *et al.*, 1981) and this finding has been confirmed in specimens in the BMNH collection. Where the key to females is used for the identification of Brazilian material, collected from human bait, that shows (with a posterior light source) the presence of intervittal marks and long sublateral vittae extending to the anterior scutal border, the specimens would run out to couplet three and a choice between four species would be obtained. In such a case they should be assigned to *S. minusculum* rather than *S. roraimense*, due to the possible synonymy of the latter species with *S. minusculum* for the reason previously indicated. It is unlikely that such females are *S. sanguineum*, which has a pupa with an eight-filamented gill. Although the two species are indistinguishable as adult females, *S. sanguineum* has only been recorded from north-western Colombia, being replaced in the Colombian Amazon by *S. minusculum*, which has a pupa with a six-filamented gill. Similarly, confusion with *S. chaquense*, which also has a pupa with an eight-filamented gill, is unlikely as this species has only been recorded from a quite different type of habitat in Argentina. Variations in the appearance of the intervittal marks in *S. minusculum* females, including the syntypes, have been regarded as infra-specific as they cannot be associated with either fixed pupal characters, other adult characters or particular localities in Brazil. The significance of these variations at the species level as well as the status of *S. roraimense* may only become apparent once reared *S. minusculum* topotypes have been studied or by cytogenetic or enzymatic means.

The scutal patterns described relate to specimens in a horizontal position with the light source anterior to the specimen unless otherwise indicated. It is essential that undamaged specimens are used and attention paid to the exact positioning of both specimen and light source. For practical reasons scutal patterns referred to in the keys have been regarded as black vittae, in various stages of development, depending on the species, on a silver pruinose background. These patterns may be considered alternatively as silver ornamentations on a black background, but in such a case would unnecessarily complicate the keys due to the lengthier descriptions that would be required. Although variation in scutal pattern has been seen within some species of the *S. amazonicum*-group the patterns described in the three couplets in the key to females are distinctive.

### Females

- 1 Three velvet-black vittae occupying most of width of anterior three-fourths of silver pruinose scutum: median vitta narrow anteriorly, widening posteriorly, drop-shaped; sublateral vittae pointed and narrow posteriorly, widening anteriorly and only joining scutal margin at two points, their form not altered by change in direction of light, intervittal marks absent (Fig. 1); row of silvery gold setae along entire mid line of median vitta giving appearance of two adjacent vittae in perfect specimens.  
[Zoophilic species; stream and small-river breeder; pupal gill with four filaments]  
*quadridum* (p. 25)
  - Three velvet-black vittae in anterior three-fourths of silver pruinose scutum: median vitta of varying width, widening posteriorly but never drop-shaped; sublateral vittae of variable length depending on position of light: with light anterior sublateral vittae oblong with rounded extremities not reaching anterior scutal border and indistinct cuneiform marks between median and sublateral vittae (intervittal marks); with light posterior length of sublateral vittae unaltered (short) or sublateral vittae reaching anterior scutal border (long), intervittal marks present or absent; setae not concentrated along mid line of median vitta . . . . . 2
  - 2 Median vitta narrow, often appearing as thin black line; sublateral vittae narrow, often reduced in length but always wider than median vitta, in median third of scutum diverging anteriorly; cuneiform black intervittal marks with slightly indistinct borders, arising on anterior scutal border and extending for half length of scutum (Fig. 2); with light source posterior scutal pattern similar with short sublateral vittae but intervittal marks indistinct and silvery white pruinose.  
[Anthropophilic species; large-river breeder; pupal gill with six filaments]  
. . . . . undescribed species (Madeira) (p. 27)
  - Median vitta wider and conspicuous; lateral vittae of approximately same width as median vitta in median third of scutum and diverging anteriorly; black intervittal marks of indistinct form or cuneiform, arising on anterior scutal margin; with light posterior to specimen sublateral vittae long or short, intervittal marks present or absent. . . . . 3
  - 3 Sublateral vittae short and intervittal marks of indistinct form irrespective of position of light. In some cases intervittal marks appear to be absent with posterior light source. (Figs 3, 4.)  
[Anthropophilic species; large-river breeder; pupal gill with eight filaments.]  
*amazonicum* (pp. 8, 10)  
[Biting habits and habitat details unknown; pupal gill with six filaments.]  
. . . . . undescribed species (Barbacoas) (p. 27)
  - (Species only separable by reference to pupal gill.)
  - Sublateral vittae short, intervittal marks distinct, cuneiform and extending up to half length of scutum; with light posterior sublateral vittae long, inner half of intervittal mark silver pruinose and merging with background scutal pruinosity, outer half dark and merging with sublateral vitta. (Figs 5–12.)  
[Anthropophilic species; large-river breeder; pupal gill with six filaments.]  
*minusculum* (p. 22)  
[Anthropophilic species; large-river breeder; pupal gill with six filaments.]  
*roraimense* (p. 22)  
[Anthropophilic species; large-river breeder; pupal gill with eight filaments.]  
*sanguineum* (p. 26)  
[Anthropophilic species; slow-flowing stream breeder; pupal gill with eight filaments.]  
*chaquense* (p. 22)
- (Further identification only possible by reference to pupal gill; *S. roraimense* may only be separated from *S. minusculum* on male scutal pattern.)

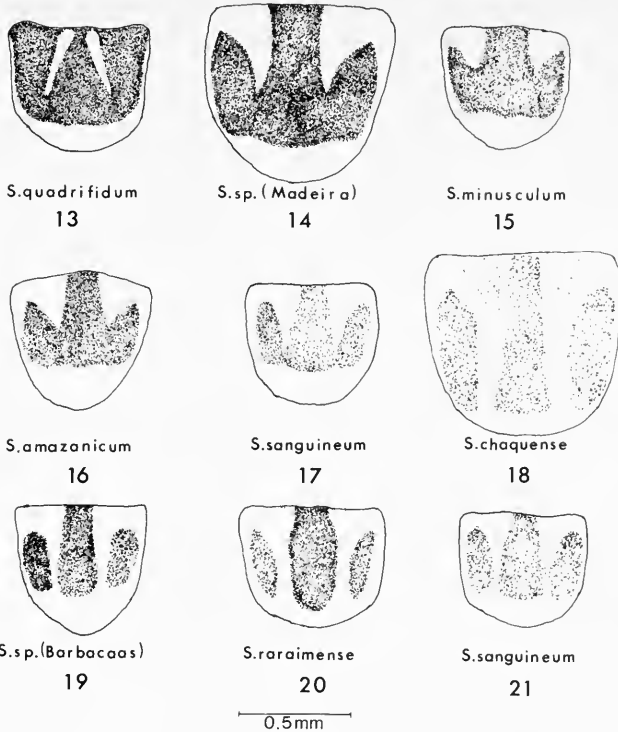


**Figs 1–12** Female scutal patterns of *S. amazonicum*-group species. (Arrows indicate direction of light; arrows omitted where scutal pattern not greatly altered by direction of light.)

### Males

- 1 Scutum with three velvet-black vittae merged and covering most of scutal area except lateral and posterior borders, and submedian area forming two fine silver pruinose bands diverging posteriorly and not reaching anterior scutal border. (In some specimens these bands are absent). (Fig. 13.)
  - [Pupal gill with four filaments.] . . . . . *quadrifidum* (p. 25)
- Scutum with three velvet-black vittae either merging posteriorly or distinctly separate . . . . . 2
- 2 Vittae merging posteriorly and appearing as black anchor on silver pruinose background, no intervittal marks present; distimere of genitalia with one apical spine. (Figs 14–17.)
  - [Pupal gill with six filaments.] . . . . . undescribed species (Madeira) (p. 27)
  - [Pupal gill with six filaments.] . . . . . *minusculum* (p. 22)
  - [Pupal gill with eight filaments.] . . . . . *amazonicum* (pp. 8, 12)
  - [Pupal gill with eight filaments.] . . . . . *sanguineum*\* (p. 26)
 (Further identification only possible by reference to pupal gill.)
- Vittae distinctly separate; median vitta broad, arising on anterior scutal border and extending three-fourths length of scutum, lateral vittae short, in central half of scutum, intervittal marks present or absent; distimere of genitalia with one or two apical spines (Figs 18–21) . . . . . 3

\* Tidwell *et al.* (1981) comment on the variation in the male scutal pattern of *S. sanguineum*; sublateral vittae may merge at posterior extremity or be separate.

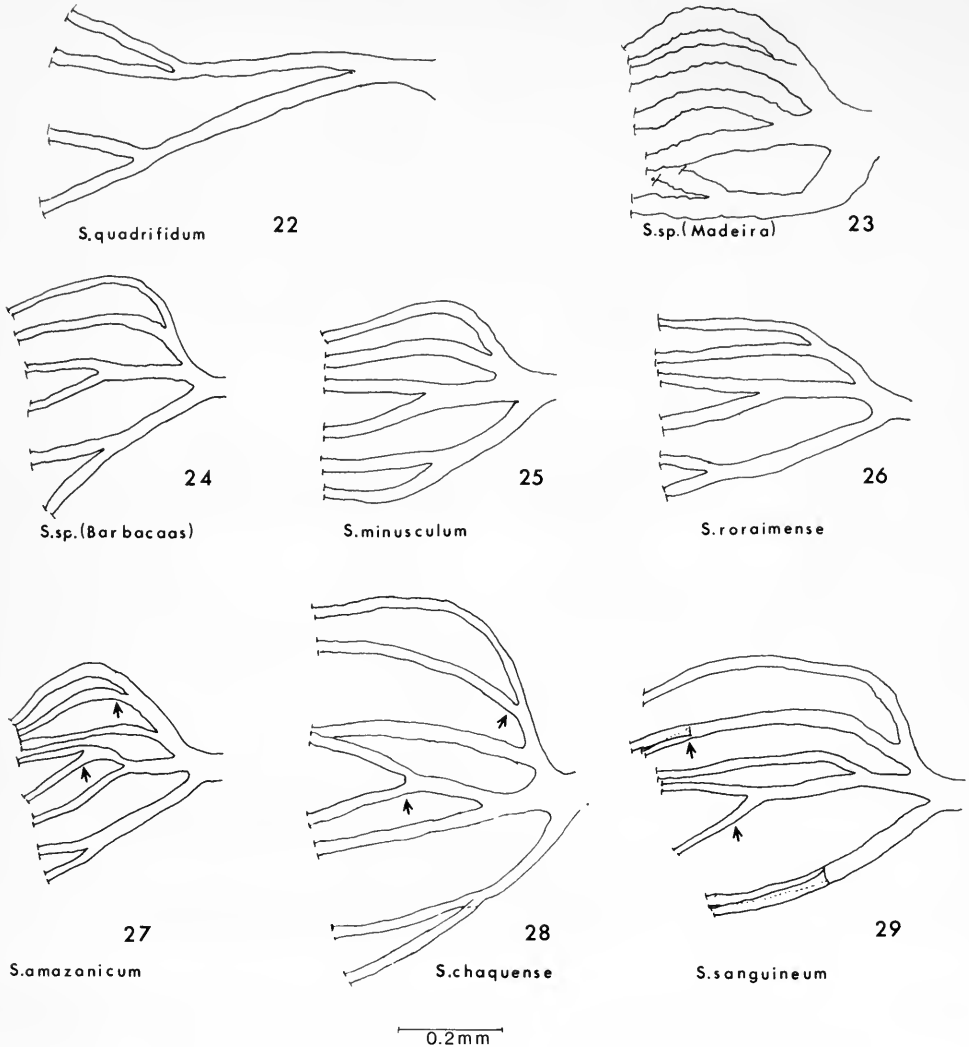


Figs 13–21 Male scutal patterns of *S. amazonicum*-group species.

- 3 Distimere of genitalia with two apical spines.  
 [Pupal gill with eight filaments.] . . . . . *chaquense* (p. 22)
  - Distimere of genitalia with one apical spine.  
 [Pupal gill with six filaments.] . . . . . undescribed species (Barbacoas) (p. 27)  
 [Pupal gill with six filaments.] . . . . . *roraimense* (p. 22)  
 [Pupal gill with eight filaments.] . . . . . *sanguineum*\* (p. 26)
- (Further identification only possible by reference to pupal gill. *Simulium* sp. (Barbacoas) only separable from *S. roraimense* on female scutal characters.)

**Pupae**

- 1 Gill with four filaments longer than pupal body; trunk of gill with basal bifurcation, each primary branch having a secondary bifurcation at approximately the same level in basal fifth of gill (Fig. 22); filaments arranged in horizontal plane; cocoon slipper-shaped . . . . . *quadrifidum* (p. 25)
  - Gill with six or eight filaments shorter than pupal body; branching in basal fourth of gill; filaments arranged in vertical plane; cocoon slipper- or shoe-shaped. . . . . 2
  - 2 Gill with six filaments in a 2 : 2 : 2 configuration . . . . . 3
  - Gill with eight filaments in a 3 : 3 : 2 configuration: dorsal and median primary branches each with three secondary branches, ventral primary branch with a single bifurcation . . . . . 4
  - 3 Gill about one-third length of pupal body; bifurcation of ventral primary branch always more distal than those on dorsal and median primary branches; filaments wide at base, tapering apically (Fig. 23); cocoon shoe-shaped . . . . . undescribed species (Madeira) (p. 27)
  - Gill almost as long as pupal body; bifurcations on three primary branches at variable distance from base of gill; width of filaments approximately equal throughout entire length (Figs 24, 25, 26); cocoon slipper-shaped.  
 . . . . . undescribed species (Barbacoas) (p. 27), *minusculum* (p. 22), *roraimense* (p. 22)
- (Further identification only possible by rearing to adult).
- 4 Trifid dorsal and median primary branches with most apical fork on dorsal secondary branch (Figs 27, 28) . . . . . *amazonicum* (pp. 8, 14), *chaquense* (p. 22)
  - (Further identification only possible by rearing to adult).
  - Trifid dorsal and median primary branches with most apical fork on ventral secondary branch (Fig. 29) . . . . . *sanguineum* (p. 26)



Figs 22–29 Pupal gills of *S. amazonicum*-group species. (Arrows indicate branch bifurcations referred to in key.)

### *Simulium amazonicum* Goeldi

(Figs 30–94)

*Simulium amazonicum* Goeldi, 1905: 138; Smart, 1942: 46. Syntypes ♀, BRAZIL: Amazonas, Bom Lugar, R. Purus (BMNH) [examined]. [Application to International Commission on Zoological Nomenclature for setting aside extant syntypes and establishment of neotype under plenary powers (Shelley, 1981).]

? *Simulium tallaferoae* Ramirez Pérez, 1971: 339. Holotype [sex unspecified], VENEZUELA: Guárico, Camaguán (División de Endemias Rurales, Maracay), [not examined; type-material lost or destroyed, see World Health Organization, 1979].

TYPE-MATERIAL OF *S. amazonicum*. Goeldi's description of *S. amazonicum* in 1905 was based on females collected by A. Ducke from Teffé (now Tefé) on the river Solimões (Upper Amazon) and by J. Huber from the rivers Purus and Acre, in the Brazilian state of Amazonas. Goeldi stated in the original description that a series of 'cotypes' was sent to the BMNH but did not indicate their precise provenance nor make reference to other type-series. Some confusion then followed in succeeding publications over the type-locality and status of the BMNH 'cotypes'.

Pinto (1932), in his catalogue of Central and South American Simuliidae, stated that Goeldi's description of *S. amazonicum* was based on specimens collected by Ducke at Tefé, neglecting to mention the material collected by Huber from the two other localities but recording that Goeldi had sent a series of 'cotypes' to the BMNH. Both Smart (1940) and Vargas (1945) erroneously believed that a *S. amazonicum* 'type' (i.e. holotype) had possibly been deposited in the Goeldi collection at the NM and the latter author followed Pinto's citation of the type-locality as Tefé. Smart (1942) discussed Goeldi's meaning of 'cotype', and allowing for its possible sensu stricto use made a slide preparation of one of the BMNH 'cotypes' which he labelled as 'plesio-cotype'; Smart regarded this specimen as a provisional lectotype to be designated, if necessary, once the status of the 'cotypes' had been established. In the same paper Smart gave details of the labels of the BMNH 'cotypes' showing the specimens to have been collected by Huber from Bom Lugar on the river Purus, thus correcting Pinto's inference (1932) that they were collected at Tefé. However, Tefé is still wrongly considered as type-locality by Cerqueira & Nunes De Mello (1964) in their redescription of *S. amazonicum*, and no mention is made by them of the BMNH type-material. A male 'holotype', female 'topotype' and male and female 'paratypes' were designated by these authors from their own material collected at Tefé, regardless of the fact that under the *International Code of Zoological Nomenclature* only the original author of a name can designate or indicate a holotype. Vulcano (1967), however, correctly quotes the three original *S. amazonicum* type-localities in her catalogue of Neotropical Simuliidae, omitting reference to Cerqueira & Nunes de Mello's paper (1964).

As Goeldi (1905), in his description of *S. amazonicum*, made no reference to designating a 'type' the only designation being that of 'cotypes', this series of specimens can only have the status of syntypes under Article 73 of the current *International Code of Zoological Nomenclature*. Whether a 'type' was selected or not by Goeldi, as has been assumed by several authors, would not alter the situation as no published designation was made.

Since the BMNH syntypes are in poor condition, having been preserved in alcohol for three-quarters of a century, attempts were made by the authors to locate other possible syntypes from the two other localities indicated by Goeldi, as he made reference to pinned specimens. No specimens were found in any of the major Brazilian depositories (INPA; IOC; Museu Goeldi, Belém; Museu Nacional, Rio de Janeiro; Museu de Zoologia, São Paulo). However, a series of 27 pinned specimens was located in the NM with the following labels in Goeldi's handwriting: 'Piúm. Purús, schreckliche Landplage am Amazonasstrom' and 'An Austen in London British Museum einsenden zum bestimen trockenens & Spiritusmater'. These have been examined and are also in poor condition. Although not cited as 'cotypes' by Goeldi in his 1905 paper, these 27 specimens were almost certainly examined by him when preparing the *S. amazonicum* manuscript and hence have syntype status.

Reference has already been made to the importance of separating *S. amazonicum* from its related vector and non-vector species in the epidemiology of human filariasis in Brazil. Though this is possible in some instances using the form of the pruinose pattern of the female scutum, reliable separation to species level is often only feasible when pupal characters are also considered. The complete redescription of *S. amazonicum*, necessary as a basis for the elucidation of the *S. amazonicum*-group, could not be made using the poorly preserved syntypes and hence has been based on a reared female (proposed as neotype, Shelley, 1981) and other reared adults and immature stages collected at the type-locality Bom Lugar on the river Purus. Because of the necessity of associating pupae with adults and the poor condition of the extant syntypes, a request has been made to the International Commission on Zoological Nomenclature (Shelley, 1981) to set aside the latter type-material and designate as neotype the principal specimen used in this redescription. A comparison of dissected female topotypes with five of the Goeldi syntypes showed the material to be conspecific.

Bom Lugar, the type-locality, was a rubber collecting community on the river Purus early in this century. It was abandoned in the 1930s when this part of the river formed an oxbow lake, Lagoa Bom Lugar, and the new community of Valparaíso was constructed about 2 km upstream from the original site. Collections made by the authors are labelled Valparaíso, Bom Lugar and Canto Escuro, the community on the opposite bank to Valparaíso.

IMPORTANT MISIDENTIFICATIONS AND NOMENCLATRURAL CHANGES. Because of the incrimination of *S. amazonicum* as a vector of *M. ozzardi* in Brazil, and the incorrect references to it as a vector of *O. volvulus* both in Brazil (Rassi *et al.*, 1975) and Venezuela (Rassi *et al.*, 1977), it became necessary to examine all references to this species in the literature so that the confusion surrounding its identity could be clarified. Only a small proportion of the 30 or so publications are quoted as the majority involves either the description of insignificant morphological details that are impossible to check without reference to the specimens used, or notes on its biology. As far as can be ascertained only Smart (1942) and possibly Cerqueira & Nunes de Mello (1964, female only) were dealing with true *S. amazonicum*, and in the case of the latter authors' description an admixture of at least three species was involved. The main material available to the authors on which a description of *S. amazonicum* had been based, apart from the original syntypes, was that in Lutz's Simuliid collection at the Oswaldo Cruz Institute. Most of the specimens are in bad condition or inadequately labelled, but of those that were identifiable, judging by the scutal vittae, none was *S. amazonicum*. Where possible, specimens labelled by Lutz as *S. amazonicum* or *S. amazonense* (incorrect subsequent spelling by Lutz of *S. amazonicum*; also incorrectly cited in Lutz, 1917) have been assigned to either *S. minusculum* or *S. quadrifidum*.

Nomenclatural changes involving *S. amazonicum* have only been made by Lutz (1917) and Cerqueira & Nunes de Mello (1964). Lutz described two new species, *S. exiguum* (not Roubaud) in 1909 and *S. minusculum* in 1910, only to synonymize them in 1917 with *S. amazonicum*. Our reasons for not accepting these synonymies may be found in the sections on *S. lutzi* and *S. minusculum* respectively. Similarly the reader is referred to the section on *S. metallicum* for details of Lutz's incorrect synonymy (1917) of *S. nitidum* Malloch with *S. amazonicum*. The synonymy of *S. quadrifidum* with *S. amazonicum* and the resurrection of *S. minusculum* by Cerqueira & Nunes de Mello (1964) are dealt with under the sections on *S. quadrifidum* and *S. minusculum*.

DESCRIPTION. *Female*. General body colour black. Length of body 1.2–2.5 mm; alcohol specimens 1.5–2.5 mm, pinned specimens 1.2–2.3 mm. Length of wings 1.2–1.9 mm, breadth of wings 0.6–0.9 mm.

Eyes dark red. Clypeus, frons and occiput black with bluish silver pruinosity. Frons and clypeus with scattered dark brown lateral marginal hair, occiput with denser dark brown hair. Antennae brown to brownish black, pedicel and basal part of scape brownish orange. Mouthparts dark brown.

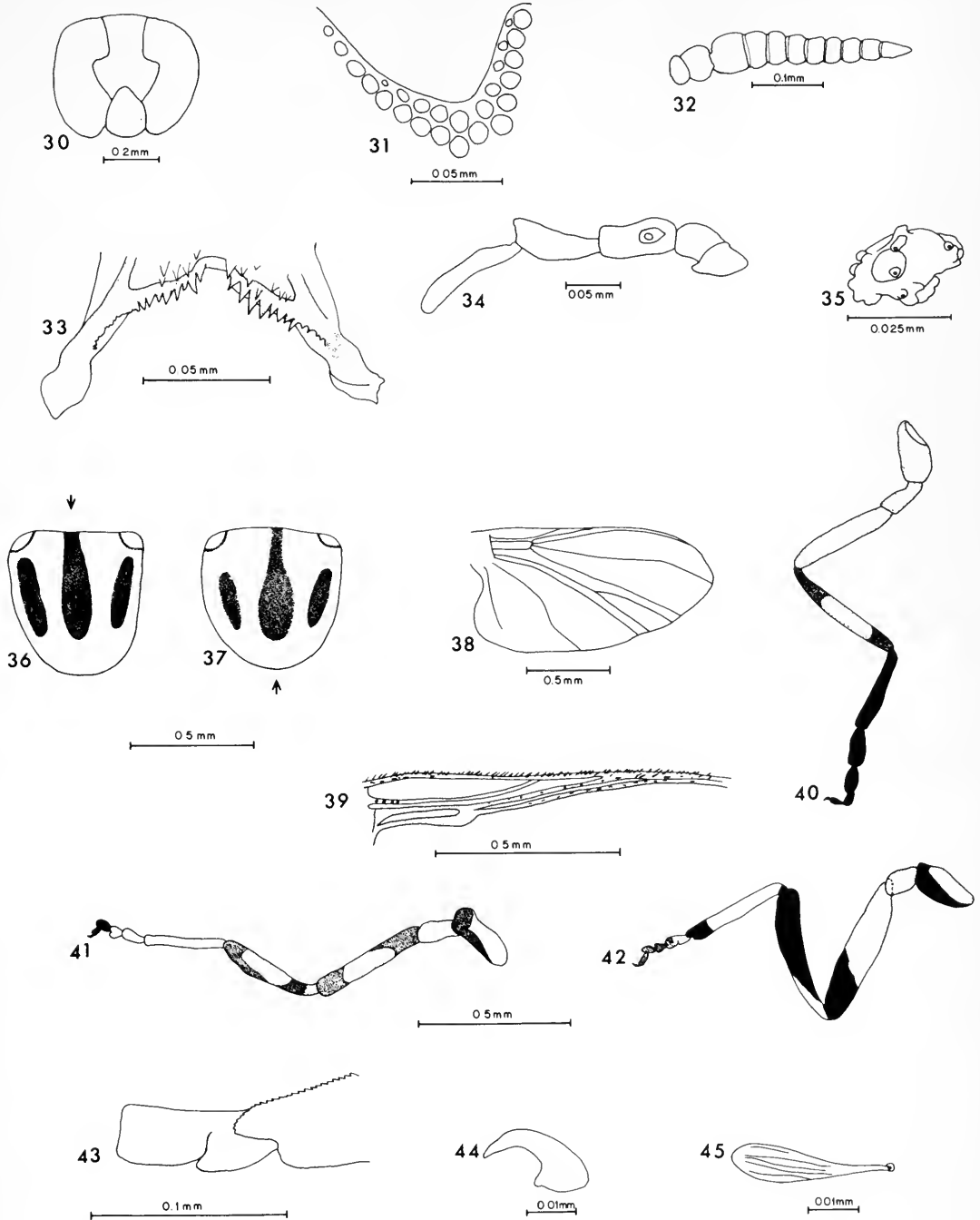
Frons narrow, about one and a half times as wide at vertex as at narrowest point (Fig. 30). Fronto-ocular triangle absent (Fig. 31). Clypeus slightly longer than broad. Antenna 11-segmented (Fig. 32). Cibarium (Fig. 33) with median margin and cornuae strongly sclerotised; central portion of margin glabrous, submedian and lateral portions with 25–40 sharp and uneven teeth arranged in two to four rows; anterior row of teeth extending to base of cornuae as fine serrations. Maxillary palp with apical segment approximately two-thirds the combined length of the two preceding segments (Fig. 34); sensory vesicle slightly elongate with many tubercles and short neck, its diameter about one-third the width of third segment of maxillary palp (Fig. 35). Maxillae and mandibles with teeth on both margins: maxillae with 16–21 teeth, mandibles with 3–6 poorly developed teeth on outer margin and 28–32 teeth on inner margin.

Scutum with pattern appearing variable depending on position of light: when light anterior to specimen scutum black with silver-grey pruinosity and a median black vitta occupying first three-fourths, 1 + 1 sublateral vittae, slightly divergent anteriorly and occupying central third of scutum, and 1 + 1 diffuse dark areas in pruinose region between vittae abutting anterior margin of scutum (Fig. 36); when light posterior to specimen sublateral vittae shorter and median vitta wider posteriorly (Fig. 37); scutal pattern indistinct when light source in other positions; when specimen on its side and anterior margin tilted slightly downwards 1 + 1 fine black bands present close to and running parallel to lateral margin of scutum. Humeri and scutum with dense silver-yellow adpressed hairs. Pleura and sterna greyish black with silver pruinosity; pleural membrane brownish black, bare. Scutellum greyish black with long adpressed brown hairs becoming upright on posterior margin. Postnotum black with silver pruinosity, bare. Mesepimeral sulcus complete, katapisternum bare, longer than deep in profile.

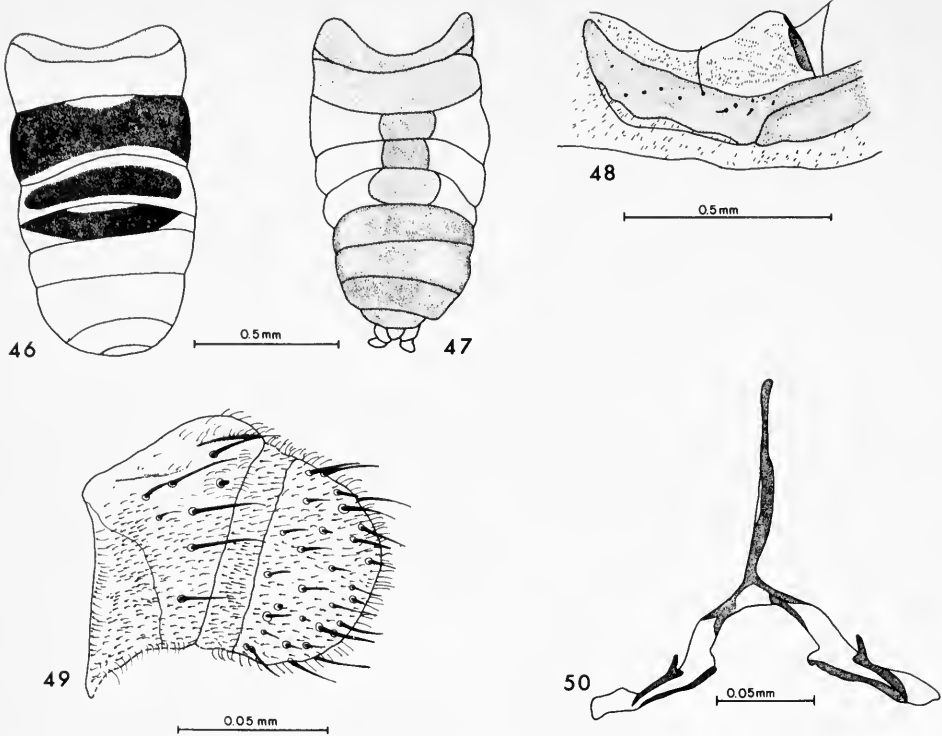
Wing shape and venation as shown in Figs 38 and 39. *C* with hairlike and spiniform macrotrichia; *Sc* with two prominent and 4–6 fine sensillae on basal fifth; basal section of *R* bare, apical section with single row of spiniform macrotrichia; *Rs* simple with single row of hairlike macrotrichia along entire length except for base; *Cu*<sub>2</sub> sinuous.

Coxa, trochanter and femur of fore leg light brown; tibia light brown with basal and apical fourths mid-brown; tarsus black. Coxa of mid leg dark brown, faintly pruinose; trochanter light brown with basal articulation yellow; femur and tibia light brown with basal and apical fourths dark except at articulation





**Figs 30–45** *S. amazonicum* female. 30, head, anterior view; 31, fronto-ocular triangle; 32, antenna; 33, cibarium; 34, maxillary palp; 35, sensory vesicle of maxillary palp; 36, colour pattern of scutum with anterior light source; 37, colour pattern of scutum with posterior light source; 38, wing; 39, anterior veins of wing; 40, fore leg; 41, mid leg; 42, hind leg; 43, apex of posterior basitarsus with second tarsal segment; 44, claw of hind leg; 45, scale from hind leg.



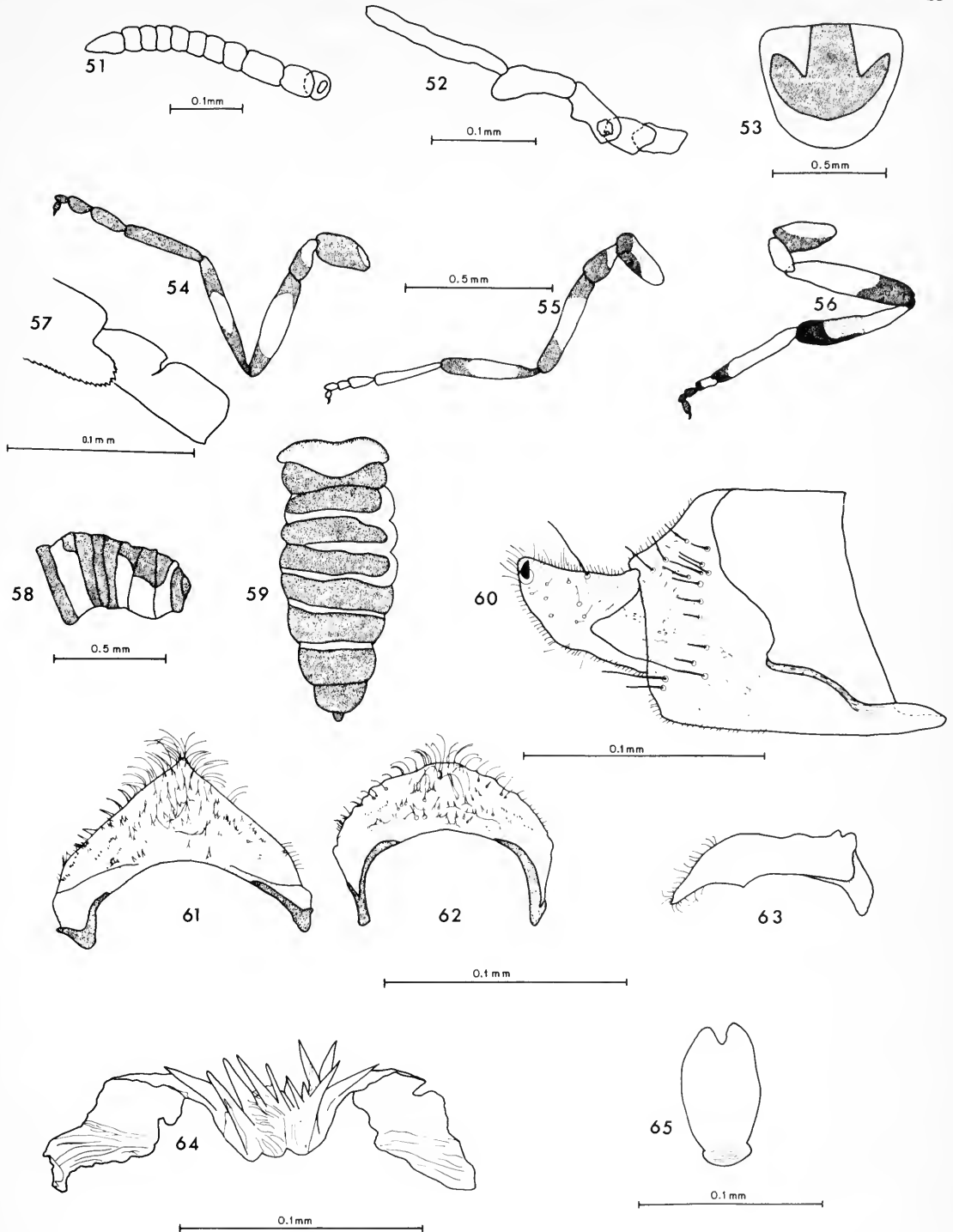
**Figs 46–50** *S. amazonicum* female. 46, dorsal view of abdomen showing colour pattern; 47, dorsal view of abdomen showing tergal plates; 48, part of eighth sternite with gonopophysis; 49, paraproct and cercus; 50, genital fork.

points; first three tarsomeres light brown, rest dark brown. Hind leg coxa dark brown, faintly pruinose; trochanter light brown with basal articulation orange brown; femur light to mid brown with distal third dark brown; tibia dark brown with basal fourth to half cream, and basal articulation dark brown; basitarsus cream with basal articulation and apical fourth mid to dark brown, basal half of second tarsomere cream, apical half mid to dark brown, third tarsomere cream to light brown, fourth and fifth tarsomeres mid to dark brown. Leg shapes and proportions as in Figs 40–42, first and second fore tarsomeres slightly flattened. Calcipala as long as wide, extending almost to base of pedisulcus (Fig. 43). Claws without teeth (Fig. 44). Femur and tibia of mid and hind legs with scattered scales (Fig. 45). Haltere with capitulum and distal tip of pedunculus pale yellow, rest of pedunculus light brown.

Abdomen with first tergite brownish black, basal fringe with dark brown hair; second tergite velvet-black with silver pruinosity; third to fifth tergites velvet-black, anterior and posterior margins silver pruinose; sixth to ninth tergites shiny black (Fig. 46). Terminalia and sternites brownish black. Tergal plates well developed, covering almost entire surface in segments 2 and 6–9, but only median part of segments 3–5 (Fig. 47). Eighth sternite strongly sclerotised with about 12 + 12 setae, gonopophyses broadly subtriangular with sclerotised median borders and numerous scattered hairs (Fig. 48). Cerci and paraprocts with strong spines and numerous hairs, cerci semi-oval and slightly concave on inner surface, paraprocts broadly rectangular (Fig. 49). Genital fork with slender heavily pigmented stem, posterior arms long and slender with median and sublateral sections of posterior margin pigmented; fine pigmented anterior processes arising from broad pigmented base (Fig. 50). Spermatheca oval, externally smooth, internally with needle-like spicules of varying size, arranged in groups of 6–8 in regular rows in anterior three-fourths of spermatheca; spermathecal duct and its area of insertion membranous.

**Male.** General body colour black. Length of body 1.3–2.4 mm; alcohol specimens 1.5–2.4 mm, pinned specimens 1.3–1.9 mm. Length of wings 1.2–1.6 mm, breadth of wings 0.5–0.9 mm.

Eyes red. Coloration of head as in female, antennae dark brown. Length of antennae as in female except pedicel and first flagellomere longer (Fig. 51). Single vertical row of hairs between eyes. Maxillary palp as shown in Fig. 52, sensory vesicle oval, smaller, and with fewer tubercles than in female.



**Figs 51–65** *S. amazonicum* male. 51, antenna; 52, maxillary palp; 53, colour pattern of scutum; 54, fore leg; 55, mid leg; 56, hind leg; 57, apex of posterior basitarsus with second tarsal segment; 58, lateral view of abdomen showing colour pattern; 59, dorsal view of abdomen showing colour pattern; 60, paramere, ventral view; 61, ventral plate, dorsal view; 62, ventral plate, ventral view; 63, ventral plate, profile; 64, endoparameral organ; 65, median sclerite.

Scutum black with silver-blue pruinosity; three velvet-black vittae merge posteriorly to form an anchor-shaped area almost filling scutum (Fig. 53). Rest of thorax as in female.

Wing shape and venation as in female, Sc with 2–3 sensillae on basal fifth.

Coxa of fore leg mid brown; trochanter yellow-brown on basal half, light brown on apical half; femur yellow-brown, generally with basal fourth light brown; tibia cream to mid brown with basal and apical articulations darker brown, anterior face white pruinose; tarsus dark brown to black. Mid leg coxa dark brown; trochanter mid brown with basal half and articulation light brown; femur and tibia mid to dark brown with darkened basal and apical articulations; basitarsus cream to light brown, rest of tarsus cream to dark brown. Coxa and trochanter of hind leg light to dark brown; femur light to dark brown with apical third dark brown to black; basal half of tibia cream, apical half light to dark brown, basal articulation dark brown; basitarsus cream with apical fourth light to dark brown, second tarsomere cream basally becoming light to dark brown apically, other tarsal segments light brown. Leg shape and proportions as shown in Figs 54–56. Calcipala and pedisulcus as in Fig. 57. Legs scaled on fore tibia, mid trochanter, femur and tibia, and hind femur and tibia. Haltere with capitulum lemon-yellow, pedunculus grey with faint silver pruinosity.

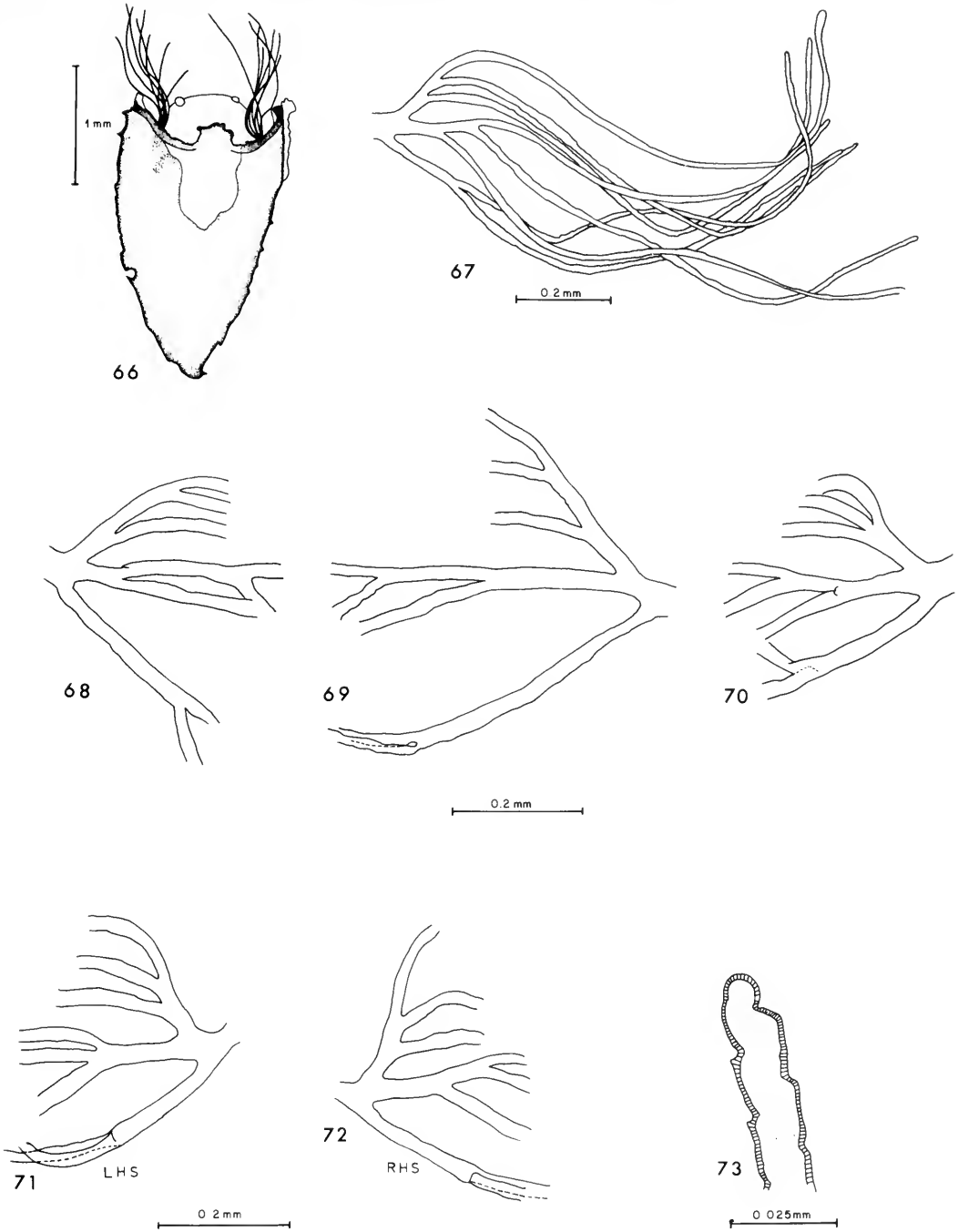
Abdominal tergites velvet-black, basal fringe with long black hair. Tergites with pruinose areas as follows: tergite 2 silver pruinose except median black spot on posterior margin; tergites 6–8 with 1 + 1 lateral silver pruinose bands as shown in Fig. 58. Terminalia black with faint silver pruinosity. Sternites velvet-black. Paramere black, setose, with faint silver pruinosity. Tergal plates on segments 2–9 well developed (Fig. 59), rectangular plates on central portions of sternites 3–8. Basimere almost as long as wide, distimere conical, shorter than basimere and with blunt subapical spine (Fig. 60). Ventral plate subtriangular with numerous setae and spines, apex slightly concave ventrally (Figs 61, 62), profile as shown in Fig. 63, basal arms pigmented; endoparameral organ as in Fig. 64; median sclerite (Fig. 65) with distal incision.

*Pupa.* Length of cocoon dorsally 1.6–2.3 mm, ventrally 2.0–2.7 mm; length of pupa 1.6–2.5 mm; length of gill 1.0–1.5 mm.

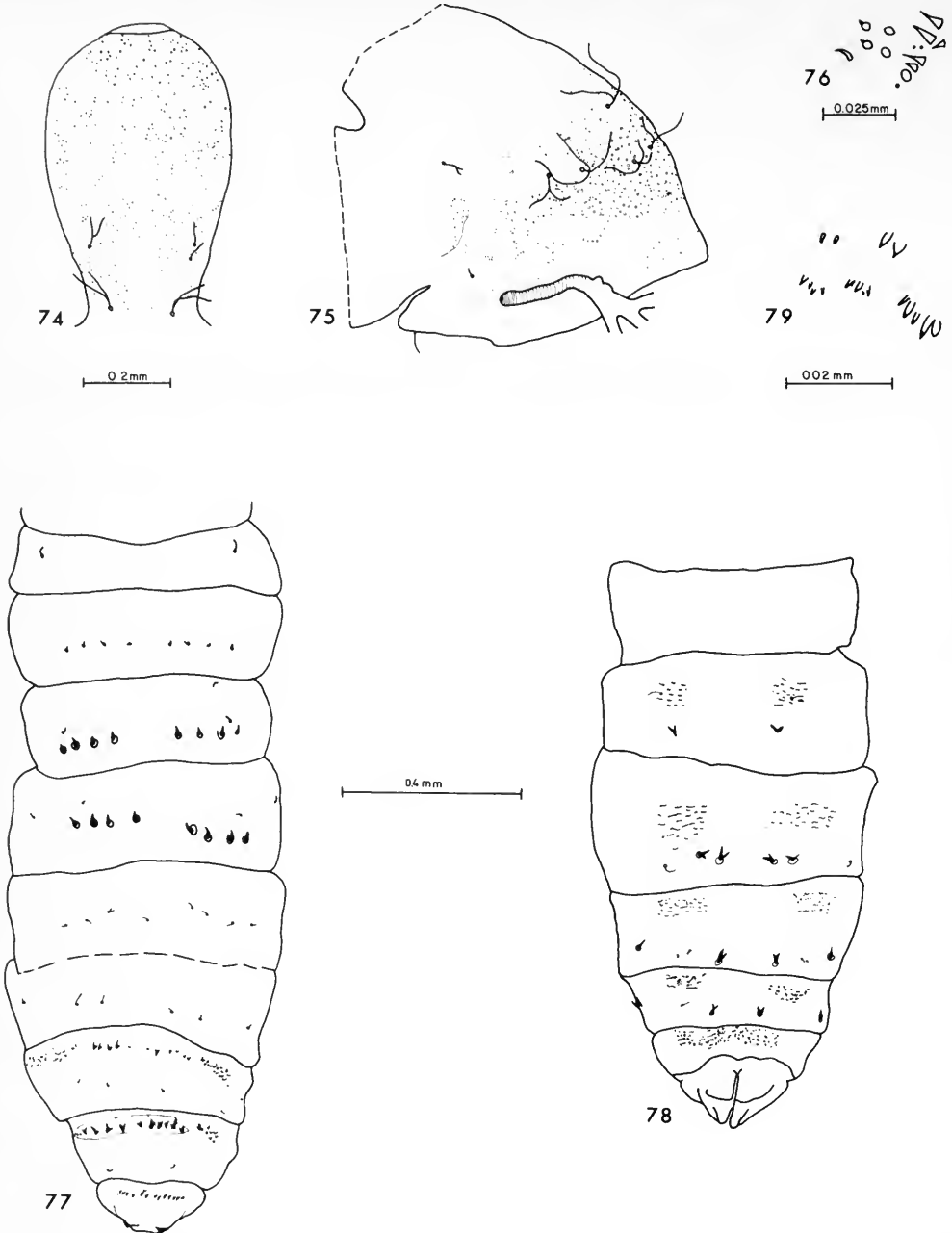
Cocoon slipper-shaped, mid brown; rim of aperture dark brown, reinforced and usually with small median projection (Fig. 66). Cocoon surface composed of fine threads, more loosely woven ventrally and only occupying distal half of cocoon. Gill light brown with eight forwardly directed filaments arranged irregularly in a vertical plane (Fig. 67): main trunk gives rise to three primary branches, ventral with two filaments, median and dorsal each with three filaments; filaments of all primary branches arise basally but branch height varies (Figs 68–70) even in same specimen (Figs 71, 72); filaments slender with crenated margins and rounded distally, their surfaces covered with fine spicules (Fig. 73). Head with 2 + 2 frontal and 1 + 1 facial trichomes; surface of head with numerous irregularly arranged platelets and fine spines (Fig. 74). Thorax with 5 + 5 dorsal trichomes each with 2–4 branches, 1 + 1 unbranched or bifid lateral trichomes, and 1 + 1 latero-ventral unbranched trichomes (Fig. 75). Surface of thorax with platelets, densely distributed and in area of dorsal trichomes interspersed with spinules (Fig. 76); 1 + 1 groups of dense platelets and fine spines ventral to lateral trichomes on slight cuticular prominence. Onchotaxy of abdomen as illustrated in Figs 77 and 78: tergite 1 with 1 + 1 lateral hairlike setae; tergite 2 with 4 + 4 spine-like setae; tergite 3 with 4 + 4 simple hooks and 1 + 1 hair-like setae; tergite 4 with 4 + 4 simple hooks and 2 + 2 simple hair-like setae; tergite 5 with 4 + 4 simple or bifid hair-like setae; tergite 6 with 3 + 3 hair-like setae; tergite 7 with 2 + 2 simple hair-like setae; tergite 8 with 1 + 1 simple hair-like setae. Tergites 7–9 with anterior margins faintly pigmented and with spine combs; tergites 7 and 8 with 1 + 1 antero-lateral groups of spiny cuticular processes; apex of abdomen with 1 + 1 well-sclerotised pointed tubercles. Sternite 4 with 1 + 1 bifid hooks; sternite 5 with 2 + 2 adjacent bifid to quadrifid hooks and 1 + 1 hair-like setae; sternite 6 with 2 + 2 well-spaced hooks, lateral simple and median bifid to quadrifid, and 2 + 2 hair-like setae; sternite 7 with 2 + 2 well-spaced hooks, median bifid and lateral simple, and 1 + 1 simple hair-like setae. Sternites 4–7 with 1 + 1 antero-lateral groups of backwardly directed spiny cuticular processes; sternite 8 with band of these processes on anterior margin (Fig. 79).

*Mature larva.* Length 3.8–4.3 mm. Width of head capsule 0.38–0.45 mm. Body colour varying from yellow to brown with grey mottling. Ventral nerve cord grey. Body form as in Fig. 80.

Head yellow to light brown with faint positive pattern on cephalic apotome consisting of an antero-medial group of three spots, 1 + 1 antero-lateral group of two or three spots, and 1 + 1 postero-lateral head spots (Fig. 81). Head spots only visible in spirit material with anterior part of head tilted downwards. Scattered spines on head capsule, densest on cephalic apotome. Postgenal cleft large, broader than long with rounded anterior margin (Fig. 82); postgenal bridge short, one-third as long as hypostomium. Hypostomium (Fig. 83) with nine apical teeth: corner teeth large and blunt, median tooth less developed but slightly larger than subequal intermediate teeth: 6–7 lateral serrations with hindmost serration lying posterior to first hypostomial seta; 1 + 1 groups of 3–4 hypostomial setae lying parallel to lateral margins of hyposto-

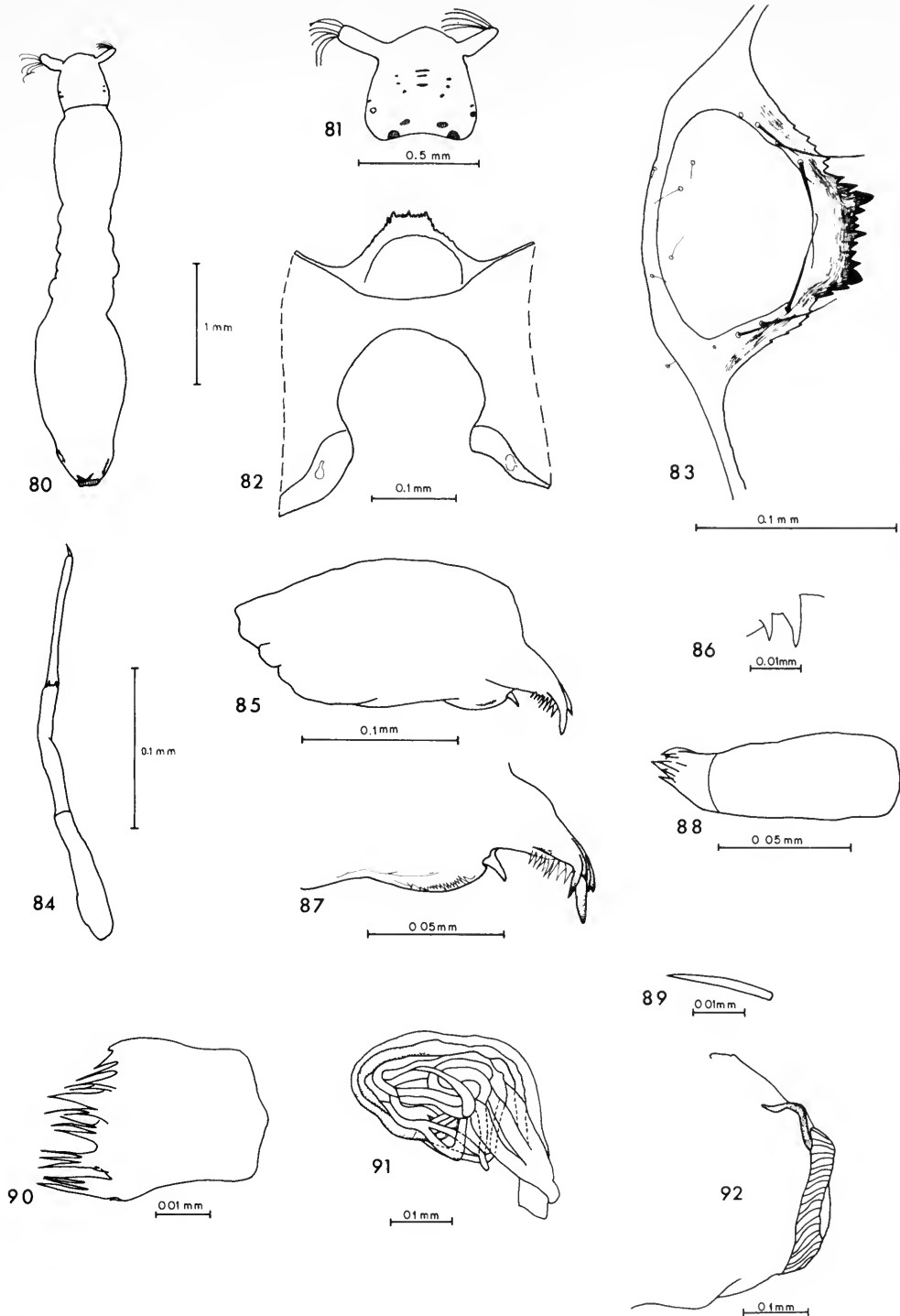


**Figs 66–73** *S. amazonicum* pupa. 66, cocoon and pupa, dorsal view; 67, gill; 68–70, variations in branching pattern of gill; 71, 72, variations in branching pattern of gill of one specimen (LHS = left-hand side, RHS = right-hand side); 73, gill filament, detail of distal part.

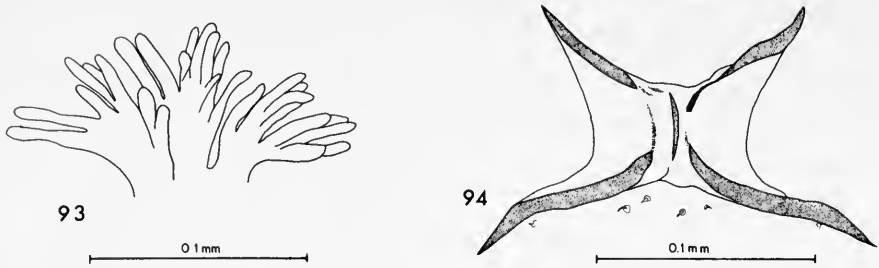


Figs 74–79 *S. amazonicum* pupa. 74, frontoclypeus; 75, thorax; 76, platelets and spinules of thorax; 77, abdomen, dorsal view; 78, abdomen, ventral view; 79, spiny cuticular processes of eighth sternite.

mium: distance between apex of corner tooth and first hypostomial seta slightly less than that between corner teeth. Antenna long (Fig. 84), unpigmented; first segment about five times as long as broad, segment length ratios about 5 : 4.8 : 5.5 (only one antenna examined). Mandible (Fig. 85) with one narrow elongate mandibular serration, sometimes with small serration posterior to this (Fig. 86); first three comb teeth equal in size; ventral margin of mandible posterior to mandibular serration with row of saw-like serrations (Fig. 87). Maxillary palp short, about three times as long as breadth at base (Fig. 88). Cephalic fan with 12–15 rays.



**Figs 80–92** *S. amazonicum* larva. 80, larva, dorsal view; 81, head, dorsal view; 82, head, ventral view (flattened); 83, hypostomium; 84, antenna; 85, mandible; 86, mandibular serrations; 87, mandible, ventral margin showing saw-like serrations; 88, maxillary palp; 89, cuticular spine; 90, lateral sclerite of proleg; 91, pupal respiratory histoblast; 92, posterior end of abdomen, lateral view, showing ventral papillae.



Figs 93, 94 *S. amazonicum* larva. 93, anal gills; 94, anal sclerite.

Thorax yellow to light brown with scattered dark mottling of variable form dorsally and one or two central patches posterior to proleg ventrally. Cuticle of dorsal surface densely covered with fine spines (Fig. 89), lateral surface with scattered spines and ventral surface bare. Proleg circlet with about 22 rows of 1–6 hooks, lateral sclerite faintly pigmented with about eight processes (Fig. 90). Pupal respiratory histoblast (Fig. 91) with eight tightly coiled filaments divided into three primary branches near base.

Abdomen yellow to brown with grey annular mottling on four anterior segments and varying patterns on other segments. Cuticle with spines arranged as on thorax except scattered spines present ventrally also. Ventral papillae small (Fig. 92). Scattered short spines on anterior fold of anus, tri-lobed rectal gills with about eight secondary lobules on each lobe (Fig. 93). Anal sclerite (Fig. 94) with arms strongly sclerotised; posterior arm extending to between ninth and twelfth rows of posterior circlet hooks. Posterior circlet with about 54–56 rows of 2–12 hooks. 2 + 2 (sometimes 1 + 1) mid-dorsal and 1 + 1 lateral strongly developed setae between posterior arms of anal sclerite and posterior circlet.

#### MATERIAL EXAMINED

Syntypes ♀, **Brazil**: Amazonas, Bom Lugar, R. Purus, v.1904 (*Huber*) (25 ♀ in alcohol, pinned or as slide preparations, BMNH; 27 ♀, pinned, NM). [The International Commission on Zoological Nomenclature has been requested to set aside these syntypes under their plenary powers (Shelley, 1981).]

**Brazil**: 1 ♀, Amazonas, Valparaiso (near Lagoa Bom Lugar), R. Purus, approx. 8°42'S 67°22'W, approx. elevation 120 m, ex pupa, 22.xi.1977 (*Shelley*) (BMNH). [The International Commission on Zoological Nomenclature has been requested to designate this specimen as a neotype under their plenary powers (Shelley, 1981).]

Topotypes. 18 ♀, ex pupae (pinned and as slide preparations); 31 ♂, ex pupae (pinned and as slide preparations); 16 pupae (in alcohol); 10 larvae (slide preparations); data as for proposed neotype. Numerous ♀, collected from human bait and horse (pinned, in alcohol, slide preparations); data as for proposed neotype. (AMNH, BMNH, IOC, MLP, USNM.) Numerous ♀, collected from human bait (pinned, in alcohol); locality data as for proposed neotype, 29.xi.–3.xii.1976, 17–19.vi.1977 (*Arouck*) (BMNH, IOC). 1 ♂, Amazonas, Igarapé Escondido (Lagoa Bom Lugar), R. Purus, ex pupa, 17.xi.1977 (*Shelley*) (BMNH).

**DISTRIBUTION.** Because of the previously confused situation over the identity of *S. amazonicum* the confirmed distribution of this species is based only on material studied by the authors for the present work. The distribution of this species in relation to other species in the *S. amazonicum*-group that occur in Brazil is shown in Fig. 95. *S. amazonicum* was found at the following localities in addition to the type-locality on the Purus river system, the specimens having been deposited in the BMNH and IOC: several ♀, Boca de Acre, confluence of R. Acre and R. Purus, 8°45'S 67°24'W, 24.xi.1977 (*Shelley*); numerous ♀, Labrea, R. Purus, 7°14'S 64°50'W, 8.x.1973 (*Shelley*); numerous ♀, Capacini, near Labrea, R. Purus, 25.ix.1976 (*Shelley*); numerous ♀, Parana do Ituxi, confluence of R. Ituxi with R. Purus, near Labrea, 30.ix.1976 (*Shelley*).

Specimens tentatively determined as *S. amazonicum* have also been collected biting man at the following localities (slight scutal variations are apparent from the Bom Lugar form but their significance cannot be decided until immature stages and males have been examined).

Numerous ♀, Amazonas State, Feijoal, R. Solimões, 4°10'S 69°25'W, 5.x.1979 (*Shelley & Luna Dias*); numerous ♀, Tefé, R. Solimões, 3°22'S 64°43'W, 8.x.1978 (*Shelley & Luna Dias*); numerous ♀, Roraima Territory, Km 50, Northern Perimeter Road (BR 210), R. Ajarani, 1, 2°01'N 61°28'W, 16.i.1979 (*Shelley & Luna Dias*).





Fig. 95 The distribution of species of the *S. amazonicum*-group in Brazil. Inset: detail of Roraima Territory. (Based on reared specimens and type-material.)

**BIOLOGY.** Although various aspects of the biology of *S. amazonicum* have already been investigated by several workers in Brazil and neighbouring countries their value is dubious as it is probable that other species were involved. Studies on the biology of this species as well as other anthropophilic species in the *S. amazonicum*-group that are large-river breeders are hampered by the difficulties involved in sampling for immature stages. Breeding grounds, even in localities where adults attack man in enormous numbers, are difficult to find. Apart from the more obvious difficulties involved in sampling large rivers, such as water depth, current speed and the time and manpower needed to examine vast areas of substrate for larvae and pupae, account must be taken of the large fluctuation in river depth over a short period of time principally in the rainy season. Even large rivers in the Amazon basin may rise by as much as a metre over night as a result of rainfall often some considerable distance away.

Detailed investigations at Valparaiso, near Bom Lugar, the type-locality of *S. amazonicum*, were not possible and hence only brief comments are made mainly on larval and pupal habitat. However a study made some years ago at Capacini, also on the R. Purus, by one of the authors (A.J.S.) is cited, now that the correct identity of *S. amazonicum* has been established.

*Studies at Valparaiso.* The river Purus at Valparaiso is about 100 m wide, has a fast current and few suitable objects for mooring a boat to facilitate sampling. The banks of the river, with its many meanders, are either steep and devoid of vegetation, in the form of sandy spits, or marshy and covered with herbaceous vegetation and scattered bushes. Immature stages of *S. amazonicum* were found only on a small submerged wild guava bush near the river bank in strong current up to 1.5 m below the water surface. This was the only breeding ground found after four days of searching in the river Purus at a time of the year when swarms of *S. amazonicum* attack man at the river's edge throughout the day. Pupae were found mainly on small branchlets but sometimes attached to leaves, and were usually covered in sediment. No pupae or mature larvae of other *Simulium* species were found. Collections from several forest streams draining into the R. Purus or into Lagoa Bom Lugar produced large numbers of immature stages of *S. quadrifidum* but only one male *S. amazonicum* pupa. In a collection from human bait several thousand *S. amazonicum* females were identified as well as one female *Simulium* sp. (Madeira), which has been shown to be a vector of *M. ozzardi* on the R. Solimões (Shelley *et al.*, 1980). *S. amazonicum* was also collected feeding on a horse at Valparaiso.

*Studies at Capacini.* Aspects of the biology of *S. amazonicum* were studied at Capacini, a small rubber collecting community near Labrea on the R. Purus, in low lying (altitude 60 m) tropical rain forest. The observations were made during investigations into the vector of *M. ozzardi* at this locality (Shelley & Shelley, 1976) but not hitherto published because of uncertainty as to the identity of the species. Reexamination of voucher specimens (deposited in the BMNH and IOC) has confirmed that true *S. amazonicum* is the species involved.

Only *S. quadrifidum* was found in the two local streams, Igarapé Capacini and Igarapé Ca-Te-Espera, and no immature stages were found in the R. Purus. Studies were therefore confined to adult *S. amazonicum*, the only anthropophilic black-fly found in the area.

To discover the resting sites of *S. amazonicum* searches with a sweep net were made in potential resting sites alongside the river and at the forest's edge by the two streams. Host preference was determined by making a 12-hour catch using baits of man, cow, sheep, dog, monkey and chicken. These were positioned, 10 m apart, in bean fields at the edge of the river and three collectors captured all flies biting from 06.00 to 18.00 hrs; two further collectors captured flies biting a human and a bovine bait in the cattle pastures above the bean fields. To determine the biting pattern of *S. amazonicum* five collections were made from human volunteers clad in shorts and seated in the bean fields for three consecutive days. One collector was assigned to each bait and commenced capturing flies at 06.00 hrs (dawn) until midday; he was replaced by another collector who worked from midday to 18.30 hrs (dusk). Flies were collected directly into alcohol, a small number being set aside for taxonomic studies, the rest being dissected later for filariae. Daily records of temperature and relative humidity were kept.

No *S. amazonicum* were found on vegetation at the forest edge but 29 females were collected from long grass in the cattle pasture and 15 females from cracks in the soil in the bean fields. *S. amazonicum* showed a marked preference for human blood although the cow could be an important secondary host in the area (Table 1). During the three consecutive days of the biting catch

**Table 1** Biting preferences of *S. amazonicum* at Capacini

Bait	Bean fields		Pasture	
	No. collected	% of total catch	No. collected	% of total catch
Man	794	90.7	1292	80.1
Cow	80	9.1	321	19.9
Sheep	1	0.1	0	—
Dog	0	—	0	—
Monkey	0	—	0	—
Chicken	0	—	0	—
Totals	875	99.9	1613	100.0

*SIMULIUM AMAZONICUM* GOELDI

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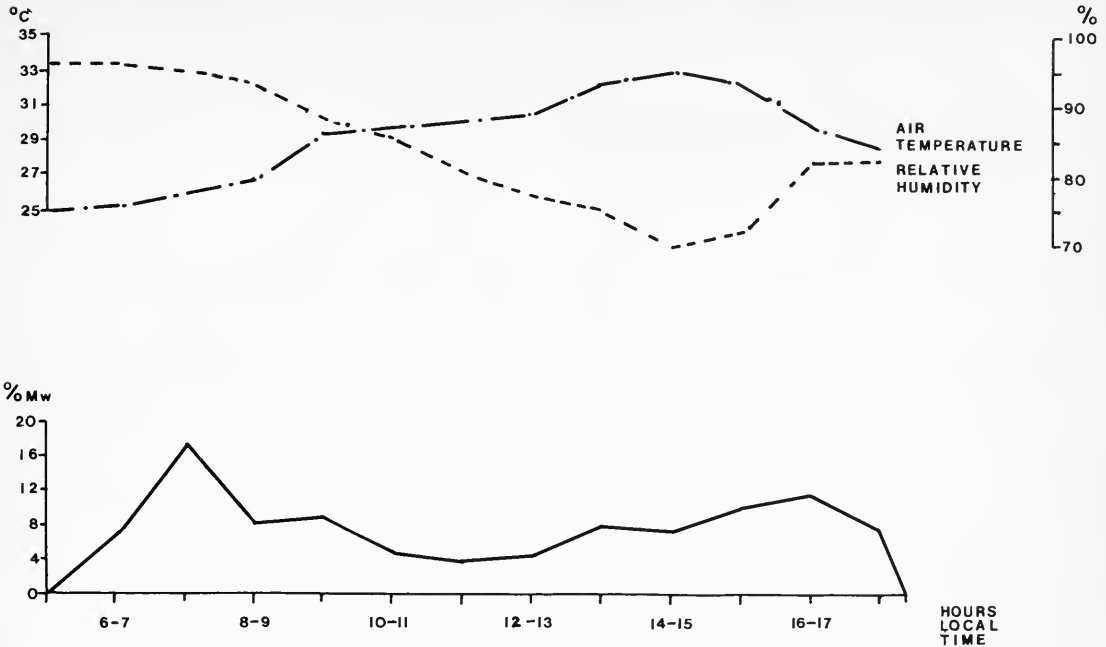


Fig. 96 The biting cycle of *S. amazonicum* at Capacini.

3 400 *S. amazonicum* were collected from the human baits. The biting pattern is shown in Fig. 96 where the geometric mean hourly catch ( $M_w$ , after Williams) expressed as a percentage of the total days' catch (%  $M_w$ ) is plotted against time. Biting occurred between dawn and dusk with the main peaks at 07.00–08.00 and 15.00–18.00 hrs local time.

**MEDICAL IMPORTANCE.** Formerly *S. amazonicum* was considered to be a noxious man-biting species in several countries in South America and many published reports concerning this exist in the literature. It is impossible to establish which, if any, of these reports actually refer to *S. amazonicum* as specimens were not deposited in collections at the time. However, investigations have been made where this species has been cited as a vector of pathogens to man. Only two have been found, both involving human filariae. In Brazil Cerqueira (1959) named *S. amazonicum* as the vector of *M. ozzardi* at Codajas on the R. Solimões. No critical analysis of Cerqueira's data had been made until Shelley *et al.* (1980) challenged his conclusions on the data that he had presented, as well as on his identification of the vector. Specimens from Codajas identified by Cerqueira as *S. amazonicum* have now been determined (A.J.S.) as an undescribed species of the *S. amazonicum*-group referred to in this paper as *Simulium* sp. (Madeira) (p. 27). That this species is a vector of *M. ozzardi* in Brazil has now been confirmed by these authors (Shelley *et al.*, 1980) at Feijoa on the river Solimões. They also showed that *S. amazonicum*, a less common species at this locality, is also a vector of this filaria. This species is responsible for transmission of mansonelliasis along the river Purus as Shelley & Shelley (1976) found a female *S. amazonicum* naturally infected with *M. ozzardi* at Capacini, and more recently an infective larva of this filaria was recovered from an experimentally infected fly that had previously fed on a person with mansonelliasis at Valparaiso (A.J.S., unpublished data). The supposed incrimination of *S. amazonicum* as a vector of onchocerciasis at the R. Toototobi in Brazil by Rassi *et al.* (1975) is an error stemming from their misidentification of *S. minusculum* as *S. amazonicum*. A summary of the distribution, host preference and vector capacity of species in the *S. amazonicum*-group is given in Table 2.

**Table 2** The distribution, host preference and vector capacity of species in the *S. amazonicum*-group (based on a report by the World Health Organization, 1979).

Species	Distribution	Host preference		Vector of	
		Man	Animal	<i>M. ozzardi</i>	<i>O. volvulus</i>
<i>S. amazonicum</i>	Brazil	+	+	+	—
	? Colombia	+	—	+	—
<i>S. chaquense</i>	Argentina	? +	—	—	—
<i>S. minusculum</i>	Brazil	+	—	—	+
	Colombia	+	—	+	—
	Guyana	+	—	—	—
	Venezuela	+	—	—	+
<i>S. quadrifidum</i>	Brazil	—	+	—	—
<i>S. sanguineum</i>	Colombia	+	—	+	—
<i>Simulium</i> sp. (Barbacoas)	Venezuela	?	?	—	—
<i>Simulium</i> sp. (Madeira)	Brazil	+	—	+	—
	Colombia	+	—	+	—

## Taxonomic notes on other species in the *S. amazonicum*-group

### *Simulium chaquense* Coscarón

*Simulium chaquense* Coscarón, 1971: 33. Holotype ♀, ARGENTINA: Chaco, Arroyo Zapirain, approx. 27°S 59°W, ex pupa (MLP) [examined]. [Coscarón (1971) gives the type-locality as Formosa Province. Arroyo Zapirain is a stream running through a small farm crossed by Route 11 on the border of Chaco and Formosa Provinces; the actual collection site is in Chaco Province (Coscarón, pers. comm.).]

This is a recently described species only known from one locality in northern Argentina. It has most of the characters of the *S. amazonicum*-group but is exceptional in having two distal spines on the male distimere whereas all other species in the group possess one. The extent to which *S. chaquense* feeds on man is uncertain but it does not appear to be of medical importance.

#### MATERIAL EXAMINED

*Simulium chaquense* Coscarón, holotype ♀ (ex pupa), ARGENTINA: Chaco, Arroyo Zapirain, 14.vii.1971 (Coscarón) (MLP).

ARGENTINA: 5 ♀, 2 ♂ (ex pupae), data as for holotype (2 ♀, 1 ♂ in BMNH; 3 ♀, 1 ♂ in MLP); 1 ♀ (ex pupa), Corrientes, Arroyo Santa María, 9.vii.1971 (Coscarón) (MLP) (all paratypes of *Simulium chaquense* Coscarón).

### *Simulium minusculum* Lutz

*Simulium minusculum* Lutz, 1910: 253. Syntypes ♀, BRAZIL: Minas Gerais, Lassance, Rio das Velhas (IOC) [examined]. [Synonymised with *S. amazonicum* Goeldi by Lutz, 1917: 64; resurrected from synonymy by Cerqueira & Nunes de Mello, 1964: 102.]

*Simulium minusculum*: Malloch, 1912: 653. [Incorrect subsequent spelling.]

[*Simulium amazonicum* Goeldi sensu Lutz, 1917: 63 and subsequent authors except Smart, 1942: 46 and Cerqueira & Nunes de Mello, 1964: 102 (♀ only). Misidentifications.]

? *Simulium roraimense* Nunes de Mello, 1974: 45. Holotype ♂, BRAZIL: Roraima, Cachoeira, R. Cauamé, ex pupa (INPA) [not examined, unlocated in type-depository].

*S. minusculum* is the common Brazilian species of lowland tropical forest that has been most often confused with *S. amazonicum*. The three most significant contributors to the morphology and medical importance of *S. minusculum* (as *S. amazonicum*) have been Lutz, Porto and Rassi. Each is dealt with separately.

LUTZ. The major Brazilian contribution to the morphology of the species that we regard as *S. minusculum* in this paper was made by Lutz who believed that he was dealing with *S. amazonicum*. Because of the rather involved nature of Lutz's taxonomic studies on *S. minusculum* and allied species, a summary of his work covered by his 1909, 1910 and 1917 papers is given followed by our interpretation of his findings.

His first reference (Lutz, 1909) to *S. amazonicum* simply quoted Goeldi's original description (1905) and described a new species, *S. exiguum* (Lutz, not Rouband) from females collected at the R. Grande, near Franca in São Paulo state. This was followed in 1910 by a description of a new species, *S. minusculum*, from females sent in alcohol by Chagas from Lassance, Minas Gerais. In the same paper he compared these with specimens, also sent in alcohol, from the Madeira-Mamoré region in Rondônia and judged them to be conspecific, but at the same time noting differences in the pruinose pattern of the female scutum due, possibly, to different storage times in alcohol of the material from these two localities. He also noted that, apart from leg coloration, *S. minusculum* closely resembles *S. amazonicum*, and suggested their possible synonymy. Pupae with four gill filaments, collected from a stream near the Madeira-Mamoré railroad and assumed to be *S. minusculum*, were described. Having examined more specimens of '*S. amazonicum*' from localities in the Territory of Rondônia, states of Bahia and Minas Gerais, as well as the river Tocantins (state not indicated), Lutz (1917) observed that the angle of incident light affects the form of the pruinose scutal pattern and that this pattern is altered by alcohol preservation and hence is only clear in fresh or dried material. He also noted that darkening of tissues, particularly in the legs, occurs following a blood meal. He therefore attributed the differences previously noted between *S. minusculum* and *S. amazonicum* to these causes, sank the former species as a synonym of *S. amazonicum* and suggested the possible synonymy of *S. exiguum* (Lutz, not Roubaud) with this species. Furthermore, he sank *S. nitidum* Malloch, from Huancabamba, Peru, as a synonym of *S. amazonicum* after examining specimens but not the 'type' from this locality. As his previous description of '*S. amazonicum*' in 1910 was based on spirit material, Lutz (1917) redescribed both the female and pupa of '*S. amazonicum*' from fresh material obtained by mass rearing six-filamented pupae collected at Sant'Anna de Sobradinho on the R. São Francisco above Joazeiro, Bahia. The four-filamented pupa collected at Madeira-Mamoré and previously attributed (Lutz, 1910) to *S. amazonicum* was given the name *S. quadrifidum*.

The synonymy (Lutz, 1917) of *S. minusculum* with *S. amazonicum* cannot be upheld. Apart from coloration Lutz's main criterion for erecting *S. minusculum* in 1910 was its small size (body length 1.00–1.25 mm). Thirteen of Lutz's original series of pinned syntypes from Lassance, Minas Gerais (nos. 12552–12555, 12558) have been examined and the body length (eight specimens measured) found to range from 1.4–2.1 mm; the scutal pattern, only discernible in the better preserved specimens, is distinct from that of *S. amazonicum* but similar to that of the *S. sanguineum* holotype, with which the specimens were compared. Three of Lutz's slides were also examined: no. 12001 with two six-filamented pupae from Madeira-Mamoré, labelled as *S. amazonicum* but not referred to in any of his papers, no. 12005 with a male and pupal pelt, and no. 12007 with eight six-filamented pupae from Sant'Anna do Sobradinho labelled as *S. amazonense* (error for *S. amazonicum* used by Lutz, 1917), which in 1917 he considered conspecific with the *S. minusculum* specimens from Lassance. In their redescription of *S. amazonicum* Cerqueira & Nunes de Mello (1964) referred to Lutz's material and revalidated *S. minusculum* for the specimens reared from six-filamented pupae collected at Sant'Anna do Sobradinho as well as the females from the type-locality at Lassance, but considered the females collected at Madeira-Mamoré as *S. amazonicum*. Until reared material is available from Lassance it is convenient to accept Cerqueira & Nunes de Mello's revalidation of *S. minusculum* for Lutz's material collected from the first two localities as well as the females and six-filamented pupae in the Lutz collection from Madeira-Mamoré. Cerqueira & Nunes de Mello regarded material from the last locality as *S. amazonicum* but they had confused three species of the *S. amazonicum*-group in their 1964 redescription. Our collections of six-filamented pupae from the R. Jacy Parana in the Madeira-Mamoré region gave rise to females indistinguishable from Lutz's *S. minusculum* from Lassance. As *S. sanguineum* s.str., which at present is only distinguishable from *S. minusculum* by

its eight-filamented pupa, has not been recorded in Brazil, females from Brazil without associated pupal pelts that key out to *S. sanguineum* or *S. minusculum* are provisionally regarded as *S. minusculum*. *S. chaquense* and *S. roraimense*, also inseparable from *S. minusculum* in the female, are also excluded due to the restricted distribution and the uncertainty surrounding the validity of the species respectively. The main vector of *O. volvulus* at Toototobi, tentatively determined as *S. sanguineum* (Shelley *et al.*, 1979) and subsequently, when the pupa of *S. sanguineum* became known, as *S. sanguineum* s.l. (Shelley *et al.*, 1980) until it could be assigned to a species, now falls provisionally under *S. minusculum*.

PORTO. Porto (1939) accepted Lutz's synonymy (1917) of *S. minusculum* with *S. amazonicum* as he believed the morphological variations described by Lutz in his material not to be interspecific. Although Porto (1939) did not see type-material of *S. amazonicum* he redescribed this species from females collected in the states of Mato Grosso and Bahia, which are now in the Public Health Faculty of São Paulo University (see Forattini *et al.*, 1971). Vulcano examined them as well as additional specimens from other states in 1943, and concluded that all were two infra-specific taxa of *S. amazonicum* which she labelled with (unpublished) manuscript varietal names. The senior author examined this material and recognized three species among the pinned specimens, none of which is *S. amazonicum*: specimen nos. 4345–4348 and 4350–4352 from Rio das Mortes, Mato Grosso as well as no. 1157 from Rio de Cobre, Salvador, Bahia were provisionally determined as *S. minusculum*; specimen nos. 4330–4340 from Rio das Mortes, Mato Grosso are of an undetermined species. The additional material determined as *S. amazonicum* by Vulcano and also included in the Forattini *et al.* catalogue (1971) are as follows: specimen nos. 4554–4555 from Acre state are now provisionally determined as *S. minusculum*; specimen nos. 4309–4312 from Porto Cabral, São Paulo, 4313–4316 from Rio Claro, São Paulo, 4321–4323 from Dourados, Mato Grosso and 4324–4326 from Juquia, São Paulo and Itatiaia and Teresopolis, Rio de Janeiro are now determined as *S. incrustatum*.

RASSI. Rassi's two publications, resulting from a visit in 1974 to the Brazilian onchocerciasis foci, are important as they refer to *S. amazonicum* as a vector of *O. volvulus* in Brazil. The flimsy evidence provided by Rassi *et al.* (1975) for this incrimination has been discussed elsewhere (Shelley *et al.*, 1979). In his earlier paper Rassi (1974) refers to *S. amazonicum* as a vector but acknowledges the difficulties involved in the identification of this species, which he considers to be a complex. He recognizes two species of this 'complex', which he separates on female size, to be widespread in the Brazilian Amazon, including the onchocerciasis foci. The commoner and smaller species he refers to as *S. amazonicum* Goeldi Lutz (1910, 1917), which he maintains corresponds to *S. minusculum* and *S. quadrifidum* as described by Lutz, and the larger as *S. amazonicum* Goeldi as described by its original author. A redescription of the smaller species is given and it is this species that Rassi (1974) and Rassi *et al.* (1975) believe to be the vector of *O. volvulus* in Brazil. In this redescription based on material collected at Toototobi, females were found to have a body length of 1.0–1.5 mm compared to Goeldi's reference to 2.06 mm body length for *S. amazonicum*. Pupae with four gill filaments, assumed to be of the smaller species, were found by Rassi (1974) in the Toototobi river. He also assumes that the larger species, of which no body length measurements or description are given, has a six-filamented pupa, presumably based on Lutz's description (1917) of '*S. amazonicum*'.

We made collections of man-biting black-flies as well as larvae and pupae from the river Toototobi and surrounding forest streams on eight occasions over three years in both wet and dry seasons, but were unable to find the two species of the '*S. amazonicum* complex' detailed by Rassi (1974). Only one anthropophilic species of the *S. amazonicum*-group, now provisionally assigned to *S. minusculum* until the status of *S. roraimense* is confirmed, was found by us at this locality where it was shown to be a vector of onchocerciasis (Shelley *et al.*, 1979). This was the most common black-fly in the area and showed considerable variation in female body length in February 1976: 1.2–2.0 mm for dried females (101 specimens measured) and 1.7–2.7 mm for females preserved in alcohol (210 specimens measured) with a normal distribution for body length. A zoophilic species, *S. quadrifidum*, was reared from four-filamented pupae collected in the

river Toototobi. It is apparent that Rassi (1974) misidentified both *S. minusculum* and *S. quadrifidum* as *S. amazonicum*. The vector of *O. volvulus* in the Upper Orinoco region of Venezuela, adjacent to the Toototobi in Brazil, indicated as *S. amazonicum* by Rassi *et al.* (1977) has probably been similarly misidentified.

Variations in the scutal pattern of female *S. minusculum* collected by us from different localities in Amazonia as well as in Lutz's syntype-series from Minas Gerais have been noted. Due to the paucity of reared material from these localities and the total lack of such material from the type-locality, it cannot at this stage be decided whether *S. minusculum* is a polymorphic species or whether more than one species is being assigned to this name. A further complication is seen in the case of *S. roraimense*. Although we have examined reared topotypes the only means of separating this species from *S. minusculum* is by the form of the male scutal pattern. The validity of the presence or absence of merging of the three scutal vittae as an interspecific character for separating these two species is not known. As this is the only apparent difference and since *S. sanguineum* males show variation in the extent of merging of these vittae (Tidwell *et al.*, 1981), *S. roraimense* is tentatively treated as a synonym of *S. minusculum* in this paper. This may be confirmed only when reared *S. minusculum* topotypes are available and more reared material has been collected to examine the degree of variation in this character.

#### MATERIAL EXAMINED

*Simulium minusculum* Lutz, 16 ♀ syntypes, **Brazil**: Minas Gerais, Lassance, Rio das Velhas. 17°53'S 44°34'W 3.iv.1910 (*Chagas*) (IOC, nos. 12552, 12554 & 12558) [labelled by Lutz as *S. minusculum*].

**Brazil**: 2 ♀, 1 ♂, 1 ♂ (ex pupa), 8 pupae, Bahia, Sant'Anna do Sobradinho, R. São Francisco, 9°23'S 40°50'W, 25.vi.1912 (*Lutz*) (IOC, nos. 12005, 12007, 12461, 12462) [labelled by Lutz as *S. amazonicum*, *S. amazonense* or *S. minusculum (amazonicum)*]; 2 pupae, Rondônia, Madeira-Mamoré region, R. Madeira. 1910 (*Cruz*) (IOC, no. 12001) [labelled by Lutz as *S. amazonicum*]; 5 ♀, 5 ♂ (ex pupae), Madeira-Mamoré region, Jacy Parana, R. Jacy Parana, 9°15'S 64°24'W, 16.x.1978 (*Shelley & Luna Dias*) (BMNH & IOC); 34 ♀, 34 ♂ (ex pupae), Roraima, Cachoeira Bem Querer, R. Branco, 1°58'N 61°00'W, 16.i.1979 (*Shelley & Luna Dias*) (BMNH & IOC); 4 ♂ (ex pupae), Northern Perimeter Road (BR 210), R. Ajarani 1, 2°01'N 61°28'W, 16.i.1979 (*Shelley & Luna Dias*) (BMNH & IOC); 1 ♀ (ex pupa), 8 ♀, 8 ♂ (ex pupae), Boa Vista-Venezuela road, R. Uraricoera, 3°03'N 60°30'W, 20.i.1979 (*Shelley & Luna Dias*) (BMNH, IOC); 1 ♀ (ex pupa), near Boa Vista, R. Cauamé, 2°52'N 60°38'W, 16.viii.1977. (*Shelley*) (BMNH); 4 ♀, 5 ♂ (ex pupae), Amazonas, R. Ituxi, 7°18'S 64°52'W, 30.ix.1978 (*Shelley*) (BMNH, IOC). **Guyana**: 2 ♀, 2 ♂ (ex pupae), Bonfim, R. Takutu. 3°21'N 59°50'W, 13.i.1975 (*Davies*) (BMNH). **Venezuela**: 2 ♀, 3 ♂ (ex pupae), Bolivar, R. Cuyuni, between Guyana & Anacoco [no collection date] (*Ramirez Pérez*) (BMNH).

The following material provisionally placed as *S. minusculum* corresponds to the description of *S. roraimense* given by Nunes de Mello (1974).

**Brazil**: 27 ♀, 15 ♂ (ex pupae), Roraima, Cachoeira, R. Cauamé [type-locality of *S. roraimense*], 2°52'N 60°39'W, 19.i.1979 (*Shelley & Luna Dias*) (BMNH, IOC); 13 ♀, 18 ♂ (ex pupae), Catrimani Mission Post, R. Catrimani, 1°44'N 62°17'W, 9.i.1977 & 13.i.1979 (*Shelley*) (BMNH, IOC); 1 ♀, 1 ♂ (ex pupae), Amazonas, Toototobi Mission Post, R. Toototobi, 1°47'N 63°37'W, 2.xii.1976 (*Shelley*) (BMNH).

#### *Simulium quadrifidum* Lutz sp. rev.

*Simulium quadrifidum* Lutz, 1917: 66. Syntypes ♂ and pupae, **BRAZIL**: Rondônia, Madeira-Mamore region (IOC) [examined]. [Here resurrected from synonymy with *S. amazonicum* Goeldi (Cerqueira & Nunes de Mello, 1964).]

This name was proposed by Lutz (1917) for the four-filamented pupae from the Madeira-Mamoré region of Rondônia Territory that he had previously assigned to *S. amazonicum* in 1910. The species is listed in all the earlier catalogues of the region's Simuliidae (Pinto, 1932; Smart, 1945; Vargas, 1945) but is sunk as a synonym of *S. amazonicum* by Cerqueira & Nunes de Mello (1964). Vulcano (1967) omits this synonym in her catalogue. We have reared adults from four-filamented pupae collected from streams in the Madeira-Mamoré region, as well as some of the localities sampled by Cerqueira & Nunes de Mello for their 1964 paper, and

compared them with Lutz's material; no differences were apparent and we consider our specimens to be true *S. quadrifidum*. The slide preparation of a male (no. 12310) and four pupae (nos. 12307–12309) of *S. quadrifidum* made by Lutz have syntypic status.

The synonymy of *S. quadrifidum* with *S. amazonicum* and the resurrection of *S. minusculum* contained in Cerqueira & Nunes de Mello's paper (1964) have already been discussed and it therefore only remains to decide on which species these authors were basing their redescription of '*S. amazonicum*'. In our own collections from the three streams at Tefé indicated in the 1964 paper only four-filamented pupae were found and these were reared to adults. Both pupae and adults were readily distinguishable from *S. amazonicum* topotypes. Pupae were also indistinguishable from those described by Cerqueira & Nunes de Mello (1964) and determined by them as *S. amazonicum*, and were conspecific with *S. quadrifidum* syntypes. Our collections from many other Amazonian localities showed *S. amazonicum* to breed almost exclusively in large rivers whereas *S. quadrifidum* is found principally in small shaded forest streams, as are those at Tefé. It is therefore probable that the larvae and males described and figured by Cerqueira & Nunes de Mello (1964) as *S. amazonicum* are also in fact *S. quadrifidum* that have been misidentified. It is also not known whether their description and figures of the female of *S. amazonicum* are based on correctly identified specimens since we have found both *S. amazonicum*-like and *Simulium* sp. (Madeira) females biting man at Tefé. As previously mentioned by Shelley *et al.* (1980) specimens of the latter species misidentified as *S. amazonicum* by Cerqueira are deposited in both the BMNH and INPA collections.

#### MATERIAL EXAMINED

*Simulium quadrifidum* Lutz, 1 ♂, 4 pupae syntypes, **Brazil**: Rondônia, Madeira-Mamoré region, 1910 (Cruz) (IOC).

**Brazil**: 10 ♀, 10 ♂ (ex pupae), Rondônia, Madeira-Mamoré region, Igarapé Caracol, 9°13'S 64°20'W, 16.x.1978 (Shelley & Luna Dias) (BMNH & IOC); 6 ♀, 1 ♂ (ex pupae), Madeira-Mamoré region, Jacy Parana, R. Jacy Parana, 9°15'S 64°24'W, 16.x.1978 (Shelley & Luna Dias) (BMNH, IOC); 1 ♂ (ex pupa), Roraima, Km 104, Northern Perimeter Road (BR 210), R. Ajarani 2, 1°56'N 61°58'W, 16.i.1979 (Shelley & Luna Dias) (BMNH); 2 ♀, 1 ♂ (ex pupae), stream at Km 96, Northern Perimeter Road (BR 210), 1°57'N 61°53'W, 16.i.1979 (Shelley & Luna Dias) (BMNH, IOC); 4 ♀ (ex pupae), stream at Km 211, Northern Perimeter Road (BR 210), 1°20'N 63°10'W, 12.i.1979 (Shelley & Luna Dias) (BMNH, IOC); 4 ♀, 3 ♂ (ex pupae), stream near Cachoeira Bem Querer, R. Branco, 1°58'N 61°00'W, 29.iv.1979 (Crosskey & Shelley) (BMNH); 11 ♀, 7 ♂ (ex pupae), Amazonas, Toototobi Mission Post, R. Toototobi, 1°47'N 63°37'W, 26.ii.1976, 11.iii.1976, 3.xii.1977 (Shelley) & 14.viii.1976 (Pinger) (BMNH, IOC); 10 ♀, 8 ♂ (ex pupae), Igarapé Tarumazinho (near Manaus), 2°58'S 60°04'W, 28.x.1976 (Pinger) & 2.v.1979 (Crosskey & Shelley) (BMNH, IOC); 2 ♀, 1 ♂ (ex pupae), Feijoa, Igarapé São Jorge (R. Solimões), 4°10'S 69°25'W, 3.x.1978 (Shelley & Luna Dias) (BMNH, IOC); 29 ♀, 26 ♂ (ex pupae), Tefé, R. Bauana, 3°29'S 64°58'W, 10.x.1978 (Shelley & Luna Dias) (BMNH, IOC); 11 ♀, 7 ♂ (ex pupae), Tefé, Igarapé Repartimento, 3°22'S 64°43'W, 22.vii.1976 (Shelley) (BMNH, IOC); 22 ♀, 13 ♂ (ex pupae), Bom Lugar, R. Purus, Igarapé Escondido, 8°42'S 67°22'W, 17.xi.1977 (Shelley) (BMNH, IOC); 1 ♀ (ex pupa), R. Ituxi, 7°18'S 64°52'W, 30.ix.1976 (Shelley) (BMNH); 39 ♀, 13 ♂ (ex pupae), Capacini, R. Purus, 7°18'S 64°58'W, 25.ix.1976 (Shelley) (BMNH, IOC).

#### *Simulium sanguineum* Knab

*Simulium sanguineum* Knab, 1915: 279. Holotype ♀, **Colombia**: Chocó, Boca de Arquia, R. Atrato (BMNH) [examined].

This species is only known from northern Colombia where it attacks man. Little is known of its distribution due to the previous confusion with *S. amazonicum*. It is not thought to occur in the tropical forests of southern Colombia where *S. minusculum* is present.

#### MATERIAL EXAMINED

*Simulium sanguineum* Knab, holotype ♀, **Colombia**: Chocó, Boca de Arquia, R. Atrato, 6°14'N 76°44'W, v.1914 (Balfour) (BMNH).

**Colombia**: 1 ♀, data as for holotype (USNM) (paratype of *Simulium sanguineum* Knab); 9 ♀, 1 ♀ (ex pupa), 7 ♂, 3 pupae, R. Tagachi, near R. Atrato, 12.ix.1978 (Tidwell) (BMNH).



*Simulium* sp. (Barbacoas)

Reared specimens from Barbacoas, Venezuela in the BMNH collection could not be assigned to any named species in the *S. amazonicum*-group. Although in poor condition females resemble *S. amazonicum* while males are nearer *S. sanguineum* or *S. roraimense*. The pupal gill with its six filaments in combination with the adult characters separates this material from the other species of the group. Further collection of material is required before the status of this species can be clarified.

## MATERIAL EXAMINED

**Venezuela:** 3 ♀, 5 ♂ (ex pupae), Guárico, Barbacoas, 9°31'N 66°57'W [no collection date] (*Ramírez Pérez*) (BMNH).

*Simulium* sp. (Madeira)

This species, as yet undescribed, is found along the river Madeira and river Solimões in Brazil. Cerqueira & Nunes de Mello (1964) were probably dealing with a mixture of this species and *S. amazonicum* in their redescription of female *S. amazonicum*. *Simulium* sp. (Madeira) has been shown to be a vector of *M. ozzardi* in Brazil (*Shelley et al.*, 1980, as *Simulium* n. sp.).

## MATERIAL EXAMINED

**Brazil:** 6 ♀, 6 ♂ (ex pupae), Rondônia, Cachoeira Teotônio, R. Madeira, 8°50'S 64°05'W, 10.x.1978 (*Shelley & Luna Dias*) (BMNH, IOC); 1 ♀, Amazonas, Codajás, R. Solimões, 3°55'S 62°00'W, 21.vii.1958 (*Antonio*) (BMNH) [identified by Cerqueira as *S. amazonicum*].

Other species previously confused with *S. amazonicum**Simulium lutzi* Knab

*Simulium exiguum* Lutz, 1909: 141. Syntypes ♀, BRAZIL: São Paulo, Franca, R. Grande (IOC) [examined]. [Junior primary homonym of *Simulium exiguum* Roubaud, 1906.] [First recovered from synonymy with *S. amazonicum* Goeldi and correctly cited as *S. lutzi* Knab by Pinto, 1932: 705; recovery here confirmed after examination of syntypes.]

*Simulium exigum*: Lutz, 1910: 234. [Incorrect subsequent spelling.]

*Simulium minutum* Surcouf & Gonzalez-Rincones, 1911: 290. [Replacement name for *Simulium exiguum* Lutz, 1909.] [Junior primary homonym of *Simulium minutum* Lugger, [1897].]

*Simulium lutzi* Knab, 1913: 155. [Replacement name for *Simulium minutum* Surcouf & Gonzalez-Rincones, 1911.]

*Simulium luzti*: Pinto, 1932: 705. [Incorrect subsequent spelling.]

In 1917 Lutz suggested the possible synonymy of *S. exiguum* Lutz with *S. amazonicum*, apparently being unaware of either Roubaud's species of this name or of Knab's new name. This synonymy was followed in the catalogues of Smart (1945), Vargas (1945) and Vulcano (1967), but Pinto (1932) preferred to maintain *S. lutzi* as a valid name in his catalogue of Central and South American Simuliidae.

Two pinned females in Lutz's collection (no. 12519) from R. Grande on the Minas Gerais/São Paulo state border were badly greased and consequently no scutal pattern was discernible. These have now been cleaned in 'Cellosolve'—both are in poor condition, but in one specimen the thorax appears black with silver pruinose lateral and posterior borders and fits the description of *S. lutzi* given by Lutz (as *S. exiguum*) in his 1910 paper. However, four other specimens (no. 12459) from the same locality are now placed as *S. minusculum*. Apparently Lutz assumed that all specimens from the R. Grande were conspecific even though the scutal patterns of some were obscured due to greasing. Three further females mounted on slide no. 12520 and labelled as *S. exiguum* Lutz have cerci distinct from those of *S. exiguum* Roubaud, but are similar in form to species in the *S. amazonicum*-group to which they possibly belong. We are therefore unable to support Lutz's synonymy of *S. lutzi* (as *S. exiguum* Lutz) with *S. amazonicum* and maintain *S. lutzi* for the two specimens numbered 12519.

Knab's description of *S. lutzii* (1913), based on material sent by Urich from Trinidad, does not agree with either of Lutz's descriptions (1909; 1910 as *S. exiguum* Lutz) nor with the syntype (no. 12519) mentioned above, but suggests that he may have been dealing with *S. incrustatum* or a closely related species because of his reference to two large triangular iridescent white spots on the anterior scutal margin. The single specimen in the BMNH which is one of the series sent to Knab has been examined and placed as *S. incrustatum*.

#### MATERIAL EXAMINED

*Simulium exiguum* Lutz, 2 ♀ syntypes, **Brazil**: São Paulo, near Franca, R. Grande, 23.ix.1903, (Lutz) (IOC).

#### *Simulium metallicum* Bellardi

*Simulium metallicum* Bellardi, 1859: 14; 1861: 214. Type(s) ♂, **MEXICO**: locality unspecified (MNHN) [not examined, presumed lost].

*Simulium nitidum* Malloch, 1912: 652. Holotype ♀, **PERU**: Huancabamba (USNM) [examined]. [Synonymised with *S. amazonicum* Goeldi by Lutz, 1917: 64.]. **Syn. n.**

As previously mentioned Lutz based his synonymy of *S. nitidum* with *S. amazonicum* on examination of material from Huancabamba but did not consult the holotype of *S. nitidum*. This has now been done and the species is undoubtedly a synonym of *S. metallicum*.

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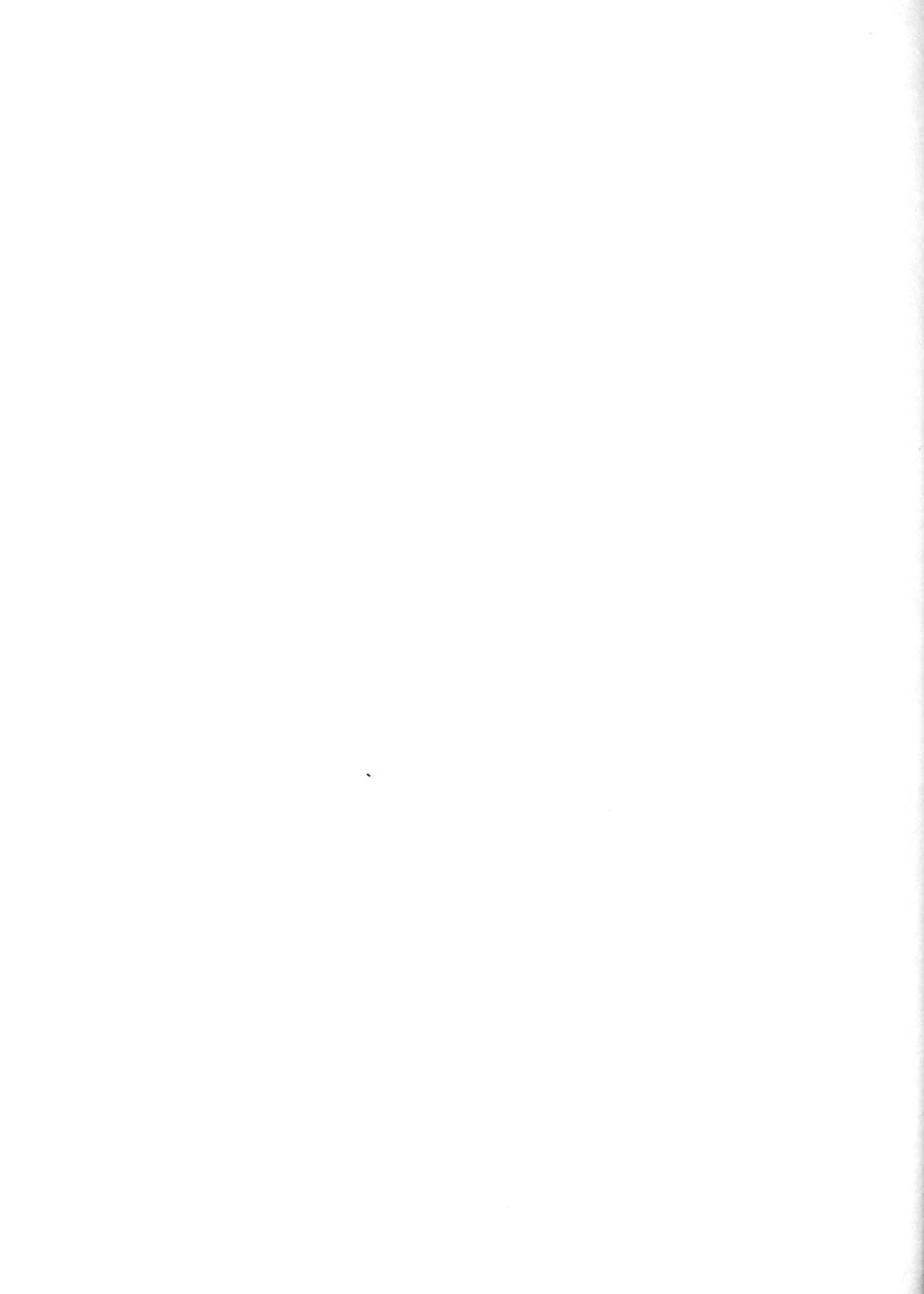
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**Bulletin of the British Museum (Natural History)**

**Entomology series Volume 37 Number 6, 1978**

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### **A re-classification of the Simuliidae (Diptera) of Africa and its islands.**

By R. W. Crosskey

**Bulletin of the British Museum (Natural History) Entom. Supp. No 14, 1969**

196 pp, 1 plate, 331 text figures, 11 maps, 4to paper, £10.50.

### **Simuliidae of the Ethiopian Region**

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1953 (reprinted 1968), v + 224 pp, 1 plate, 68 text figures, 8vo boards, £8.80.

## **Titles to be published in Volume 44**

**The taxonomy, biology and medical importance of *Simulium amazonicum* Goeldi (Diptera : Simuliidae), with a review of related species.**

By A. J. Shelley, R. R. Pinger & M. A. P. Moraes.

**A revision of the genus *Belonogaster* de Saussure (Hymenoptera : Vespidae).**

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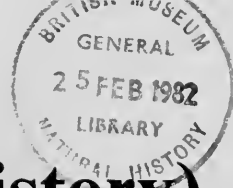
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By J. Mark Ritchie.



# Bulletin of the British Museum (Natural History)



A revision of the genus *Belonogaster*  
de Saussure (Hymenoptera: Vespidae)

O. W. Richards

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# A revision of the genus *Belonogaster* de Saussure (Hymenoptera: Vespidae)



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## Synopsis

This paper is a revision of the species of *Belonogaster*, a genus of social wasps which is almost confined to Africa and Madagascar, though a few species are found in Arabia and two extend as far as India. There has been no comprehensive paper on the group since du Buysson's monograph (1909), which has not been found to make identification of species very easy. There now seem to be 69 species of which 10 are confined to Madagascar and 31 are new; four of the species are each represented by two subspecies. Keys are provided to the species and subspecies. Twenty-eight lectotypes and seven specific synonyms are newly established.

## Introduction

*Belonogaster* is a large, almost entirely African genus of social wasps whose taxonomy has been little studied since du Buysson's revision in 1909. Those who have tried to use du Buysson's keys for identifying their specimens find that they are unsatisfactory, partly, I think, because there are many more species than he recognized but also because their identification is unusually difficult. In my experience nearly all the characters, even those which seem quite diagnostic in most specimens, prove variable in others. Possibly additional material, particularly series known to be derived from single nests, would solve some of these problems, but at the moment not all identifications, especially of the females, can be made with complete confidence. This is especially the case if the characters of the pubescence and tomentum have been obscured by bad preservation. On the whole the males have more distinctive characters than the females, but they are also considerably rarer in collections, the ratio being about 1 : 5.

The genus is almost confined to Africa south of the Sahara where it is a highly characteristic member of the fauna (Bequaert, 1918: 230). A few species are established in Arabia and a few specimens, apparently strays, come from North Africa. One species, *B. indica*, seems to be peculiar to India, though specimens with a reliable Indian locality label do not seem to exist in European collections. Recently, the common African species, *B. juncea*, has also been found in India. There is a small, highly distinctive group of species in Madagascar. I believe these are all peculiar to that island, though it is just possible that one or two African species have been introduced (as indeed they have into England, though not in that case becoming established). The African fauna seems to consist of a few common species which are widely spread and a large

number which are at present known from a few, often only one or two specimens, as shown below.

Number of specimens	Number of species or subspecies
1	16
2-10	16
11-40	18
41-200	17
201-649	3
650-770	2

*B. leonina* is exceptional in being apparently generally rare, but quite common in a small area of the Republic of Congo. Species represented by a single specimen have only been described when the characters are unusually distinct.

The main basis of the present work was the very large collection (about 2000 specimens) of the British Museum (Natural History) which I was allowed to study owing to the kindness of Dr L. A. Mound. Dr S. Kelner-Pillault was good enough to allow me to study the collection in the Muséum national d'Histoire Naturelle, Paris, which includes some of the de Saussure and most of du Buysson's types, as well as a collection recently made by herself in the Republic of Congo. Dr Arnold Menke obliged me by sending all the specimens in the National Museum of Natural History, Washington, and Prof. J. van der Vecht with the kind permission of the director brought me all the specimens from Leiden, including one holotype. Dr M. de V. Graham arranged the loan of about 500 specimens from the University Museum, Oxford. Dr P. Oosterbroecke sent 570 specimens from the Instituut voor Taxonomische Zoölogie, Amsterdam.

The types in this genus seem to have had an unfortunate history. Before 1950 none of the authors of new species designated holotypes; unless the form happens to have been described from a single specimen one has to look for a set of syntypes and then designate a lectotype. However, in a number of species the types do not seem to be in the museum from whose collection the author described them. I am very indebted to the following gentlemen who lent type-material from the collections of which they are in charge.

Dr Max Fischer, Naturhistorisches Museum, Vienna (Kohl's types); Dr L. Besuchet, Muséum d'Histoire Naturelle, Geneva (some of de Saussure's and one of du Buysson's types); Dr E. Königsmann, Museum für Naturkunde der Humboldt-Universität, Berlin (types of Gerstaecker); Prof. W. Sauter, Entomologische Institut, Eidgenössische Technische Hochschule, Zurich (von Schulthess types); Dr Roberto Poggi, Museo Civico di Storia Naturale, Genoa (Gribodo and Guérin-Méneville types); Dr L. A. Janson, Naturhistoriska Riksmuseet, Stockholm (types of Degeer, Tullgren and P. Cameron). Unsuccessful enquiries about types were also answered by Dr P. P. d'Entrèves, Museo ed Istituto di Zoologia Sistemática dell'Università, Turin; Dr D. S. Peters, Forschungsinstitut Senckenberg, Frankfurt-am-Main; Dr Paul Dessart, Institut Royal des Sciences Naturelles de Belgique, Brussels.

The distribution I give for each species is, unless otherwise stated, based on specimens I have myself examined. In general the distribution is a list of the countries (political regions) where the species are found. The names of the countries are given according to modern usage, not necessarily what was on the label, e.g. Ghana, not Gold Coast, although Fernando Po is used for Bioko.

## Depositories

ITZ, Amsterdam  
 MNHU, Berlin  
 IRSNB, Brussels  
 MHN, Geneva  
 MCSN, Genoa  
 RNH, Leiden  
 BMNH

Instituut voor Taxonomische Zoölogie, Amsterdam  
 Museum für Naturkunde der Humboldt-Universität, Berlin  
 Institut Royal des Sciences Naturelles de Belgique, Brussels.  
 Muséum d'Histoire Naturelle, Geneva  
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 Rijksmuseum van Natuurlijke Historie, Leiden  
 British Museum (Natural History), London

UM, Oxford	University Museum, Oxford
MNHN, Paris	Muséum National d'Histoire Naturelle, Paris
NR, Stockholm	Naturhistoriska Riksmuseet, Stockholm
NM, Vienna	Naturhistorisches Museum, Vienna
USNM, Washington	National Museum of Natural History, Washington
EI, Zurich	Entomologische Institut, Eidgenössische Technische Hochschule, Zurich

***BELONOGASTER* de Saussure**

*Raphigaster* de Saussure, 1853: 12. Type-species: *Vespa juncea* F., 1781: 468, by subsequent designation (Bingham, 1897: 381). [Homonym of *Raphigaster* Lepeletier, 1833.]

*Belonogaster* de Saussure, 1854: 235. [Replacement name for *Raphigaster* de Saussure.]

According to the *International Code of Zoological Nomenclature*, 1964 (Article 30(a) (i)), names ending in *gaster* are feminine. All authors except Dalla Torre (1894) have treated *Belonogaster* as masculine.

Species elongate and usually rather large, though slender. Antennae in ♂ with 12 segments, the last 4 more or less modified and spirally rolled, in ♀ with 11 segments. Clypeus in male usually white- or yellow-marked, sometimes pointed below but quite often roundly produced or even subtruncate; in ♀ usually acutely pointed below and only occasionally yellow-marked, sometimes less acutely produced and in one species rounded. Maxillary palpi with 5 segments, labial palpi with 3, the third with two long stout bristles and sometimes another shorter one. Malar space moderately long. Pronotum without an acute transverse keel, no lateral fovea, lateral lobe narrow and little produced but marked off by a distinct furrow. Anterior spiracular entrance wide but little raised, followed by a low, forwardly curved raised keel. Mesopleuron with no dorsal episternal furrow, no or only a very rudimentary scrobe or scrobal furrow. Propodeal orifice subcircular, valves in side view more or less rounded; orifice preceded by a posterior subtriangular depression from which an impressed line usually leads upwards and forwards, if complete ending in a small but often quite deep anterior depression. Hind wing with the anal lobe small. Gastral segment 1 forming a petiole which is at least relatively long and narrow, segment 2 also narrowed to an anterior stalk which is often quite long and narrow. Male aedeagus serrate beneath from ventral process to near its tip.

Larval head without bristles, clypeus very transverse, at least four times as wide as high, labrum trilobed, ventral margin with numerous, strong, black, angular papillae; both labrum and clypeus capable of compression from side to side and protrusion, as in *Mischocyttarus* de Saussure. Mandible with a long, acute dorsal tooth and a shorter, ventral preapical one. First thoracic spiracle, though not very large and only two-thirds as big as the antennal ring, yet twice as large as the other spiracles.

The nest is a single, pedunculate, exposed comb, the cells usually forming a compact more or less oval group but in the Madagascan *B. brevipetiolata* they are arranged in a long thread (du Buysson, 1909: pl. 6, fig. 1). In the usual type of comb there are often a few very large completed or nearly completed cells round whose bases are grouped many very short cells. When the large cells are vacated much of their material seems to be re-used in new cells. The colonies are social, though usually not very large. The worker caste seems to differ little from the queens and only statistically (Richards, 1969; Pardi & Piccioli, 1970). The males are much more distinct. According to du Buysson (1909: 211) the prey consists mainly of caterpillars. Other notes on the biology will be found in Roubaud (1916), Pardi (1977), Pardi & Piccioli (1978), and Piccioli (1968). The genus seems to be rather uniform and I have not found it possible to divide it into subgenera. Even species-groups are often rather indefinite and intergrade.

**Key to species of *Belonogaster* (excluding Madagascar, see p. 46)****Females**

No females have been seen of *B. hirsuta* sp. n., *B. libera* sp. n., *B. nitida* sp. n., *B. punctata* sp. n., *B. rothkirchi* von Schulthess, *B. ugandae* sp. n.

- 1 Clypeus below regularly rounded and a little produced over its whole width. Gastral petiole with proximal half wider than distal half, stalk of second gastral tergite as long as broad.  
Ferruginous, spot on frons; mesosoma, gastral tergites 3–4, black, second tergite with 2

- large comma-shaped yellow spots. Legs ferruginous. Wings light ferruginous, tip fuscous, length 18.0 mm. Natal . . . . . *B. acaulis* sp. n. (p. 61)
- Clypeus below strongly pointed and produced. Gastral petiole with distal half as wide or wider than proximal half, stalk of second tergite at least as long as broad (except *B. turgida*) . . . . . 2
- 2(1) Part of gastral petiole from the spiracles to apex not more than 1.5 times as long as broad. Stalk of second gastral tergite hardly developed, much wider than long. Gastral tergites 2–4 each with two creamy white spots. Fernando Po . . . . . *B. turgida* Kohl (p. 60)
- Gastral petiole with part behind the spiracles much longer. Stalk of second gastral tergite at least as long as broad . . . . . 3
- 3(2) Gena nearly twice as wide as eye in profile. . . . . 4  
Stalk of second gastral tergite 1.5–2.0 times as long as broad. (When in doubt try also couplet 54.) . . . . . 4
- Gena not more than 1.5 times as wide as eye in profile . . . . . 6
- 4(3) Gaster posteriorly with numerous obliquely outstanding, short pale or blackish bristles. Gastral tergite 2 usually not yellow marked (only 1 out of 15 specimens with a pair of round spots). Gena a little narrower. Stalk of second gastral tergite rather longer. Tips of wings a little darkened. (*B. brunnea* Ritsema) . . . . . 44
- Gaster posteriorly with only a few, mostly marginal, pale or black bristles. Gastral tergite 2 with a narrow transverse yellow band or much larger pale yellow comma-shaped spots. Gena a little wider. Stalk of second gastral tergite rather shorter. Tips of wings more darkened. (*B. clypeata* Kohl) . . . . . 5
- 5(4) More ferruginous, less black. Gastral tergites 3–4 dark ferruginous. Legs usually entirely ferruginous. Wings light brown, tips somewhat darkened. Propodeal hairs pale. Bristles amongst tomentum on gaster less distinct. Uganda, Zambia, Zaire, Zimbabwe, Malawi, Tanzania, Mozambique, South Africa . . . . . *B. clypeata clypeata* Kohl (p. 66)
- More black, less ferruginous. Thorax, propodeum and gastral tergites 3–4, black. Coxae and femora black. Wings, especially the tips, darkened. Propodeal hairs black. Bristles amongst the tomentum on gaster more distinct, blacker. Zaire, Angola, Uganda, Zambia . . . . . *B. clypeata fuscata* subsp. n. (p. 67)
- 6(3) Gaster on posterior tergites with short black bristles protruding amongst the pale tomentum . . . . . 7
- Gaster with no black bristles, though sometimes white or brownish ones protruding amongst the tomentum (occasionally a few fine black hairs in *B. brevitarsus*) . . . . . 22
- 7(6) Propodeum smooth, closely and finely reticulate, without striae, punctures, tomentum or hairs . . . . . 8
- Propodeum not so smooth, with at least traces of striae, punctures, tomentum and hairs . . . . . 10
- 8(7) Wings blackish, mesosoma and legs black. Mesoscutum with no tomentum but with outstanding black hairs and close, very large shallow punctures. Mid and hind femora beneath with distinct pale tomentum and greyish hairs. Stalk of second gastral tergite 1.5 times as long as broad. Wing-length 14.0 mm. Cameroun . . . . . *B. atrata* von Schulthess (p. 59)
- Wings red-brown; at most tip blackish. At least propodeum ferruginous. Mesoscutum with distinct tomentum and with small, deep or practically no punctures . . . . . 9
- 9(8) Mesoscutum with outstanding black hairs, dense punctures and dense brassy tomentum. Thorax largely, legs and much of antenna ferruginous. Mid and hind femora with short fine tomentum and numerous black bristles. Stalk of second gastral tergite 3 times as long as broad. Wing-length 17.5 mm. Nigeria . . . . . *B. aurata* sp. n. (p. 59)
- Mesoscutum with no outstanding hairs or punctures, but with appressed, brownish tomentum. Thorax, legs and antennae mostly blackish. Mid and hind femora with close pale tomentum and a few short bristles. Stalk of second gastral tergite 1.5 times as long as broad. Wing-length 14.0–16.0 mm. Liberia, Congo, Uganda . . . . . *B. levior* sp. n. (p. 58)
- 10(7) Stalk of second gastral tergite 2.0–4.5 times as long as broad; when stalk is short, the wings are black or blackish. Face not yellow-marked . . . . . 11
- Stalk of second gastral tergite 1.5–2.0 times as long as broad. Humeri and mesoscutum with very short appressed black bristles which are sometimes indistinct in *B. dubia*, which nearly always has a yellow-marked face . . . . . 15
- 11(10) Stalk of second gastral tergite 4.5 times as long as broad. Propodeum below usually with two yellow spots, surface striate with rather dense, short outstanding hairs. Mesopleuron practically not punctured. Mid and hind femora with relatively long

- black hairs beneath. Colour largely dark ferruginous, wing-length 15.0 mm. Fernando Po, Congo, Uganda . . . . . *B. kohli* Schulz (p. 53)
- Stalk of second gastral tergite not more than 3 times as long as broad. Propodeum with less dense hairs. Often differing in other characters . . . . . 12
- 12(11) Rather small species, wing-length 16.5 mm. Last segment of fore tarsus short. Hind femur beneath with many black and white bristles.  
Stalk of second gastral tergite 3 times as long as broad (cf. couplet 55). Kenya, Uganda  
 . . . . . *B. brevitarsus* sp. n. (p. 92)
- Larger species. Last segment of fore tarsus long. Hind femur with no conspicuous bristles beneath . . . . . 13
- 13(12) Black insect with purplish black wings. West Africa, Zaire, Uganda, Kenya, Zambia, Sudan, Malawi, Tanzania, Mozambique, South Africa (strays in Algeria (Tripoli), Arabia and India) . . . . . *B. juncea juncea* (F.) (p. 48)
- Wings reddish brown with tips darker . . . . . 14
- 14(13) Punctures of mesothorax often hard to see, surface with outstanding hairs and very close, silvery tomentum. Hind femora and tibiae with numerous black bristles beneath. Frons almost without black. Mesopleuron strongly punctured. Kenya, Zambia, Tanzania, Malawi, South Africa (Natal, Orange Free State), Niger . . . . . *B. somereni* sp. n. (p. 50)
- Punctures of mesothorax more distinct, surface without outstanding hairs, tomentum less dense and silvery. Hind femora and tibiae with fewer black bristles beneath. Frons with more black. Mesopleuron less strongly punctured. Kenya, Zimbabwe, Uganda, Zambia, Zaire, Angola, Tanzania, Mozambique, South Africa . . . . . *B. juncea colonialis* Kohl (p. 48)
- 15(10) Face nearly always with wide yellow side stripes. Large species.  
Antennae almost always black, at least above. Wings brown with darker tips, rarely entirely blackish, length ca 25.0 mm. Hind femora with sparse white tomentum and short fine white bristles beneath (cf. couplet 42). West Africa, Zaire and Kenya to Tanzania, Malawi, Mozambique, South Africa . . . . . *B. dubia* Kohl (p. 53)
- Face without yellow side stripes. Usually smaller and some of the other characters often different . . . . . 16
- 16(15) Large species, wings purplish black, length 23.0–27.0 mm.  
All femora with a line of dense white pile beneath. Mesoscutum with very short forward-pointing bristles. Stalk of second gastral tergite about twice as long as broad. Congo, Zaire, Angola, Zambia, Kenya, Zimbabwe, Malawi, Tanzania, Mozambique  
 . . . . . *B. vasseae* du Buysson (p. 56)
- Moderate sized species, wings brown or red-brown, tips usually darker, length 19.0–21.0 mm . . . . . 17
- 17(16) Hind femora almost quite bare beneath. Mesoscutum with scattered moderate-sized punctures and very inconspicuous brown tomentum.  
Ferruginous, including antennae, gastral tergites 3–4 black, 2–4 with yellow lateral spots. India . . . . . *B. indica* (de Saussure) (p. 58)
- Hind femora at least with distinct tomentum beneath. Mesoscutum with some fine hairs or some very short bristles . . . . . 18
- 18(17) Hind femora with distinct tomentum but no bristles beneath. Stalk of second gastral tergite about twice as long as broad.  
Mesoscutum with rather strong and numerous punctures. Antennae ferruginous. Bristles of gaster sometimes weak (cf. couplet 45), second tergite without yellow spots. Ethiopia . . . . . *B. meneliki* Gribodo (p. 52)
- Hind femora with some distinct black or paler bristles beneath. Stalk of second gastral tergite 1.5–2.0 times as long as broad . . . . . 19
- 19(18) Gastral tergite 2 with large triangular yellow spots.  
Mesoscutum with distinct punctures. . . . . 20
- Gastral tergite 2 without yellow spots.  
Antennae black or darkened above, segments 4–5 or at least 4 distinctly longer than broad . . . . . 21
- 20(19) Antennae ferruginous, segments 4–5 quadrate. No yellow spots on sternite 2 or tergites 3–4. Zimbabwe, Malawi, Tanzania, Lesotho, South Africa. (cf. couplet 32)  
 . . . . . *B. petiolata* (Degeer) (p. 71)
- Antennae black above, segments 4–5 longer than broad. Often with yellow spots on sternite 2 and sometimes on tergites 4–5.

Mesoscutum with short but dense brownish tomentum. Uganda, Kenya

- B. maculata* sp. n. (p. 71)
- 21(19) Hind femora beneath with tomentum and fine black bristles. Mesoscutum indistinctly punctured, usually with short oblique black bristles. Gastral petiole moderately stout but little widened behind, dull, densely tomentose. Congo, Zaire, Angola, Zambia, Uganda, Kenya, Sudan, Malawi
- B. pennata* sp. n. (p. 51)
- Hind femora beneath with fine pale tomentum. Mesoscutum with many rather small punctures and some short hairs. Gastral petiole short, stout, very shining, scarcely tomentose. Grande Comore
- B. ferruginea* sp. n. (p. 52)
- 22(6) Gena 0·4–0·6 times as wide as eye in profile. Fore tarsus with segment 5 short or else legs and gaster entirely black.
- Stalk of second gastral tergite 2·5–3·5 times as long as broad . . . . . 23
- Gena 0·7–1·5 times as wide as eye in profile; or if the gena is hardly so wide, fifth segment of fore tarsus long or legs and gaster not entirely black . . . . . 24
- 23(22) Last segment of fore tarsus somewhat shortened. Legs ferruginous, fore tarsi and mid and hind legs except coxae, black or nearly. Wings red-brown, tip not dark, length 13·0–18·0 mm. Gaster black, segments 1–2 ferruginous with no segment (22 specimens), segment 2 (16 specimens), segments 2–3 (3 specimens) or segments 2–4 (1 specimen) with two yellow spots. Africa south of the Sahara
- B. filiventris* (de Saussure) (p. 75)
- Last segment of fore tarsus elongate. Legs black. Wings grey, costal region brown, tips not dark, length 17·0 mm. Gaster black. Congo
- B. nigricans* sp. n. (p. 77)
- 24(22) Gena about 0·5 times as wide as eye in profile . . . . . 25
- Gena more than 0·7 times as wide as eye in profile . . . . . 26
- 25(23) Stalk of second gastral tergite 3·5–4·0 times as long as broad. Wings yellow-brown, tips a little darkened, length 14·0–17·5 mm. Gastral tergite 2 with two yellow spots but no other yellow markings (*cf.* couplet 37)
- B. macilenta* (F.) (p. 81)
- Stalk of second gastral tergite twice as long as broad. Wings tinged with red-brown, length 18·0 mm. Gastral tergite 2 with no yellow spots but mandibles, clypeus, tibiae and stalk of second gastral tergite, yellow.
- Thorax not punctured, more or less granulate. Gaster ferruginous, tergites 3–6 a little darker. Congo . . . . . *B. kelnepillautea* sp. n. (p. 77)
- 26(24) Mesoscutum and gastral tergites 3–5 with dense brassy tomentum.
- Gena as wide as eye in profile. Antennae and legs black. Mesoscutum with a few outstanding hairs. Stalk of second gastral tergite 2·5 times as long as broad. Uganda, Burundi, Zaire . . . . . *B. leonhardii* du Buysson (p. 87)
- Mesoscutum and gastral tergites 3–5 without dense brassy tomentum . . . . . 27
- 27(26) Frons and whole mesosoma with very close and rather strong punctures.
- Femora with very short white pile beneath. Mesoscutum with sparse brownish tomentum. No yellow markings. Uganda . . . . . *B. multipunctata* sp. n. (p. 55)
- Frons and mesosoma not so uniformly and very rarely so strongly punctured . . . . . 28
- 28(27) Clypeus and gena entirely yellow. Stalk of second gastral tergite 4–5 times as long as broad.
- Antennal segments 4–5 distinctly longer than broad . . . . . 29
- Clypeus and gena not entirely yellow or, if the clypeus is entirely yellow, the stalk of the second gastral tergite is not longer than broad . . . . . 30
- 29(28) Front tarsal segments rather short. Stalk of second gastral tergite a little longer. Hind femora with moderately long and numerous black bristles. Much of thorax, legs and four pairs of spots on gaster, yellow. Uganda, Cameroun
- B. flava* sp. n. (p. 75)
- Front tarsal segments long. Stalk of second gastral segment a little shorter. Hind femora with numerous moderately long, pale hairs beneath. Thorax, legs and gaster pale yellowish brown. Sierra Leone, Congo
- B. turbulenta* Kohl (p. 74)
- 30(28) Clypeus, mandibles, inner orbits, yellow. Stalk of second gastral tergite 1·0–1·5 times as long as broad.
- Traces of suffused yellow spots on gastral tergite 2, light ferruginous with very inconspicuous brown tomentum, wing-length 14·0–16·0 mm (*cf.* couplet 32)
- B. lateritia* Gerstaecker (p. 72)
- Clypeus not entirely yellow, though sometimes more or less yellow suffused or striped. Stalk of second gastral tergite at least 1·5 times as long as broad and often much longer . . . . . 31
- 31(30) Clypeus more or less evenly suffused with yellow. Antennal segments 4–5 not or scarcely longer than broad; at least 5 quadrate.



Antennae and legs ferruginous except sometimes the femora. Gastral tergite 2 with large triangular yellow spots

- Clypeus with ventral quarter yellow, or with yellow side stripes, or entirely ferruginous. . . . . 32
- Antennal segments 4–5 or at least 4 clearly longer than broad . . . . . 33
- 32(31) Antennal segments 4–5 quadrate, 4 occasionally a little longer. Clypeus with more punctures bearing black bristles on the upper half. Mesosoma usually black with more punctures, humeri and mesoscutum usually with more short black bristles. South Africa, Lesotho, Malawi, Zimbabwe, Tanzania . . . . . *B. petiolata* (Degeer) (p. 71)
- Antennal segments 4 usually a little longer, rarely quadrate. Clypeus usually with fewer black-bristle-bearing punctures dorsally. Mesosoma usually ferruginous, rarely a little blackened, punctures often less numerous, humeri and mesoscutum usually with fewer bristles which are often pale. Angola, South Africa, Mozambique, Tanzania, Kenya, Malawi, Zimbabwe, Zambia . . . . . *B. lateritia* Gerstaecker (p. 72)
- 33(31) Clypeus with somewhat variable yellow or creamy markings.  
(Some specimens of *B. dubia*, couplet 15, in which the short black bristles on the gastral tergites 3–5 are indistinct, may run down here) . . . . . 34
- Clypeus without yellow markings. (But see *B. abyssinica* du Buysson, couplet 58) . . . . . 38
- 34(33) Clypeus with ventral quarter yellow.  
Antennae much blackened, four hind legs mainly blackish. Gena 0·8 times as wide as eye in profile. Gastral tergite 2 with two large yellow spots. Stalk of second gastral tergite 2·5 times as long as broad. Mid and hind femora with short white and a few black bristles beneath. Segment 5 of fore tarsus short. Zambia, Tanzania . . . . . *B. bimaculata* sp. n. (p. 78)
- Clypeus with creamy yellow side stripes; sometimes only narrowly separated on disk . . . . . 35
- 35(34) Stalk of second gastral tergite about 1·5 times as long as broad. Gena 1·4 times as wide as eye in profile. Fifth segment of fore tarsi short.  
Gastral tergite 2 with two small yellow spots. Tanzania (including Zanzibar) . . . . . *B. tarsata* Kohl (p. 73)
- Stalk of second gastral tergite twice or more as long as broad. Gena never more than a little broader than eye in profile. Fifth segment of fore tarsi long, except in *B. facialis* . . . . . 36
- 36(35) Gaster with two yellow spots on each of tergites 2–4. Mesoscutum with dense silvery tomentum. Fore tarsi with segment 5 short.  
Mid and hind femur with numerous white bristles beneath. Gena just broader than eye in profile. Stalk of second gastral tergite 2·5 times as long as broad. Pronotum, scutellum, metanotum and coxae not yellow-marked. Kenya, Uganda, Tanzania, Zambia, Malawi, Mozambique . . . . . *B. facialis* du Buysson (p. 80)
- Gaster with a pair of yellow spots on tergite 2 or none. Mesoscutum with somewhat yellow dense silvery tomentum. Fore tarsus with fifth segment elongate . . . . . 37
- 37(38) Face with sides and ventral margin creamy yellow, but no other parts yellow; no spots on gastral tergite 2. Hind femur with numerous white, moderately long bristles beneath. Gena as wide as eye in profile. Stalk of second gastral tergite more than 2·5 times as long as broad. Mid and hind legs black but fifth tarsal segment reddish. Wings a little brown, tips not darker. Kenya, Uganda, Congo . . . . . *B. pusilloides* sp. n. (p. 80)
- Sides of clypeus, sometimes spot on pronotum, stripes on coxae, stalk and spots on second gastral tergite yellow. Mid and hind femur with short black bristles at base beneath. Gena half as wide as eye in profile. Stalk of second gastral tergite twice as long as broad. Femora and segment 5 of tarsi ferruginous, rest of tarsi black. Wings yellowish brown, tips a little darkened. Sierra Leone, Ghana, Nigeria, Guinea-Bissau . . . . . *B. macilenta* (F.) (p. 81)
- 38(33) Mesoscutum and humeri with outstanding hairs, long except in *B. brunnea*, *B. brunnescens*, *B. pileata* and sometimes *B. saeva* . . . . . 39
- Mesoscutum and humeri without or almost without outstanding hairs, long or short . . . . . 47
- 39(38) Large species (wing-length 24·0 mm), black except for much of the head and gastral petiole and stalk of tergite 2. Hind femora without bristles or pile beneath.  
Wings dark, usually black without slight purple reflections. Mesoscutum and humeri with close small punctures bearing outstanding black bristles. Propodeum dorsally obliquely striate and punctured but without hairs. Kenya, Tanzania, Malawi . . . . . *B. pileata* sp. n. (p. 62)
- Similar large, dark species have stronger thoracic punctures or bristles or pile beneath the hind femur . . . . . 40
- 40(39) Mesoscutum and humeri with dense, quite strong punctures and dense but inconspicuous

brownish tomentum. All femora with a line of dense very short white pile beneath, sometimes more feeble on hind pair.

Propodeum more or less rugose. Large, wing-length 24.0 mm, black species with uniformly more or less dark wings. Clypeus, legs except tibiae and tarsi, base of gaster reddish. Sierra Leone, Ghana, Zaire, Kenya, Uganda, Zimbabwe, Malawi, Congo, Ivory Coast, Gabon, Chad . . . . . *B. saeva* de Saussure (p. 61)

- Mesoscutum and humeri without dense, strong punctures. Hind femur with short black bristles beneath near base (except in the pale winged, uniformly red-brown *B. brunescens*) . . . . . 41
- 41(40) Wings brownish hyaline. Whole body uniformly reddish brown. Femur with white tomentum and a few white bristles beneath.
- Wing-length 17.0–24.0 mm. Clypeus finely reticulate with rather large punctures on ventral half. Ethiopia and Africa south of the Sahara . . . . . *B. brunescens* sp. n. (p. 70)
- Wings darker brown with darker tips. Body partly black, often with some yellow markings. Hind femur with short black bristles at base beneath . . . . . 42
- 42(41) Usually larger (wing-length 22.0 mm or more), usually with yellow side lines on face. Usually with black bristles protruding between the tomentum on the gaster posteriorly. Dorsal half of clypeus with fine reticulation and relatively close punctures (*cf.* couplet 15). West, East and South Africa . . . . . *B. dubia* Kohl (p. 53)
- Usually smaller, rarely with yellow side lines on face. Gaster with black bristles posteriorly only in some specimens of *B. meneliki*. Dorsal half of clypeus with rather strong granulation and sparse punctures. Or else a uniformly brown species or one with black hairs on propodeum . . . . . 43
- 43(42) Bristles of mesoscutum and humeri short, more or less stout. Clypeus with dorsal three-quarters with unusually coarse reticulation. Gena wide, at least 1.5 times as wide as eye in profile. Mesoscutum with quite dense brownish tomentum.
- Wing-length 14.5–18.0 mm (*cf.* couplet 4) (*B. brunnea* Ritsema) . . . . . 44
- Bristles of mesoscutum and humeri longer and finer, hair-like. Clypeus rarely with such coarse reticulation. Gena narrower. Mesoscutum with sparser, whitish or dense greyish tomentum . . . . . 45
- 44(43) Wings uniformly pale greyish brown. Femora reddish. Senegal, Liberia, Ghana, Sierra Leone, Nigeria, Fernando Po, Gabon, Congo, Rwanda . . . . . *B. brunnea brunnea* Ritsema (p. 64)
- Wings dark red-brown, tips darker. Femora usually black. Uganda, Kenya . . . . . *B. brunnea nigriclava* subsp. n. (p. 66)
- 45(43) Larger, wing-length 19.0 mm. Hind femora with a few pale or more rarely short black bristles beneath.
- Black, head except frons, usually front of pronotum, scutellum and metanotum, gastral tergites 1–2, sometimes 5–6 (more or less), red; tergite 2 sometimes with two yellow spots. Wings yellow-brown, tips dark. Stalk of second gastral tergite twice as long as broad. Propodeum with dense black hairs and usually strong, oblique striae but sometimes striae weaker and large, shallow punctures more obvious. Gaster sometimes with a few protruding black bristles. Ethiopia . . . . . *B. meneliki* Gribodo (p. 52)
- Smaller, wing-length 16.0–17.5 mm. Hind femora with numerous short black bristles beneath . . . . . 46
- 46(45) Wings brownish hyaline, length 17.5 mm. Stalk of second gastral tergite 3.5 times as long as broad. Mesosoma and gaster ferruginous, segment 4 a little darkened, 5–6 usually reddish, tergite 2 with a pair of transverse yellow spots. Mesoscutum without tomentum. Principé I. . . . . *B. principalis* sp. n. (p. 82)
- Wings brown, tips darker, length 16.0 mm. Stalk of second gastral tergite 2.5 times as long as broad. Black, head except frons in part, tibiae and tarsi, gastral segments 1–2, 5–6, reddish, tergite 2 with two small round yellow spots. Mesoscutum with not very dense, dull greyish tomentum. Angola . . . . . *B. jordani* sp. n. (p. 83)
- 47(38) Mesoscutum with dense silvery tomentum . . . . . 48
- Mesoscutum with less dense, fine tomentum which is usually quite inconspicuous . . . . . 51
- 48(47) Mesoscutum and scutellum with deep, rather large punctures. Propodeum with strong striae.
- Mesoscutum with very dense silvery tomentum. Whole frons, upper part of gena, antennae, mesosoma, legs, gaster behind the stalk of tergite 2, black. Wings blackish with slight purple reflection, length 16.5 mm. Hind femora with dense but rather short hairs beneath. Uganda . . . . . *B. punctilla* sp. n. (p. 83)

- Mesoscutum and scutellum with much smaller less deep punctures. Propodeum less strongly striate . . . . . 49
- 49(48) Wings blackish or dark grey, length 17.0–22.5 mm. Stalk of second gastral tergite 2.5 times as long as broad.  
 Dark ferruginous, mesoscutum and gastral segments 3–5 blackish, 2 with large whitish yellow triangular spots. Hind femur with a few pale bristles beneath. Sudan (Kordofan, Dhafur), Congo (northern) . . . . . *B. fuscipennis* du Buysson (p. 86)
- Wings red- or yellow-brown, tips darker, length 16.0–22.5 mm. Stalk of second gastral tergite 2.5–3.5 times as long as broad . . . . . 50
- 50(49) Gaster often with 3 pairs of yellow spots in West African specimens but sometimes with 1 pair only on tergite 2, or, in South African specimens often with none. Legs often reddish with dark tarsi. Wings usually rather pale with tips darkened, length 16.0–22.5 mm. Antennal segment 3 nearly = 4 + 5 + half 6. Stalk of second gastral tergite 2.5–3.5 times as long as broad. Mid and hind femora with practically no bristles beneath. Chad, West, Central and South Africa . . . . . *B. grisea* (F.) (p. 87)
- Gaster usually with no yellow spots, rarely a pair on tergite 2. Legs black or ferruginous with mid and hind tibiae and tarsi black. Wings red-brown, tips infuscate, length 18.0–20.0 mm. Antennal segment 3 nearly = 4 + 5 + 6. Stalk of second gastral tergite 2.5 times as long as broad. Hind femur with a few short bristles beneath.  
 Head and mesosoma ferruginous, mesoscutum black with tomentum hiding the cuticle, gaster with very dense silvery tomentum posteriorly, cuticle ferruginous with tergites 3–6 more or less blackened. Kenya, Tanzania . . . . . *B. neavei* sp. n. (p. 89)
- 51(47) Hind femora with numerous short black bristles beneath. Stalk of second gastral tergite 1.5–2.5 times as long as broad. Fifth segment of fore tarsus long.  
 Mesoscutum blackish with at most indistinct punctures. Wings with dark tips, length not more than 19.5 mm. Gaster with no yellow markings . . . . . 52
- Hind femora without black bristles beneath or (*B. brevitarsus*) stalk of second gastral tergite 2.5–3.5 times as long as broad and fifth segment of fore tarsus short . . . . . 53
- 52(51) Stalk of second gastral tergite 2.0–2.5 (rarely 3.5) times as long as broad. Gena 1.5 times as wide as eye in profile. Mesosoma granulate, not punctured. Legs dark ferruginous, tarsi black. Wings dark grey, length 16.5–19.0 mm. Sierra Leone, Gabon, Congo  
*B. leonina* sp. n. (p. 90)
- Stalk of second gastral tergite 1.5 times as long as broad. Gena 1.5 times as wide as eye in profile. Mesosoma with a few punctures on the mesoscutum and many fine ones on the mesopleuron. Legs ferruginous, tibiae and tarsi black. Wings dark reddish brown, length 19.5 mm. Congo . . . . . *B. barbata* sp. n. (p. 92)
- 53(51) Stalk of second gastral tergite not more than 2, usually 1.5 times as long as broad.  
 Hind femur with a few short white bristles beneath. Gaster tergite 2 usually with yellow spots. Mesoscutum with close brownish tomentum . . . . . 54
- Stalk of second gastral tergite twice as long as broad or longer . . . . . 55
- 54(53) Stalk of second gastral tergite usually yellowish, twice as long as broad. Hind femora ferruginous. Gaster with two large comma-shaped yellow spots on tergite 2. Thorax and gastral tergites 3–4 usually more or less blackened. Wings rather pale. Zambia, Zimbabwe, Malawi, Tanzania, Mozambique, South Africa . . . . . *B. brachystoma* Kohl (p. 68)
- Stalk of second gastral tergite usually ferruginous, rarely more than 1.5 times as long as broad. Hind femora usually blackened at base. Gaster with or without comma-shaped yellow spots on second tergite. Thorax and gastral tergites 3–4 more often blackened. Wings usually rather dark.  
 Clypeus strongly reticulate above. Apex of gastral petiole usually with two pale dots. Kenya, Zambia, Zimbabwe, Malawi, Tanzania, Botswana, South Africa  
*B. freyi* du Buysson (p. 69)
- 55(53) Stalk of second gastral tergite 3.0–3.5 times as long as broad. Fifth segment of fore tarsus short.  
 Mid and hind legs blackish, hind femora beneath with some black bristles. Gaster normally without yellow spots, often with some black hairs protruding through the tomentum (*cf.* couplet 12). Kenya, Uganda . . . . . *B. brevitarsus* sp. n. (p. 92)
- Stalk of second gastral tergite not longer than 2.5 times as long as broad, or, in *B. longitarsus* sometimes as long as 3.5 times but then the fifth segment of the fore tarsus is long . . . . . 56
- 56(55) Mesoscutum dull coal-black with very distinct punctures, especially in front. Mesopleuron closely and coarsely punctured.

- Scutellum and metanotum red, contrasting with the mesoscutum and propodeum. Stalk of second gastral tergite 2 as long as broad. Legs ferruginous, each femur with a line of white pile beneath. Gaster black, segments 1-2 red, tergite 2 with two elongate, transverse yellow spots, second sternite with two smaller yellow spots. Wings dark purplish brown, length 16.0-18.0 mm. Socotra . . . . . *B. saussurei* Kirby (p. 93)
- Thorax ferruginous or, if black, much less strongly punctured . . . . . 57
- 57(56) Thorax black, scutellum and metanotum sometimes red.  
Stalk of second gastral tergite 2.5 times as long as broad . . . . . 58
- Thorax ferruginous . . . . . 59
- 58(57) Legs and thorax entirely black. Wings purplish black, length 20.0 mm. Femora with a line of white pile beneath. Ethiopia . . . . . *B. abyssinica* du Buysson (p. 96)
- Legs ferruginous, scutellum and metanotum red. Wings yellow-brown, tips very dark fuscous, length 17.0-20.0 mm. Femora beneath only with white tomentum.  
Second gastral tergite sometimes with large triangular yellow spots but the yellow sometimes more or less completely invaded by ferruginous. Somalia  
*B. adenensis somaliensis* subsp. n. (p. 100)
- 59(57) Wings dark purplish brown, length 19.0-21.0 mm. Femora with lines of not very dense white pile beneath.  
Thorax with numerous rather fine punctures. Propodeum striate behind. Gastral tergite 2 with transverse yellow spots, sternite 2 with spots or a band; gastral tergites 3-4 largely blackish. Oman (Dhofar) . . . . . *B. guichardi* sp. n. (p. 94)
- Wings much paler, at least on proximal three-quarters. Femora without lines of white pile beneath . . . . . 60
- 60(59) Gena 0.6-0.7 times as wide as eye in profile. Prementum and base of stipes beneath bare.  
Stalk of second gastral tergite 2.5-3.5 times as long as broad.  
Ferruginous, gastral tergite 2 with or without two round yellow spots. Uganda, Zambia, Angola, Mozambique, Tanzania, South Africa . . . . . *B. longitarsus* sp. n. (p. 97)
- Gena 0.8-1.0 times as broad as eye in profile. Prementum and base of stipes with several long black bristles beneath. Stalk of second gastral tergite 2.0-2.5 times as long as broad.  
Second gastral tergite, if with yellow spots, with narrow transverse ones . . . . . 61
- 61(60) Gastral tergites 3-4 black. Stalk of second gastral tergite 2.5 times as long as broad.  
Wings reddish brown with fuscous tips, length 17.0-20.0 mm. Gaster with no yellow spots. Southern Yemen (including Aden) . . . . . *B. adenensis adenensis* Giordani Soika (p. 99)
- Gastral tergites 3-4 ferruginous. Stalk of second gastral rather shorter.  
Tips of wings less darkened; wing-length 18.0-21.5 mm. (Two species often not certainly distinguishable in ♀ except by the locality.) . . . . . 62
- 62(61) Gastral tergite 2 with two narrow, very transverse spots at apex; sternite 2 also with two yellow spots or a band. Mesoscutum more strongly punctured. Southern Yemen, Yemen, SE. Saudi Arabia . . . . . *B. arabica* Giordani Soika (p. 96)
- Gastral tergite 2 sometimes without yellow spots. Mesoscutum usually less strongly punctured. W. Saudi Arabia (around Jiddah) . . . . . *B. filiformis* (de Saussure) (p. 100)
- In *B. adenensis*, *B. arabica* and *B. filiformis*, the clypeus and malar space are sometimes yellowish. A female of *B. arabica* from Southern Yemen: W. Aden, Jebel Jihaf, 7,100 ft [2330 m], has the whole face yellow.

### Males

No males have been seen of *B. acaulis* sp. n., *B. atratus* von Schulthess, *B. aurata* sp. n., *B. barbata* sp. n., *B. ferruginea* sp. n., *B. flava* sp. n., *B. fuscipennis* du Buysson, *B. indica* (de Saussure), *B. jordani* sp. n., *B. kelnepillautae* sp. n., *B. kohli* Schulz, *B. multipunctata* sp. n., *B. nigricans* sp. n., *B. punctilla* sp. n., *B. turbulenta* Kohl, *B. turgida* Kohl.

- 1 Whole body including propodeum, smooth and shining. Small species, wing-length 12.0 mm.  
Clypeus very obtusely angled below. Antennal segments 4 and 5 four to five times as long as broad, segments 10-11 with a prominence at each end beneath, segment 12 about five times as long as broad. Nigeria (eastern province) . . . . . *B. nitida* sp. n. (p. 60)
- Body dull with reticulation and tomentum. Species larger . . . . . 2
- 2(1) Propodeum smooth and rounded, very finely granulate without striae, punctures, hairs or tomentum.

Mesosoma without punctures and little tomentum. Stalk of second gastral tergite 1·5 times as long as broad. Gastral tergite 2 without yellow marks, posterior segments with short black bristles protruding. Wing-length 14·0 mm. Uganda, Liberia, Congo

- B. levior* sp. n. (p. 58)
- Propodeum not smooth, without sculpture or vestiture . . . . . 3
  - 3(2) Clypeus below centrally only slightly protruding though obtusely angled, hardly protruding beyond the lateral lobes. Antennal segment 12 more or less blackened, flattened and shining . . . . . 4
  - Clypeus below either little projecting but round or strongly pointed and projecting beyond the lateral lobes. Antennal segment 12 rarely blackened, flattened and shining . . . . . 7
  - 4(3) Clypeus below centrally with a slightly protruding blunt point but little bent down. Antennal segment 12 less flattened, narrower, usually blackened. Gena not quite as wide as eye. Hind trochanter and femur beneath with dense short white, and some longer blackish hairs. Very little yellow on clypeus, no yellow spots on gaster (*B. brunnea* Ritsema) . . . . . 22
  - Clypeus with central process rounded. Antennal segment 12 strongly flattened, very broad, nearly always blackened beneath. Gena as wide or distinctly wider than eye. Hind trochanter and femur with longer and denser black or white hairs. Clypeus with yellow side-stripes, tergite 2 with yellow spots . . . . . 5
  - 5(4) Clypeus with very short, distinctly bent down central process. Gena much wider than eye. Hind femur and tibia with long hairs beneath. Gastral tergite 2 with narrow transverse yellow apical spots (*B. clypeata* Kohl) . . . . . 6
  - Clypeus with somewhat longer, not bent down, rounded central process. Gena about as wide as eye or a little wider. Hairs of hind femur and especially of hind tibia fewer and shorter. Gastral tergite 2 with two large comma-shaped yellow spots. Zimbabwe, Zambia, Malawi, Tanzania, Mozambique, South Africa . . . . . *B. brachystoma* Kohl (p. 68)
  - 6(5) Colour paler ferruginous; knees, especially the mid pair, yellowish. Sides of clypeus with little yellow. Hairs of femora and tibiae mostly white. Congo, Zambia, Uganda, Zimbabwe, Malawi, South Africa . . . . . *B. clypeata clypeata* Kohl (p. 67)
  - Colour darker, head beneath and frons black; knees not yellow. Sides of clypeus pale yellow. Long hairs of hind legs black. Zaire, Angola, Uganda, Zambia . . . . . *B. clypeata fuscata* subsp. n. (p. 67)
  - 7(3) Large (wing-length 22·0–25·0 mm), mainly black species, wings dark or black. Clypeus angled below but tip more or less rounded. Antennal segment 12 somewhat flattened, widened to apex, hardly curved . . . . . 8
  - Smaller and not black or, if approaching this size and black, either the clypeus is widely rounded or pointed below, or antennal segment 12 is cylindrical and curved . . . . . 11
  - 8(7) Femora without pile or hairs beneath. Gaster without bristles among the tomentum . . . . . 9
  - Femora beneath with pile, tomentum or hairs beneath. Mesoscutum more or less strongly punctured . . . . . 10
  - 9(8) Mesoscutum punctured, without hairs. Propodeum striate. Flagellar segments longer, segment 8 2·1 times as long as broad. Kenya, Tanzania, Uganda, Zaire, Sierra Leone (?), Congo, Ivory Coast, Gabon, Chad . . . . . *B. saeva* (de Saussure) (p. 61)
  - Mesoscutum hardly punctured with very short hairs. Propodeum not striate. Flagellar segments shorter, segment 8 not quite twice as long as broad. Kenya, Malawi, Tanzania . . . . . *B. pileata* sp. n. (p. 62)
  - 10(8) All femora with a line of dense white tomentum beneath, hind femur beneath without hairs. Mesoscutum strongly punctate, without hairs. Propodeum striate. Gaster with black bristles amongst the tomentum. Congo, Zaire, Zambia, Uganda, Kenya, Zimbabwe, Angola, Malawi, Mozambique . . . . . *B. vasseae* du Buysson (p. 56)
  - Fore and mid femora with a line of dense white pile beneath, hind femora with rather less close white pile and many long black hairs. Mesoscutum very strongly and densely punctured and with long black hairs. Propodeum clathrate above, striate below. Gaster with very fine black bristles amongst the tomentum. Congo, Tanzania . . . . . *B. hirsuta* sp. n. (p. 55)
  - 11(7) Clypeus widely rounded below, not or scarcely pointed, not much projecting beyond the lateral lobes . . . . . 12
  - Clypeus below always with a pointed tip and usually produced well beyond the lateral lobes . . . . . 24
  - 12(11) Fore and mid tarsi shortened and widened, segment 4 of mid tarsus much broader than long. Gastral tergite 2 with two yellow spots, stalk at least 3 times as long as broad. Gastral

- petiole very long and slender. Thorax hairy. Antennal segment 11 with a strong protuberance beneath 13
- Fore and mid tarsi longer and narrower (as usual or almost so), segment 4 of mid tarsus clearly longer than broad 14
- 13(12) Antennae with segments 1–8 darkened above. Mid tarsus moderately widened, segment 5 at least twice as long as wide. Legs not marked with yellow, mid and hind legs largely dark. Hind femur with dense white pile and scattered longer black bristles beneath.  
Fore tarsus very wide. Mid tibia without long hairs beneath. Kenya, Uganda
- *B. brevitarsus* sp. n. (p. 92)
- Antennae with segments not darkened above. Mid tarsus with segment 5 clearly less than twice as long as broad. Mid and hind legs largely ferruginous, fore and mid tarsi and mid femur anteriorly, mid tibia beneath, yellow. Hind femur beneath, especially towards the base, with long white or sometimes black hairs.  
Hind tibia with sparse long hairs beneath. Africa south of the Sahara
- *B. filiventris* (de Saussure) (p. 75)
- 14 Antennal segment 12 flattened and curved, usually blackened. Clypeus with ventral margin bisinuate. Stalk of second gastral tergite 1.5 times as long as broad.  
Antennal segments 1–7 more or less blackened above, segment 3 longer than 4 + 5. Clypeus with a slightly produced central point below. Hind femur with black and white bristles beneath. Gaster with no yellow spots. West Africa (cf. couplet 23)
- *B. brunnea* Ritsema (p. 64)
- Antennal segment 12 less flattened and curved. Clypeus smoothly curved from side to side.  
Stalk of second gastral tergite longer 15
- 15(14) Stalk of second gastral tergite 4.0–4.5 times as long as broad 16
- Stalk of second gastral tergite 1.5–2.5 times as long as broad 18
- 16(14) Gaster with no black hairs amongst the tomentum. Propodeum with strong striae and long outstanding silvery hairs. Cameroun 17
- Gaster with fine black hairs amongst the silvery tomentum. Propodeum dull, granulate with mostly recumbent silvery grey hairs.  
Antennae dark above, 8–11 pale, 9–11 with flat projections beneath, 12 somewhat flattened, distal three-quarters shining black, tip narrowly rounded. Gastral petiole long and narrow. Wings brown, segments 2–3 with large yellow spots. Liberia *B. libera* sp. n. (p. 86)
- 17(16) Mesoscutum, humeri and most of mesopleuron blackish with strong quite close punctures. Antennae black above, segment 12 slightly flattened, straight below, curved above, segments 10–11 long cylindrical, without prominences beneath. Gastral petiole very long and narrow. Wings light grey, length 19.5 mm. Gastral tergite 2 with no yellow spots. Cameroun *B. punctata* sp. n. (p. 84)
- Thorax ferruginous with weak, indistinct punctures. Antennae ferruginous, segment 12 shorter, more curved below, segments 10–11 short with a strong projecting keel below. Gastral petiole rather short, apical part distinctly widened. Wings hyaline, veins ferruginous, length 17.0 mm. Gastral tergite 2 with two suboval almost contiguous spots. Cameroun *B. rothkirchi* von Schulthess (p. 85)
- 18(15) Large species, wing-length 19.0–28.0 mm. Gaster with short black bristles protruding amongst the tomentum.  
Clypeus with wide yellow side-stripes. Tips of wings hardly darkened. Frons ferruginous 19
- Smaller species, wing-length 13.0–19.0 mm. Gaster without black bristles amongst the tomentum 20
- 19(18) Larger species, wing-length 22.0–28.0 mm. Antenna blackened above except segments 10–12, 12 sometimes more or less blackened but not strongly contrasting with adjoining segments, somewhat flattened, straight beneath, curved above, widening to apex. Tarsi black.  
Clypeus below bisinuate, central lobe regularly curved, a little projecting. West Africa, Zaire and Kenya to Tanzania, Malawi, Mozambique, South Africa. *B. dubia* Kohl (p. 53)
- Wing-length 22.0 mm. Antennae black above, segments 1–2 and extreme base of 3 yellow beneath, 3–9 ferruginous beneath, 10–11 light ferruginous, 12 blackish, not shining, a little flattened and curved, tip rounded, 10–11 cylindrical, not swollen beneath. Tarsi black, last segment of front pair reddish. Uganda *B. ugandae* sp. n. (p. 54)
- 20(18) Antennal segment 12 ferruginous, hardly shining with a few hairs, flat, straight below, curved above, tip rounded-truncate.

- Antennal segment 11 cylindrical, 10 with a slight hump below. Mesoscutum with short, humeri with longer hairs. Face except for a rather narrow brown central stripe, light yellow, central lobe below regularly rounded. Hind femur beneath with tomentum and a few short bristles. Kenya, Uganda . . . . . *B. pusilloides* sp. n. (p. 80)
- Antennal segment 12 shining, nearly always black, at least above, usually less flattened, more curved, tip rounded . . . . . 21
- 21(20) Mesoscutum and humeri without outstanding hairs. Antennal segments 10–11 pale ferruginous without prominences beneath.  
Clypeus with wide lateral white side-stripes, central lobe below just rounded, distinctly projecting. Hind femur beneath with long black and sometimes also some white hairs. Sierra Leone, Gabon, Congo . . . . . *B. leonina* sp. n. (p. 90)
- Mesoscutum and humeri with distinct outstanding hairs or else antennal segments 10–11 with distinct prominences beneath . . . . . 22
- 22(21) Frons brown. Antennal segment 12 shining black above, ferruginous below, much flattened and curved, 10–11 with considerable protuberances beneath. Clypeus almost regularly curved below, lateral white stripes quite wide. Hind femur beneath with white tomentum and a few short hairs. Guinea-Bissau, Sierra Leone, Ivory Coast, Ghana, Nigeria  
 . . . . . *B. macilenta* (F.) (p. 81)
- Frons black. Antennal segment 12 usually entirely shining black, rather less flattened, segment 11 cylindrical, 10 considerably thicker with a raised line beneath.  
All tarsi with fifth segment pale. All femora with long, rather dense hairs beneath (*cf.* couplet 14), (*B. brunnea* Ritsema) . . . . . 23
- 23(22) Posterior part of gaster with less dense silvery tomentum. Wings distinctly reddish brown. Antennal segment 12 a little narrower. Kenya, Uganda  
 . . . . . *B. brunnea nigriclava* subsp. n. (p. 66)
- Posterior part of gaster with very dense silvery tomentum. Wings greyer. Antennal segment 12 a little thicker. Sierra Leone, Liberia, Ghana, Fernando Po, Congo  
 . . . . . *B. brunnea brunnea* Ritsema (p. 64)
- 24(11) Thorax and gaster with dense, brassy tomentum, hiding the cuticle.  
Antennae black, segment 12 much flattened, long oval, straighter below, more curved above, shorter than 11, dull; segments 10–11 with only raised line beneath. Clypeus obtusely pointed beneath, yellow with a narrow black central stripe. Coxae 1–2 yellow beneath, femora 1–2 with an anterior yellow spot at base. Wings dark brown, length 21·0 mm. Uganda, Burundi, Zaire . . . . . *B. leonhardii* R. du Buysson (p. 87)
- Thorax and gaster without dense, brassy tomentum . . . . . 25
- 25(24) Antennal segments 4 and 5 each clearly less than twice as long as broad.  
Antennae ferruginous, segment 12 curved, hardly flattened, longer than 5. Clypeus ventrally, though pointed, not much protruding. Mesoscutum, scutellum, metanotum and propodeum with short, stout, curved bristles. Tibiae and tarsi ferruginous. Stalk of second gastral tergite not more than 1·5 times as long as broad. South Africa, Lesotho, Malawi, Zimbabwe, Tanzania . . . . . *B. petiolata* (Degeer) (p. 71)
- Antennal segments 4 and 5 each more than twice as long as broad . . . . . 26
- 26(25) Thorax and propodeum dorsally with dense, relatively long, black hairs.  
Antennae except segments 1–3 dorsally, ferruginous; segment 12 a little flattened and curved, as long as 9; 9–11 elongate, not much prominent beneath. Legs black, femora and tibiae 1–2 or 1–3 with pale yellow stripes beneath. Gaster with more or less distinct protruding black bristles, stalk of second gastral sternite 2·0–2·5 times as long as broad. Ethiopia . . . . . *B. meneliki* Gribodo (p. 52)
- Thorax and propodeum without such dense long black hairs . . . . . 27
- 27(26) Stalk of second gastral tergite not more than 1·5 times as long as broad.  
Antennae usually entirely ferruginous . . . . . 28
- Stalk of second gastral tergite 2–3 times as long as broad . . . . . 31
- 28(27) Gaster posteriorly with short black bristles protruding from the tomentum. Clypeus usually not or little yellow-marked; body except the head usually black or very dark ferruginous. Wings light to dark brown, tips a little darker, length about 19·0 mm.  
Antennal segment 12 moderately flattened and curved, about as long as 9. Kenya, Uganda, Zambia, Angola, Zaire . . . . . *B. pennata* sp. n. (p. 51)
- Gaster without bristles in the tomentum or in *B. lateritia* only with very short ones. Clypeus with whitish or yellow side-stripes. At least the legs ferruginous. Wings yellowish brown, with dark tips (except in *B. tarsata*), length 16·5–19·0 mm. . . . . 29



- 29(28) Tarsi shortened, mid and hind pairs shining, without any hairs or bristles.  
Two small spots on gastral tergite 2, yellow. Wings light fuscous, length 17.5 mm. Stalk of second gastral tergite as long as broad. Thorax and propodeum black, former not punctured. Tanzania . . . . . *B. tarsata* Kohl (p. 73)
- Tarsi not shortened, mid and hind pairs not so shining with numerous small bristles . . . . . 30
- 30(29) Antennal segment 12 slightly flattened, distinctly curved, as long as segment 9; 10–11 with gently raised elongate prominences. Second gastral tergite sometimes with narrow yellow spots.  
Mesoscutum, mesopleuron and propodeum, gastral tergites 3–7 more or less blackened; segments 1–2 ferruginous. Kenya, Tanzania, Zambia, Angola, South Africa . . . . . *B. freyi* R. du Buysson (p. 69)
- Antennal segment 12 cylindrical, strongly curved, at least as long as 5; 10–11 not all raised beneath. Gastral tergite 2 with a large yellow spot.  
Small area on the frons, gastral tergites 4–5 more or less blackened. Kenya, Zambia, Zimbabwe, Angola, Malawi, Mozambique, South Africa . . . . . *B. lateritia* Gerstaecker (p. 72)
- 31(27) Gaster posteriorly with short black bristles protruding amongst the tomentum.  
Antennae more or less blackened, segment 12 more or less flattened and curved, stalk of second gastral tergite 2.0–2.5 times as long as broad. Gaster rarely with two yellow spots . . . . . 32
- Gaster posteriorly without black bristles amongst the tomentum, except sometimes at the extreme sides . . . . . 34
- 32(31) Antennal segment 12 wider, more strongly flattened, moderately curved, especially above, as wide as segment 11 but a little longer than it; segments 9–11 with strong rounded protuberances beneath. Thorax and propodeum rather strongly punctured with relatively long black hairs. Clypeus sometimes not white at sides. Wings a little darkened. Kenya, Zambia, Tanzania, Malawi, South Africa (Natal, Orange Free State), Niger . . . . . *B. somereni* sp. n. (p. 50)
- Antennal segment 12 narrower, less flattened, more curved and rather longer, as long as 9; 9–11 beneath with elongate, more or less raised protuberances beneath. Thorax without hairs. Clypeus white at sides (*B. juncea* (F.)) . . . . . 33
- 33(32) Wings black with metallic reflections. Arabia, Algeria (Tripoli) (? strays), West Africa, Zaire, Uganda, Kenya, Malawi, Sudan . . . . . *B. juncea juncea* (F.) (p. 48)
- Wings brownish with tips darker. Zaire, Uganda, Kenya, Malawi, Sudan . . . . . *B. juncea colonialis* Kohl (p. 48)
- 34(31) Wings dark brown, tips hardly darker, veins reddish, length 17.0–18.0 mm.  
Antennal segment 12 flattened, dorsal side curved, ventral side straight. Antennae and legs ferruginous . . . . . 35
- Wings less dark and their colour usually less uniform . . . . . 37
- 35(34) Whole mesosoma ferruginous. Mesoscutum and pleuron less punctured. Antennal segment 12 shorter, 9–11 cylindrical with stronger ventral prominences whose surfaces are curved. Apex of gastral tergite 2, whole of 3, base of 4, blackish; wide transverse spots on tergite 2, apical band of sternite 2, light yellow. Oman (Dhofar) . . . . . *B. guichardi* sp. n. (p. 94)
- Mesosoma, except partly ventrally, black. Mesoscutum and pleuron more punctured. Antennal segment 12 longer, 9–11 little projecting below, with flattened elongate prominences. Gastral tergites 3–4 black . . . . . 36
- 36(35) Antennal segment 12 broader and flatter. Antennal scape not yellow beneath. Gaster without yellow markings.  
Mesopleuron less punctured. Ethiopia . . . . . *B. abyssinica* du Buysson (p. 96)
- Antennal segment 12 narrower and less flattened. Antennal scape yellow beneath. Gastral segment 2 light ferruginous with apex of tergite and spots on sternite yellow. Socotra . . . . . *B. saussurei* Kirby (p. 93)
- 37(34) Fore and mid tarsi shortened, segments 4 and 5 clearly shorter than on the hind pair.  
Antennal segment 12 long, curved, cylindrical, a little longer than 11.  
Antennal segments 10–11 with quite strong protuberances beneath. Ferruginous, mesoscutum and gastral segments 3–7 a little darkened. Clypeus with wide lateral white stripes; gastral tergites 2–4 and sternite 2 each with a pair of yellow spots. Fore and mid femora and mid tibia with yellow stripes beneath. Wings hyaline, tips dark, length 15.5 mm. Kenya, Uganda, Zambia, Tanzania (including Zanzibar), Malawi, Mozambique . . . . . *B. facialis* du Buysson (p. 80)
- Fore and mid tarsi not shortened. Antennal segment 12 shorter, less curved, less cylindrical . . . . . 38



- 38(37) Stalk of second gastral tergite 4·5 times as long as broad. Wings hyaline with ferruginous venation, length 17·0 mm.  
 Largely ferruginous, femora somewhat darkened, gastral segments 2–7 blackish, 2 with two large contiguous yellow spots. Antennal segment 12 moderately flattened, a little curved above and below, segments 10–11 short with strongly protruding keels below.  
 Cameroun . . . . . *B. rothkirchi* von Schulthess (p. 85)
- Stalk of second gastral tergite 2–3 times as long as broad. Wings, except in the large *B. brunescens*, with more or less distinct dark tips . . . . . 39
- 39(38) Large species, length 20·0–22·0 mm, uniformly light brown. Uniformly ferruginous, at most the mesoscutum and gastral tergites 3–7 a little darkened.  
 Stalk of second gastral tergite 2 as long as broad. Antennal segments 9–11 with slight convexities beneath. Ethiopia and Africa south of the Sahara . . . . . *B. brunescens* sp. n. (p. 70)
- Smaller species or not uniformly ferruginous. Wings usually with distinct dark tips . . . . . 40
- 40(39) Mesoscutum with dense silvery tomentum more or less hiding the cuticle.  
 Gena clearly narrower than eye in profile . . . . . 41
- Mesoscutum with much finer and less dense tomentum, leaving the cuticle, which is very little punctured, exposed . . . . . 43
- 41(40) Mesosternum with long black hairs in front of mid coxa.  
 Mesoscutum and propodeum with dense, moderately long hairs. Antennal segment 12 as in *B. grisea* but rather shorter, segment 9 with a strong angular protuberance beneath. Femora 1 and 2 usually with yellow stripes beneath. Kenya, Tanzania . . . . . *B. neavei* sp. n. (p. 89)
- Mesosternum without long black hairs in front of mid coxa . . . . . 42
- 42(41) Antennal segment 12 cylindrical, as long as 8, slightly curved, segments 9–11 beneath with elongate, almost flat-topped elevations. Mesothorax (except scutellum), propodeum, gaster and mid and hind legs, practically black; mid and hind coxae beneath, strips on mid femur and tibia, large spots on gastral tergite 2, yellow. Zambia . . . . . *B. bimaculata* sp. n. (p. 78)
- Antennal segment 12 somewhat flattened, as long as 8, more curved dorsally than ventrally; segments 8–9 with flat-topped elevation, 10–11 with angular protuberances, sometimes weak on 11. Mesothorax (except scutellum) usually more or less black, propodeum more ferruginous; base of gaster and femora ferruginous, only fore femur with a yellow stripe. Gaster tergite 2 with or without a pair of yellow spots. Chad, West, Central and South Africa . . . . . *B. grisea* (F.) (p. 87)
- 43(40) Stalk of second gastral tergite usually twice as long as wide. Clypeus white, with a faint darker central stripe.  
 Antennal segment 12 as long as 11, moderately flattened and curved; 10–11 with gently rounded protuberances beneath, prominence of 9 flatter. Thorax very feebly punctured. Ferruginous, sometimes gastral tergites 3–4 a little darker; sometimes narrow yellow spots at apex of gastral tergite 2. Wings reddish brown, tips a little darker. Yemen and Southern Yemen (Aden) . . . . . *B. arabica* Giordani Soika (p. 96)
- Stalk of second gastral tergite 2·5–3·0 times as long as broad. Clypeal dark stripe more distinct . . . . . 44
- 44(43) Ferruginous, gastral tergite 2 with two suffused yellow spots. Wings pale yellow-brown, length 15·0 mm.  
 Antennal segment 12 moderately flattened, curved above, straight below, about as long as 7; 9–11 with strong but rounded protuberances beneath. Uganda, Zambia, Angola, South Africa, Tanzania . . . . . *B. longitarsus* sp. n. (p. 97)
- At least gastral tergites 3–4 more or less darkened. Wings dark . . . . . 45
- 45(44) Antennal segment 12 cylindrical, curved, very little flattened; segment 11 with an angular prominence.  
 Antennal segment 9 with a flat prominence, 10 with an angular one. Ferruginous, gastral segments 3–7 usually blackish; apparently tergite 2 sometimes with yellow spots. SW. Saudi Arabia . . . . . *B. filiformis* (de Saussure) (p. 100)
- Antennal segment 12 rather more flattened and less curved, 11 with a feeble prominence . . . . . 46
- 46(45) Wings blackish. Much of gaster blackish, segment 2 without yellow spots.  
 Head dorsally, mesosoma, blackish. Clypeus with wide lateral white stripes. Ethiopia . . . . . *B. abyssinica* R. du Buysson (p. 96)
- Wings considerably paler. Gaster segments 3–7 black, segment 2 with narrow yellow spots (*B. adenensis* Giordani Soika) . . . . . 47
- 47(46) Mesoscutum and propodeum sometimes darkened. Whole of clypeus except ventral margin

- whitish yellow. Wings yellow-brown, tips light fuscous. Yemen and Southern Yemen (Aden) . . . . . *B. adenensis adenensis* Giordani Soika (p. 99)
- Mesothorax (except pronotum, scutellum, metanotum and propodeum) black. Wings yellow-brown, tips dark fuscous. Somalia . . . . . *B. adenensis somaliensis* subsp. n. (p. 100)

### Key to Malagasy species of *Belonogaster*

- 1 Stalk of second gastral tergite half as long as broad or a little longer. Gastral petiole swollen distally.  
Black; wings pale brown, length 18.0–20.0 mm. Female antenna with segments 4, 5 and 6, 1.1, 1.0 and 0.9 times as long as broad. Male mandibles and clypeus with dense outstanding white pubescence, clypeus below feebly produced; antennal segment 12 elongate, as long as 8, subcylindrical, quite strongly curved with numerous short hairs, 4–9 black, 10–12 light brown, 9–12 successively a little thinner *B. brevipetiolata* de Saussure (p. 101)
- Stalk of second gastral tergite at least clearly longer than broad. Gastral petiole not or only very gradually swollen distally . . . . . 2
- 2(1) Very large, wing-length 25.0–29.0 mm. Disk of frons with outstanding black bristles. Genal margin to near or beyond the bottom of the eye. Practically no bristles beneath the femora. Tomentum very sparse, denser on posterior gaster but there very fine. Uniform brown, ♀ stalk of second gastral tergite 2.5, of ♂ 1.7 times as long as broad. Male antennal segment 12 moderately flattened and curved, black, a little shining beneath  
*B. guerini* (de Saussure) (p. 102)
- Smaller, wing-length not more than 21.0 mm . . . . . 3
- 3(2) Stalk of second gastral tergite 3.5–4.0 times as long as broad. . . . . 4
- Stalk of second gastral tergite not more than 3 times as long as broad . . . . . 6
- 4(3) Females (unknown in *B. keiseri*).  
Light brown, clypeus and legs beyond the coxae rather paler. Wings brownish hyaline, length 11.0–14.0 mm. Disk of frons with rather fine outstanding brown bristles. Genal margin ending rather before the bottom of the eye. Tomentum very sparse, denser on posterior gaster but very fine. Femora with fine hairs beneath. Scutellum, metanotum and propodeum with numerous fairly long brown hairs. Valves of propodeum pale yellowish with a transparent, oval 'eye'-mark above it . . . . . *B. madecassa* (de Saussure) (p. 103)
- Males . . . . . 5
- 5(4) Yellowish ferruginous, head, legs and gaster beneath yellower. Wings hyaline, length 11.0 mm. Clypeus below gently rounded with moderately long and dense white hairs. Mesoscutum and femora beneath with no tomentum. Antennal segments 4–5 about 3 times as long as broad; 12 short (not quite as long as 8), flattened, a little widened to apex, tip narrowly black with a few short hairs; 8–11 beneath with protruding flat, table-like projections . . . . . *B. madecassa* (de Saussure) (p. 103)
- Brownish ferruginous, most of mandibles, face below antennal sockets, legs except coxae, more or less dark brown. Malar space and gena, band across pronotal keel, lateral sclerites of scutellum, most of metanotum, valves and large posterior area on propodeum, mesopleural spot, pale yellow; fore coxa and femur, mid femur, tibiae and tarsi with creamy yellow marks. Wings light brownish hyaline, length 11.5 mm. Clypeus projecting below in a rounded obtuse angle with dense outstanding hairs at sides. Mesoscutum with some long hairs, femora with fine pile rather than tomentum beneath. Antennal segments 4–5 about 3.5 times as long as broad, 12 narrow, considerably flattened, as long as 11 which is cylindrical, 8 a little more than 2.5 times as long as broad, 9–12 considerably longer and thinner, 6–10 with raised lines beneath . . . . . *B. keiseri* sp. n. (p. 104)
- 6(3) Wing-length 17.0–21.0 mm. Stalk of second gastral tergite usually 3 times as long as broad, 2.5 times in *B. apicalis* ♂ . . . . . 7
- Wing-length 10.0–16.5 mm. Stalk of second gastral tergite not more than 2.5 times as long as broad.  
Mesoscutum granulate, not punctured . . . . . 10
- 7(6) Bristles of mesosternum and fore coxa beneath, black.  
Antennal segment 3 clearly longer than 4 + 5. Wings yellowish hyaline, length 20.0 mm. Mid and hind femora (in good condition) with numerous hairs beneath. Ferruginous; scape greenish black, coxae, femora, sometimes fore tibiae, black; gaster black, tergites 4–6 more or less ferruginous suffused. Mid and hind tibiae and sometimes fore

- tibia, all tarsi, ochreous. Stalk of second gastral tergite blackish, slightly shorter than in *B. prasina*. Male not seen . . . . . *B. bicolor* de Saussure (p. 104)
- Bristles of mesosternum and fore coxa pale or at most partly brown . . . . . 8
- 8(7) Mid and hind femora with no hairs beneath. Wing-length 17·0–21·0 mm.  
 Female antennal segment 3 a little longer than 4 + 5. Light ferruginous, frons, humeri, part of mesoscutum and sometimes scutellum, gastral petiole and anterior part of tergites 2–3, part of mid and sometimes hind femora, blue-green.  
 Male with sides of clypeus, base of mandibles with dense outstanding white hairs. Clypeus roundly produced below. Antenna with segments 1–9 light brown, 10–12 black, 8 and 9 black marked beneath, segment 12 shining, curved, subcylindrical, 10–11 with a strongly raised ridge beneath projecting a little at apex. Fore and mid tarsus with segments rather short and broad . . . . . *B. prasina* de Saussure (p. 107)
- Mid and hind femora with quite conspicuous hairs as well as tomentum beneath. Wing-length 16·5–18·5 mm. Males not seen . . . . . 9
- 9(9) Antennal segment 3 distinctly longer than 4 + 5. Wings dark grey with tip largely light red-brown. Black, mandibles pitchy, ventral quarter of clypeus dark ferruginous. Antennae ferruginous, segments 1–3 darkened above. Tarsi more or less reddened. Stalk of second gastral tergite more or less ferruginous . . . . . *B. apicalis* de Saussure (p. 105)
- Antennal segment 3 a little longer than 4 + 5. Wings red-brown, tips if anything, paler. Ferruginous, frons, mesosoma, coxae and femora, gastral petiole and stalk of second gastral tergite somewhat darkened. Gaster sometimes vaguely darkened  
*B. maromandia* sp. n. (p. 108)
- 10(7) Females . . . . . 11
- Males . . . . . 12
- 11(10) Hind tibia pale yellow with apex black. Mesosoma with surface granulate, not punctured, ferruginous, large part of humeri, mesoscutum and upper part of propodeum, black. Gaster black, tergites 2–6 with yellow apical bands spreading along the sides. Four hind coxae, all femora, four hind tarsi, black; tibiae yellow. Wings very pale brownish hyaline, length 12·0–13·5 mm . . . . . *B. hildebrandti* de Saussure (p. 108)
- Hind tibia of uniform colour, usually black but sometimes reddish. Thorax generally with a few distinct punctures, probably always some on pleuron. Colour usually light reddish brown but there is also a form which is largely blackish. Gaster usually not banded, but rarely a linear band on tergite 2. Wings hyaline, length 13·0 mm  
*B. eumenoides* de Saussure (p. 110)
- 12(10) Wings hyaline, length 12·0 mm. Anterior streaks on all femora, all tibiae, traces of bands at sides of gastral tergites 3–4, yellowish. Stalk of second gastral tergite about 2·5 times as long as broad. Antennae a little shorter, segments 8–12 shining beneath, 12 cylindrical, curved, as long as 8. Gastral petiole with distal part distinctly widened  
*B. hildebrandti* de Saussure (p. 108)
- Wings light brown, length 12·0 mm. Head light ferruginous brown, mandibles, malar space, narrow streak on gena, wide stripes from mid sinus to bottom of clypeus, whitish yellow. Spot above antennal sockets, antennal segments 1–2 beneath, basicostal plate, anterior streaks on femora 1–2, anterior streaks on all tibiae, narrow end and sides of gastral tergite 2, narrow end of sternite 2, broad streaks on coxae beneath, meso- and metasternum, broadly, tip of pronotum below, creamy. Mid and hind tibiae blackish brown above. Stalk of second gastral tergite 2 as long as broad. Antennae longer, 6–10 with feeble raised lines beneath, 9–11 not shining beneath, segment 12 of similar shape but longer, as long as 9, traces of a division (into 12 and 13) rather before the middle. Gastral petiole with distal part widened . . . . . *B. eumenoides* de Saussure (p. 110)

## Descriptions of African species

### *Belonogaster juncea* (F.)

(Figs 1–5)

*Vespa juncea* Fabricius, 1781: 468.

*Raphigaster junceus* (Fabricius) de Saussure, 1853: 14, pl. 2, fig. 2.

*Belonogaster junceus* (Fabricius) Gerstaecker, 1862: 468.

This is a common species in tropical Africa and occurs in two forms, the nominotypical one with darker wings in more northern parts and a subspecies with lighter wings in the south. De Saussure includes *B. juncea* in his conspectus of the species of Madagascar but I know of no reliable record from that island.

*Belonogaster juncea juncea* (F.)

*Vespa juncea* Fabricius, 1781: 468. Holotype ♀, AFRICA AEQUINOCTIALI (Banks coll., BMNH) [examined].  
? *Vespa guineensis* Fabricius, 1793: 277. Holotype ♀, GUINEA (Isert coll., Kiel) [not examined].

**FEMALE.** Head ferruginous; antennal segments 1–7 darkened above. Mesosoma ferruginous, dorsal part of humeri and mesoscutum darkened. Legs ferruginous, tibiae 2–3 a little darkened, tarsi black. Gaster dark ferruginous, tergites 2–6 gradually more blackened. A very few ♀ in West Africa have two small yellow spots on gastral tergite 2. Wings black with purple reflections, length 17.0–23.5, mean (156 ♀) 20.35 mm.

Clypeus (Fig. 3) acute below, ventral quarter shining with scattered large punctures bearing short black bristles, dorsal part finely granulate, dull with more but smaller punctures and with very short black bristles and not very dense white tomentum. Frons with fairly close small punctures and outstanding black bristles, also rather sparse white tomentum. Gena not quite as wide as eye in profile. Antenna (Fig. 1) with segment 3 clearly longer than 4 + 5, 4 and 5 about 1.5 times as long as broad, 8 quadrate. Base of submentum and stipes with a few short black bristles. Mesoscutum and humeri finely granulate dull, with many small punctures and close silvery tomentum, mesopleuron similar; scutellum and metanotum with rather closer and stronger punctures, former with a strong impressed central line. Propodeum (Fig. 4) dull, very finely granulate, dorsally striate, sides punctured, tomentum close and silvery, bristles outstanding, short and black, posterior depression nearly half the dorsal length of propodeum, impressed line strong for two-thirds of length, anterior depression rather large, shallow. Last segment of the foretarsus long. Femora beneath with pale tomentum and not many short outstanding black or brown bristles. Gastral petiole relatively short and stout, a little widened at apex, spiracles little projecting, hairs sparse. Stalk (Fig. 5) of second gastral tergite 2–3 usually 2.5 times as long as broad. Gaster posteriorly with rather close pale tomentum through which numerous short black bristles protrude.

**MALE.** Very like the female; dorsal streak on mandibles, sides of clypeus, inner orbits, anterior streak on scape, yellow. Two males with two small yellow spots on gastral tergite 2. Wing-length 15.5–22.0, mean (42 ♂) 19.12 mm.

Gena distinctly narrower than eye in profile. Antenna (Fig. 2) with segment 3 about as long as 4 + 5, 4 more than, 5 = 2.5 times as long as broad, 8 twice as long as broad, 9–11 a little but usually not strongly prominent below, 12 flattened and curved with a few short bristles on the underside. Stalk of second gastral tergite 1.5–2.5 times as long as broad, usually 2. Bristles on the gaster sometimes less distinct.

**DISTRIBUTION** (599 ♀, 130 ♂). **India** (2 ♀, Rajasthan, Jaisalmer, 14.ix.1979, *G. Popov*), **Saudi Arabia** (Mahidh), **Libya** (Tripoli), **Ethiopia, Sudan, Rwanda** (Benoit, 1956: 352), **Chad, Mali, Senegal, Gambia, Guinea, Sierra Leone, Liberia, Ivory Coast, Ghana, Togo, Benin Republic, Nigeria, Cameroun** (including Sao Thomé), **Gabon, Congo, Zaire, Angola, Zimbabwe, Zambia, Kenya, Uganda, Malawi, Mozambique, Tanzania** (including Zanzibar), **South Africa** (Transvaal).

The subspecies seems to be rare or perhaps very local in the northern desert regions. In the south it intergrades with subsp. *colonialis* but specimens of the true subsp. *juncea* seem to occur occasionally right down to Zanzibar.

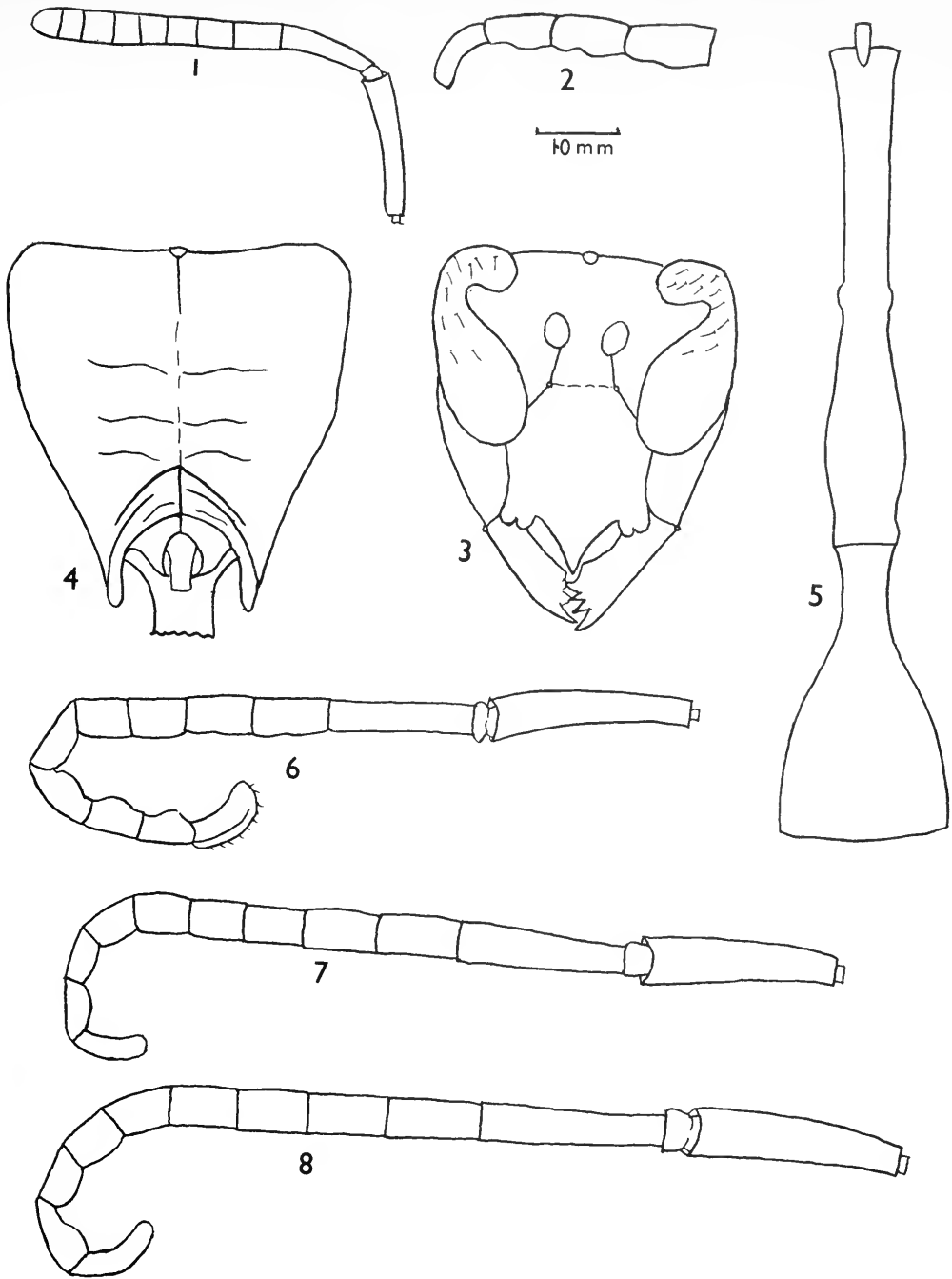
In the Salt coll. (BMNH) there are 1 ♂, 5 ♀, of this subspecies which are stylized. The adult is little modified.

*Belonogaster juncea colonialis* Kohl stat. n.

*Belonogaster colonialis* Kohl, 1894: 320, 323, pl. 11, figs 72, 84, pl. 17, fig. 132. LECTOTYPE ♂, TANZANIA: Dar-es-Salaam, 1893 (*R. Pachinger*) (NM, Vienna), here designated [examined].

Like *B. j. juncea* but the wings are usually much less darkened and lack the purple reflections. The degree of darkening of the wings varies a good deal and the two forms more or less intergrade. As in *j. juncea* yellow spots on the gaster are rare and occur more often in the ♀ and more in the northern part of its range. There may be small round spots on gastral tergite 2, or 2–3, or 2–4. These are usually accompanied by a small spot on sternite 2.

**DISTRIBUTION** (134 ♀, 27 ♂). **Congo, Zaire, Angola, Zambia, Uganda, Kenya, Malawi, Zimbabwe, Tanzania** (including Zanzibar), **Mozambique, South Africa** (Transvaal, Natal).



**Figs 1-8** *Belonogaster*. 1-5, *B. juncea juncea* (F.). (1) ♀, left antenna; (2) ♂, left antenna, segments 9-12; (3) ♀, clypeus; (4) ♀, propodeum; (5) ♀, gastral tergites 1-2. 6, *B. somereni* sp. n., ♂, left antenna. 7, *B. pennata* sp. n., ♂, left antenna. 8, *B. meneliki* Gribodo, ♂, left antenna.

*Belonogaster somereni* sp. n.

(Fig. 6)

**MALE.** Head ferruginous; small rings round ocelli, antennal segments 1–7 above, blackish; inner orbits to bottom of ocular sinus, sometimes sides of clypeus, creamy white. Mesosoma black; front of pronotum, subepimeral area, mesosternum, metasternum, valves and adjacent area of propodeum, ferruginous. Legs ferruginous, tibiae and tarsi black, hind femora somewhat blackened. Gaster black; petiole and nearly whole of segment 2 ferruginous, segments 3–4 very slightly reddened at apex; 1 ♂ with roundish yellow spots on tergite 2. Wings hyaline, slightly yellow-brown suffused, tips lightly infusate. Length 20.0 mm.

Clypeus below obtusely angled, tip hardly sharp, side with close silvery tomentum, with quite numerous large, shallow punctures with sparse outstanding black hairs. Frons dull with not very close shallow punctures with short black and longer pale outstanding hairs. Gena rather more than half as wide as eye in profile. Antenna (Fig. 6) with segment 3 as long as 4 + 5, 4 longer than 5, more than 2.5 times as long as broad, 8 rather less than twice as long as broad, 9–11 with strong shining humps beneath, 4–8 with shining raised lines beneath, 12 about as long as 9, 10 and especially 11 a little shorter, 12 much flattened (more than in *B. juncea*), outside shining, dorsal edge curved, ventral edge nearly straight but slightly concave. Whole mesosoma with dense silvery tomentum and whole upper side with quite dense, outstanding black and greyish hairs; hairs on propodeum black, longer and denser. Mesoscutum with a few small punctures at sides and in front, rather more numerous on mesopleuron; scutellum and metanotum with stronger punctures than mesoscutum. Propodeum with posterior depression nearly half its dorsal length, impressed line feeble, anterior depression small and narrow but deep; surface of propodeum with dense strong punctures and some striae on the angles. Mid and hind femora with rather dense white tomentum beneath. Front tarsi with segment 5 long. Gastral petiole long and narrow, not widened behind, spiracles little protruding. Stalk of second gastral tergite about 2.5 times as long as wide; gaster posteriorly with dense silvery-greyish tomentum and a number of protruding short black bristles.

**FEMALE.** Very like male but face not pale-marked, antennal segments 3–11 dark above. Gaster with segments 1–2 ferruginous, narrow apex of 2 black, 3–5 black, 6 reddish. Wings brown, tips hardly darker, length 10.0–20.0 mm.

Clypeus acute below, finely reticulate with scattered large punctures and subappressed black bristles. Frons dull, reticulate with close moderate sized punctures and many outstanding black hairs. Gena a little wider than eye in profile. Antenna with segment 3 much longer than 4 + 5, 4 and 5 a little longer than broad, 8 quadrate. Whole mesosoma with dense silvery tomentum but no outstanding hairs except on propodeum, punctures small and indistinct except on mesopleuron. Propodeum with angles punctate-striate. Mesosternum with rather conspicuous black bristles in front of mid coxae. Hind femora with numerous short black bristles in front of mid coxae. Hind femora with numerous short black bristles beneath. Gastral petiole moderately long, a little widened behind. Stalk of second gastral tergite 2.5 times as long as broad; posterior tergites with dense greyish tomentum and short protruding black bristles.

**Holotype** ♂, **Kenya**: Teita Hills (ca 38°3'E, 2°4'S), viii.1947 (*V. G. L. van Someren*) (BMNH).

**Paratypes.** **Kenya**: 1 ♂, same data as holotype (BMNH). **Tanzania**: 1 ♀, Lake Prov., Old Shinyanga, window, 8.iv.1958 (*O. W. Richards*) (BMNH); 1 ♀, West Kilimandjaro, Ngare-Nairobi, 4500 ft [1370 m], iv.–v.1937 (*B. Cooper*) (BMNH); 1 ♀, Kilimandjaro (*Raurige*) (RNH, Leiden); 1 ♂, Maranga, 11.vii.1978 (*H. R. Feijen*) (ITZ, Amsterdam). **Zimbabwe**: 1 ♀, Salisbury, i.1906 (*G. A. K. Marshall*) (stalk of gastral tergite 2 short, 1.5 times as long as broad) (BMNH). **Zambia**: 1 ♀, Lake Bangweolo, Chishi I., 3800 ft [1160 m], 3.vi.1908 (*S. A. Neave*) (UM, Oxford); 1 ♂, 2 ♀, N. of Lake Bangweolo, Lawingu, 4200 ft [1280 m], 10.i–13.vii.1908 (*S. A. Neave*); 1 ♂, 1 ♀, Lake Chambezi, Kasama district, 3900 ft [1190 m], 4–8.vi.1908 (*S. A. Neave*); 4 ♀, Chinsali district, 4300 ft [1310 m], 9.iv.–3.v.1908 (*S. A. Neave*) (UM, Oxford). **Malawi**: 1 ♀, Zomba, 1915 (*H. Stannus*) (BMNH); 1 ♂, Zomba, 10.iii.1974 (*H. R. Feijen*); 3 ♂, Limbe Maone, 10.v.1973, 7.vi.1973 (*H. R. Feijen*); 3 ♂, Ntchisi Forest, 21.viii.1974, 21.ix.1974 (*H. R. Feijen*); 1 ♂, Ntocha Forest, 21.viii.1974 (*H. R. Feijen*); 1 ♂, Cape Maclean, 18.iv.1973 (*H. R. Feijen*); 1 ♂, 1 ♀, Chelinda, 25.ii.1972 (*H. R. Feijen*); 1 ♂, Liwonde, 24.iv.1975 (*H. R. Feijen*); 1 ♀, Salima, 25.ii.1975 (*C. G. Schulten*); 1 ♂, Chumbe, 1.vi.1972 (*C. G. Schulten*) (ITZ, Amsterdam). **Mozambique**: 1 ♂, Maputo, 1.v.1977 (*H. R. Feijen*); 1 ♂, Maxaquin, 1.v.1977 (*H. R. Feijen*) (ITZ, Amsterdam). **South Africa**: 2 ♂, Natal, Durban, iv.1896–99 (*F. N. Brown*) (UM, Oxford); 1 ♂, Natal, Howick, 3000–4000 ft [900–1200 m], 1895–99 (*F. N. Brown*) (no yellow spots on gastral tergite 2); 1 ♂, Orange Free State, 4000–5000 ft [1200–1500 m], i.–iii.1896 (*F. N. Brown*) (UM, Oxford). **Niger**: 3 ♀, Air, Mts, Baguezane, 1200–1300 m, 26–31.viii. (*L. Chopard, A. Villiers*) (MNHN, Paris).

*Belonogaster pennata* sp. n.

(Fig. 7)

**FEMALE.** Black; head ferruginous, centre of frons black; antennae darkened, especially above; legs blackish ferruginous. A few specimens considerably ferruginous tinged. Wings brownish ferruginous, tips fuscous, length 20.0 mm.

Clypeus acute below, very finely reticulate, more shining below with a few scattered punctures and dorsally with a few dark oblique bristles. Frons with fairly numerous punctures and short outstanding bristles. Gena about as wide as eye, shining below, with very few punctures. Antennal segment 3 not quite as long as 4 + 5 + 6, 4 and 5 about 1.5 times as long as broad, 8 about quadrate. Mesosoma and gaster with close silvery grey tomentum. Mesoscutum usually not very distinctly punctured, but distinct oblique short black bristles, mesopleuron, scutellum and metanotum more distinctly punctured. Propodeum distinctly punctured, angles punctate-striate, with short, stout oblique bristles, posterior depression nearly half as long as propodeum, no impressed line, anterior depression small and deep. Hind femora beneath with tomentum and some short black bristles. Fifth segment of fore tarsus long. Gastral petiole stout but little widened posteriorly, spiracles not prominent, tomentum dense, sometimes black bristles at sides. Stalk of second gastral tergite about 1.5 times as long as broad. Gaster posteriorly with distinct short black bristles protruding through the tomentum.

**MALE.** Very like the female, wing length ca 20.0 mm. Orbits, sides of clypeus, spot between antennal sockets, more or less white-marked, sides of clypeus often not much so. Clypeus much less acute below. Antenna (Fig. 7) with segment 3 a little longer than 4 + 5 which are each about 2.5 times as long as broad, 8 twice as long as broad, 6–8 with a shining line beneath, 9 and to a less extent 10 convex and shining beneath, 11 almost cylindrical, 12 a little flattened, well curved, tip rounded.

**Holotype** ♀, **Zaire:** Shaba prov. (Katanga), Kambove, 4000–5000 ft [1220–1500 m], 13.ii.07 (*S. A. Neave*) (BMNH).

**Paratypes.** **Gabon:** 1 ♀, Pays Mandja, Bassin du Chari, 1904 (Mission Chad-Chari, *Dr J. Decorse*) (MNHN, Paris). **Congo:** 1 ♀, Mbomo, Route Odzala, 21.ix.1977 (*S. Kelner-Pillaut*); 4 ♀, Brazzaville, 1907 (*E. Roubaud, J. Weiss*); 1 ♀, Bokomé, Village de Karamaion, 1905 (*Capn<sup>ne</sup> Fourneau*); 3 ♂, 2 ♀, Congo (*Dybowski*) (MNHN, Paris). **Zaire:** 1 ♂, Shabah prov. (Katanga), Kambove, 4000–5000 ft [1220–1500 m], 5.vii.1907 (*S. A. Neave*); 1 ♀, Shabah, Dilolo, 24–7.vii.1931 (*J. Ogilvie*); 1 ♂, 1 ♀, Shabah, Lualaba R., 2500–4000 ft [760–1220 m], 21.iv.1907 (*S. A. Neave*); 1 ♂, 150–200 miles [240–320 km] N. of Kambove, 3500–4500 ft [1060–1370 m], 4.x.1907 (*S. A. Neave*) (BMNH); 3 ♀, Garamba, 29°40'E, 4°10'S, vi.vii.1912 (*Lang-Chapin*) (USNM, Washington); 1 ♀, Lubumbashi (Elisabethville), 25.viii.1932; 1 ♀, Shabah, Kwatabala, 9.vii.1957 (*H. W. Croockewit*) (ITZ, Amsterdam). **Rwanda:** 4 ♀, Kisenyi, 4.ix.1958 (*J. Pasteels*) (USNM, Washington). **Angola:** 4 ♀, Salazar, 9–15.iii.1972 (Southern African Exped.); 1 ♀, Luimbali, Mt. Moco, 1800–1900 m, iii.1934 (*K. Jordan*) (BMNH). **Kenya:** 1 ♀, Nasisi Hills, 20 miles [32 km] N. of Mumias, 4800 ft [1460 m], 14–15.vi.1911 (*S. A. Neave*); 1 ♀, Nairobi (*Loveridge*); 2 ♀, Nairobi, i.1956 (*F. J. Jackson*) (BMNH); 2 ♀, Ngong Forestry Station, 13–18.i.1968 (*Krombein & Spangler*) (USNM, Washington). **Uganda:** 1 ♂, 3 ♀, Eastern Mbale distr. S. of Mt. Elgon, 3700–3900 ft [1130–1190 m] 2–5.viii.1911 (*S. A. Neave*); 2 ♀, between Jinja and Busia, E. Busoga, 3800–4000 ft [1160–1220 m], 28.vii., 1.viii.1911 (*S. A. Neave*); 2 ♀, Sitroko R., W. foot of Mt Elgon, 3600 ft [1100 m], 12–14.viii.1911 (*S. A. Neave*); 8 ♀, Torroro distr., Sukulu, iv.1961 (*E. Burtt*); 2 ♀, Kigezi distr., 6000 ft [1830 m], 19.xi.1934 (*J. Ford*); 1 ♀, Entebbe, ii.1912 (*C. A. Wiggins*); 1 ♀, Lango, viii.1934 (*D. R. Buxton*) (BMNH). **Tanzania:** 1 ♂, Malagarasi, Moyonasi, 29.vii.1950 (*D. Vesey Fitzgerald*); 1 ♀, N. Shore, Lake Manyara, ii.–v.1930 (*B. Cooper*) (BMNH); 1 ♀, Morogoro, 1963 (*Brother Ananias-Denis*) (ITZ, Amsterdam). **Zambia:** 1 ♀, Lake Bangweolo, Chishi I., 3800 ft [1160 m], 3.vi.1908 (*S. A. Neave*) (UM, Oxford); 1 ♂, 2 ♀, north of Lake Bangweolo, Lawingu, 4200 ft [1280 m], 13.vii.1908 (*S. A. Neave*); 1 ♂, 1 ♀, Lake Chambezi, Kasama district, 3900 ft [1190 m], 4–8.v.1908 (*S. A. Neave*); 4 ♀, Mid Chambezi Valley, Chinsali district, 4300 ft [1310 m], 9.iv.–3.v.1908 (*S. A. Neave*); 1 ♀, Lofu River, 4000 ft [1220 m], 8.viii.1908 (*S. A. Neave*) (UM, Oxford); 4 ♂, 14 ♀, Abercorn, i.1951–ii.1952 (*F. O. Albrecht*); 1 ♀, Niumadzi R., near Nawalia, 2000 ft [610 m], 17–22.viii.1910 (*S. A. Neave*) (BMNH). **Malawi:** 1 ♀, Blantyre, 1911 (*Dr J. E. S. Old*); 1 ♀, Zomba, 1915 (*H. S. Stannus*); 1 ♀, Chiromo, 1917 (*R. C. Wood*); 1 ♀, Bowa district, 1918 (*J. B. Davey*) (BMNH); 1 ♀, Nkata Bay, 27.ii.1974 (*H. R. Feijen*); 2 ♀, Nchisi Forest, 25.iv.1974, 25.viii.1974 (*H. R. Feijen*); 2 ♀, Salima Beach, 25.ii.1975, 17.iii.1970 (*C. G. Schulten*) (ITZ, Amsterdam). **Zimbabwe:** 1 ♂, Salisbury, iv.1899 (*G. A. K. Marshall*) (BMNH); 1 ♂, Victoria Falls natl. Park, 3–6.iv.1968 (*P. Spangler*) (USNM, Washington). **South Africa:** 1 ♂, Cape of Good Hope, Ft Beaufort, iii.1953 (*J. S. Taylor*) (USNM, Washington).

In the MNHN, Paris, some specimens of this species were found in the series of *B. grisea* var.



*fuscipennis* du Buysson and *R. brunnea* Ritsema. In my opinion both these series included five distinct species.

***Belonogaster ferruginea* sp. n.**

FEMALE. Ferruginous; antennae black except for the scape beneath, ocellarium black. Mesoscutum marbled with black. Stalk of second gastral tergite more or less black. Tibiae and tarsi black. Wings reddish brown, tips not darker, length 21.0 mm.

Clypeus acute below, moderately shining-reticulate with many scattered large punctures bearing black bristles, a little pale tomentum, inner orbit with a yellow spot. Frons dull, closely punctured with outstanding short black bristles, little pale tomentum. Gena not quite so wide as eye in profile, reticulate with many moderate sized punctures. Antennal segment 3 as long as 4 + 5 + half 6, 4 + 5 a little but not much longer than broad, 8 quadrate. Mesoscutum and humeri with many rather small punctures, the former with some short hairs, tomentum very short, brownish and not very dense. Mesopleuron quite closely punctured with sparse tomentum. Scutellum and metanotum distinctly punctured. Propodeum with many rather coarse punctures, traces of striae dorsally, a little pale tomentum and below a few short hairs, posterior depression half as long as propodeum, impressed line rather distinct and nearly complete, anterior depression large and deep. Fifth segment of the fore tarsus long. Hind femur only with fine tomentum beneath. Gastral petiole short, stout, very shining, little widened posteriorly, a few short hairs. Stalk of second gastral tergite 1.5 times as long as broad. Gaster posteriorly with moderately dense pale tomentum with short black bristles protruding through it.

MALE. Not seen.

Holotype ♀, **Grande Comore**: La Grille (Guiri), 850–900 m, 15.xi.1973 (*L. Matile*) (MNHN, Paris).

Paratype. 1 ♀, same data as holotype (MNHN, Paris).

This species is very close to *B. pennata* but it has no black bristles beneath the hind femur and the gastral petiole is stouter and less hairy. The Comoro Is. are much nearer to Africa than to Madagascar.

***Belonogaster meneliki* Gribodo**

(Fig. 8)

*Belonogaster meneliki* Gribodo, 1879: 242; du Buysson, 1909: 250, 265, pl. 7, fig. 1 (in part). Syntypes 2 ♀, ETHIOPIA: Shoa (Scioa), Mathal-Uonz (MCSN, Genoa).

I was sent 1 ♂, 1 ♀, from MCSN, Genoa and the ♀ (Scioa, *Antinori*, 1879) may well be one of the syntypes; the male was collected in the same region in 1881.

A box of specimens in MNHN, Paris, labelled *B. grisea meneliki* seemed to me to consist of six species: (5 ♂, 20 ♀), *B. meneliki*, all from Ethiopia; 5 ♀, *B. adenensis somaliensis* subsp. n.; 3 ♂, 5 ♀, *B. grisea* (F.); 2 ♂, 5 ♀, *B. juncea colonialis* Kohl; 7 ♂, 3 ♀, *B. freyi* du Buysson; 1 ♂, 2 ♀, *B. neavei* sp. n. In my opinion *B. meneliki* is confined to, though widespread, in Ethiopia. The records by other authors (du Buysson, Bequaert, etc.) from other parts of Africa are, I think, in error.

FEMALE. Head ferruginous, antennae dark ferruginous, large frontal spot and head beneath black. Mesosoma, legs, gaster except petiole and base of tergite 2, black; scutellum and metanotum sometimes reddish. Wings red-brown. tips fuscous, length 17.0–20.0 mm.

Clypeus acute below, with scattered large punctures, on lower third shining with black bristles, upper two-thirds finely granulate. Frons with close rather large punctures and interstices finely reticulate with numerous outstanding short black hairs. Gena just wider than eye in profile, shining with a few small punctures below, reticulate with more numerous larger punctures above. Antenna with segment 3 as long as 4 + 5 + 6, 4 and 5 each a little longer than broad, 8 almost transverse. Thorax, especially mesopleuron with very distinct moderate-sized punctures, mesoscutum with dense, very fine, greyish tomentum and more or less distinct outstanding hairs. Propodeum with rather strong punctures and traces of striae on the angles, with long black hairs especially posteriorly, posterior depression about one-quarter as long as propodeum, impressed line more or less obsolete, anterior depression small but deep. Fifth segment of fore tarsi long. Hind femora with moderately numerous short black hairs beneath. Gastral petiole long, moderately thick, widened posteriorly, spiracles not very prominent. Stalk of second gastral tergite about 2.5 times as long as



broad. Gaster posteriorly with dense silvery tomentum and protruding through it more or less distinct black bristles.

**MALE.** Head ferruginous; mandibles, face except a narrow light brown central streak, scape beneath, creamy; frons and vertex, head beneath, antennae 1–3 above, black. Mesosoma black, scutellum and metanotum more or less reddish. Legs black, prosternum beneath, fore coxa, trochanter and femur beneath, spot beneath hind coxa, anterior spot at apex of and streak beneath apical quarter of hind femur, creamy. Last segment of front tarsi reddish. Gaster black, petiole and base of second tergite dark reddish. Wings reddish brown, tip large, length 18–19 mm.

Structurally very like ♀. Clypeus acute below, finely reticulate with very few punctures, silvery tomentum at sides, short black bristles on upper half of disk. Frons with short silvery hairs as well as the black ones. Gena rather narrower than eye. Antenna (Fig. 8) with segment 3 hardly longer than 4 + 5, 4 and 5 each about 2.5 times as long as broad, 8 just over twice as long as broad, 5–8 with raised lines beneath, 9–11 with elongate rounded protuberances beneath, 12 a little curved and flattened, end rounded, shining, as long as 8 or a little longer. Black hairs on mesosoma more developed. Hind femur with tomentum beneath but few or no bristles.

**DISTRIBUTION** (51 ♀, 12 ♂). **Ethiopia** (in mountains at 6000–11500 ft [1850–3500 m]): Shoa (i.e. round Addis Ababa), Simien, Jimma, Sidano, Harra, Diredawa, Eritrea (BMNH; MNHN, Paris; MCSN, Genoa; RNH, Leiden; ITZ, Amsterdam; USNM, Washington).

Dr Hugh Scott caught a ♀ visiting the crown of *Lobelia rhynchopetalum* at 11500 ft [3500 m], Argline, Simien, 23.vi.1952 (BMNH).

Mons. M. de Rothschild caught a ♀ at Harrare with a ♂ strepsipterous puparium beneath gastral tergite 3 on the right.

### *Belonogaster kohli* Schulz

(Fig. 9)

*Belonogaster kohli* Schulz, 1906: 322. Holotype ♀, FERNANDO PO: Malabo (Santa Isabel), 15.viii.1900 (*L. Conrad*) (BMNH) [examined].

**FEMALE.** Head ferruginous, ocellarium and antennal segments 3–6 above, darkened; lateral lobes of clypeus yellowish. Mesosoma ferruginous, darkened dorsally, propodeum sometimes with 2 yellow posterior spots; legs ferruginous; gaster ferruginous, segments 3–6 much darkened. Wings hyaline, costal stripe slightly brownish, length 15.0–16.0 mm.

Clypeus acute below, surface finely reticulate, lower quarter with shallow large punctures bearing brownish bristles, upper half duller, more granulate with sparse, very short, white tomentum. Frons with small rather sparse punctures, sparse pale tomentum and in front short black bristles. Gena a little narrower than eye, dull, reticulate; more shining below with a few small punctures. Bases of stipes and submentum with a tuft of long black bristles. Antenna with segment 3 much longer than 4 + 5, which are 1.5 or rather more times as long as broad, 8 a little longer than broad. Mesoscutum and humeri coarsely granulate with sparse inconspicuous small punctures, sparse pale tomentum, no hairs, mesopleuron similar, scutellum and metanotum rather more strongly punctured, former without an impressed line. Propodeum coarsely granulate, a few weak striae below, many outstanding black hairs, no distinct tomentum, posterior depression one-third as long as propodeum, impressed line very weak, anterior depression transverse, small. Last segment of fore tarsi a little shortened. Femora with scattered black bristles beneath, very little tomentum. Gastral petiole (Fig. 9) long and narrow, little widened posteriorly, spiracles moderately prominent, surface dull granulate with very fine tomentum and many long black hairs. Stalk of second gastral tergite (Fig. 11) 4.5 times as long as broad. Gaster posteriorly with close greyish tomentum and numerous protruding black bristles.

**MALE.** Not seen.

**DISTRIBUTION.** **Fernando Po:** 1 ♀, same data as holotype (MNHN, Paris). **Congo:** 1 ♀, Brazzaville, 1886; 1 ♀, Dimonika, 26.i.1971 (*J. Grillot*) (no yellow spots on propodeum) (MNHN, Paris); 1 ♀, ?Congo, Moumouna, 18.v.1971 (*C. Morin*) (no yellow spots on propodeum) (MNHN, Paris). **Uganda:** 1 ♀, Tero Forest, SE. Buddu, 3800 ft [1160 m], 26–30.x.1911 (*S. A. Neave*) (no yellow spots on propodeum) (BMNH).

### *Belonogaster dubia* Kohl

(Figs 10, 11)

*Belonogaster dubia* Kohl, 1894: 322, 323, 329, pl. 15, figs 79, 94. LECTOTYPE ♂, TANZANIA: Dar-es-Salaam, 1893 (*R. Pachinger*) (NM, Vienna), here designated [examined].

*Belonogaster occidentalis* Tullgren, 1904: 455, pl. 25, fig. 4. LECTOTYPE ♂, CAMEROUN: Itoka, 20.i. (Sjöstedt) (NR, Stockholm), here designated [examined].

*Belonogaster massaicus* Cameron, 1910: 171. LECTOTYPE ♀, TANZANIA: Kilimandjaro, Kibonoto (Sjöstedt) (RM, Stockholm), here designated [examined]. **Syn. n.**

Although most specimens of this species are easily recognized by their large size, the yellow marked face of the ♀, the short stalk of the second gastral tergite and the bristles on the posterior gastral tergites, it is an unusually variable species and specimens occur in which these characters are not or only partially developed.

It also seems to be one of the species which has led to confusion in the fauna of Madagascar owing to the misidentification of unusual specimens of *B. dubia* as *B. guerini* de Saussure, a species which I believe is confined to Madagascar.

**FEMALE.** Ferruginous, often rather dark; clypeus including lateral lobes and inner orbits, spot between antennal sockets creamy white or yellow, the yellow occasionally reduced or even absent. Antennae dark, often almost black. Legs rather dark ferruginous, mid and hind tibiae darker, mid and hind tarsi black. Wings normally brown, occasionally pale or black, tips usually rather darker, length 23.0–26.5 mm.

Clypeus acute below, moderately shining, hardly reticulate with scattered fine punctures and short oblique dark bristles. Frons with fairly numerous, rather small punctures, outstanding black bristles and fine pale tomentum. Gena nearly as wide as eye. Antenna with segment 3 nearly as long as 4 + 5 + 6, 4 and 5 about 1.25 times as long as broad, 8 quadrate. Mesoscutum with numerous small punctures, more on the mesopleuron, tomentum pale, not very dense, humeri with very short, subappressed black bristles. Propodeum with strong striae on the angles, hairs short and not very dense, posterior depression half as long as propodeum, impressed line distinct, anterior depression small but deep. Posterior femora with white tomentum and a few pale bristles beneath. Gastral petiole moderately long, regularly but not very much widened to posterior end, spiracles little projecting. Stalk of second gastral tergite normally 1.5–2.0 times as long as broad, but occasionally 2.5 times. Posterior tergites with pale tomentum and normally more or less strongly protruded black bristles; but these bristles are sometimes paler or less prominent.

**MALE.** More ferruginous than the ♀. Sides of clypeus, inner orbits, spot between antennal sockets, scape beneath usually all whitish yellow or yellow. Antennae usually darkened above except on segments 10–12. Wings usually not so dark as in ♀, length 19.0–24.5 mm.

Clypeus (Fig. 11) more or less rounded below, at most with an obtuse point at centre, with scattered fine black bristles and little tomentum. Gena distinctly narrower than eye-width. Antenna (Fig. 10) with segment 3 about as long as 4 + 5, 4 and 5 about 2.5 times as long as broad, 8 rather less, 4–9 with shining lines beneath, 10–11 cylindrical, 12 moderately flattened, end rounded-truncate, nearly straight below, distinctly curved above. Mesosoma with sculpture usually rather weaker than in ♀. Bristles on posterior tergites sometimes little developed or pale.

**DISTRIBUTION** (304 ♀, 69 ♂). Common over most of Africa south of the Sahara. **Senegal, Gambia, Guinea, Liberia, Ivory Coast, Ghana, Nigeria, Fernando Po, Niger, Congo, Zaire, Rwanda, Kenya, Uganda, Tanzania, Zambia, Malawi, Angola, Zimbabwe, Mozambique, South Africa** (Transvaal, Natal).

Two males (Zambia: Lake Bangweolo, 3800 ft [1160 m], north shore, 31.v.1908 and Chirui I., 5–7.vii.1908 (*S. A. Neave*) (UM, Oxford) seem to be a form of this species but the clypeus below is sharply pointed and has less yellow at sides and has fewer black bristles; antennal segment 12 is more curved, less flattened and less widened to the apex.

### *Belonogaster ugandae* sp. n.

(Fig. 12)

**MALE.** Ferruginous; dorsal streak of mandibles, face below antennal sockets except a rather narrow, pale brown, central stripe, pale yellow; ill-defined rings round ocelli blackish. Antennae black above, segments 1–2 and extreme rings round ocelli blackish. Antennae black above, segments 1–2 and extreme base of 3 yellow beneath, 3–9 ferruginous beneath, 10–11 light ferruginous (Fig. 12), 12 black. Legs ferruginous, coxae 1–2 beneath, mid trochanter and base of mid femur anteriorly, pale yellow. Mid, and to a greater extent hind femur darkened. Tarsi black, segment 5 of fore tarsi, proximal half of 5 on mid tarsi, pale brown. Gaster ferruginous. Wings dark reddish brown, tips darker, length 22.0 mm.

Clypeus beneath obtusely produced with the tip rounded; surface moderately shining, finely reticulate with scattered large punctures bearing fine black bristles, white tomentum very inconspicuous. Frons with

small, fairly close punctures, with outstanding black bristles. Eyes somewhat swollen, gena only about half eye-width in profile. Antenna (Fig. 12) with segment 3 a little longer than 4 + 5, 4 and 5 about 2.5 times as long as broad, 8 a little more than twice as long as broad, 12 a little flattened and curved, tip rounded, about as long as 11, 10 and 11 cylindrical, not swollen beneath, 5-9 with a slight raised line beneath. Mesoscutum and humeri with indistinct small punctures and very short pale hairs, tomentum silvery, not dense. Mesopleuron with rather sparse small punctures, little tomentum. Scutellum with an indistinct central line, closely punctured. Propodeum rather feebly punctate-striate with moderate silvery tomentum and oblique black hairs, posterior depression one-quarter as long as propodeum, impressed line rather well marked, anterior depression deep, quite large. Last segment of fore tarsi elongate. Fore femur with short white pile beneath. Mid femur with white tomentum and some short black hairs beneath. Hind femur with short pile or tomentum beneath and at base some short black hairs. Gastral petiole rather thick, not very long, gradually and not very much widened posteriorly, spiracles not much protruding. Stalk of second gastral tergite about 2.5 times as long as broad. Gaster posteriorly with very close silvery tomentum through which fine bristles protrude.

FEMALE. Not seen.

Holotype ♂, **Uganda**: eastern Mbale district, S. of Mt Elgon, 3700-3900 ft [1130-1190 m], 3-5.viii.1911 (S. A. Neave) (BMNH).

*Belonogaster hirsuta* sp. n.

MALE. Head ferruginous, whole frons black; mandibles except ventral margin, clypeus except central stripe which is black above and ferruginous below, inner orbits, creamy white. Antennae black, radicle and segments 1-8 beneath creamy, 9-11 ferruginous on both sides, 12 blackish. Mesosoma black except front edge of pronotum and the propodeum around the orifice. Legs black, fore femur ferruginous below, propleuron beneath, small base of fore femur beneath, fore trochanter beneath, anterior streak of mid coxa, trochanter and femur, small basal streak beneath hind femur, creamy white. Gastral petiole and stalk of second gastral tergite ferruginous, rest of gaster blackish. Wings hyaline, margins of veins darkened, costal region on proximal half dark brown, length ca 22.0 mm.

Mandibles rather narrow and parallel-sided. Clypeus rounded below, little protruding, weakly convex from side to side, very feebly reticulate, a little shining with scattered large punctures bearing black hairs, no tomentum except a little on frons which is closely and rather coarsely punctured with long outstanding black bristles. Gena about 0.7 of the eye width, rather broader below. Antenna with segment 3 about as long as 4 + 5, segments 4 and 5 about 3 times as long as broad, 8 2.5 times as long as broad, 12 almost straight below, well curved above, a little flattened, tip rounded, as long as 10; segments except 12 all cylindrical, not protuberant beneath. Mesoscutum coarsely closely but shallowly punctured, humeri similar but rather less coarsely punctured, while pleuron more or less strongly and closely punctured; very little tomentum but mesoscutum, humeri, scutellum and metanotum with long black hairs. Scutellum well raised with central impressed line, contiguously punctured. Propodeum behind with oblique striae below and very coarse close shallow punctures above, with a little pale tomentum and close, long black hairs. Last segment of fore tarsus elongate, fore femur with dense pale pile beneath. Mid femur with dense white pile beneath, hind femur with close rather long black hairs beneath. Gastral petiole elongate, gradually a little widened to apex, spiracles little protruding, stalk of second gastral tergite 2.5 times as long as broad. Posterior gaster with dense fine silvery tomentum through which rather fine black bristles protrude.

FEMALE. Not seen.

Holotype ♂, **Tanzania**: Mahali peninsula, Kungwe Camp, 15.ix.1958 (2nd Oxford Expedition) (BMNH).

*Belonogaster multipunctata* sp. n.

FEMALE. Head ferruginous; small spot at top of clypeus, frons, dorsal boundary of ocular sinus, centre of occiput, antennae except base of segment 3, and whole 1-2 beneath, black. Mesosoma black, front margin of pronotum, metanotum and sides of scutellum, narrow ventral margin of pleuron and propodeum, ferruginous; legs ferruginous, tibiae and tarsi except to some extent hind tibia, black. Gaster black, petiole, base of tergite 2 and some tinge of its posterior part, ferruginous. Wings light brownish, tips hardly darker, venation ferruginous, length 22.0 mm.

Head with clypeus acute below, surface slightly shining with numerous rather large punctures, sparse pale tomentum and scattered black bristles; frons dull with moderately large and close punctures with sparse

pale tomentum and outstanding brown hairs; gena a little wider than eye in profile, dull, especially above, and with rather close medium-sized punctures; base of submentum with some moderately long bristles; antenna with segment 3 longer than 4 + 5, 4 1.5 times as long as broad, 5 rather shorter, 8 a little longer than broad. Mesosoma dull with very close, moderately large punctures, inconspicuous brown tomentum but no outstanding hairs. Scutellum with an impressed line on front half; propodeum with some outstanding hairs below, posterior depression to mid point, impressed line complete, rather strong, anterior depression small, deep. Last segment of fore tarsus elongate; femora beneath with very short white pile. Gastral petiole moderately thick but little widened posteriorly, numerous short hairs on proximal half, spiracles not prominent; stalk of second gastral tergite about 2.5 times as long as broad; gaster posteriorly with rather dense silvery tomentum but no protruding bristles.

MALE. Not seen.

Holotype ♀, **Uganda**: Entebbe, 3800–4000 ft [1160–1220 m], forest within 4 miles [6.5 km] of Kitabi Hill (C. A. Wiggins) (UM, Oxford).

This has some resemblance to *B. hirsuta* of which the ♀ is not known, but that species is blacker with many dark outstanding hairs on the mesosoma and occurs in Tanzania.

### *Belonogaster vasseae* du Buysson

(Fig. 13)

*Belonogaster vasseae* du Buysson, 1906: 189; du Buysson, 1909: 219, pl. 2, fig. 8. LECTOTYPE ♀, MOZAMBIQUE: 'Basin inférieur du Zambèze, Vallée du Muza', 32°E 18'S, 1000–1120 m, 1905 (*G. Vasse*) (MNHN, Paris), here designated [examined].

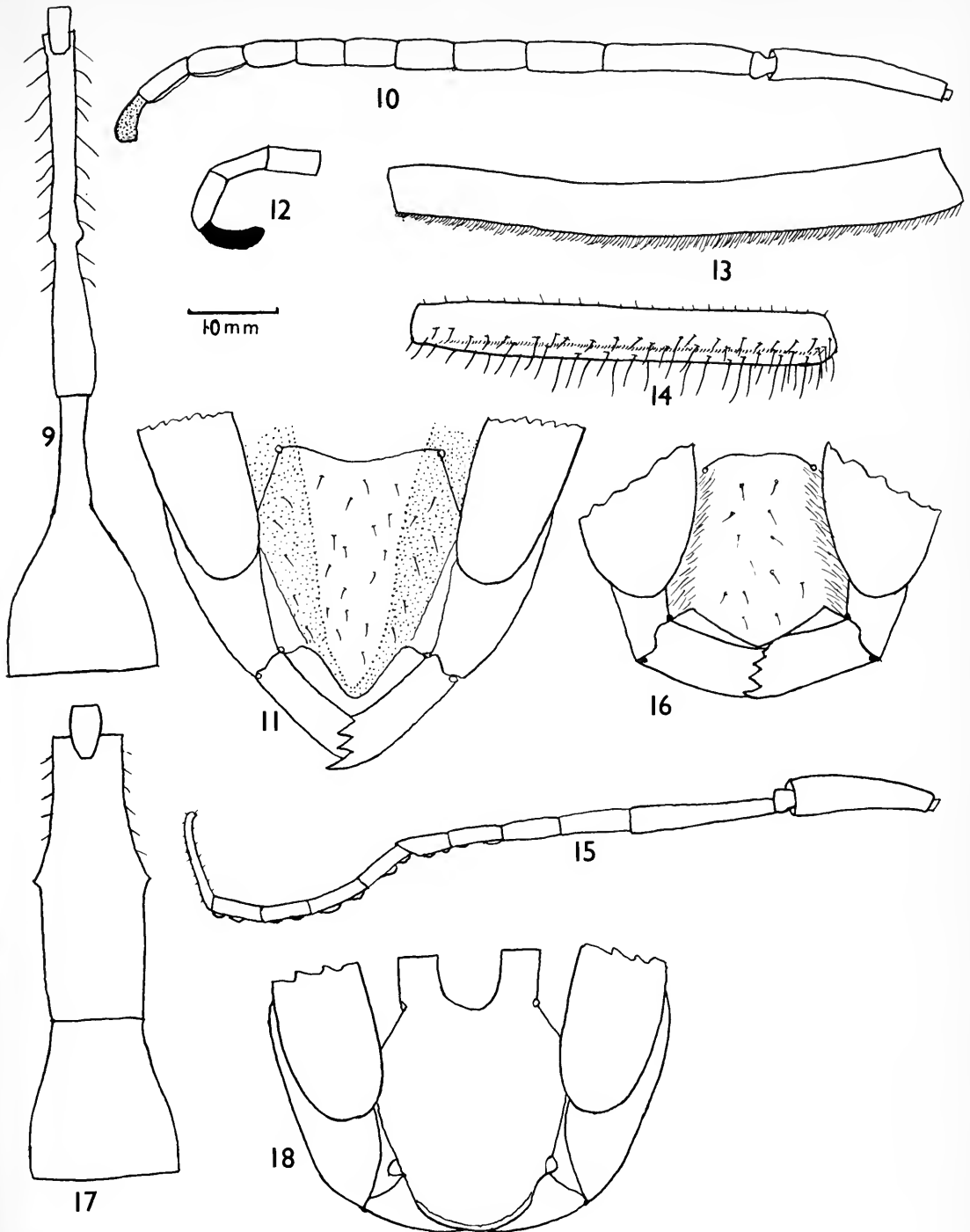
In the MNHN, Paris, 8 ♀ are all labelled type and one of them with the correct locality data is here designated lectotype.

FEMALE. Head ferruginous; frons black, antenna 3–11, 1–2 above, black. Mesosoma dark ferruginous or more often black, mesoscutum black. Legs ferruginous, tibiae and tarsi black, hind tibia ferruginous tinged. Gaster black, petiole ferruginous. Wings black with purple reflections, length 24.0–28.0 mm.

Clypeus acute below, fine reticulate, more shining below, with fairly abundant scattered, moderate-sized punctures, especially above, bearing short black bristles, sparse silvery pubescence, frons with close small punctures bearing short suberect black bristles and close silvery tomentum. Gena about as wide as eye in profile, finely reticulate with quite close small punctures throughout, on upper third bearing suberect short black bristles. Base of submentum and stipes with dense black hairs. Antennal segment 3 longer than 4 + 5, segments 4 and 5 between 1.5 and 1.25 times as long as broad, 8 quadrate. Mesoscutum and humeri with close fine punctures bearing very short black bristles, more obvious on the humeri, rather dense brownish tomentum, mesopleuron similar but punctures a little larger, scutellum and metapleuron like mesopleuron but former with a weak impressed line in front half. Propodeum strongly punctate-striate with very short erect black bristles at sides and sparse brown tomentum, posterior depression about one-third as long as propodeum, impressed line complete, anterior depression rather large, deep. Last segment of fore tarsus long. All femora beneath with a line of dense white pile (Fig. 13) but only some very short bristles. Gastral petiole relatively short and stout, little expanded though somewhat compressed posteriorly, spiracles little projecting, hairs short and rather sparse. Stalk of second gastral tergite about twice as long as broad. Gaster posteriorly with very close pale tomentum with many protruding black bristles.

MALE. Head ferruginous, lateral stripes on clypeus, inner orbits, pale yellow. Frons, vertex and antenna 1–7 above, black, antenna, segments 1–2 yellow beneath, 9–11 ferruginous, 12 blackish. Mesosoma blackish, mesopleuron, scutellum, metanotum and propodeum somewhat ferruginous tinged. Legs dark ferruginous, tarsi black, fore coxae beneath, stripe beneath mid coxae, anterior stripe beneath mid trochanter and base of mid femur, pale yellow. Gaster black, petiole and stalk of second tergite ferruginous. Wings black with purple reflections, length 22–26 mm.

Structure very like the female. Clypeus not much projecting below, tip with a rounded acute angle, finely reticulate with numerous small punctures with erect short black bristles and sparse silvery tomentum. Antennal segment 3 about as long as 4 + 5, segments 4 and 5 between 2.5 and 3.0 times as long as broad, 8 about twice as long as broad, 3–11 with raised lines beneath, 12 much flattened, broadened to truncate apex, dull, about as long as 9. Femora beneath with lines of pale tomentum, less obvious on the hind femur which has some short black bristles beneath.



**Figs 9-18** *Belonogaster*. 9, *B. kohli* Schulz, ♀, gastral tergites 1-2. 10, 11, *B. dubia* Kohl, ♂. (10) left antenna; (11) clypeus. 12, *B. ugandae* sp. n., ♂, left antenna, segments 9-12. 13, *B. vasseae* du Buysson, ♀, right hind femur. 14, *B. aurata* sp. n., ♀, right hind femur. 15, 16, *B. nitida*, ♂. (15) left antenna; (16) clypeus. 17, *B. turgida* Kohl, ♀, gastral tergites 1-2. 18, *B. acaulis* sp. n., ♀, clypeus.

The lectotype is one of eight specimens at MNHN, Paris labelled type and it has the data mentioned in the original description.

DISTRIBUTION (60 ♀, 16 ♂). **Cameroun** (Giordani Soika, 1977: 127), **Congo, Zaire, Rwanda** (Benoit, 1956: 552), **Kenya, Uganda, Tanzania, Zambia, Malawi, Angola, Zimbabwe, Mozambique.**

*Belonogaster indica* (de Saussure)

*Raphigaster indicus* de Saussure, 1853: 17. Holotype ♀, INDIA ('Les Indes Orientales'): Bombay (MNHN, Paris) [examined].

*Belonogaster indicus* (de Saussure) F. Smith, 1857: 94; de Saussure, 1891: 87, footnote; Bingham, 1897: 382; du Buysson, 1909: 258.

The only specimen of this species I have seen is the holotype which bears several labels: a red label 'Type'; a black label '*indicus*'; a printed label 'Muséum Paris Judée Roux 1·36'; a written label 'S. Indies, Bombay'; a printed square label '50'; a blue circular label '1:35'. I suppose that the label Judée was added long after the description but I know of no other Indian specimen in European collections, though there are probably some in India which I have not been able to locate. De Saussure's record from Central Africa seems to be an error connected with his *B. indicus* var. *claripennis* (see *B. freyi*, p. 69).

At any rate, *B. indica* seems to be a distinct species and is probably native to southern India.

FEMALE. Clypeus acute below, convex, finely reticulate, dull, with quite numerous large punctures throughout, very little tomentum, scattered pale bristles. Frons dull, with scattered moderate-sized punctures and short outstanding black bristles. Gena about as wide as eye in profile, dull with fairly numerous moderate-sized punctures throughout. Antennal segment 3 as long as 4 + 5 + half 6, 4 and 5 about 1·25 times as long as broad, 8 quadrate. Mesoscutum dull with evenly scattered, fairly close, moderate-sized punctures, and very inconspicuous pale tomentum; humeri rather more finely punctured with sparse fine tomentum, mesopleuron similar. Propodeum with scattered punctures and a few weak striae below, no hairs, very little tomentum, posterior depression two-thirds as long as propodeum, impressed line moderately strong, complete, anterior depression large, shallow. Fifth segment of front tarsi long. Femora almost quite bare beneath, not even with tomentum. Gastral petiole not very long, not very slender, very gradually widened posteriorly, practically bare. Stalk of second gastral tergite 2 as long as broad. Gaster posteriorly almost without tomentum, tergites 3–5 with fine black bristles which are almost hair-like.

MALE. Not seen.

*Belonogaster levior* sp. n.

FEMALE. Head ferruginous; whole frons and occiput black, antennae black above. Thorax black, front of prothorax, prosternum, some suffusion of mesosternum, ferruginous. Propodeum ferruginous, blackened at sides; scutellum and metanotum reddish round the edges. Legs dark ferruginous, tibiae and tarsi black. Gaster black, petiole and anterior part of tergite 2 ferruginous. Wings dark red-brown, length 14·0–16·0 mm.

Clypeus strongly pointed below, lateral lobes yellow, surface finely reticulate with scattered rather fine punctures with short black bristles. Frons with fairly close fine punctures and very short outstanding black bristles and a little whitish tomentum. Gena about as wide as eye in profile. Antennal segment 3 as long as 4 + 5 + 6, 4 and 5 about as long as broad, 8 a little shorter. Mesoscutum and humeri finely granulate, not punctured, no outstanding hairs, sparse whitish tomentum, mesopleuron scarcely visibly punctured. Scutellum with strong impressed central line, it and metanotum with some fine punctures. Propodeum with posterior face finely reticulate, not punctured or striate, without hairs or tomentum, posterior depression shallow, half as long as propodeum, impressed line to mid point, anterior depression very small, transverse. Last segment of fore tarsus long. Hind femur with only some pale tomentum beneath. Gastral petiole relatively short and thick, apex a little widened, spiracles little prominent. Stalk of second gastral tergite 1·5 times as long as broad. Gaster posteriorly with moderately dense brown tomentum, through which some short blackish bristles protrude.

MALE. Head light ferruginous, dorsal stripe on mandible, broad sides of clypeus, inner orbits to bottom of sinus, spot between antennal sockets, antennae beneath, white. Vertex broadly, trident mark on frons, antennal segments 1–10 above, black. Mesosoma light ferruginous, mesoscutum with three broad black stripes. Legs dark ferruginous, tarsi and hind tibiae more black, fore femur beneath, anterior stripes on mid

femur, mid and hind tibiae, white; small white spots at base and apex of hind femur; large area on fore coxa and trochanter, mid coxa and trochanter, white. Gaster with petiole and segment 2 ferruginous, 3–6 black. Wings very pale brownish, length 14·0 mm.

Clypeus acutely produced beneath, surface little convex with scattered short black outstanding bristles, no tomentum. Frons with little greyish tomentum, no hairs or bristles. Gena about 0·7 of eye-width in profile. Antennal segment 3 distinctly longer than 4 + 5, 4 and 5 well over twice as long as broad, 8 twice as long as broad, 12 a little flattened and curved, end rounded, about as long as 10, 10 and 11 strongly convex beneath, other segments with raised lines beneath. Mesosoma as in ♀. Fifth segment of fore tarsus a little shortened. Femora with slight tomentum but no hairs beneath. Gaster as in ♀, apart from the flattened seventh sternite.

Holotype ♀, **Uganda**: Budongo Forest, Unyoro, 3400 ft [1040 m], 11–15.xii.1911 (*S. A. Neave*) (BMNH).

Paratypes. **Congo**: 1 ♀, Dimonika, 18.v.1977 (*Grillot & Morin*) (MNHN, Paris) (thorax and fore tibia largely ferruginous, wings blackish with slight violet reflections); 1 ♀, Makaba, 23.i.1977, path through abandoned plots (*S. Kelner-Pillault*) (MNHN, Paris) (pleuron and propodeum largely black). **Liberia**: 1 ♂, Bendija (*W. M. Mann*) (USNM, Washington).

The propodeum resembles those of *B. aurata* and *B. atrata* but the other characters are clearly different.

### *Belonogaster atrata* von Schulthess

*Belonogaster atrata* von Schulthess, 1912: 41; 1913: 337, fig. 1. LECTOTYPE ♀, CAMEROUN: Uelleborg (EI, Zurich), here designated [examined].

This species was described from 5 ♀, Cameroun: Uelleborg, vi.–viii.1908 (*Tessman* coll.). Only one female seems now to be available at the EI, Zurich, and I designate this as the lectotype.

**FEMALE**. Head black, malar space, clypeus, inner orbits to bottom of ocular sinus, mandibles, ferruginous. Lateral lobes of clypeus yellowish. Antennae somewhat reddened beneath. Mesosoma and legs black, area of propodeum round orifice ferruginous. Gaster black, petiole and stalk of second segment ferruginous. Wings blackish, length 14·0 mm.

Clypeus acute below, finely reticulate more strongly so above, with rather numerous and large punctures, short oblique black bristles, very little pale tomentum. Frons dull, closely reticulate with close rather coarse punctures and long outstanding black hairs, as also on vertex. Gena about 0·7 of eye-width in profile, dull, feebly reticulate and fairly closely punctured with appressed brownish hairs. Antenna with segment 3 nearly as long as 4 + 5 + 6, 4 1·5 times as, 5 as long as broad, 8 slightly shorter. Mesoscutum and humeri with close, large, shallow punctures, larger and shallower and less well-defined on mesoscutum, with rather close, outstanding black hairs, no tomentum. Scutellum like mesoscutum, with no central line. Metanotum reticulate like propodeum but with quite distinct punctures. Mesopleuron closely granulate with numerous rather small punctures especially posteriorly. Propodeum with very close, fine reticulation without punctures, striae, or tomentum or hairs except at the extreme sides; posterior depression one-quarter length of propodeum, impressed line distinct, complete, anterior depression small, transverse. Fore tarsus with fifth segment short. Mid and hind femora with distinct pale tomentum and moderately numerous greyish hairs beneath. Gastral petiole rather short and thick, distinctly widened from the little projecting spiracles, with numerous long outstanding hairs. Stalk of second gastral tergite 1·5 times as long as broad. Gaster posteriorly with appressed not close brownish tomentum and subappressed black bristles.

**MALE**. Not seen.

### *Belonogaster aurata* sp. n.

(Fig. 14)

**FEMALE**. Head ferruginous, frons and vertex black, antennae darkened above, clypeus slightly yellowish tinged. Mesosoma light ferruginous, humeri, mesoscutum and pleura in part, darkened. Legs ferruginous, mid and hind femora and tibiae darkened, tarsi black. Gastral petiole and stalk and base of second segment, ferruginous, rest of gaster black. Wings dark red-brown, tips a little darker, length 17·5 mm.

Clypeus acute below with tomentum on the upper three-quarters, with scattered rather fine punctures and fine black bristles. Frons rather strongly punctured, reticulate, dull with silvery tomentum and outstanding black hairs. Mesoscutum and humeri dull, reticulate with close coarse punctures and dense brassy tomen-

tum and long outstanding black hairs. Pleura with sparse finer punctures and sparse tomentum; scutellum and metanotum with sparse coarse punctures and outstanding black hairs; propodeum with sides not very coarsely punctured, posterior surface smooth, finely reticulate, not punctured or striate with outstanding black hairs only on valves and sides; posterior depression one-quarter as long as propodeum, impressed line complete, anterior depression shallow, transverse. Fifth segment of fore tarsus elongate. Mid and hind femora (Fig. 14) with quite long black hairs beneath and anteriorly, hind femur also with a line of white pile beneath. Gastral petiole relatively long and slender but distinctly widened distally, with long black hairs above and below, spiracles not prominent, stalk of second gastral tergite 3 times as long as broad, rest of gaster with dense brassy tomentum with fine black bristles protruding from it.

MALE. Not seen.

Holotype ♀, **Nigeria**: Lagos (*W. A. Lamborn*) (BMNH).

This and the two previous species agree in the unusual form of the propodeum but differ from one another in many other characters.

### *Belonogaster nitida* sp. n.

(Figs 15, 16)

MALE. Reddish ochreous with mandibles, whole face, front of pronotum, front of scutellum, metanotum, two large square spots on propodeum, fore tibiae, irregular band widened at sides on gastral tergite 2, ochreous yellow. Wings hyaline, venation ochreous, length 12.0 mm.

Whole body, including propodeum, smooth and shining. Frons, mesoscutum, scutellum and metanotum with long outstanding black hairs. Clypeus (Fig. 16) very obtusely angled below, with sparse black hairs on disk, long dense outstanding silvery hairs at sides. Eyes somewhat swollen below with a few scattered hairs. Gena about one-third as wide as eye in profile. Antenna (Fig. 15) with segment 3 longer than 1 + 2, a little longer than 4 + 5, segments 4 and 5 between 4 and 5 times as long as broad, 8 more than 2.5 times as long as broad, 12 cylindrical, a little curved, end rounded, about 5 times as long as broad, 9–11 cylindrical, 10 and 11 each with two connected prominences beneath, 6–8 with two shining prominences beneath, 8–12 thinner than 1–7. Mesoscutum with relatively close large punctures, pleuron very finely granulate, scutellum and metanotum punctured like mesoscutum but rather less coarsely. Propodeum not sculptured, posterior depression long and narrow, three-fifths length of propodeum, no impressed line, anterior depression large, transverse. Last segment of fore tarsus elongate. Femora tomentose but without hairs or bristles beneath. Petiole long and slender, distal two-fifths clearly thicker, spiracles not prominent, stalk of second gastral tergite 4 times as long as broad, gaster posteriorly feebly tomentose.

FEMALE. Not seen.

Holotype ♂, **Nigeria**: Eastern province, Oguta, east of Onitsha, 1.vii.1950 (*J. L. Gregory*) (BMNH).

This species is so different from all the others that it is almost like a member of another genus. It would be interesting to see the female.

### *Belonogaster turgida* Kohl

(Fig. 17)

*Belonogaster turgidus* Kohl, 1894: 322, 333, pl. 15, fig. 74, pl. 16, fig. 114. Holotype ♀, FERNANDO PO (NM, Vienna) [examined].

FEMALE. Head light ferruginous, large area round the ocelli moderately darkened, antennal segments 3–11 darkened above, 10–11 rather less so. Mesosoma light ferruginous, most of gastral tergites 2–5 darkened, tergite 2 with two large but well separated transverse spots, tergites 3–4 with transverse subapical spots, creamy white. Wings light fuscous, costal region and venation red-brown, length 19.0 mm.

Clypeus below obtusely angular but distinctly pointed, surface mostly dull and tomentose but ventral third more shining with large punctures. Frons dull with rather close moderate-sized punctures with silvery not very dense tomentum and very short, pale outstanding bristles. Gena nearly as wide as eye, mostly dull, no black hairs, moderately numerous punctures on lower quarter. Antenna with segment 3 distinctly longer than 4 + 5 which are about 1.25 times as long as broad, 8 quadrate. Humeri and mesoscutum with quite numerous but inconspicuous small punctures, tomentum very short, rather close silvery tomentum. Meso-



pleuron similar, but punctures stronger. Scutellum and metanotum quite closely punctured, former with an impressed line. Propodeum roundly convex with rather coarse close punctures, close whitish tomentum and a few outstanding hairs, posterior depression very deep and large, three-fifths as long as propodeum, impressed line moderately strong, anterior depression large and deep. Legs rather short and stout, last segment of fore tarsus elongate, tibiae and tarsi less bristly than usual, hind femora with only tomentum beneath. Gaster with petiole (Fig. 19) short and broad, about 4 times as long as broad at apex, very little widened posteriorly where about as wide as length of mid basitarsus, stalk (Fig. 17) of second gastral tergite about 4 times as wide as long, hardly developed; posterior tergites with dense silvery tomentum and no protruding bristles.

MALE. Not seen.

This is another very distinct species with the gastral petiole much wider than usual.

*Belonogaster acaulis* sp. n.

(Fig. 18)

FEMALE. Head ferruginous; large rounded-rectangular spot on the frons (including the ocelli) blackish; ventral margin of clypeus pithy. Mesosoma black, extreme front margin of pronotum, scutellum, metanotum, whole sternal region, wing-bases, posterior part, including the depression of propodeum, ferruginous; legs ferruginous. Gaster with segments 1-2 and 5-6 ferruginous, 3-4 black; basal dot on stalk of gastral tergite 2 and some narrow suffusion of its apex, black, two large subapical irregularly comma-shaped pale yellow spots. Wings light ferruginous, tips moderately darkened, length 18.0 mm.

Clypeus (Fig. 20) below produced into a broad curved lobe, margin widely pithy and slightly raised, lateral lobes prominent, reticulate but lower half more shining with a number of large punctures bearing short black bristles. Frons finely reticulate with not very close small punctures and a few outstanding short black bristles. Gena shining and finely punctured below, dull and reticulate above, a little wider than eye in profile. Antennal segment 3 almost as long as 4 + 5 which are each about as long as broad, 8 just transverse. Mesoscutum finely but quite strongly reticulate with some small inconspicuous punctures round the margins, tomentum very short and inconspicuous greyish, no outstanding hairs; humeri and mesopleuron like the mesoscutum but punctures a little more distinct; scutellum with a deep central furrow and rather weak punctures. Propodeum reticulate with rather stronger and larger punctures, traces of striae on lower part of the angles, posterior depression half as long as the propodeum, impressed line distinct, anterior depression transverse, rather shallow, surface with feeble tomentum and quite numerous but very short outstanding black hairs. Last segment of fore tarsi elongate. Hind femur beneath with tomentum a few short pale bristles. Gastral petiole (Fig. 18) short and thicker than usual with the basal part a little wider than the distal part, spiracles not at all projecting, no hairs; stalk of gastral tergite 2 not longer than broad; gaster posteriorly with short, inconspicuous tomentum.

MALE. Not seen.

Holotype ♀, **South Africa**: Natal National Park, iii.1962 (*J. Ogilvie*) (BMNH).

This is another peculiar species with a clypeus quite unlike any other species and an unusual gastral petiole.

*Belonogaster saeva* de Saussure

(Figs 19, 20)

*Belonogaster saevus* de Saussure, 1891: 91, footnote. Syntype(s) ♀, 'TROPICAL AFRICA' (depository unknown).

FEMALE. Head ferruginous, frons, vertex and antennal segments 1-3 above, black, 4-11 more or less darkened. Mesosoma ferruginous, mesoscutum, humeri, mesopleuron more or less darkened. Legs ferruginous, tibiae and tarsi black. Gaster black, petiole and much of segment 2, ferruginous. Wings usually blackish brown, sometimes paler, length 20.0-27.0 mm.

Clypeus acute below, finely reticulate, more shining below, with many moderate-sized punctures bearing short erect black bristles, also sparse pale tomentum. Frons with many small punctures with erect black bristles and not very dense pale tomentum. Base of submentum and stipes with dense long black bristles. Gena about as wide as eye in profile. Antennal segment 3 much longer than 4 + 5, 4 and 5 each about twice as long as broad, 8 a little longer than broad. Mesoscutum and humeri closely granulate with very close fine

punctures and long erect black hairs and moderate close greyish tomentum. Mesopleuron similar, metanotum and scutellum similar but with coarser punctures, latter with an impressed line on anterior half. Propodeum closely punctate-striate with long dark hairs and not very close pale tomentum, posterior depression half as long as propodeum, impressed line complete, anterior depression small, deep. Fifth segment of fore tarsus elongate. Femora beneath with a line of outstanding white pile beneath, hind pair also with numerous long blackish hairs, especially on basal half. Gastral petiole long but rather stout, very gradually but distinctly widened posteriorly, spiracles not projecting, many rather long hairs, especially proximally; stalk of second tergite 2-3, usually 2.5 times as long as broad; gaster posteriorly with fairly close silvery tomentum and sometimes some black hairs but not bristles.

**MALE.** Head ferruginous; frons vertex centrally, antennal segments 1-8 above, black; dorsal half of mandibles, scape beneath, clypeus except narrow ventral margin and a round black spot below antennal sockets and narrow central ferruginous stripe, inner orbits to centre of ocular sinus, yellow. Mesosoma black, narrow anterior part of pronotum, scutellum and metanotum, sclerites round wing-bases, area round propodeal valves, mesosternum, ferruginous. Legs ferruginous, inner side of fore coxa and trochanter, ventral stripe on mid coxa and trochanter, small basal femoral area, yellow. Gaster black; petiole of second tergite proximally ferruginous. Wings more or less blackish, length 21.5-26.0 mm.

Structurally very like the ♀. Mandibles parallel-sided, not widened. Clypeus (Fig. 20) obtusangular below, actual tip rounded, with numerous black bristles and practically no silvery tomentum. Antenna (Fig. 19) with segment 3 as long as 4 + 5, 4 and 5 2.5 times as long as broad or rather longer, 8 about twice as long as broad, 12 slightly flattened, straight beneath, dorsal edge moderately curved, tip rounded, about as long as 11, 10 and 11 almost cylindrical, scarcely projecting beneath, 3-11 with a slightly raised rather shining line beneath. Gena rather wider than half the eye-width in profile.

**DISTRIBUTION** (55 ♀ 15 ♂). **Sierra Leone, Ghana, Cameroun** (Giordani Soika, 1977: 127), **Congo, Zaire, Kenya, Uganda, Malawi, Tanzania, South Africa** (Cape of Good Hope).

### *Belonogaster pileata* sp. n.

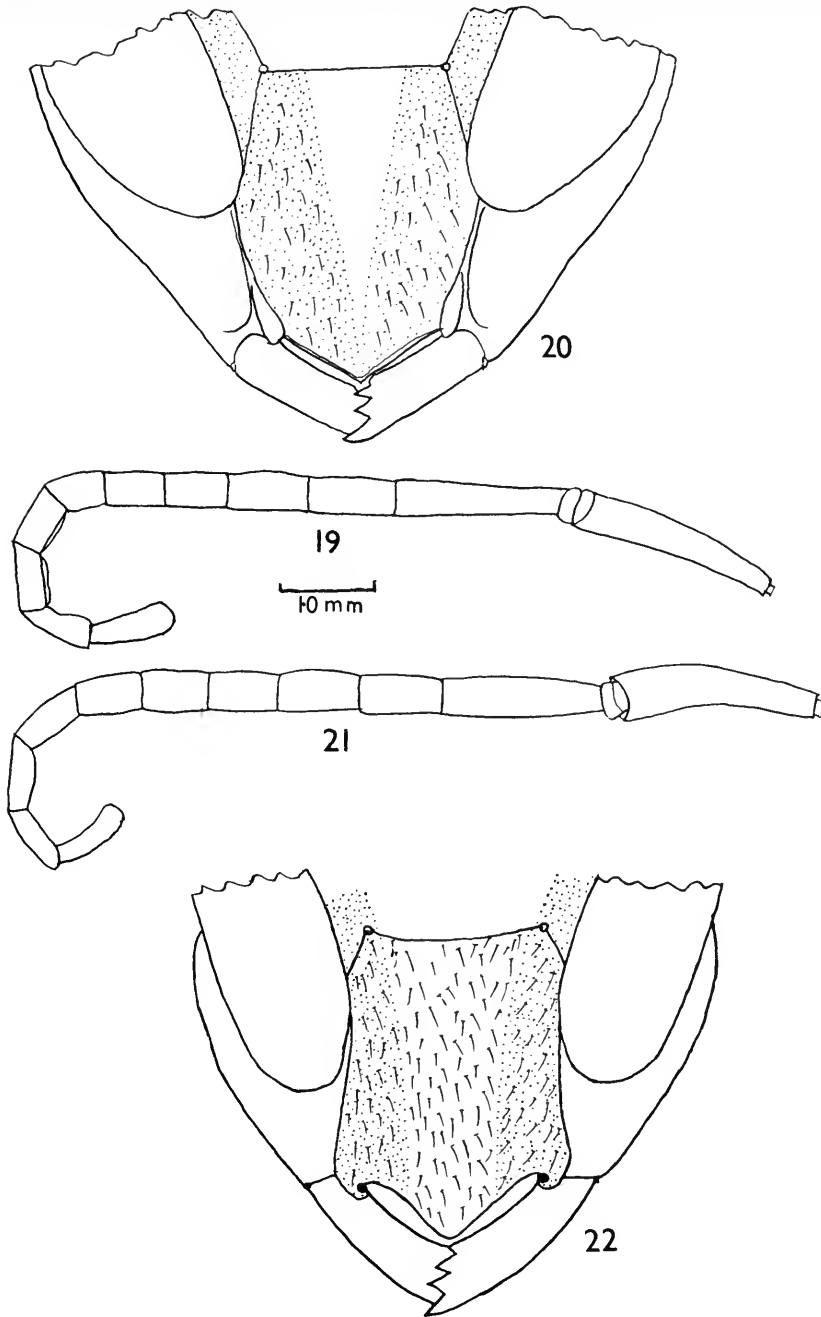
(Figs 21, 22)

**FEMALE.** Black. Head ferruginous except ocellarium and antennae. Gastral petiole and stalk of tergite 2, dark ferruginous. Wings dark fuscous with faint purplish reflections, length 24.0 mm.

Clypeus acutely angled below, feebly and very finely reticulate with scattered large punctures bearing short black bristles, fine brownish tomentum. Frons dull, reticulate with small shallow punctures and short outstanding black bristles. Gena about 1.5 times as wide as eye in profile, raised margin hardly reaching down to mid-point of eye. Antennal segment 3 nearly as long as 4 + 5 + 6, 4 and 5 about 1.25 times as long as broad, 8 just longer than broad. Bases of submentum and stipes with a few long dark hairs. Mesoscutum and humeri with close small shallow punctures bearing short black bristles, tomentum brown, inconspicuous, mesopleuron with sparser, considerably larger punctures; scutellum moderately convex, densely punctured with a strong central line; metanotum closely punctured with a smooth depression at centre of front margin. Propodeum punctured at sides, dorsally obliquely punctate-striate, no hairs, tomentum very inconspicuous; posterior depression rather more than half as long as propodeum, impressed line strong, anterior depression deep but narrow. Fifth segment of fore tarsus elongate. Fore and mid femora with very dense outstanding pale pile, hind femur bare beneath except for inconspicuous tomentum. Gastral petiole long but wide, clearly widening posteriorly, spiracles little projecting; stalk of second tergite 1.5-2.25 times as long as broad; gaster posterior with no black bristles amongst the short brownish tomentum.

**MALE.** Dark ferruginous, much blackened, especially antennae above and on segments 3-5 below, mesoscutum, lower mesopleuron, tarsi, distal segments 3-6. Sides of clypeus, inner orbits, whitish yellow. Wings blackish brown, length 22.0 mm.

Clypeus (Fig. 22) feebly produced below, tip almost rounded, clypeus almost shining with scattered moderate-sized punctures and short black bristles, tomentum inconspicuous. Frons dull, feebly punctured with short outstanding black hairs. Gena two-thirds as wide as eye in profile. Antennal segment 3 about as long as 4 + 5, 4 and 5 each about 2.5 times as long as broad, 8 rather less than twice as long as broad, 9-12 pale ferruginous, 12 as long as 11, slightly widened to apex, moderately flattened, a little curved, especially dorsally, 10-11 cylindrical, but 10 with a slight elongate prominence beneath, 5-8 with weak raised lines beneath. Mesoscutum, humeri and mesopleuron scarcely punctured; very short outstanding hairs on mesoscutum, tomentum inconspicuous, as on pleuron; scutellum and metanotum more punctured; propodeum feebly punctured, with feeble tomentum and no hairs, posterior depression one-third as long as propodeum, impressed line weak, anterior depression transverse. Segment 5 on fore tarsus elongate. Hind femur with



Figs 19–22 *Belonogaster*. 19, 20, *B. saeva* de Saussure, ♂. (19) left antenna, (20) clypeus, 21, 22, *B. pileata* sp. n., ♂. (21) left antenna; (22) clypeus.

only feeble tomentum beneath. Gastral petiole long, widened to apex, spiracles little projecting; stalk of second gastral tergite hardly twice as long as broad. Gaster with rather close silvery tomentum but no bristles.

Holotype ♀, Kenya: Tareta forest (near Tanzanian border), viii.1947 (*V. G. L. van Someren*) (BMNH).

Paratypes. Kenya: 1 ♀, Malindi, 20.ix.1948 (*V. G. L. van Someren*); 1 ♀, Nairobi, 20.i.1956 (*F. J. Jackson*) (BMNH); 1 ♂, Voi, x.1909 (*C. I. Alluaud*) (MNHN, Paris). Tanzania: 1 ♀, Tanga iv.1912 (*Alluaud & Jeannel*) (MNHN, Paris). Malawi: 2 ♀, Mulanga Mountain, 17.x.1971 (*C. G. M. Schulten*); 1 ♀, Tuchila, 4.v.1971 (*C. G. M. Schulten*) (ITZ, Amsterdam).

Apparently a variety of this species. Gastral tergite 2 with two transverse, moderate-sized yellow spots. Wings browner. Stalk of second gastral tergite 2.5 times as long as broad. Uganda: 1 ♀, about 2 miles [3 km] ENE. of Entebbe, 3100 ft [945 m], forest shore of lake, 7.ii.1912 (*C. A. Wiggins*) (BMNH).

### *Belonogaster brunnea* Ritsema

(Figs 25–27)

*Belonogaster brunneus* Ritsema, 1874: 202, pl. 11, fig. 1.

Ritsema described this species without giving any locality in a paper dealing mainly with New Guinea material but including a few African species. The holotype is labelled 'Piget & Woerdon, Congo'. Colour described under the two subspecies.

FEMALE. Clypeus acute below, dull, more shining below with some large punctures, above finely granulate, tomentum very sparse, black bristles few and scattered. Frons dull with indistinct punctures and dense short outstanding black hairs and sparse reddish tomentum. Gena as wide as eye in profile (Fig. 27). Antenna with segment 3 nearly as long as 4 + 5 + 6, 4 and 5 a little longer than broad, 8 just longer than broad. Mesoscutum not punctured, rather strongly granulate with very short brownish tomentum and outstanding black hairs; scutellum and metanotum distinctly punctured; mesopleuron dull, granulate with very weak fine punctures. Propodeum very closely punctate-striate or granulate with moderately dense outstanding fine black hairs; posterior depression half as long as propodeum, impressed line strong to rather above mid point, anterior depression large. Last segment of fore tarsi elongate. Mid and hind femur with numerous oblique black hairs and bristles, especially on proximal third, also fine silvery tomentum. Gastral petiole long, relatively narrow, a little widened on posterior half, with close silvery tomentum and short hairs, spiracles little projecting. Stalk of second gastral tergite about twice as long as broad, gaster posteriorly with dense silvery tomentum and sometimes some pale or black protruding bristles.

MALE. Mandibles approximately parallel-sided. Clypeus (Fig. 24) below little produced, ventral margin very obtuse, tip just rounded, disk a little flattened, ventral third with a number of large punctures, dorsal part finely granulate with sparse tomentum which is a little longer and more silvery at sides but not conspicuous. Frons dull, finely granulate, scarcely punctured, with rather sparse pale tomentum and scattered short dark hairs. Gena about two-thirds as wide as eye in profile. Antenna (Figs 23, 26) with segment 3 just longer than 4 + 5, 4 and 5 rather less than 2.5 times as long as broad, 8 rather more than 1.5 times as long as broad, segment 12 normally shining black but sometimes partly ferruginous, very little flattened, gently curved, tip rounded, 9–11 reddish yellow, 11 cylindrical, as long as 12, 9–10 considerably thicker than 11, distal half of 3–10 with raised shining lines beneath. Mesosoma as in ♀. Last segment of fore tarsi elongate. Hind tibia and femur (Fig. 25) with black bristles or hairs beneath. Gaster as in ♀ but petiole rather thicker. There are two subspecies.

### *Belonogaster brunnea brunnea* Ritsema

(Figs 23–25)

*Belonogaster brunneus* Ritsema, 1874: 202, pl. 11, fig. 1. Holotype ♀, CONGO (RNH, Leiden) [examined].

*Belonogaster distinguendus* Kohl, 1894: 322, 323, 328, pl. 15, figs 79–81. LECTOTYPE ♂, WEST AFRICA: 'Chutes de Sambliá, Riv. N. Gamio' [untraced] (*Moquersys*) (NM, Vienna), here designated [examined].

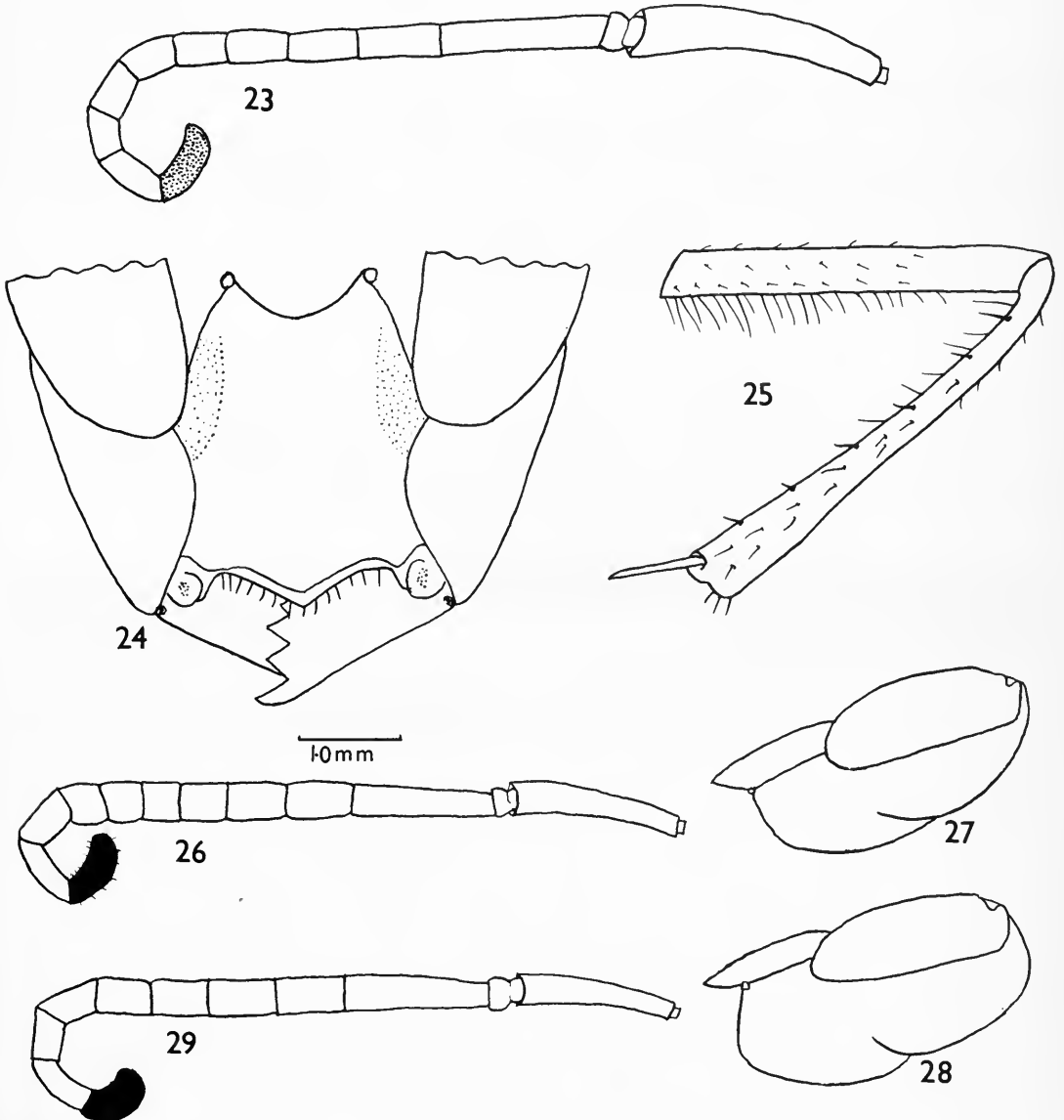
Syn. n.

FEMALE. Head ferruginous, frons black, antennal segments 3–7 darkened above. Mesosoma ferruginous, mesoscutum, humeri, mesopleuron posteriorly, propodeum dorsally, a little darkened. Legs ferruginous,

tibiae a little darkened, tarsi black but last segment more ferruginous. Gaster black, segments 1–2 ferruginous, more or less darkened posteriorly. Wings evenly light fuscous, venation red-brown, length 14.5–18.0 mm.

**MALE.** Like ♀ but clypeus and orbits yellow at sides, top half usually also yellow-marked. Mesosoma and legs little darkened. Wings more or less dark red-brown, length 15.5–18.0 mm.

**DISTRIBUTION** (25 ♀, 24 ♂). **Liberia, Ghana, Sierra Leone, Nigeria, Fernando Po, Gabon, Congo, Rwanda,** (Benoit, 1956: 552). Also the type-locality of *B. distinguendus* Kohl.



**Figs 23–29** *Belonogaster*. 23–25, *B. brunnea brunnea* Ritsema, ♂. (23) left antenna; (24) clypeus; (25) left hind femur and tibia. 26, 27, *B. brunnea nigriclava* subsp. n. (26) ♂, left antenna; (27) ♀, left gena. 28, 29, *B. clypeata clypeata* Kohl. (28) ♀, left gena; (29) ♂, left antenna.

*Belonogaster brunnea nigriclava* subsp. n.

(Figs 26, 27)

MALE, FEMALE. Similar to subsp. *brunnea* but wings darker with the tips dark. Thorax often darker. Femora largely black.

Holotype ♂, Uganda: Mt Kokanjero, SW. Mt Elgon, 6400 ft [1950 m], 7–9.viii.1911 (S. A. Neave) (BMNH).

Paratypes. Uganda: 1 ♀, East Butiaba, L. Albert, 3200 ft [970 m], 9–10.xii.1911 (S. A. Neave) (BMNH); 1 ♂, Mabira Forest, Chagwe 3500–3800 ft [1060–1160 m], 16–25.vii.1911 (S. A. Neave); 2 ♀, between Kafu R. and Kigoma, 3600–3800 ft [1100–1160 m], 1–3.i.1912 (S. A. Neave); 1 ♂, 1 ♀, north of Lake Isolt, 3700 ft [1130 m], 4–6.i.1912 (S. A. Neave); 1 ♂, between Jinja and Bwia, E. Busoga, 3800–4000 ft [1060–1220 m], 1.viii.1911 (S. A. Neave); 1 ♂, near Kampala, 4000 ft [1220 m], 12–13.viii.1911 (S. A. Neave); 1 ♀, Eastern Mbale district, S. of Mt Elgon, 3700–3900 ft [1130–1190 m], 2–5.viii.1911 (S. A. Neave); 1 ♀, Entebbe, ii.1912 (C. A. Wiggins); 1 ♀, Entebbe, xi.1912 (C. C. Gowdey) (BMNH); 1 ♂, eastern Toro province, 1909 (C. Alluaud) (MNHN, Paris); 1 ♀, Entebbe, 3800–4000 ft [1160–1220 m], 26.v.1912 (C. A. Wiggins) (UM, Oxford); 1 ♀, 4 miles [6.5 km] from Kitabi Hill, viii.–ix.1913 (C. A. Wiggins); 1 ♂, NNE. of Kitabi Hill, 29.vi.1912 (C. A. Wiggins) (UM, Oxford). Kenya: 1 ♀, Mtito Andei, 2500 ft [760 m], 26–8.iii.1911 (S. A. Neave) (BMNH); 2 ♂, Nandi Plateau, 5700–6200 ft [1740–1890 m], 20.v.–4.vi.1911 (S. A. Neave); 1 ♂, 1 ♀, Kibwezi, ii. and xii.1929 (van Someren); 7 ♂, 10 ♀, Ngare Norok, Masai reserve, 6000 ft [1830 m] (A. D. Luckman); 7 ♂, 5 ♀, Mgorr River, v.1913 (A. D. Luckman) (BMNH); 1 ♀, Namanga, 13.ii.1958 (P. Strinati & V. Aellen) (MHN, Genoa), 1 ♂, Embu, Mjakini forest, 1400 m, 6.x.1974 (R. de Jong) (RNH, Leiden); 1 ♀, Nairobi, Kabete, 15.ii.1978 (C. G. M. Schulten) (ITZ, Amsterdam). Zambia: 2 ♀, N. shore of Lake Bangweolo, 3800 ft [1160 m], 27.v.1908 (S. A. Neave), 2 ♂, 17.vi.1908 (S. A. Neave), 2 ♀, 13.vi.1908, 1 ♀, 12.vii.1908; 1 ♂, Lake Bangweolo, Luwingu, 4200 ft [1280 m], 4.vi.1908 (S. A. Neave); 1 ♀, E. shore of Lake Bangweolo, 3800 ft [1160 m], 22.v.1908 (S. A. Neave); 1 ♀, Upper Luangwa Valley, 1800–2000 ft [550–610 m], 30.iii.1908 (Neave), 3 ♀, Lower Chambezi Valley, Kasuma district, 3900 ft [1190 m], 30.iv.–i.v.1908 (Neave); 2 ♀, Mid-Chambezi Valley, Chinsali distr., 4000 ft [1220 m], 24–5.iv.1908 (Neave); 1 ♀, Alata Plateau, Ndobi district, 4000 ft [1220 m], 12.x.1905 (Neave); 2 ♂, Upper Kalungwizi Valley, 4200 ft [1280 m], 24.vii., 11.ix.1908 (Neave) (BMNH). Malawi: 2 ♀, Salima, 17.iii.1970 (C. G. M. Schulten); 1 ♀, Limbe, 9.ii.1968 (C. G. Schulten); 2 ♀, Mzuzu, 3.v.1972 (C. G. Schulten); 1 ♀, Karonga, 15.ii.1971 (C. G. M. Schulten) (ITZ, Amsterdam). Tanzania: 1 ♂, 1 ♀, S. of Lake Tanganyika, 4500 ft [1370 m], 18–21.viii.1908 (Neave) (BMNH); 1 ♀, Maranga, 1.vii.1978 (C. G. M. Schulten) (ITZ, Amsterdam). Zaire: 1 ♀, 150–200 miles [240–320 km] N. of Kambove, 3500–4000 ft [1070–1220 m], 28.ix.1907 (S. A. Neave) (BMNH).

*Belonogaster clypeata* Kohl

(Figs 28–31)

*Belonogaster clypeatus* Kohl, 1894: 321, 328, pl. 15, figs 88, 91.

Kohl described the species from '♂ ♀ Deutsch Mozambique (Dr Fischer leg. 1892), Madagascar'. I do not believe that the species occurs in Madagascar but a male from Mozambique, received from Dr Fischer, is in the collection of the NM, Vienna and is here designated lectotype.

FEMALE. Colour described under the subspecies. Clypeus acute below, finely granulate above, on lower quarter finely reticulate with large punctures and a few brown bristles and rather sparse silvery pubescence. Frons finely granulate with short small bristles in front and rather close silvery tomentum. Gena (Fig. 28) nearly twice as wide as eye in profile, finely reticulate with scattered fine punctures below. Antennal segment 3 clearly longer than 4 + 5, 4 and 5 only just longer than broad, 8 quadrate. Base of stipes and submentum with quite numerous black bristles. Mesoscutum and humeri granulate, scarcely punctured with dense silvery tomentum; mesopleuron similar but with close moderately large punctures; scutellum with weak punctures and an impressed line on front half; metanotum with considerably closer punctures. Propodeum granulate, punctate-striate above with close silvery tomentum and numerous bristles, posterior depression rather less than half as long as propodeum, impressed line strong for two-thirds the length of propodeum, anterior depression large and deep. Last segment of fore tarsus elongate. Hind femur with sparse tomentum and sparse short bristles. Gastral petiole long, moderately wide, spiracles not much projecting, posterior part moderately widened, hairs short and very numerous; stalk of second gastral tergite 1.5–2.0 times as long as broad. Gaster posteriorly with moderately dense pale tomentum, usually no bristles but some often present in the north-western subspecies.

MALE. Mandibles with a strong hump just beyond base, widened towards apex. Clypeus (Fig. 30) with lateral lobes large, clypeus slightly emarginate and depressed between them, the central lobe being a small rounded process not protruding beyond the lateral lobes; upper part of clypeus flattened, granulate with very little tomentum. Frons finely granulate, a band of small punctures in front, projecting bristles very short, silvery tomentum moderately close, vertex unusually wide behind eyes. Gena about twice as wide as eye-width in profile, slightly shining, very finely reticulate, not punctured. Base of submentum and stipes with a few long bristles. Antenna (Fig. 29) with segment 3 much longer than 4 + 5, 4 and 5 about 2.25 times as long as broad, 8 about 1.5 times as long as broad, 12 very wide and flattened, spoon-shaped, blackened on concave side, convex side with fine hairs, 10–11 pale yellow, cylindrical, both at least twice as long as broad, 9 considerably thicker than 10 or 11, 6–8 with a weak raised line beneath. Mesosoma much as in female. Fore tarsus with last segment elongate. Mid and especially hind femur (Fig. 31) and trochanter with close white pile and long black hairs beneath; hind tibia with not very close long pale hairs beneath. Gastral petiole long, considerably widened to apex, spiracles moderately projecting, hairs short, not conspicuous. Stalk of second gastral tergite about 1.5 times as long as broad; gaster posteriorly with not very close pale tomentum and projecting bristles only in the north-western subspecies.

There are two subspecies which to some extent overlap in distribution and intergrade in colour.

### *Belonogaster clypeata clypeata* Kohl

*Belonogaster clypeatus* Kohl, 1894: 321, 328, pl. 15, figs 88, 91. LECTOTYPE ♂, MOZAMBIQUE (NM, Vienna), here designated [examined].

FEMALE. Ferruginous, mandibles, malar space and clypeus a little yellow tinged. Mesopleuron and sternum somewhat darkened. Gaster a little darkened posteriorly, tergite with large yellow comma-shaped spots on posterior margin, narrowly separated. In dark specimens, the mesosoma, coxae, base of femora or even the whole of mid and hind femora, apex of gastral tergite 2, and whole of 3–4, more or less darkened; yellow spots of tergite 2 whitish. Propodeal hairs pale. Wings light brown, tips somewhat darkened, length 17.0–18.0 mm.

MALE. Colour much as in female, knees, especially the mid pair and sides of clypeus, with a little yellow. Hairs of femora and tibiae mostly white.

DISTRIBUTION (42 ♀, 9 ♂). **South Africa** (Transvaal, Natal, Cape of Good Hope), **Tanzania** (Lindi, Zanzibar), **Malawi, Zimbabwe, Zambia, Uganda, Zaire**.

### *Belonogaster clypeata fuscata* subsp. n.

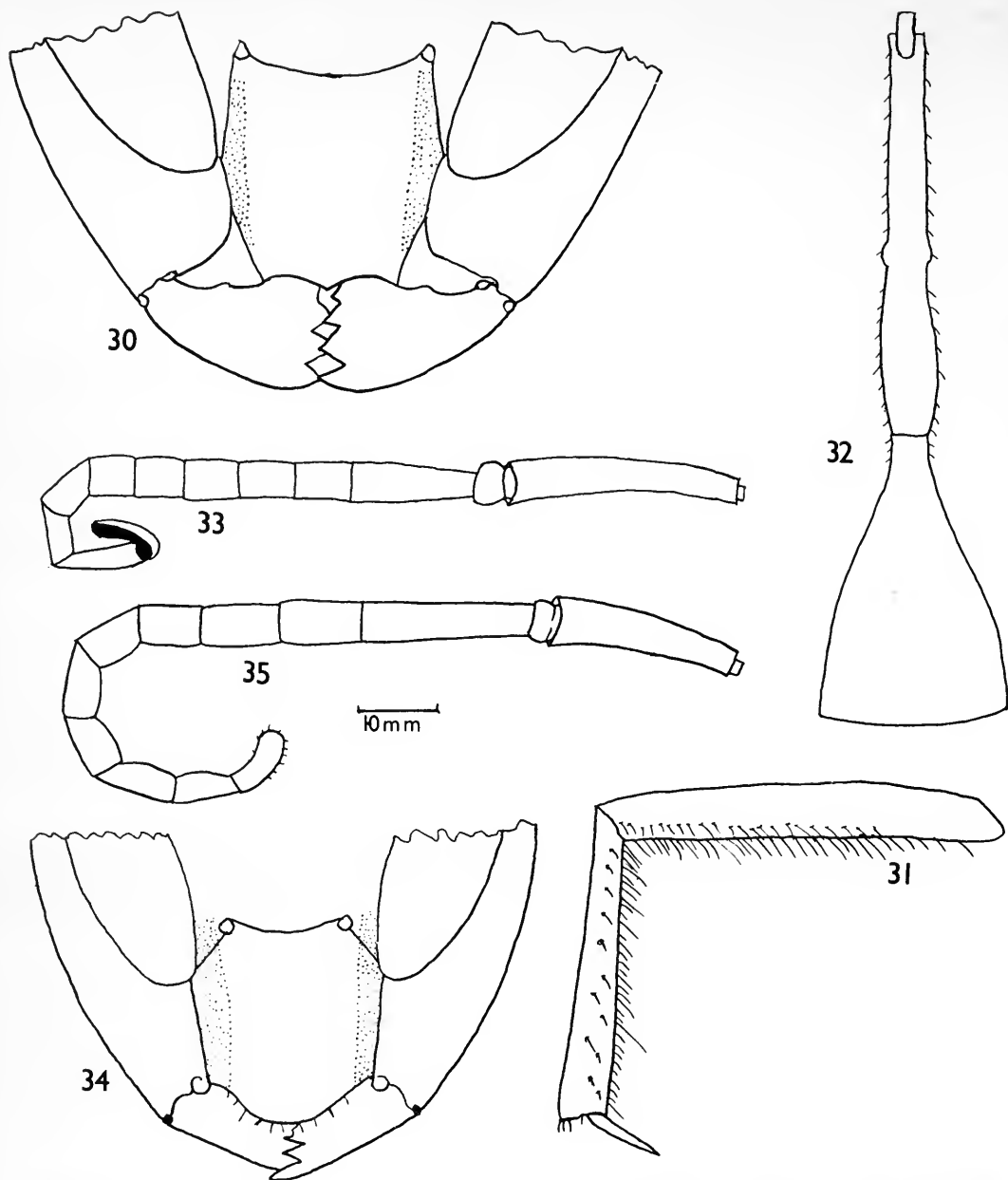
FEMALE. Colour more black and less ferruginous. Mesosoma and gastral tergites 3–4 usually black. Coxae and femora usually black. Propodeal hairs black. Posterior tergites with more or less black bristles protruding through the tomentum.

MALE. Colour much as in female; sides of clypeus with more extensive yellow stripes than *C. clypeata*.

Holotype, ♀, **Uganda**: Ankole-Toro border, east of Lake George, 4500 ft [1370 m], 20–21.x.1911 (*S. A. Neave*) (BMNH).

Paratypes. **Uganda**: 1 ♀, southern Toro, Mbarara, Fort Portal Rd, 3800–4200 ft [1160–1280 m], 22–24.x.1911 (*S. A. Neave*) (BMNH); 1 ♀, eastern Mbale district, south of Mt Elgon, 3700–3900 ft [1130–1190 m], 2–5.viii.1911 (*S. A. Neave*); 1 ♀, Mzozzi, i.1903 (*Delme Ratcliffe*); 1 ♀, north of Lake Isolt, 3700 ft [1130 m], 4–6.i.1912 (*S. A. Neave*); 1 ♀, Entebbe, xi.1912 (*C. C. Gowdey*) (BMNH). **Zambia**: 1 ♂, 1 ♀, Mporokoso, 4500 ft [1370 m], 20.vii.–3.viii.1908 (*S. A. Neave*) (UM, Oxford); 1 ♀, Upper Kalongwisi Valley, 4200 ft [1280 m], 25.vii.1908 (*S. A. Neave*); 1 ♀, High Plateau S. of L. Tanganyika, 4500 ft [1370 m], 18–21.viii.1908 (*S. A. Neave*); 2 ♀, N. shore of Lake Bangweolo, 3800 ft [1160 m], 14.vi.1908 (*S. A. Neave*); 1 ♂, 1 ♀, N. of L. Bangweolo, Lawinga, 4200 ft [1280 m], 17.vii.–13.viii.1908 (*S. A. Neave*) (UM, Oxford). **Angola**: 1 ♀, Chianga, 21–24.iii.1972 (*Southern African Exped.*) (BMNH); 1 ♂, Mt Labiri, 10 miles [16 km] NW. Alto-Hama, 7.iii.1972 (*Southern African Exped.*). **Zaire**: 2 ♀, Katanga (Shaba), Kambove, 13.ii.1907 (*S. A. Neave*); 1 ♀, Katanga (Shaba), 5.viii.1907 (*S. A. Neave*); 1 ♀, Katanga (Shaba), 150–200 miles [240–320 km] W. of Kambove, 3500–4500 ft [1070–1370 m], 18.x.1907 (*S. A. Neave*); 1 ♀, Katentanio, 1600 m, i.viii.1946 (BMNH).

A ♀ of subsp. *clypeata* from **Zimbabwe**: Salisbury, iv.1902 (*G. A. K. Marshall*) (BMNH) has the puparium of a ♀ Strepsipteran beneath gastral tergite 4 on the right.



Figs 30–35 *Belogaster*. 30, 31, *B. clypeata clypeata* Kohl, ♂. (30) clypeus; (31) left hind femur and tibia. 32, *B. lateritia* Gerstaecker, ♀, gastral tergites 1–2. 33, 34, *B. brachystoma* Kohl, ♂. (33) left antenna; (34) clypeus. 35, *B. freyi* du Buysson, ♂, left antenna.

*Belogaster brachystoma* Kohl

(Figs 33–34)

*Belogaster brachystomus* Kohl, 1894: 322, 376. LECTOTYPE ♂, MOZAMBIQUE: Delagoa Bay (NM, Vienna), here designated [examined].

FEMALE. Entirely ferruginous, gastral tergite 2 with two large comma-shaped pale yellow spots; sometimes



mesoscutum and gastral tergites 3–4 rather darkened. Wings light red-brown, tips a little darker, length 18.0 mm.

Clypeus acute below, ventral quarter a little more shining with large shallow punctures bearing pale bristles, dorsally dull granulate, not punctured, without bristles, only sparse tomentum. Frons dull, hardly punctured and hardly any projecting hairs but close pale brown tomentum. Gena as wide as eye in profile. Antennal segment 3 about as long as 4 + 5 + 6, 4 and 5 hardly longer than broad, 8 quadrate. Mesoscutum and humeri dull, granulate, not punctured with close long pale brown tomentum; mesopleuron with moderately numerous fine punctures almost hidden by the tomentum. Propodeum with a few striae on the angles, covered in dense pale brown tomentum but no outstanding hairs, posterior depression one-quarter as long as propodeum, impressed line complete but not strong, anterior depression large and deep. Last segment of fore tarsi elongate. Hind femur beneath with sparse whitish tomentum and a few white bristles. Gastral petiole moderately long and slender but distinctly widened distally, spiracles not at all projecting; stalk of second gastral tergite twice as long as broad; posterior tergites with close short pale tomentum and a few projecting pale bristles.

**MALE.** Head ferruginous, spot between antennal sockets, inner orbits to sinus, sides of clypeus rather narrowly, stalk of second gastral tergite chrome yellow. Mesosoma and legs ferruginous, front tarsi segments 1–2 mainly black above. Gaster ferruginous, tergite 2 with two large comma-shaped pale yellow apical spots. Wings red-brown, tips fuscous, length 18.0 mm.

Clypeus (Fig. 34) somewhat flattened, ventrally with a small rounded projection not reaching appreciably beyond the lateral lobes, end slightly bent downwards, surface finely granulate with almost no tomentum, anterior tentorial pit large; frons granulate, almost unpunctured, a few short brown bristles. Gena 1.33 as wide as eye in profile. Antenna (Fig. 33) with segment 3 a little longer than 4 + 5, 4 and 5 about twice as long as broad, 8 rather shorter, 12 much flattened and curved, underside normally shining black, upperside dull, dark ferruginous, about as long as 11, 11 flattened, 10 much shorter, neither with a raised line or prominence beneath, 9 much thicker than 10, 6–9 with a raised line beneath. Mesosoma as in the ♀. Last segment of fore tarsi elongate. Mid and hind trochanter and femur with dense pale hairs, longer on hind femur; hind tibia with sparser obliquely outstanding hairs. Gaster as in female but stalk of second gastral tergite usually a little shorter, sternite 7 flattened.

**DISTRIBUTION** (33 ♀, 7 ♂). **Zambia, Zimbabwe, Tanzania** (including Zanzibar), **Malawi, Mozambique, South Africa** (Natal, Transvaal).

### *Belonogaster freyi* du Buysson

(Fig. 37)

*Belonogaster freyi* du Buysson, 1909: 255. Holotype ♀, SOUTH AFRICA (MHN, Geneva) [examined].

*Belonogaster indicus* de Saussure var. *claripennis* du Buysson, 1909: 259. Holotype ♀, TANZANIA: Kigonsera (10°40'S, 35°03'E) (MNHN, Paris) [examined]. **Syn. n.**

**FEMALE.** Ferruginous, patch on frons, sometimes posterior part of pronotum, mesoscutum, mesopleuron, propodeum except part adjacent to petiole, suffusion of apex of gastral tergite 2, tergites 3–4, black; apex of gastral tergite 2 with a large whitish yellow comma-shaped spot in 35 ♀ or spot small in 5 ♀ or no spot in 20 ♀. Wings light brown, tips a little darker, length 16.0–20.0 mm.

Clypeus acute below; dull, very finely granulate, lower half with scattered large punctures bearing very short brown bristles, tomentum pale, inconspicuous; frons with indistinct punctures, a few short outstanding pale bristles, tomentum silvery, not very dense; gena a little broader than eye in profile, dull, some fine punctures on lower third; base of submentum and stipes with a few long, pale bristles; antennal segment 3 nearly as long as 4 + 5 + 6, 4 and 5 little longer than broad, 8 about quadrate. Mesoscutum, humeri, scutellum and metanotum with indistinct, fine punctures, mesopleuron with punctures rather stronger and denser, tomentum fine, dense and pale; propodeum with silvery tomentum and on lower half with short outstanding pale bristles, with distinct punctures on sides and usually traces of striae on the angles; posterior depression hardly one-quarter as long as propodeum, impressed line weak, anterior depression triangular, usually small. Fifth segment of fore tarsi elongate. Hind femur beneath with pale tomentum and a few short pale bristles near base. Gastral petiole not very long, distinctly widened posteriorly, spiracles not at all prominent, stalk of second tergite about 1.5 times as long as broad, or even rather less, gaster posteriorly with very fine pale tomentum.

**MALE.** Coloured like the ♀ but mandibles, sides of clypeus and inner orbits to middle of sinus whitish; only 1 out of 9 specimens with small, transverse, white spots on gastral tergite 2. Clypeus with close outstanding white hairs on sides. Gena rather narrower than eye in profile. Antenna (Fig. 35) with segment 3 a little

longer than 4 + 5, 4 and 5 about 2.5 times as long as broad, 8 twice as long as broad, 12 moderately thick, curved; underside shining, about as long as 8, tip rounded, 11 appreciably narrower than 10, slightly swollen beneath, 10 markedly so, 7–11 with shining areas beneath which are elongate and a little convex.

**DISTRIBUTION** (114 ♀, 26 ♂). **South Africa** (Natal, Orange Free State, Transvaal), **Botswana, Tanzania, Malawi, Zimbabwe, Zambia, Kenya, Zaire.**

*Belongaster brunnescens* sp. n.

Many of the specimens of this species in collections were identified as *B. brunnea*.

**MALE.** Ferruginous brown, mesoscutum, top part of propodeum, gastral tergites 3–4 a little darker. Upper part of clypeus and inner orbits slightly yellow tinged. Wings yellow-brown, tips scarcely darker, length 20.0–21.0 mm.

Clypeus obtusely pointed below, dull, lower fifth shining with two or three large punctures, upper part with white tomentum and some outstanding black hairs, anterior tentorial pit very large; frons with close, fairly coarse punctures, appressed white tomentum and fine outstanding black hairs; gena two-thirds as wide as eye in profile, surface dull, not punctured; antenna with segment 3 as long as 4 + 5, 4 and 5 about 3 times as long as broad, 8 nearly twice as long as broad, 12 slightly flattened, well curved, tip rounded, a little longer than 11, 9–11 with a strong rounded hump beneath, 6–8 with a weak raised line beneath. Mesoscutum, humeri, scutellum, metanotum and mesopleuron with inconspicuous close punctures and rather close pale tomentum. Propodeum with no striae but rather close fine punctures, dense white tomentum and moderately dense pale outstanding hairs, posterior depression about one-third as long as propodeum, impressed line strong on lower half, anterior depression small, triangular, deep. Last segment of fore tarsus elongate. Mid and hind coxae with tomentum but no hairs. Hind femur beneath with rather dense white tomentum. Gastral petiole moderately long and stout, little widened posteriorly, spiracles strongly projecting; stalk of second gastral segment rather more than twice as long as broad, gaster posteriorly with close white tomentum but no projecting bristles.

**FEMALE.** Light ferruginous. Antennae and four hind tarsi sometimes blackish. Wings light brownish hyaline, tips very little darker, length 17.0–24.0 mm.

Clypeus acute below, finely reticulate with scattered large punctures on ventral half, short outstanding brown bristles, dorsal two-thirds without close pale tomentum; frons dull, reticulate with inconspicuous small punctures and short outstanding brown bristles. Gena as wide as eye in profile, finely reticulate, a little more shining below where there are scattered small punctures; base of submentum and stipes with a few long pale hairs; antennal segment 3 much longer than 4 + 5, 4 and 5 distinctly longer than broad, 8 almost quadrate. Mesoscutum, humeri and mesopleuron dull, granulate with a few inconspicuous punctures when not rubbed with numerous short pale hairs and inconspicuous pale tomentum. Scutellum and metanotum rather more clearly punctured, former with an impressed line on front half. Propodeum dull granulate, angles weakly striate, surface with not very close white tomentum and rather numerous short outstanding brown bristles; posterior depression rather less than half as long as propodeum, impressed line strong but short, anterior depression small but deep. Last segment of fore tarsus elongate. Femora beneath with not very close tomentum and a few short brown bristles. Gastral petiole rather long, proximally narrow, posteriorly distinctly widened, spiracles moderately prominent, hairs few and short; stalk of second gastral tergite 2.5 times as long as broad, gaster posteriorly with close silvery tomentum and no bristles.

**Holotype** ♂, **Zimbabwe:** Mashonaland, 1894 (*G. A. K. Marshall*) (BMNH).

**Paratypes.** **Ethiopia:** 1 ♀, equatorial region, Gofa, Basketo-Dimé, 1909 (*Mission du Bourg de Bozas*) (MNHN, Paris). **Gabon:** 1 ♀, 1883 (*Duparquet*) (MNHN, Paris). **Congo:** 2 ♀, Libreville, 1899 (*J. Bonher*); 1 ♀, Fernand-Vaz, ix.–x.1902 (*L. Fea*); 2 ♀, San Benito, 1885 (*Guiral*); 1 ♀, Ogoué, chutes de Doumé, iii.1881 (MNHN, Paris). **Zaire:** 1 ♀, 150–200 miles [240–320 km] N. of Kambove, 3500–4500 ft [1070–1370 m], 26.x.1907 (*S. A. Neave*) (BMNH). **Zimbabwe:** 26 ♀, near Chirinda, Gazaland, viii.1907 (*G. A. K. Marshall*); 18 ♀, Chirinda, SE. Mashonaland, 10.viii.1907 (*G. A. K. Marshall*); 6 ♀, 13–24.viii.1907 (*G. A. K. Marshall*); 1 ♂, Mashonaland, 1894 (*G. A. K. Marshall*) (BMNH). **Zambia:** 3 ♀, Upper Luangwa Valley, 1800–2000 ft [550–610 m], 21.iii.–17.v.1908 (*S. A. Neave*) (UM, Oxford); 1 ♂, Mid Luangwa Valley, 2000 ft [610 m], 14–16.viii.1900 (*S. A. Neave*) (BMNH); 1 ♀, East Luangwa distr., Petauke, 2400 ft [730 m], 9–13.i.1915 (UM, Oxford). **Kenya:** 1 ♀, 'Brit. East Africa', 1894 (*Dr J. W. Gregory*) (BMNH); 1 ♀, Kitale distr., Trans-Nzoia, i.–iv.1955 (*E. M. Waterfield*); 1 ♀, Mombasa, 2.i.1913 (*R. C. Wroughton*) (BMNH). **Uganda:** 1 ♀, Jinja, iii.–iv.1932 (*V. G. L. van Someren*); 1 ♂, Kawanda, 4.v.1942 (*T. H. C. Taylor*). **Mozambique:** 1 ♂, Zambesi, Caia, 8.xii.1912 (*H. Swale*) (BMNH). **Malawi:** 1 ♂, Cape Maclean, 18.iv.1973 (*C. G. M. Schulten*) (ITZ, Amsterdam) (variety with legs dark and sides of clypeus broadly white). **Tanzania:** 1 ♀, 14.xii.1906 (*A. F. R.*

*Wollaston*) (BMNH); 1 ♂, Zanzibar, (*Staudinger*) (RNH, Leiden). **South Africa**: 1 ♀, Transvaal, Kruger National Park, 27.xi.1954 (BMNH); 1 ♂, 1 ♀, Soutpansberg, 800 m, vii. (*G. A. J. Rothney ex H. Rolle*) (UM, Oxford).

*Belonogaster maculata* sp. n.

**FEMALE.** Head ferruginous, antennae above almost entirely, frons, black. Mesosoma black, ventral point of pronotum and posterior depression of propodeum ferruginous; legs black, stripe on last segment of fore tarsus reddish. Gaster black, petiole and anterior half of second segment, ferruginous; large, closely approximating triangular spots on tergite 2, yellow (1 specimen) or a pair of small spots at apex of tergite 2 also yellow (5 specimens) or besides these four spots, a pair of small spots on gastral tergites 3 and 4 (4 specimens). Wings pale brown, tips hardly darker, venation yellow brown, length 16.0–18.0 mm.

Clypeus acute below, surface with scattered but sparse large punctures bearing short black bristles on whole surface, finely reticulate, more weakly below where it is shining, sparse whitish tomentum, especially dorsally; frons coarsely reticulate with quite close, moderately strong punctures bearing outstanding black bristles. Gena not quite as wide as eye in profile, surface feeble, reticulate with numerous small punctures. Antenna with segment 3 nearly as long as 4 + 5 + 6, 4 nearly 1.5 times as long as broad, 5 a little longer than broad, segment not quite as long as broad. Base of stipes and submentum with a few long bristles. Humeri and mesoscutum dull with quite numerous but not very conspicuous small punctures and close, pale brown, fine tomentum and scattered subappressed, fine short bristles; mesopleuron with numerous rather small punctures and similar tomentum; scutellum and metanotum with closely and rather larger punctures; propodeum rather closely and strongly punctured, angles more punctate-striate, scattered moderately long pale hairs on angles, surface generally with pale brown tomentum; posterior depression nearly one-third as long as propodeum, impressed line to about the mid point, anterior depression small but deep. Femora beneath with inconspicuous tomentum and scattered short rather pale bristles; last segment of fore tarsus elongate. Gastral petiole moderately long, distinctly widened posteriorly, spiracles moderately prominent, tomentum rather close, sides with some outstanding hairs; stalk of second gastral tergite 1.5–2.0 times as long as broad; posterior tergites with close pale tomentum through which short, rather fine, black bristles protrude.

**MALE.** Not seen.

**Holotype** ♀, **Uganda**: eastern Mbale district, S. of Mt Elgon, 2700–3000 ft [820–915 m], 2.–5.viii.1911 (*S. A. Neave*) (UM, Oxford).

**Paratypes**. **Uganda**: 3 ♀, same data as holotype; 2 ♀, between Jinja and Busia, E. Busoga, 3800–4000 ft [1160–1220 m], 28.vii.–1.viii.1911 (*S. A. Neave*). **Kenya**: 2 ♀, Yala River, S. edge Kakamega Forest, 4800–5300 ft [1460–1620 m], 21–28.v.1911 (*S. A. Neave*); 1 ♀, Ilaba, Marathas district, 14 miles [22.5 km] E. of Mumias, 4500 ft [1370 m], 9–12.v.1911 (*S. A. Neave*). All in UM, Oxford except 1 ♀ (Uganda) and 1 ♀ (Kenya) now in BMNH.

*Belonogaster petiolata* (Degeer)

(Figs 36, 37)

*Vespa petiolata* Degeer, 1778, 7: 610, pl. 45, fig. 10, Holotype ♀, no locality (NR, Stockholm) [examined].

? *Vespa linearis* Olivier, 1792: 673. Type, SOUTH AFRICA: Cape of Good Hope (lost).

*Belonogaster brachycerus* Kohl, 1894: 323, 331, pl. 15, fig. 78, pl. 17, fig. 136. Holotype ♀, SOUTH AFRICA: 'Cap b. sp.' (depository unknown).

*B. brachycera* was described by Kohl from (apparently) 1 ♀ from the Cape of Good Hope (NM, Vienna). There seems in the Vienna collection to be some confusion in the labelling between *B. brachystoma* and *B. brachycera* but there was no ♀ amongst the type-material from Cape of Good Hope. Nevertheless, from Kohl's description and figures there is little doubt what his species was.

The female is very close to *B. lateritia*, but the males have different antennae.

**FEMALE.** Colour like the male but often rather more ferruginous. Clypeus and adjacent parts of the head more or less yellow suffused. Wing-length 17.0–19.5 mm.

Clypeus acutely pointed below, moderately shining, very finely reticulate, whole surface with scattered moderate-sized punctures bearing short black bristles and sparse pale tomentum. Frons dull, reticulate with scattered black bristles. Antenna as in Fig. 36. Posterior gastral tergites with sometimes a few protruding, fine black bristles.

**MALE.** Head ferruginous, usually much of the frons black. Sides of clypeus to the bottom of the ocular sinus and spot between the antennal sockets, yellow. Antennae with segments 9–11 yellow. Mesosoma usually mainly black, only rarely with a ferruginous tinge or even with considerable ferruginous areas. Legs ferruginous, hind femora often partly blackish. Gaster ferruginous, gastral tergite 2 with two large triangular yellow spots; apical area of tergite 2 between the spots and much of tergites 3–5 more or less blackened; sternites more or less blackened. Wings red-brown, tips darkened, length 17·0–18·0 mm.

Clypeus acute below but not protruding far, punctured at sides quite closely but hidden by dense silvery pubescence, disk with scattered short, black outstanding bristles, clypeus transversely convex above but flattened below, anterior tentorial pits large and deep. Frons dull, reticulate, with close rather large punctures, close silvery tomentum and outstanding short black bristles. Gena dull, reticulate with sparse small punctures, a little wider than eye. Antenna (Fig. 37) with segment 3 clearly longer than 4 + 5, neither 4 nor 5 twice as long as broad, even 4 not nearly so, segments 8–10 with slightly raised elongate area beneath, 10–11 cylindrical, 12 long (longer than 4), rather thin cylindrical curved, dull with microscopic hairs, tip rounded. Mesoscutum with scattered small punctures, rather fewer on humeri, many on mesopleuron, mesoscutum and humeri with not very close silvery tomentum and close short black outstanding hairs or bristles. Scutellum and metanotum distinctly punctured, former with a weak impressed line. Propodeum reticulate with scattered black bristles, posterior depression one-third as long as propodeum, impressed line moderate to mid-point, anterior depression small and deep. Last segment of front tarsi long. Hind femur beneath with silvery tomentum and a few suberect black bristles and a few white ones. Gaster with petiole moderately long, almost parallel-sided, spiracles prominent; stalk of second tergite rather longer than broad (1·0–1·5 times), gaster posteriorly without protruding black bristles, tomentum silvery, rather close.

**DISTRIBUTION** (19 ♀, 46 ♂). **South Africa** (Cape of Good Hope, Orange Free State, Transvaal, Natal), **Lesotho, Malawi, Zimbabwe.**

The female differs from *B. lateritia* in having the clypeus often more punctured dorsally; antennal (Fig. 36) segment 4 usually a little shorter and almost quadrate; humeri and mesoscutum with more distinct short bristles and the general colour usually blacker.

A male, South Africa: Cape of Good Hope, Aliwal North, xii.1922 (*R. E. Turner*) (BMNH) has the puparium of a ♂ Strepsipteran beneath the centre of gastral tergite 5.

### *Belonogaster lateritia* Gerstaecker

(Figs 32, 38)

*Belonogaster lateritius* Gerstaecker, 1855: 463. Syntypes ♀, MOZAMBIQUE (*W. C. Peters*) (MNHU, Berlin) [fragments examined].

*Belonogaster elegans* Gerstaecker, 1862: 468, pl. 30, fig. 8. Holotype, MOZAMBIQUE: Inhambane (depository unknown).

*Belonogaster fleckii* Kohl, 1894: 332. LECTOTYPE ♀, SOUTH WEST AFRICA ('Damaraland') (*Dr Fleck*) (NH, Vienna), here designated [examined].

*Belonogaster agilis* Kohl, 1893: 187, figs 1, 4, 9, 10, 15. LECTOTYPE ♂, ANGOLA (NH, Vienna), here designated [examined].

The syntypes of *B. lateritius* are represented in MNHU, Berlin by fragments (the wings, one foreleg, most of one antenna) of a ♀ labelled 'Type Mozambique Peters'. As far as can be judged, it is the same species as other specimens I have seen from that region.

No syntypes of *B. elegans* seem to exist, but it appears to have been a colour variant of *B. lateritius*.

*B. fleckii* was described from 2 ♀ and one was examined and is here designated lectotype. *B. agilis* was described from several ♂ ♀ from Angola; 4 ♂, 1 ♀ were examined and 1 ♂ has been labelled lectotype.

**MALE, FEMALE.** Colour generally ferruginous but mesosoma and hind femora sometimes rather darkened. Femals usually with fewer punctures on dorsal half of clypeus, wing-length 16·0–20·0 mm, wing-tips often little darkened. Antenna with segment 4 usually distinctly a little longer than broad, though 5 about quadrate. Mesosoma rarely much blackened, bristles on humeri and mesoscutum rarely much developed and nearly always pale. Mesoscutum and humeri usually less punctured. Gaster as in Fig. 32. As in *B. petiolata* the amount of yellow on the face is rather variable. Male with antennal (Fig. 38) segment 3 a little longer than 4 + 5, 4 and 5 clearly a little more than twice as long as broad, 5 about 2·5 times, 8 twice as long

as broad, 12 very long (as long as 5), thin, cylindrical, strongly curved, tip rounded, a number of very short hairs above, shining beneath, 9–11 cylindrical, little protuberant beneath, though 9–10 have an obtuse raised area, 6–8 with distinct raised lines.

**DISTRIBUTION** (218 ♀, 25 ♂). **Angola, South West Africa, Botswana, South Africa** (Cape of Good Hope, Orange Free State, Natal, Transvaal), **Lesotho, Tanzania, Mozambique, Kenya** (Mombasa), **Malawi, Zimbabwe, Zambia**.

Three specimens have been seen parasitized by Strepsiptera. Malawi: 1 ♂, SW. shore L. Malawi, between Ft Johnston and Monkey Bay, 1650 ft [500 m], 25.ii–4.iii.1910 (*S. A. Neave*) (BMNH), empty ♂ puparium under gastral tergite 5 on right. Mozambique: 1 ♀, Beira, vi.1902 (*J. Ogilvie*) (BMNH), ♂ puparium beneath tergite on right; ♀, Delagoa Bay, 1883 (BMNH), ♂ puparium under gastral tergite 3 on left.

### *Belonogaster tarsata* Kohl

(Figs 39–41)

*Belonogaster tarsatus* Kohl, 1893: 187, figs 2, 5, 7, 8, 11, 16. **LECTOTYPE** ♂, **TANZANIA**: 'E. Africa, Mbusini' (*F. Stuhlmann*) (NH, Vienna), here designated [examined].

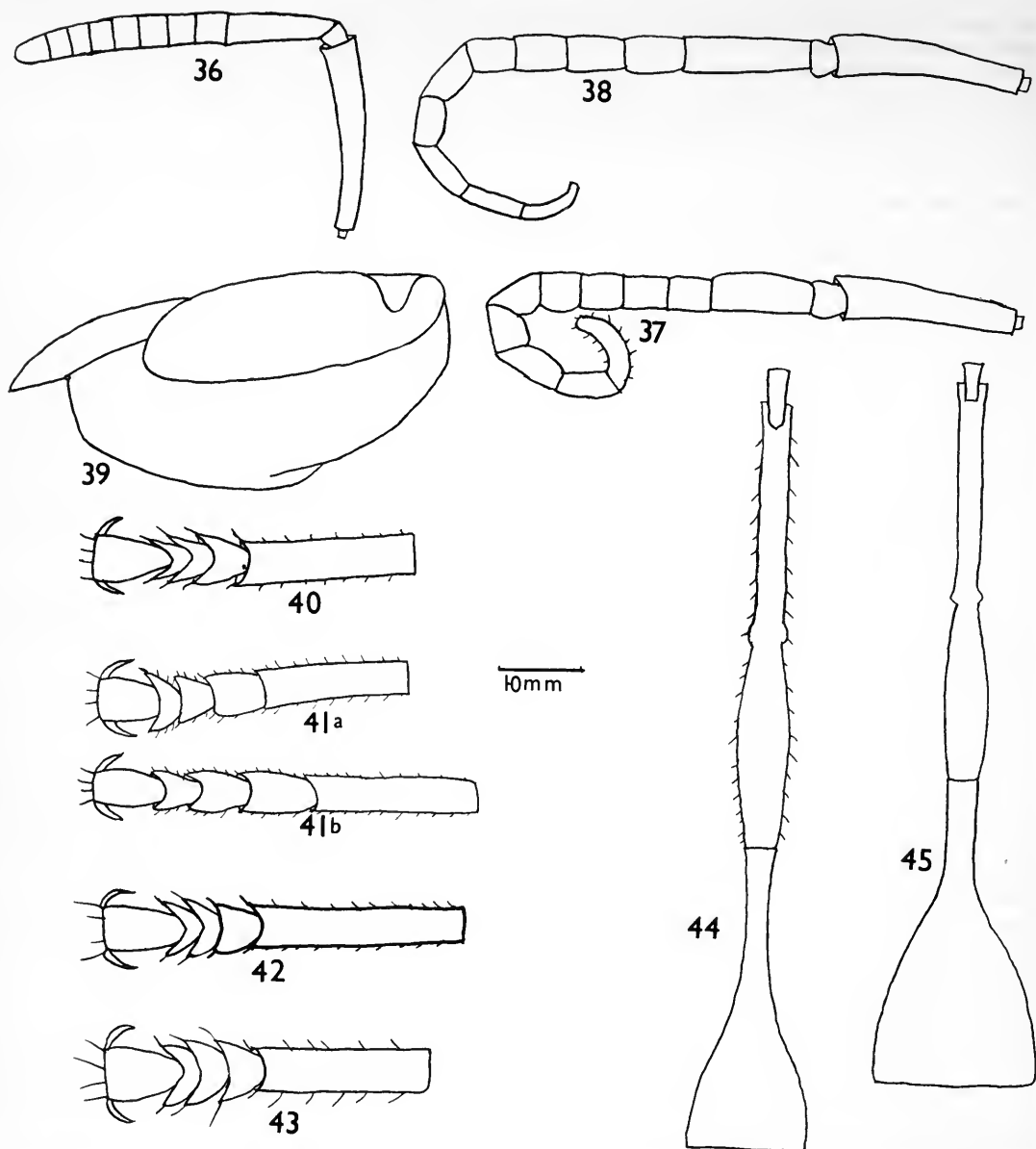
**FEMALE.** Head including the antennae, ferruginous; clypeus (except a narrow ferruginous mid line) and broad inner orbits, yellow. Mesosoma and legs ferruginous. Gaster rather dark ferruginous, tergite 2 with two small yellow spots. Wings light reddish brown, tips hardly darker, length 18.0 mm.

Clypeus acute below, very finely reticulate, a little shining, with pale hairs and no visible tomentum, some rather large punctures on ventral quarter. Frons reticulate, not punctured, some very short outstanding bristles, very little tomentum. Gena (Fig. 39) nearly 1.5 times as wide as eye in profile, very fine reticulate, shining, especially below where there is a moderate number of medium sized punctures; antennal segment 3 almost as long as 4 + 5 + 6, 4 and 5 hardly longer than broad, 8 rather shorter. Mesoscutum and humeri rather finely granulate, not punctured, with inconspicuous brownish tomentum, mesopleuron similar, without punctures; scutellum hardly punctured, with a strong median line. Propodeum with punctures and short black hairs at sides, no real striae but a little brownish tomentum; posterior depression not quite half as long as propodeum, impressed line moderately strong, complete, anterior depression strong, deep. Fore tarsus (Fig. 40) rather short, other tarsi normal. Hind femur beneath with a moderate number of short pale bristles. Gastral petiole moderately long, distinctly widened behind; stalk of second gastral tergite about 1.5 times as long as broad; gaster posteriorly with close brownish tomentum and no protruding bristles.

**MALE.** Ferruginous; mesosoma and gaster behind the petiole mottled with black. Whole face up to top of ocular sinus white except for a narrow brown central stripe on clypeus; antennal segments 1–2 white beneath. Mesosternum, fore and mid coxae beneath, anterior stripe on mid femur, short basal stripe on hind femur, two small oval spots on gastral tergite 2, spot on malar space, and most of outer side of mandibles, yellow. Frons black. Wings light fuscous, length 17.5 mm.

Clypeus feebly angularly produced below, unpunctured with dense silvery tomentum, especially at sides; frons with dense greyish tomentum with scattered fine punctures bearing short fine black bristles. Gena about as wide as eye in profile; antennal segment 3 clearly longer than 4 + 5, 4 and 5 about 2.5 times as long as broad, 8 rather shorter, 7–12 paler yellowish, 8–11 practically cylindrical, 12 longer than 9, 10 or 11, gently bent, more above than below, shining, slightly flattened. Mesoscutum blackish, effectively unpunctured with inconspicuous greyish tomentum, humeri unpunctured with dense pale tomentum; mesopleuron unpunctured, slightly shining. Fore tarsus (Fig. 41) short, a little broadened, with fine tomentum and some bristles at sides, femur with dense whitish tomentum beneath; mid and hind tibiae and tarsi (Fig. 41) unusually shining with fine, pale, inconspicuous tomentum but no bristles, slightly shortened; mid and hind femora with white moderately dense tomentum beneath. Propodeum with moderately close coarse punctures, no striae except at edge of posterior depression which is nearly half as long as propodeum, impressed line weak but complete, anterior depression rather large, deep surface with pale inconspicuous tomentum. Gastral petiole rather short, gently widened to a little before apex, stalk of second gastral tergite as long as broad, gaster posteriorly without protruding bristles, with inconspicuous tomentum.

**DISTRIBUTION.** **Tanzania:** Kohl's material; 1 ♂, M'Busini Ousegouba, 1907 (*M. von Broun*); 1 ♀, Zanzibar, 1887 (*Le Roy*) (MNHN, Paris); 1 ♀, Wanii River, near Msata (just N. of Dar-es-Salaam), 6.vi.1945 (*T. Clifton*) (BMNH).



**Figs 36–45** *Belonogaster*. 36, 37, *B. petiolata* (Degeer). (36) ♀, left antenna; (37) ♂, left antenna. 38, *B. laterita* Gerstaecker, ♂, left antenna. 39–41, *B. tarsata* Kohl. (39) ♀, left gena; (40) ♀, fore tarsus; (41) ♂, fore (a) and mid (b) tarsi. 42, *B. turbulenta* Kohl, ♀, fore tarsus. 43, 44, *B. flava* sp. n., ♀. (43) fore tarsus; (44) gastral tergites 1–2. 45, *B. filiventris* (de Saussure), ♀, gastral tergites 1–2.

***Belonogaster turbulenta* Kohl**

(Fig. 42)

*Belonogaster turbulentus* Kohl, 1894: 323, 330, pl. 15, fig. 87, pl. 17, fig. 147. Holotype ♀, SIERRA LEONE (*Moquerys*) (NM, Vienna) [examined].

**FEMALE.** Pale yellowish brown, clypeus and malar space really yellow; gaster, especially the stalk of second tergite, a little darker. Wings yellowish brown, length 17.0 mm.

Clypeus acute below, convex, dull and finely reticulate, not punctured, with short outstanding pale hairs. Frons dull, granulate, punctured in holotype but not in other specimens, with short outstanding pale hairs. Gena rather more than half as wide as eye in profile, rather dull. Antennal segment 3 nearly as long as 4 + 5 + 6, 4 and 5 about 1.5 times as long as broad, 8 a little longer than broad. Mesoscutum dull, granulate, unpunctured, tomentum very inconspicuous, very short outstanding hairs, humeri similar, mesopleuron similar but without hairs. Propodeum dull, unpunctured, traces of striae on angles, sparse tomentum and a few hairs; posterior depression one-third as long as propodeum, impressed line weak, anterior depression practically obsolete. Legs very long and thin, fore tarsus (Fig. 42) with last segment elongate, hind femur with numerous rather long pale hairs beneath. Gastral petiole very long and slender but posterior part markedly thicker, petiole beneath with hairs; stalk of second gastral tergite about 4 times as long as broad, gaster posteriorly with rather close tomentum but no bristles.

MALE. Not seen.

DISTRIBUTION. **Sierra Leone**: 1 ♀ *Kohl*; 1 ♀ (*E. André*, 1900) (MNHN, Paris) (dark form with top of head, mesoscutum and gaster posteriorly, blackish). ? **Congo**: 2 ♀, San Benito, 1885 (*Guiral*) (MNHN, Paris). **Congo**: 1 ♀, Ogooné, Sam Kita, 1910 (*R. Ellenberger*) (MNHN, Paris). ? **Zaire**: 1 ♀, 'Congo', Luebo (*D. W. Snyder*) (USNM, Washington).

The specimen from Sierra Leone in MNHN, Paris was placed under *B. filiventris*. The variety mentioned by du Buysson (1909: 24) is described below under *B. flava*.

### *Belonogaster flava* sp. n.

(Figs 43, 44)

FEMALE. Head ferruginous, mandibles except teeth, clypeus, inner orbits to sinus, spot between antennal sockets, whole gena to near the top of the eye, malar space, scape beneath, pale yellow; small patch round ocelli, antennal segments 1–9 or in paratypes 1–3, blackish. Thorax pale yellow, anterior spot on pronotum, large humeral spot, mesoscutum except two short posterior lines, square, central spot of scutellum dark red-brown. Propodeum pale yellow, large inverted U-shaped spot red-brown. Tegula brown with wide inner margin, yellow; humeral plate yellow. Legs yellow, tarsi black, mid and hind tibiae brownish, mid pair with a yellow basal dorsal spot; mid and hind femora brownish above. Gaster dark brown or in paratypes, black, sides of petiole, large almost joined spots on tergite 2, narrow transverse lunules on tergite 3–4, pale yellow; sternite 1 dark brown except near apex; sternite 2 with its broad part yellow, 3–5 light brown with small lateral apical pale lunules, 6 brown. Wings rather dark red-brown, length 18.0 mm.

Clypeus acute below, finely granulate, some large punctures on the lower quarter, bristles pale, fine and sparse. Frons dull, hardly punctured with some brown or black bristles. Gena two-thirds or in paratypes half as wide as eye in profile, surface reticulate, scarcely punctured. Antennal segment 3 not quite as long as 4 + 5 + 6, 4 and 5 just longer than broad, 8 similar. Mesoscutum dull, finely granulate, not punctured, no hairs, brown tomentum not dense. Mesopleuron similar. Scutellum with no impressed line in the holotype but a fine one in the paratypes, it and the metanotum dull, granulate. Propodeum in holotype more coarsely granulate, posteriorly almost finely clathrate but evenly granulate in the paratypes, bristles short and brown, posterior depression one-quarter as long as propodeum, impressed line to mid point, anterior depression broad and shallow. Last segment of fore tarsi (Fig. 43) rather short. Hind femur beneath with numerous, moderately long, black bristles. Gastral petiole (Fig. 44) long, slender, distinctly widened at apex, spiracles not strongly projecting, petiole with scattered long hairs beneath, in paratypes with the posterior wide part a little shorter and wider; stalk of second gastral tergite (Fig. 44) 5 times as long as broad, or in paratypes 4–5 times and a little wider; gaster posterior with moderately dense brown tomentum, denser in the paratypes.

MALE. Not seen.

Holotype ♀, **Uganda**: Budongo Forest, Unyoro, 3400 ft [1040 m], 11–15.xii.1911 (*S. A. Neave*) (BMNH).

Paratypes. **Cameroun**: 2 ♀, north, Joh.-Albrechtshöhe, 21.xi.1895, ii.1896 (*L. Conradt*) (MNHN, Paris).

The paratypes are the two females mentioned by du Buysson (1909: 240) as a variety of *B. turbulenta*. The specimen mentioned by du Buysson with a ♀ stylops puparium on the right of tergite 4 was not found.

### *Belonogaster filiventris* (de Saussure)

(Figs 45–47)

*Raphigaster filiventris* de Saussure, 1853: 16, pl. 2, fig. 5. Holotype ♀, ? SENEGAL (MNHN, Paris) [examined].

*Belonogaster filiventris* (de Saussure) Smith, 1857: 94.



- Belonogaster gracilis* Cameron, 1910: 173. LECTOTYPE ♀, TANZANIA: Kilimandjaro, Kibonoto, cultivated zone, 1300–1900 m. April–May (*Sjöstedt*) (NR, Stockholm), here designated [examined]. **Syn. n.**
- Belonogaster sexmaculatus* Cameron, 1910: 174. Holotype ♂, TANZANIA: Kilimandjaro, Kibonoto, cultivated zone, May (*Sjöstedt*) (NR, Stockholm) [examined]. **Syn. n.**
- Belonogaster buyssoni* Meade-Waldo, 1911: 99. Holotype ♀, NIGERIA: south, Iganga, Busuga (*J. J. Simpson*) (BMNH) [examined]. **Syn. n.**

The holotype of this species in MNHN, Paris is labelled 'Cayenne, *Bosc*, 1828'. As du Buysson points out, this must be incorrect and the specimen must be African, though as the species seems to be widespread it need not have come from West Africa; de Saussure's locality '? Sénégal' is only a guess. The specimen is a female with no fore legs and the gaster seems to have no yellow spots as indicated by the description.

By tradition, the species described below is given this name, but without the fore tarsi it is difficult to be sure of its identity. The series under this name at Paris seemed to me to include at least five other species (*B. kohli*, *B. nigricans*, *B. longitarsus*, *B. turbulenta* and a species near *B. jordani*).

The holotype of *B. buyssoni* also has no complete fore tarsus but a topoparatype sent to Paris by Meade-Waldo is certainly the present species.

The holotype of *B. sexmaculata* is a troublesome specimen, very dirty and with only segments 1–10 of one antenna preserved. I believe it belongs here, though the other 4 males I have seen have only 2 yellow spots on the gaster, not six. Von Schulthess thought that *B. sexmaculata* was the male (then undescribed) of *B. facialis*. This is possible but I think the narrow gena, narrow gastral petiole and stalk to the second gastral tergite make the present synonymy more likely. The female in any case has 0–6 yellow spots on the gaster.

**FEMALE.** Head ferruginous, antennae more or less blackened above. Mesosoma ferruginous, humeri and mesoscutum blackened, patch on mesopleuron and sides of propodeum a little darker. Legs ferruginous, fore tarsi, mid and hind femora, tibiae and tarsi, darkened, more or less black. Gaster black, petiole and stalk of second tergite, ferruginous with or without a pair of spots on tergites 2, 2 + 3, or 2 + 3 + 4 (in 63♀, 41 no spots, 16 two spots, 5 four spots, 1 six spots). Wings reddish brown, tips not darker, length 17.5 mm.

Clypeus acute below with scattered large punctures on lower third, moderately shining, finely reticulate with very few black bristles except on lower quarter. Frons dull, reticulate with numerous moderately strong punctures, with sparse pale tomentum and many short outstanding black hairs on frons and occiput. Gena (Fig. 46) about half as broad as eye in profile, very finely reticulate, more tomentose above, more shining and punctured on malar space. Humeri and mesoscutum with numerous moderate punctures, rather close brownish tomentum and short outstanding hairs. Scutellum quite strongly punctured, central line weak. Mesopleuron with fine reticulation, scattered weak punctures posteriorly and moderately dense tomentum. Propodeum coarsely granulate, no striae and very few punctures, moderately close brown tomentum, many moderately short outstanding black hairs; posterior depression not quite half as long as propodeum, no impressed line, anterior depression very weak, transverse. Fore tarsus with last segment somewhat short. Mid and hind femur with a few black bristles at base beneath. Gastral petiole (Fig. 46) moderately long and slender, posterior end distinctly widened, spiracles moderately projecting; stalk (Fig. 45) of second gastral tergite about 3 times as long as broad; gaster posteriorly with close pale tomentum.

**MALE.** Light ferruginous; mandibles, broad sides of clypeus, usually whole inner orbits, space between antennal sockets, antennal segments 1–2 beneath, white; antennal segments 8–12 yellowish brown; mesosternum, fore and mid coxae beneath, broad anterior stripe on mid femur and tibia, dot at anterior apex of hind femur, white; mid and hind legs and central stripe on fore tarsi, blackish ferruginous. Gastral tergite 2 nearly always and sometimes 3 and 4 with two yellow spots before the apex, tergite 3 sometimes basally yellow suffused. Wings brownish hyaline, length 13.0–14.5 mm.

Mandibles parallel-sided, base with silvery hairs. Clypeus very obtusely rounded below, dull with dense silvery hairs especially at sides; central strips of clypeus with dark brown hairs; frons reticulate with inconspicuous close punctures and moderately long, outstanding, black hairs. Gena one-third as wide as eye in profile, dull, scarcely punctured. Antennal segment 3 about as long as 4 + 5, 4 and 5 at least 2.5 times as long as broad, 8 about twice as long as broad, 12 slightly flattened, cylindrical; distinctly curved, dull, with a few hairs, tip rounded, not quite as long as 11, 8–11 strongly prominent beneath 3–7 with a weak raised line beneath. Mesoscutum and pronotum granulate, not punctured, with dense silvery tomentum and quite long outstanding brown or black hairs; mesopleuron similar but rather more distinctly punctured; scutellum with a central impressed line. Propodeum weakly rugose with long, outstanding, brownish black hairs;



posterior depression one-quarter as long as propodeum, impressed line weak, anterior depression distinct, deep, transverse. Fore tarsus (Fig. 47) short and broad, last segment 1.5 times as long as broad; mid tarsus (Fig. 47) with segments 2-4 increasingly transverse, 5 in dorsal view oval, as long as 3 + 4. Hind basitarsus longer than the mid tibia. Hind femur with long blackish hairs beneath, especially at its base where they are nearly as long as the femoral diameter; hind tibia beneath with quite close, outstanding silvery hairs which are more than half as long as the tibial diameter. Gastral petiole slender, little widened posteriorly, spiracles scarcely protruding; stalk of second gastral tergite about 3 times as long as broad; gaster posteriorly with close, fine pale tomentum.

**DISTRIBUTION** (115 ♀ 16 ♂). **Liberia, Nigeria, Cameroun, Zaire, Angola, Zimbabwe, Zambia, Kenya, Uganda, Malawi, Mozambique, Tanzania, South Africa** (Natal, Transvaal, Cape of Good Hope).

Three specimens have been seen parasitized by Strepsiptera. Liberia: 1 ♀, Robts. Field, ix. (*N. H. L. Krauss*) (USNM, Washington), ♀ Strepsipteran pupa on left tergite 5; Zaire: 1 ♀, Katanga (Shaba), La Panda, 9.x.1920 (*J. Bequaert*) (stylops removed) (BMNH); Tanzania: 1 ♀ Marunga, 1-20.iii.1913 (*Lindner*) (BMNH), ♀ Strepsipteran pupa under tergite 4 on the right.

### *Belonogaster nigricans* sp. n.

(Fig. 48)

**FEMALE.** Head black; clypeus except central spot above, inner orbits, mandibles, ferruginous; antennae black above, ferruginous beneath. Mesosoma black, scutellum and metanotum more or less reddish. Legs and gaster black. Wings grey, costal region brown, tips not darkened, length 17.0 mm.

Clypeus pointed below, lower half with irregular large punctures, finely reticulate with not very dense pale brown tomentum, a few black bristles on lower quarter. Frons dull, reticulate with fine punctures, outstanding short bristles and inconspicuous pale tomentum. Gena about half as wide as eye in profile, dull, finely granulate, not punctured. Antennal segment 3 longer than 4 + 5, 4 and 5 about 1.5 times as long as broad, 8 quadrate. Mesosoma moderately strongly granulate, not punctured, mesoscutum and humeri with short pale outstanding hairs and close brassy tomentum; mesopleuron with less close tomentum, no hairs. Propodeum dull, coarsely granulate, traces of dorsal punctures, large punctures on sides, no striae, some short brassy tomentum, dense short stout bristles, posterior depression rather less than half as long as propodeum, impressed line weak to near dorsum, anterior depression deep, very transverse. Last segment of fore tarsus elongate; hind femur with short oblique black hairs beneath, hind tibia with a few short bristles beneath. Gastral petiole (Fig. 48) narrow, moderately long, spiracles very prominent, moderately thickened to a little before apex then a little narrowed, many long hairs at sides and beneath; stalk (Fig. 48) of second tergite 2.5 times as long as broad; gaster posteriorly finely granulate, rather dull with fine pale tomentum and some longish oblique black hair-like bristles.

**MALE.** Not seen.

**Holotype** ♀, Congo: Dimonika, iv.1969 (*J. P. Grillo*) (MNHN, Paris). **Paratypes**. Congo: 1 ♀, between Sam-Quilo and N'Jolé, 1900 (*J. Bouyson*) (tomentum of mesoscutum apparently grey); 1 ♀, Lambarène, xi.-xii.1902 (*L. Fea*); 1 ♀, Bassin de l'Imindo, aff. del'Ogoué, 1961 (*J. Gravot & Cap. Cottés*) (MNHN, Paris).

### *Belonogaster kelnerpillautae* sp. n.

**FEMALE.** Ferruginous, gastral segments 3-6 a little darker marbled, mid and hind tarsi black, fore tarsi a little darkened. Wings tinged with red-brown, length 16.5-18.0 mm.

Clypeus acute below, surface a little shining, feebly finely reticulate, a few large punctures on lower quarter, oblique short black bristles scattered all over and some inconspicuous brownish tomentum. Frons reticulate dull, with scattered small punctures and outstanding black bristles. Gena half as wide as eye in profile, very finely reticulate, more shining below with a few very small punctures. Stipes with rather numerous outstanding black hairs at base. Antennal segment 3 considerably longer than 4 + 5, 4 nearly twice as long as broad, 5 less than 1.5 times, 8 just longer than broad. Mesoscutum and humeri granulate, dull with very indistinct fine punctures, short outstanding hairs and not very close brown tomentum; mesopleuron similar but more distinctly punctured; scutellum granulate, hardly punctured with long black bristles, central line weak. Propodeum granulate, angles striate below, few punctures, long black bristles, posterior depression one-third as long as propodeum, impressed line weak to mid-point, anterior depression obsolete. Last segment of fore tarsus elongate; all femora with a moderate number of short black hairs

beneath; hind tibia with a moderate number of brownish oblique bristles beneath. Gastral petiole long and thin, especially proximally, spiracles rather prominent, distal part moderately swollen but narrowed before apex; stalk of second segment 3.5–4.0 times as long as broad, gaster posteriorly with moderately close brownish tomentum and numerous black hair-like bristles protruding from it.

MALE. Not seen.

Holotype ♀, Congo: Dimonika, 18–30.i.1977 (*S. Kelner-Pillault*) (MNHN, Paris).

Paratypes. Congo: 1 ♀, same data as holotype (BMNH); 1 ♀, Dimonika, 'lit. de la rivière à Afio, forêt primitive' (MNHN, Paris).

*Belonogaster bimaculata* sp. n.

(Figs 49, 50)

FEMALE. Head ferruginous; inner orbits, small spot at sides of clypeus connected to a narrow ventral margin, whitish yellow; a line from eye to eye through the posterior ocelli, produced into a small triangle which includes the median ocellus, black; dorsal side of antennal segments 1–6 darkened. Mesosoma black, pronotum, suffused spot on front of mesopleuron, posterior impression of propodeum, ferruginous. Legs ferruginous, much of fore coxa, mid and hind coxae blackened, mid and hind femora and tibiae somewhat darkened. Gaster with petiole and stalk of segment 2 dark ferruginous, rest of gaster black but tergite 2 with large yellow spots. Wings light fuscous, tips darker, venation brown, length 17.0–19.0 mm.

Clypeus acute below, surface with close large punctures below, reticulate with smaller punctures and sparse tomentum above; frons reticulate with small punctures and a few outstanding pale bristles. Gena (Fig. 49) about three-quarters as wide as eye in profile, surface finely reticulate with quite numerous small punctures below. Base of stipes with many long black hairs. Antennal segment 3 about as long as 4 + 5 + 6, 4 and 5 about 1.25 times as long as broad, 8 quadrate. Mesoscutum and humeri finely granulate, hardly perceptibly punctured with dense appressed silvery tomentum and in front with a few outstanding pale hairs, mesopleuron more distinctly punctured, tomentum less close. Propodeum rather more strongly punctured with slight traces of striae, coarsely reticulate with not very close tomentum and outstanding pale hairs, posterior depression nearly half as long as propodeum, impressed line weak, anterior depression small, transverse. Fore tarsus with segment 4 a little broader and 5 a little shorter than usual. Mid and hind femur with close tomentum and moderately numerous short black and some white bristles beneath, especially on basal half. Hind tibia with some obliquely projecting bristles beneath. Mid and hind tarsi unusually long. Gastral petiole moderately long, distinctly widened posteriorly, spiracles little projecting, with close tomentum and short white hairs; stalk of second tergite 2.0–2.5 times as long as broad, rest of gaster with moderately close pale tomentum but all bristles pale.

MALE. Head ferruginous; inner orbits and sides of clypeus broadly, spot between antennal sockets, greater part of mandibles, whitish yellow; ocellarium and part connecting it to eye blackened. Dorsal side of antenna, especially segments 1–3, darkened. Pronotum and scutellum ferruginous, rest of thorax and propodeum black. Legs ferruginous, apical spot beneath fore coxa, underside of mid coxa, stripe beneath mid femur, pale yellow. Gaster black, tergite 2 with two large round yellow spots. Wings very light fuscous with brown stripe along costa, tips fuscous and venation brown, length 16.5 mm.

Mandibles parallel-sided. Clypeus very little produced below but nevertheless just pointed, surface with long appressed silvery pubescence; frons dull, reticulate with a number of weak punctures and dense tomentum; gena a little more than half as wide as eye in profile, rather dull, finely granulate. Antennal (Fig. 50) segment 3 as long as 4 + 5, 4 and 5 a little more than 2.5 times as long as broad, 8 2.5 times, narrower than 7, segment 2 cylindrical, tip rounded, gently curved, rather more above than below, 11 nearly as long as 12, slightly swollen below, 9 and 10 shorter than 11 and much more swollen beneath, 5–8 with weak raised lines beneath. Mesosoma much as in ♀ but hairs of mesoscutum rather more obvious. Mid and hind femora with tomentum beneath but no bristles. Fore tarsus short, segment 4 about as wide as long, segment 5 in dorsal view about 1.5 times as long as wide. Gastral petiole moderately long, distinctly widened behind, stalk of second gastral tergite 2 as long as broad, gaster with close pale tomentum and a few protruding pale bristles.

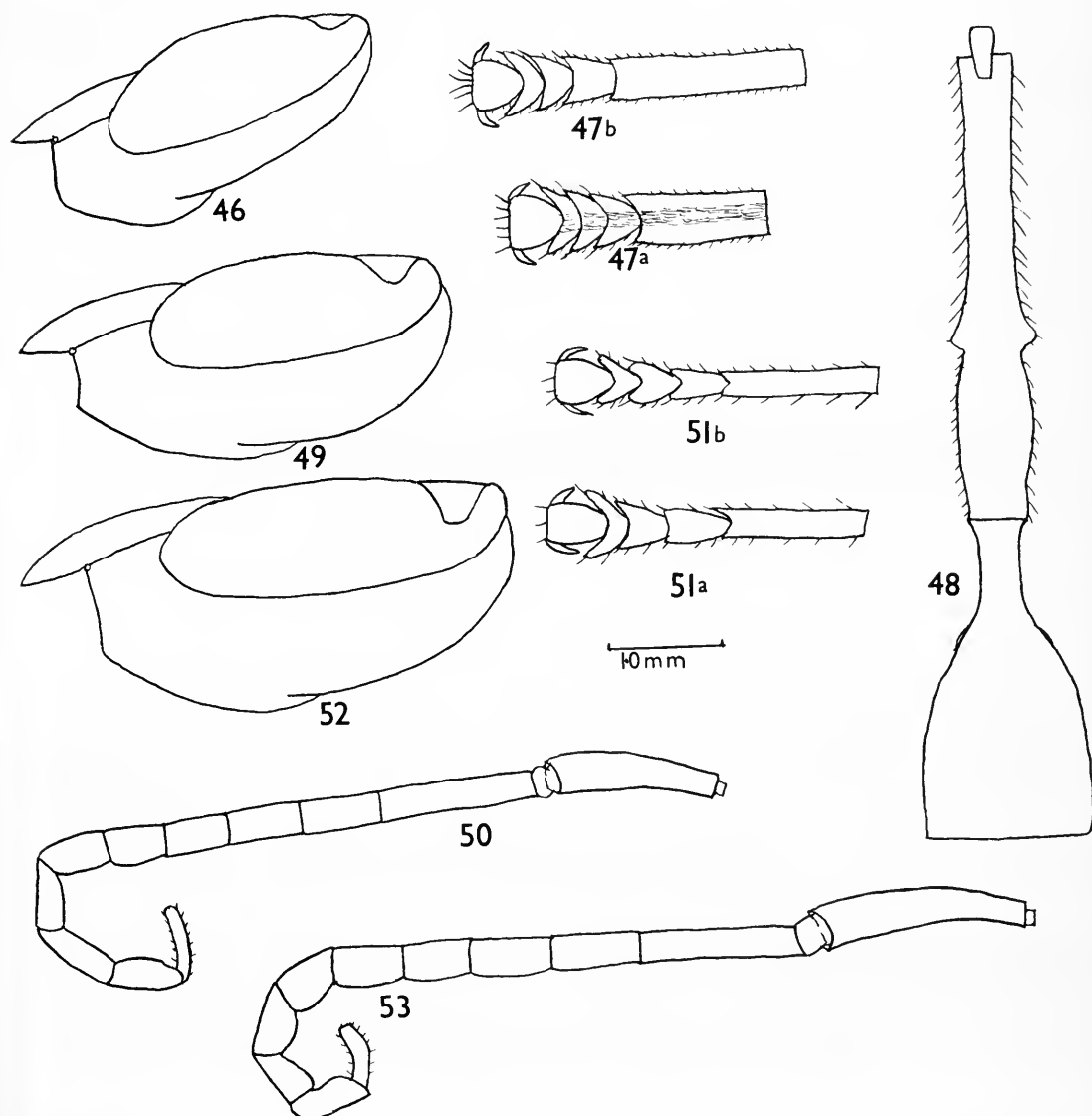
Holotype ♀, Zambia: Abercorn, 24.i.1951 (*F. O. Albrecht*) (BMNH).

Paratypes. Zambia: 7 ♀, 1 ♂, with same data as holotype but various dates between 12.i. and 13.iv.1951 (BMNH); 3 ♀, Mporokoso, 4500 ft [1370 m], 29.vii.–1.viii.1908 (*S. A. Neave*) (UM, Oxford); 5 ♀, N. Lake Bangweolo, Luwinda, 5.vi.–10.viii.1908 (*S. A. Neave*) (UM, Oxford); 1 ♀, Upper Kalungwisi Valley, 4200 ft [1280 m], 27.vii.1908 (*S. A. Neave*) (UM, Oxford); 1 ♀, near Chinsali, 4300 ft [1310 m], 14.iv.1908 (*S. A.*

*Neave*) (UM, Oxford); 1 ♀, Middle Chambezi Valley, Chinsali district, 4000 ft [1220 m], 24.iv.1908 (*S. A. Neave*) (UM, Oxford); 6 ♀, High Plateau S. of L. Tanganyika, dense forest, 4500 ft [1370 m], 13.–25.viii.1908 (*S. A. Neave*) (UM, Oxford).

A ♀ caught on 15.ii.1951 at Abercorn had a ♂ strepsipteran puparium beneath the left side of gastral tergite 5.

This species was labelled under the above name by Dr Giordani Soika as a subspecies of *B. facialis*, but no description has been published.



**Figs 46–53** *Belonogaster*. 46, 47, *B. fliventris* (de Saussure). (46) ♀, left gena; (47) ♂, fore (a) and mid (b) tarsus. 48, *B. nigricans* sp. n., ♀, gastral tergites 1–2. 49, 50, *B. bimaculata* sp. n. (49) ♀, left gena; (50) ♂, left antenna. 51–53, *B. facialis* du Buysson. (51) ♂, fore (a) and mid (b) tarsus; (52) ♀, left gena; (53) ♂, left antenna.

*Belonogaster facialis* du Buysson

(Figs 51–53)

*Belonogaster facialis* du Buysson, 1908: 65; 1909: 238. LECTOTYPE ♀, KENYA: Taita Hills, Bura, 1904 (C. Alluaud) (MNHN, Paris), here designated [examined].

The lectotype is actually labelled 'Afr. orientale anglaise; Boura, Wa-Taita', which I take to be the more southern of the two places in Kenya called Bura. Dr V. G. L. van Someren also collected the species in this locality. The male was not seen by du Buysson.

**FEMALE.** Head ferruginous; lower half of clypeus and sometimes sides and small dorsal area on malar space, yellow; inner orbits often more or less yellow. Mesosoma and legs ferruginous. Gaster ferruginous, apex of tergites 2–3 and most of tergites 4–6 a little darkened, each of tergites 2–4 with two large round yellow spots. Wings very light ferruginous, costal region darker, tips a little infusate, length 16.0–19.0 mm.

Clypeus acute below, finely reticulate with scattered moderately large punctures, dorsal three-fifths with close pale tomentum, lower part with a few outstanding pale bristles. Frons with close, rather coarse reticulation and very indistinct small punctures and short outstanding pale hairs. Gena (Fig. 52) a little wider or narrower than eye in profile, finely punctured below. Antennal segment 3 about as long as 4 + 5 + 6, 4 and 5 not or hardly longer than broad, 8 not quite so long as broad. Mesoscutum dull with fine dense reticulation and dense long appressed silvery brown tomentum, no outstanding hairs, punctures very indistinct even on pleuron; scutellum with a weak impressed line, it and metapleuron with punctures a little stronger. Propodeum scarcely punctured with dense appressed silvery brown tomentum and quite dense subappressed hairs on angles, posterior depression one-third as long as propodeum, no impressed line, anterior depression very transverse, hardly developed. Fore coxae normally with black bristles but sometimes with pale ones; mid and hind tibiae with only short pale oblique bristles; mid and hind femora with fine tomentum and a few short pale bristles beneath; last segment of fore tarsus rather shorter than usual. Gastral petiole rather long and narrow, posterior part a little wider, spiracles very little projecting, surface with close, very fine tomentum and a few short outstanding hairs; stalk of second tergite 2.5–3.0 times as long as broad; rest of gaster with close fine silvery brown tomentum and a few obliquely projecting pale bristles.

**MALE.** Ferruginous; mesosoma and gaster a little darkened; clypeus except a narrow slightly darker central stripe, inner orbits, inner margin of tegula, inner stripe of fore and mid coxae, stripe beneath mid femora and sometimes hind tibia, two roundish spots on each of gastral tergites 2–4, pale yellow. Wings hyaline, tips a little darkened, especially along the costa, length 15.5 mm.

Clypeus obtusely pointed below with moderate silvery pubescence; frons finely reticulate with moderately long outstanding pale hairs; gena a little more than half as wide as eye in profile, a little shining, very finely reticulate. Antenna (Fig. 53) with segment 3 a little longer than 4 + 5, 4 and 5 about 2.5 times as long as broad, 8 a little more than twice as long as broad, 12 cylindrical, tip rounded, well curved with very short hairs, about as long as 6, 10 and 11 rather strongly convex beneath, 4–9 with a shining line beneath. Mesosoma much as in ♀ but tomentum less dense. Fore and mid tarsi (Fig. 51) relatively short and broad, mid tarsus with segment 4 clearly transverse, segment 3 a little longer than broad. Hind femur with dense tomentum and a few white hairs beneath. Gaster as in ♀ but petiole rather less widened posteriorly.

**DISTRIBUTION** (42 ♀, 3 ♂). Senegal, Congo, Zambia, Kenya, Uganda, Malawi, Mozambique, Tanzania (including Zanzibar), South Africa (Natal).

A male from Tanzania: Mwanza, 18–19.i.1969 (*P. Gillissen, L. Blommers*) (ITZ, Amsterdam) has 2 ♀ strepsipterous puparia under tergite 3 left and tergite 5 right.

*Belonogaster pusilloides* sp. n.

(Fig. 54)

**FEMALE.** Head ferruginous; inner orbits below ocular sinus, sides and ventral margin of clypeus, pale yellow; ocellarium slightly darkened or blackish; antenna with dorsal side a little darkened. Mesosoma ferruginous, more or less blackened, especially mesoscutum and mesopleuron. Legs ferruginous, tarsi and mid and hind tibiae blackish, fifth tarsal segment red. Gaster black, segments 1–2 red. Wings brown, tips not darker, length 14.0–16.0 mm.

Clypeus acute below, finely reticulate with a few scattered punctures on lower half bearing fine black bristles. Frons dull, scarcely punctured with a few sparse outstanding black bristles. Gena nearly as broad as

eye in profile, finely reticulate, somewhat shining below with scattered fine punctures. Antenna with segment 3 about as long as 4 + 5 + 6, 4 and 5 slightly longer than broad, 8 slightly shorter. Thorax finely granulate, dull, not punctured, with close fine greyish white tomentum, pleuron with feeble punctures and similar tomentum. Propodeum feebly punctured with silvery tomentum and rather short outstanding pale hairs, posterior depression rather less than half as long as propodeum, impressed line distinct, anterior depression very small, transverse. Fore coxa with black hairs. Hind femur beneath with silvery pubescence and short oblique black bristles for its whole length; hind tibia with some oblique black bristles beneath; fore tarsus rather broad but fifth segment long (Fig. 54). Gastral petiole rather long and narrow, a little wider distally, spiracle little projecting, with fine tomentum and very few hairs; stalks of second gastral tergite 2.5 times as long as broad, gaster posteriorly with dense silvery tomentum and a few outstanding pale bristles.

**MALE.** Ferruginous; face below centre of ocular sinus (except a rather narrow brown central stripe), dorsal half of mandibles, antennal segments 1–2 and small spot beneath base of 3, light yellow. Antenna brown above (scape almost black), tip paler ferruginous; ocellarium black. Mesosoma ferruginous; mesoscutum black except sides opposite tegula. Legs ferruginous, mid and hind tibiae a little darker, tarsi black or blackish brown. Gaster ferruginous. wings rather dark red-brown, tips not darker, length 18.0 mm.

Clypeus below obtusely produced, regularly curved, projecting distinctly beyond lateral lobes, surface slightly shining, very finely reticulate with scattered large punctures bearing rather short fine black bristles, almost no tomentum. Frons dull, reticulate with numerous small punctures and outstanding black bristles. Gena about half as wide as eye in profile. Antenna with segment 3 about as long as 4 + 5, 4 and 5 2.5 times or rather more as long as broad, 8 rather more than twice as long as broad, 12 flattened, straight below, curved above, tip rounded truncate, practically no hairs, 10 with a slight rounded hump beneath, 11 cylindrical, 4–9 with a raised line beneath. Mesoscutum with moderately coarse rather sparse punctures, not very close tomentum, scattered rather short fine hairs, humeri rather less punctured with longer hairs, pleuron finely reticulate, closely punctured, very little tomentum; scutellum with no central line, it and metanotum confluent punctured. Propodeum coarsely punctate striate with long fine dark hairs which are not very dense, posterior depression rather less than half as long as propodeum, impressed line rather strong, anterior depression deep, rather large. Fore tarsus with last segment elongate. Fore and mid femur with short white pile beneath, hind femur with fine white tomentum and a few very short bristles. Gaster much as in female.

**Holotype** ♀, **Uganda**: top of escarpment, east of Batiaba, L. Albert, 3200 ft [980 m], 9–10.xii.1911 (*S. A. Neave*) (BMNH).

**Paratypes**. **Uganda**: 1 ♀, eastern Mbale district, S. of Mt Elgon, 3700–3900 ft [1130–1190 m], 2–5.viii.1911 (*S. A. Neave*); 2 ♀, Mbale-Kuni Rd, 3700 ft [1130 m], S. of L. Salisbury, 15–17.viii.1911 (*S. A. Neave*) (BMNH). **Kenya**: 1 ♀, Kisii district, S. of Kavirondo, 5000 ft [1520 m], 9–12.v.1911 (*S. A. Neave*); 1 ♂, Mgorr R., 1912 (*Capt. A. O. Luckman*); 1 ♀, Trans-Nzoia district, near Cherangani Hills, 40 miles [64 km] east of Mt Elgon, 6200 ft [1890 m], 3–5.ii.1925 (*C. R. S. Pitman*) (BMNH); 1 ♀, Kisumu, Victoria-Nyansa, 1904 (*Ch. Alluaud*) (MNHN, Paris). **Congo**: 1 ♀, bought from Deyrolle (MNHN, Paris). **South Africa**: 1 ♀, Natal, Lake St Lucia, False Bay, 13–17.ii.1967 (*D. Gillissen, L. Blommers*) (ITZ, Amsterdam).

### *Belonogaster macilenta* (F.)

(Figs 55–57)

*Vespa macilenta* Fabricius, 1781: 468. Holotype ♂, AFRICA AEQUINOCTIALI (BMNH, Banks coll.) [examined].

*Belonogaster macilentus* (Fabricius) Smith, 1857: 94.

*Belonogaster pusillus* Kohl, 1894: 320, 323, 325, pl. 15, figs 75, 77, pl. 16, fig. 116. Syntypes 3 ♂, 1 ♀, SIERRA LEONE (*Moquerys*) (IRSNB, Brussels, not found). **Syn. n.**

Fabricius' type is in bad condition. Antennal segment 12 is missing but segments 1–11 are present on the left. One set of legs is present on the left. The gaster is missing after segment 3. The antenna except the scape is not blackened above but the yellow spot on the second gastral tergite is characteristic. There is a narrow, narrowly interrupted yellow band with a dark dot in it on each side. This is a development of the more usual transverse comma-like mark with the tail of the comma spirally rolled so as to enclose a spot.

Kohl's description and figures allow his species to be identified in the absence of the type.

**FEMALE.** Ferruginous, vertex, mesoscutum, bases of gastral tergites 3–4 a little blackened; mid and hind tarsi black but segment 5 ferruginous. Dorsal half of mandibles, sides of clypeus, sometimes spot on malar space,

inner orbits, centre of pronotal collar and a narrow hind margin, inner margin of tegula, basicostal plate, axillae, front margin of scutellum, metanotum, valves and upper part of posterior depression of propodeum, ventral part of front margin of pronotum, posterior points of mesosternum and spot at mid coxal articulation, inner stripes on propleuron, stripes on fore and mid coxae, transverse comma-shaped mark on gastral tergite 2, preapical band on tergite 3, some or all whitish yellow. Wings pale yellow-brown, length 14.0–17.5 mm.

Clypeus acute below, finely granulate, lower part more shining with a moderate number of large punctures and oblique black bristles. Frons dull, granulate with a few outstanding white hairs. Gena (Fig. 55) nearly as wide as eye in profile, fine reticulate with quite numerous small punctures below. Antennal segment 3 nearly as long as 4 + 5 + 6, 4 and 5 as long or rather longer than 1.5 times as long as broad, 8 a little longer than broad. Mesoscutum dull, granulate with some small, indistinct punctures, tomentum appressed, strong and silvery; mesopleuron similar but punctures stronger; scutellum with an impressed line, it and metanotum granulate. Propodeum granulate, angles weakly punctate-striate, moderately numerous outstanding white hairs, posterior depression strong, one-third as long as propodeum, impressed line strong, anterior depression small but deep. Fifth segment of fore tarsus elongate; hind femora beneath with fine, not very dense tomentum and a few pale bristles. Gastral petiole moderately thick, a little widened at apex, with rather sparse tomentum but many white hairs beneath, spiracles little protruding; stalk of second gastral tergite about 3 times as long as broad, gaster with dense silvery tomentum with a few projecting pale bristles.

**MALE.** Head ferruginous, dorsal part of frons blackish; dorsal edge of mandible, sides of clypeus, inner orbits, white; antenna more or less blackish above, ferruginous below, segments 10–11 ferruginous. Mesosoma ferruginous, hind margin of pronotum, mesoscutum, blackish. Legs ferruginous, fore tarsus except segment 5 blackish, mid and hind tarsi black with segment 5 ferruginous. Gaster with segments 1–2 ferruginous, apex of 2 blackish with two transverse white comma-shaped spots, segments 3–4 black, 5–7 dark ferruginous. Wings yellow-brown, tips hardly darker, length 14.0–15.5 mm.

Clypeus (Fig. 57) ventrally very obtusely rounded, dull, granulate with silvery hairs, especially at sides. Frons dull, granulate with some outstanding pale hairs. Gena half as wide as eye in profile or rather less, finely reticulate with a few punctures below. Antenna (Fig. 56) with segment 3 about as long as 4 + 5, 4 and 5 about 2.5 times as long as broad or rather less, 8 rather less than 1.5 times as long as broad, 12 black above, pale ferruginous below without hairs, much flattened, oval but somewhat longitudinally curved, tip rounded, as long as 11, 8–11 somewhat convex beneath, 3–7 with a raised line beneath. Mesosoma granulate, unpunctured with close appressed silvery tomentum. Propodeum with some weak striae on sides below, moderately numerous black outstanding hairs, posterior depression one-quarter as long as propodeum, impressed line strong, anterior depression very small. Fore and mid tarsi very slightly widened, hind femora with pale tomentum and some short brown bristles beneath. Gastral petiole slender, not widened posteriorly, spiracles rather prominent, with close tomentum and some short hairs beneath. Stalk of second gastral tergite about 3 times as long as broad, gaster posteriorly with dense silvery tomentum but no protruding bristles.

**DISTRIBUTION** (35 ♀, 24 ♂). **Guinea-Bissau, Sierra Leone, Liberia, Ivory Coast, Ghana, Nigeria.**

### *Belonogaster principalis* sp. n.

**FEMALE.** Ferruginous; hind tarsi, apex of gastral tergite 2, tergites 3–4, a little darkened; tergite 2 with two large preapical transverse yellow spots. Wings light ferruginous, a little darker along the costa, tips if anything paler, length 18.0 mm.

Clypeus acute below, finely reticulate with scattered large punctures, lower half a little more shining with a moderate number of brown or blackish not very long bristles, dorsal third with fine whitish tomentum. Frons finely reticulate with close moderately large punctures, it and occiput with moderately long, outstanding fine black bristles and sparse pale tomentum. Gena about as wide as eye in profile, shining, very finely reticulate with scattered small punctures. Antennal segment 3 very little shorter than 4 + 5 + 6, 4 and 5 very little longer than broad, 8 quadrate. Whole thorax with rather numerous rather fine punctures, with sparse, very fine, whitish tomentum and numerous short outstanding hairs which are black dorsally and pale on sides. Scutellum with no central line. Propodeum with close larger punctures, more or less punctate-striate on angles with close pale tomentum and numerous moderately long outstanding black hairs, posterior depression about one-third as long as propodeum, sides strongly raised, impressed line moderately strong to mid-point, anterior depression small, transverse, only centrally deep. Fore tarsus with fifth segment elongate; mid and hind femora with fairly numerous outstanding black hairs and very fine pale tomentum beneath; mid and hind tibiae with fairly numerous short black oblique bristles. Fore coxa with long black

hairs beneath, mid and hind coxae with short pale hairs. Gastral petiole rather long and narrow, shining with very little tomentum but quite numerous pale outstanding hairs, apex a little broader than base, spiracles strongly protruding; stalk of second gastral tergite about 3 times as long as broad; gaster posteriorly with rather dense pale tomentum and a few outstanding pale bristles.

MALE. Not seen.

Holotype ♀, **Guinea-Bissau**: Príncipe I., between Roca Esperanza and Roca Sundi, 22.ix.1949 (G. R. Gradwell & D. Snow) (BMNH).

*Belonogaster jordani* sp. n.

FEMALE. Head dark ferruginous, frons somewhat blackened, antennae ferruginous. Mesosoma entirely dull, coal-black. Legs black, tibiae and tarsi light ferruginous, tarsi dark annulated. Gaster black, segments 1-2 and 5-6 red, 2 with two small round yellow spots. Wings brown, tips darker, length 16.0 mm.

Clypeus acute below, dull, finely reticulate with quite close large punctures over most of the surface with stout oblique black bristles. Frons dull with very weak punctures and rather long outstanding black hairs and little tomentum. Gena about as wide as eye in profile, finely reticulate with weak, fine but quite numerous punctures. Base of stipes and prementum with a number of rather short brown bristles. Antennal segment 3 about as long as 4 + 5 + 6, 4 and 5 slightly longer than broad, 8 quadrate. Mesoscutum and humeri dull, coarsely reticulate with numerous rather weak punctures, not very close greyish tomentum and outstanding moderately long black hairs. Mesopleuron similar but punctures rather more distinct. Scutellum with no central line. Propodeum rather more shining, punctate-striate with dense long black hairs, posterior depression one-third as long as propodeum, impressed line strong, anterior depression small, very transverse, deep. Fore tarsus with fifth segment elongate. Mid and hind femur with numerous moderately long black bristles beneath. Gastral petiole moderately long, narrow, very little widened posteriorly, spiracles strongly protruding; stalk of second gastral tergite 2.5 times as long as broad; gaster posteriorly with moderately dense greyish tomentum with a few outstanding black bristles.

MALE. Not seen.

Holotype ♀, **Angola**: Quirimbo, v.1934 (K. Jordan) (BMNH).

I have seen two forms which are close to this species but apparently not quite the same. (1) ?Kenya: 2 ♀, Ukambani coast, xi-xii.1888 (F. J. Jackson) (BMNH). Larger, wing length 22.0 mm. Mesosoma less black, humeri more distinctly punctured. Legs more red; yellow spot of gastral tergite 2 larger, comma-shaped. (2) Mozambique 1 ♀, 'bassin inférieur du Zambèze, vallée du Muza', 32°E, 18°S (Grassé) (MNHN, Paris), placed under *B. filiventris*.

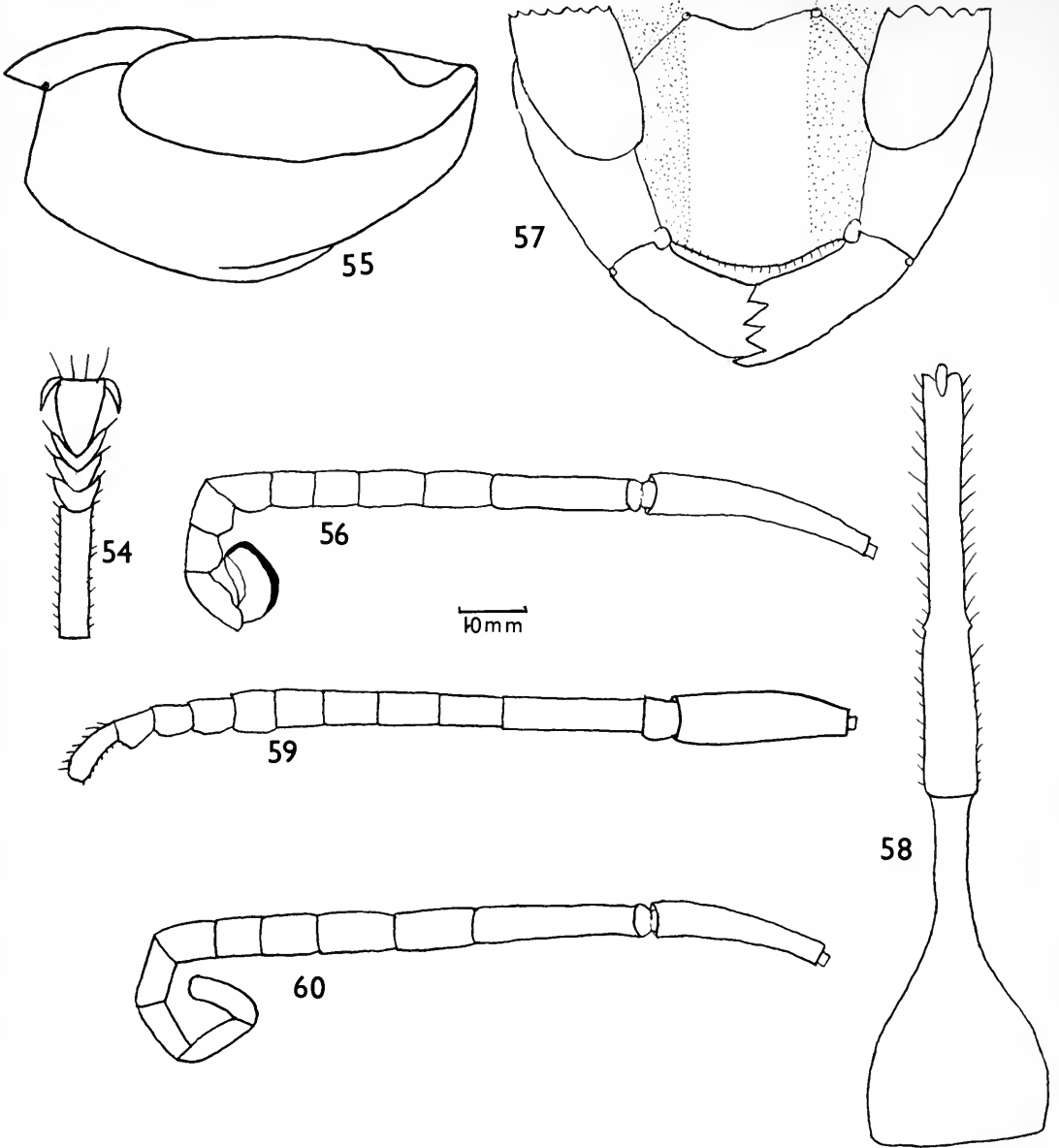
*Belonogaster punctilla* sp. n.

FEMALE. Head ferruginous; area between antennal sockets, frons and vertex, greater part of gena and head beneath, black; antenna except segments 1-2, black. Mesosoma and legs black. Gaster black, segment 1 and stalk of segment 2 dark ferruginous. Wings blackish brown with slight purplish reflections, length 16.5 mm.

Clypeus strongly acute below, very finely reticulate with scattered large punctures; frons with close, moderately strong punctures and outstanding black bristles, very little tomentum; gena about two-thirds as wide as eye in profile, very finely reticulate with numerous punctures. Antennal segment 3 as long as 4 + 5 + 6, 4 and 5 a little longer than broad, 8 not quite as long as broad. Mesoscutum and humeri with numerous deep, quite large punctures, finely granulate but surface much hidden by close silvery tomentum, no outstanding hairs or bristles; mesopleuron with sparser, rather finer punctures, tomentum similar. Scutellum and metanotum closely and coarsely punctured. Propodeum coarsely, not very closely punctured, angles and posterior surface strongly striate with silvery tomentum and short sparse outstanding black bristles; posterior depression not quite half as long as propodeum, impressed line very weak, anterior depression small but deep. Fifth segment of fore tarsi rather short, other tarsi elongate; mid and hind femora with short not very close black and white bristles beneath on proximal part. Gastral petiole moderately long and narrow, a little wider distally, numerous hairs beneath, spiracles not protruding; stalk of second gastral sternite 2.5 times as long as broad; gaster posteriorly with close silvery tomentum and some projecting silvery bristles.

MALE. Not seen.

Holotype ♀, Uganda: Mpanga forest, Toro, 4800 ft [1460 m], 13–23.xi.1911 (S. A. Neave) (BMNH).  
Paratype. 1 ♀ with same data.



Figs 54–60 *Belonogaster*. 54, *B. pusilloides* sp. n., ♀, fore tarsus. 55–57, *B. macilenta* (F.). (55) ♀, left gena; (56) ♂, left antenna; (57) ♂, clypeus. 58, *B. punctata* sp. n., ♂, gastral tergites 1–2. 59, *B. rothkirchi* von Schulthess, ♂, left antenna. 60, *B. leonhardii* du Buysson, ♂, left antenna.

*Belonogaster punctata* sp. n.

MALE. Head ferruginous; frons, vertex and underside black; antennae black above except segments 10–12; spot between antennal sockets, inner orbits to near top of sinus, broad sides of clypeus, mandibles, creamy white. Mesosoma black, ventral corner of pronotum, margins of scutellum and metanotum, mesosternum, bottom of metapleuron, most of propodeum, light ferruginous. Legs ferruginous, four hind tibiae and all



tarsi black; fore and mid coxa beneath, anterior stripes on all femora, yellow. Petiole and stalk of second gastral tergite ferruginous, petiole above darker distally, tergite 2 blackish ferruginous, rest of gaster black, sternites ferruginous suffused. Wings brownish, venation red-brown, length 19.5 mm.

Clypeus only a little produced below to just beyond the lateral lobes, tip just rounded, sides of clypeus with quite dense silvery tomentum, whole surface with scattered punctures and outstanding black bristles. Frons rather strongly punctured with a central patch of silvery tomentum and dense rather long black bristles. Gena half as wide as eye, finely reticulate with some large punctures below. Antenna with segment 3 a little longer than 4 + 5, 4 and 5 about 2.5 times as long as broad, 8 about 2.25 times as long as broad, 12 distinctly flattened, ventral side straight, dorsal side a little curved, end rounded truncate, a little darkened, not quite as long as 11, 9–11 with slight raised lines beneath but real prominences, 5–8 with slight raised lines beneath. Mesoscutum and humeri with close coarse punctures and dense hair-like silvery tomentum; mesopleuron with close coarse punctures but sparser tomentum; scutellum and metanotum closely punctured. Propodeum with sides coarsely punctured, angles and posterior surface coarsely striate with long, outstanding silvery hairs, posterior depression one-quarter as long as propodeum, impressed line strong, anterior depression small and shallow. Last segment of fore tarsus elongate; mid and hind femora with rather long outstanding white and black bristles, especially near base. Gastral petiole (Fig. 58) long and narrow, a little widened posteriorly, with many long hairs, spiracles scarcely protruding; stalk of second gastral tergite 4.5 times as long as broad, rest of gaster with dense fine silvery brown tomentum and some silvery bristles.

FEMALE. Not seen.

Holotype ♂, Cameroun: Kumba, 7.x.1949 (*H. Oldroyd*) (BMNH).

This species is very like the preceding one, but the stalk of the second gastral tergite is very much longer and the localities are far apart.

### *Belonogaster rothkirchi* von Schulthess

(Fig. 59)

*Belonogaster rothkirchi* von Schulthess, 1914: 4. LECTOTYPE ♂, CAMEROUN: Kamerunberg, Soppo, xi.1912 (*von Rothkirch*) (EI, Zürich), here designated [examined].

MALE. Ferruginous, legs and gastral segments 2–7 a little darkened. Mandibles, clypeus, inner orbits above, streak beneath scape, apparently streaks on femora, two large suboval almost contiguous spots on gastral tergite 2, yellow. Wings hyaline, venation ferruginous, length 17.0 mm.

Mandibles almost parallel-sided, little widened to apex, shining. Clypeus very obtuse-angularly projecting below, tip just rounded, slightly convex, especially transversely, with scattered fine punctures bearing fine black bristles, dense outstanding silvery hairs in a broad band on each side. Frons dull, finely reticulate with rather sparse moderate-sized punctures and outstanding black bristles which are also on the vertex, and dense long silvery tomentum. Gena rather less than half as wide as eye in profile with dense silvery, hair-like tomentum. Antenna (Fig. 59) with segment 3 a little longer than 4 + 5, 4 and 5 about 2.5 times as long as broad, 8 rather less than twice as long as broad, segment 12 distinctly flattened, gently curved, rather more so above, tip rounded, a row of minute hairs on dorsal side, segment about as long as 7, 11 a little longer than 8, 9–10 a little shorter, 8–11 with a strongly protruding keel beneath, 6–7 with weak keels. Humeri and mesoscutum moderately shining, feebly granulate with no distinct punctures, not very dense hair-like silvery tomentum and some longer black hairs; scutellum with no central line, it and metapleuron like mesoscutum; mesopleuron rather shining, finely reticulate with some fine punctures; propodeum hardly punctured but with distinct striae, especially posteriorly, moderately shining with outstanding black hairs and silvery brownish tomentum; posterior depression one-third as long as propodeum, impressed line weak to mid-point, anterior depression very weak. Last segment of fore tarsus a little shortened. Mid and hind femora with moderately dense tomentum beneath and some short black bristles, especially near base. Gastral petiole moderately long, thin to the moderately projecting spiracles, beyond them distinctly widened; stalk of second tergite 4.5 times as long as broad; posterior tergites with fine, not very dense brown tomentum, no protruding bristles.

FEMALE. Not seen.

DISTRIBUTION. Cameroun: only the lectotype ♂ and paralectotype ♂ are known.

*Belonogaster libera* sp. n.

MALE. Head dark ferruginous, dorsally darker (almost black); mandibles white with pitchy margins; clypeus white with a broad central brown stripe; antennal segments 1–7 blackish above, ferruginous beneath, 8–11 gradually rather paler, 12 with distal three-quarters shining black. Mesosoma blackish, legs dark ferruginous. Gaster with segments 1–2 ferruginous, 3 blackish, 4–6 dark ferruginous, 7 pale ferruginous. Gastral tergite 2 with two large subtriangular pale yellow spots, almost meeting along mid line, tergite 3 with two narrow transverse yellow spots. Wings brown, length 15.0 mm.

Mandibles parallel-sided, 4 apical teeth, dorsal one very short. Clypeus very little produced beneath, gently rounded from side to side, surface feebly transversely convex, hardly depressed at apex, with dense rather long white hairs, surface dull, finely granulate. Frons dull, not punctured, finely granulate with a few outstanding black hairs. Gena two-thirds as wide as eye in profile, antenna with segments 2 + 3 as long as scape, 3 thin, very elongate, a little longer than 4 + 5, 4 and 5 2.5 times as long as broad, 8 rather more than 1.5 times, 11 long, narrow cylindrical, about as long as 5, 12 long oval, slightly flattened, apex narrowly rounded, 8–10 with raised flattened low projections beneath, 6–7 with feeble lines beneath. Thorax dull, weakly granulate, not punctured with dense grey tomentum; propodeum dull, granulate with dense silvery grey hairs and some upright hairs at sides, posterior depression about one-quarter as long as propodeum, impressed line strong, almost complete, anterior depression small, indistinct. Last segment of fore tarsus hardly shortened, fore and mid tarsi not widened; hind femur with pale tomentum but no bristles beneath. Gastral petiole long and slender, little widened behind, spiracles strongly projecting, moderately shining, hairs short and moderately dense; stalk of second tergite 4 times as long as broad; gaster posteriorly with dense silvery pubescence and some fine black hairs.

FEMALE. Not seen.

Holotype ♂, Liberia: Robertsport, iii.1890 (*A. F. Derner*) (RNH, Leiden).

*Belonogaster fuscipennis* du Buysson stat. n.

*Belonogaster griseus* (F.) var. *fuscipennis* du Buysson, 1909: 251, 264. LECTOTYPE ♀, Congo: Haute Sangha, 1900 (*P. A. Ferrière*) (MNHN, Paris), here designated [examined].

The series of wasps in MNHN, Paris under the name *griseus* var. *fuscipennis* included in my opinion five distinct species—the one described below, *B. pennata*, a species near *B. saeva*, a rather dark-winged form of *B. grisea* and *B. juncea colonialis*. None of the specimens was labelled type so I designate one of four females labelled with the variety name *fuscipennis* by du Buysson and coming from Haute Sangha, 1900 (*P. A. Ferrière*). This is the first locality given in the description.

FEMALE. Head including antennae ferruginous. Mesosoma ferruginous, mesoscutum, humeri, most of pleuron, dorsal part of propodeum more or less darkened. Legs ferruginous, mid and hind tibiae somewhat darkened, tarsi also rather darker, but last segment usually red. Gaster black, petiole and basal part of tergite 2 ferruginous, tergite 2 with two large irregularly triangular yellow spots, sternite 2 with two subapical yellow dots. Forewings dark fuscous with purplish reflections, venation very dark red-brown, hind wings paler, length 17.0–23.5 mm.

Clypeus acute below, with scattered large punctures on lower third, upper part very finely granulate with sparse pale tomentum and few punctures; frons dull, finely reticulate with some rather fine punctures and not very close outstanding pale bristles; gena not quite as wide as eye in profile, finely reticulate but rather shining below with numerous small punctures; antennal segment 3 about as long as 4 + 5 + 6, 4 and 5 less than 1.5 times as long as broad, 8 quadrate. Mesoscutum finely granulate with indistinct punctures, mainly at sides, with not very dense silvery tomentum, humeri very similar but with less tomentum except on hind margin and punctures rather more obvious; mesopleuron with punctures stronger, tomentum sparser; propodeum granulate and tomentose with rather strong punctures, more punctate-striate on angles with sparse outstanding dark hairs, posterior depression half as long as propodeum, impression strong but only within the depression, anterior depression small but deep. Last segment of fore tarsus elongate, hind femur with white tomentum beneath and a few short outstanding pale bristles. Gastral petiole rather long and narrow, little widened posteriorly, with sparse tomentum and short outstanding bristles, spiracles little projecting; stalk of second gastral tergite 2.0–2.5 times as long as broad, usually nearer 2.5, gaster posteriorly with moderately close pale tomentum and some obliquely projecting pale bristles.

MALE. Not seen.

**DISTRIBUTION.** Congo: lectotype ♂, 3 ♀ (paralectotypes), Haute Sangha, 1900 (*P. A. Ferrière*) (MNHN, Paris); 1 ♀, same place and collector, 1897 (MNHN, Paris). Sudan: 9 ♀, Kordofan, Nuba Mts, Beiban, i.1922 (*Capt. F. Moysey*) (BMNH); 1 ♀, Kordofan, Talodi, xii.1967 (*J. Cloudsley-Thompson*) (BMNH); 1 ♀, Darfur, Niurnnya, 13.ii.1921; 5 ♀, 28.ii.1921 (*Admiral H. Hynes*) (BMNH); 4 ♀, El Fasher, 8000 ft [2440 m], 22.iii., 6.iv., 9.iv., 16.iv. (*H. Hynes*) (BMNH); 2 ♀, W. Darfur, Jebel Murra, Karanga, 6600 ft [2010 m], 20.iv.1932; 4 ♀, 18.iv.1932 (*Miss M. Steele*) (BMNH); 6 ♀, Jebel Murra, Derita Lakes, 8000 ft [2440 m], 27.iv.1932 (*Miss M. Steele*) (BMNH).

*Belonogaster leonhardii* du Buysson

(Figs 60, 61)

*Belonogaster leonhardii* du Buysson, 1909: 252. Holotype ♀, UGANDA: Iraouer, 1909 (*von Leonhardi & L. V. Heyden*) (MNHN, Paris) [examined].

*Belonogaster leonhardi*: Benoit, 1956: 553. [Mis-spelling.]

**FEMALE.** Head ferruginous, mandibles, dorsal triangular area on clypeus, subantennal area, frons, vertex and antennae, top of gena, much of head beneath, black. Mesosoma, legs, black. Gaster black, petiole and base of stalk of second gastral tergite, ferruginous. Wings grey, costal region browner, length 16.5–21.5 mm.

Clypeus acute below, very finely reticulate, lower half more shining with many large punctures which are closer on upper half, many short black suberect bristles, dorsal half with close silvery tomentum. Frons closely punctured with many outstanding black bristles and close silvery tomentum. Gena as wide as eye in profile, finely reticulate with many small punctures and dorsally with hairs. Base of submentum and stipes with a tuft of fine hairs. Antenna with segment 3 distinctly longer than 4 + 5, 4 and 5 about 1.5 times as long as broad, 8 a little longer than broad. Mesoscutum and humeri with dense brassy tomentum hiding the surface, a number of fine punctures indicated by fine black outstanding hairs; mesopleuron, scutellum and metanotum similar, scutellum anteriorly with a small, raised central line. Propodeum with dense brassy tomentum with fine punctures where mainly pale hairs arise, posterior depression one-third as long as propodeum, impressed line to mid point, anterior depression small but deep. Last segment of fore tarsi hardly shortened; femora beneath with fine tomentum but no bristles. Gastral petiole stout, rather short, regularly widened to apex, spiracles not projecting, hairs short; stalk of second gastral tergite 2.5 times as long as broad, thyridium on each side of posterior end of stalk large and deep; posterior part of gaster with dense brassy tomentum concealing the surface.

**MALE.** Black; upper two-thirds of mandibles, clypeus and lower face except a narrow central stripe, spot between antennal sockets, scape beneath, yellow; anterior spot at base of hind femora anteriorly, yellow. Gastral petiole dark ferruginous. Wings brown, tips darker, length 21.0 mm.

Mesosoma, gaster except petiole and stalk of gastral tergite 2, with dense brassy tomentum. Clypeus (Fig. 61) moderately angularly produced below, shining with scattered punctures bearing black bristles, very little tomentum. Frons with moderately numerous medium-sized punctures and outstanding black hairs. Gena half as wide as eye in profile. Antennal (Fig. 60) segment 3 as long as 4 + 5, 4 and 5 about 2.5 times as long as broad, 8 rather less than twice as long as broad, 12 a little flattened, underside straight, upperside moderately curved, end rounded, about as long as 11, 10 and 11 not appreciably convex beneath, 4–11 with a weak raised line beneath. Mesoscutum with a few punctures, nearly hidden by tomentum, mesopleuron slightly more clearly punctate; propodeum punctate-striate but sculpture nearly hidden by the tomentum, with numerous outstanding black hairs, depressions as in ♀. Last segment of fore tarsi hardly shortened; hind femur beneath with tomentum and a few fine bristles. Gastral petiole as in ♀, stalk of second gastral tergite about 1.5 times as long as broad.

**DISTRIBUTION** (19 ♀, 2 ♂). Uganda (on slopes of Mt Ruwenzori, 4000–8000 ft [1220–2440 m], Burundi (Benoit, 1956: 552), Zaire (Benoit, 1956: 552).

There is a ♀ specimen in the BMNH labelled 'Tanganyika T., Bukavu, 19.vii.31 (*J. Ogilvie*)' but Bukavu is in Zaire.

*Belonogaster grisea* (F.)

(Fig. 62)

*Vespa grisea* Fabricius, 1775: 372. Holotype ♀, SIERRA LEONE (BMNH, Banks coll.) [examined].

[? *Raphigaster rufipennis* (Degeer); de Saussure, 1853: 15, pl. 2, fig. 6. Misidentification.]

[? *Belonogaster fulvipennis*: de Saussure, 1891: fig. 1. Mis-spelling of *rufipennis*. Misidentification.]

- Belonogaster pictus* Kohl, 1894: 320, 323, 324, pl. 16, fig. 118. LECTOTYPE ♀, CAMEROUN: 25.iii.1892 (NM, Vienna), here designated [examined].
- ? *Belonogaster braunsii* Kohl, 1894: 331. Syntype(s) ♀, SOUTH AFRICA: Durban (Port Natal) (depository unknown).
- Belonogaster griseus* var. *pallens* du Buysson, 1909: 250, 265. LECTOTYPE ♀, CONGO: Libreville, 1909 (C. Chalot) (MNHN, Paris), here designated [examined].
- ? *Belonogaster erythrospilus* Cameron, 1910: 172. LECTOTYPE ♀, TANZANIA: Meru, 25.xi.1905 (Y. Sjöstedt) (NR, Stockholm), here designated [examined].

There are 2 ♀ labelled *B. pictus* by Kohl in NM, Vienna; I have labelled one from Cameroun as lectotype. I have not been able to find a specimen labelled *B. braunsii* Kohl in NM, Vienna or elsewhere. Under the name *B. griseus* var. *pallens* de Buysson in MNHN, Paris is a long series of wasps belonging to *B. brunnescens* and to a rather pale form of *B. grisea*. One of the latter from Congo: Libreville is here designated the lectotype. The position of *B. erythrospilus* is still uncertain. There are two syntypes ♂ ♀ in NR, Stockholm and 2 ♀ syntypes in BMNH. The male from Tanzania: Meru is here made lectotype and the form is discussed below. The species *grisea* as a whole is very variable and it is likely that studies of populations in the field will recognize further taxa.

I have seen 4 specimens of *B. erythrospilus*, the ♂ lectotype and three females (one RM, Stockholm, two BMNH). They all come from approximately the same place:— Tanzania: Meru, lower region, Ngare na nyuki, xii., i., ii. They also look very similar.

The male has the antenna very similar to that of *B. grisea* but rather shorter. The clypeus is somewhat less acute below and there are no pale stripes at the sides. The ocellarium is black. There seem to be a few outstanding hairs on the humeri and mesoscutum and there are many short, black outstanding hairs on the propodeum. The stalk of the second gastral tergite is about 1.5 times as long as broad and there seem to be a few black bristles protruding on the posterior tergites, though it is difficult to be sure in a dirty specimen. The females are very like some specimens of *B. grisea* but the propodeum has quite numerous outstanding dark brown hairs. The stalk of the second gastral tergite is about twice as long as broad. The specimens are on the small side, wing-length 18.0–20.0 mm.

It seems best at the moment to treat these as a form of *B. grisea*.

**FEMALE.** Head ferruginous, ocellarium and dorsal side of antenna often more or less darkened. Mesosoma ferruginous, humeri and mesoscutum usually more or less darkened, posterior half of mesopleuron often somewhat darkened. Legs ferruginous, tibiae and less often the femora often more or less darkened, tarsi usually blackish. Gaster blackish, petiole and anterior half of tergite 2 more or less ferruginous. Ventral quarter of clypeus rarely a little yellow-tinged. Second, third and fourth gastral tergites sometimes with a pair of yellow spots, especially in West African specimens (like the holotype); in 330 females, 11.8% had 6 spots, 1.5% 4, 21.5% 2 and 65.2% none. Gastral sternite 2 also sometimes with two small yellow spots. Wings almost hyaline to light brownish or even exceptionally dark brown with tips more or less distinctly darkened, length 15.5–25.5 mm, usually 18.0–22.0 mm.

Clypeus acute below, with sparse relatively large punctures and a few outstanding black bristles, dorsal part with dense white tomentum; frons with not very close small punctures and short outstanding white and black hairs and silvery tomentum; gena rather more than half as wide as eye in profile, very finely reticulate with numerous small punctures, especially below; base of submentum and stipes with very few bristles; antennal segment 3 distinctly longer than 4 + 5, 4 and 5 just longer than broad, 8 about quadrate. Humeri and sides of mesoscutum with small inconspicuous punctures almost hidden by the dense appressed silvery tomentum, scutellum and metanotum more strongly punctured, the former with weak central impressed line; punctures of mesopleuron distinct and not hidden by the tomentum; propodeum punctate-striate with dense appressed silvery hairs and some short pale outstanding hairs, posterior depression rather less than half as long as propodeum, impressed line rather weak, anterior depression small but deep. Last segment of fore tarsus elongate; hind femora with white tomentum beneath and sometimes a few short black or white bristles. Gaster with petiole relatively long and narrow, a little widened posteriorly, spiracles little projecting, surface with a little white tomentum and some short outstanding bristles; second gastral tergite with the stalk 1.5–3.5 times as long as wide, usually 2.5–3.0 times, gaster posteriorly with close silvery tomentum and no protruding black bristles or a very few at extreme sides.

**MALE.** Head ferruginous, ocellarium hardly darkened, antennal segments 1–7 darkened above. Dorsal half of mandibles, sides of clypeus, inner orbits, sometimes spot between antennal sockets, creamy white; scape

beneath yellow. Mesosoma ferruginous, mesoscutum usually blackish, legs ferruginous, fore femur sometimes with a yellow stripe beneath, tibiae and tarsi more or less blackened. Gaster black, petiole, stalk and some of the anterior part of tergite 2, ferruginous, tergites 2-4 sometimes each with two yellow spots, especially in West Africa (proportions with 0, 2, 4 and 6 spots much as in ♀). Wings more or less brownish with darker tips, length 16.5-22.0 mm.

Mandibles parallel-sided, clypeus acute below with scattered shallow punctures, sides with outstanding silvery pubescence, disk with shorter silvery hairs; frons dull, hardly punctured, with sparse outstanding brown hairs and some silvery pubescence; gena half as wide as eye, finely reticulate, hardly punctured; base of stipes and submentum with few black bristles. Antenna (Fig. 62) with segment 3 as long as 4 + 5, segment 4 3.5 times, 5 nearly 3 times as long as broad, 8 twice as long as broad, 12 curved, considerably flattened, end rounded, about as long as 11 which is flattened, nearly parallel-sided, lower edge a little raised and shining, 10 nearly straight and cylindrical but with a well-marked hump beneath, 9 a little humped, 5-8 with weak raised lines beneath. Mesosoma as in the ♀ but even less clearly punctured. Legs as in ♀. Gaster as in ♀ apart from the additional segment.

**DISTRIBUTION** (675 ♀, 101 ♂). **Sudan, Chad, Central African Republic, Senegal, Guinea-Bissau, Guinea, Sierra Leone, Liberia, Ghana, Nigeria, Cameroun, Gabon, Fernando Po, Congo, Zaire, Rwanda** (Benoit, 1956: 552), **Burundi** (Benoit, 1956: 552), **Angola, Zimbabwe, Zambia, Uganda, Kenya, Malawi, Mozambique, Tanzania** (including Zanzibar), **South Africa** (Transvaal, Natal, Cape of Good Hope), **Botswana, Swaziland.**

**England:** 1 ♂, Sunderland, in shop in bananas, 24.ii.1950 (? from West Africa).

2 ♂ and 4 ♀ strepsipterous puparia have been seen, one beneath gastral tergite 3 of females, others beneath tergite 4, from Nigeria, Congo, Uganda, Malawi and Tanzania.

### *Belonogaster neavei* sp. n.

**MALE.** Head ferruginous; ocellarium and antennal segments 1-3 above, blackish; greater dorsal part of mandibles, broad sides of clypeus, inner orbits to middle of ocular sinus, spot between antennal sockets, scape beneath, yellow or creamy. Mesosoma ferruginous, mesoscutum, posterior part of humeri, black; posterior margin of mesopleuron and much of propodeum somewhat darkened. Legs ferruginous; fore tarsus except central stripe of last segment, mid and hind tarsi, black; much of underside of propleuron, fore coxae, ventral stripe of fore femur, much of underside of mid coxa and anteroventral stripe of mid femur, yellow. Gaster black, petiole and most of anterior part of tergite 2, ferruginous with a small round yellow spot on each side of tergite 2. Wings reddish brown, tips fuscous, length 19.0 mm.

Clypeus pointed below but at an angle of about 120°, sides with silvery tomentum, disk and to less extent sides with fine outstanding black hairs. Frons dull, practically not punctured with long, fine outstanding dark hairs. Gena a little less than half as wide as eye in profile, rather shining, very indistinctly punctured. Base of submentum and stipes with a few long, fine dark hairs. Antennal segment 3 not quite as long as 4 + 5, 4 nearly 3 times, 5 2.5 times as long as broad, 8 twice as long as broad, 12 moderately flattened, inner side shining, dorsal edge curved, ventral edge straight, tip just pointed, a little shorter than in *B. grisea*, 9-11 with strong shining humps beneath, 10, 11 and 12 of about equal length, 5-8 with shining raised lines beneath. Whole mesosoma with dense silvery tomentum; mesoscutum, scutellum and metanotum with outstanding greyish hairs; mesoscutum with indistinct fine punctures, mesopleuron similar but punctures more distinct behind, scutellum and metanotum with stronger, closer punctures; propodeum with quite close outstanding rather long black hairs, with rather close, shallow punctures not striate, posterior depression one-third as long as propodeum, impressed line strong, anterior depression small but deep. Mesosternum in front of mid coxae with numerous long black hairs almost forming a tuft. Last segment of fore tarsus elongate; mid basitarsus shorter than in *B. grisea*; mid and hind femora beneath with silvery tomentum, hind tibiae and tarsi with some short, appressed black bristles. Gastral petiole long, little widened behind, spiracles little protruding, shining with some moderately long, black hairs; stalk of second gastral tergite nearly 3 times as long as broad, gaster posteriorly with dense silvery tomentum and some obliquely protruding pale bristles.

**FEMALE.** Head ferruginous, antennal segments 3-11 darkened above. Mesosoma black, anterior part of pronotum, scutellum, metanotum, propodeum near valves, meso- and metasternum, coxae and femora ferruginous, tibiae and tarsi mainly black. Gaster with petiole, segment 2 except narrow apical part, ferruginous, rest black. Wings red-brown, tips dark, length 19.0 mm.

Clypeus finely reticulate with scattered moderately large punctures; frons dull, reticulate, with fairly close punctures with very short outstanding black hairs; gena nearly as wide as eye in profile, very finely reticulate and punctured; base of submentum and stipes with very few dark hairs; antennal segment 3 as long as

4 + 5 + 6, 4 and 5 just longer than broad, 8 quadrate. Mesoscutum dull, reticulate, not perceptibly punctured. Scutellum, metanotum and mesopleuron distinctly punctured; mesosoma with dense silvery grey tomentum tending to hide the sculpture; propodeum with punctures but on angles more striate, with close short, outstanding dark hairs and rather sparse tomentum, posterior depression one-third as long as propodeum, impressed line distinct, anterior depression very small and transverse. Last segment of fore tarsus elongate, hind femur with scattered very short black bristles beneath, tibia with fewer but shorter bristles. Gastral petiole narrow and elongate, little widened behind, spiracles moderately protruding, tomentum very fine, hairs quite numerous below; stalk of second gastral tergite 2.5 times as long as broad, gaster posteriorly with dense tomentum but no protruding bristles.

Holotype ♂, Kenya: Masongaleni, ca 38°2'E, 2°4'S, 3000 ft [915 m], 29.iii.-1.iv.1911 (S. A. Neave) (BMNH).

Paratypes. Kenya: 10 ♀, same data as holotype (BMNH); 1 ♀, Kibwezi, 3000 ft [915 m], 2-4.iv.1911 (S. A. Neave); 1 ♂, Mombasa, 2.i.1913 (R. C. Wroughton) (BMNH); 1 ♂, Lumbusa, 1906 (with no yellow stripes on femora) (*M. de Rothschild*); 1 ♀, Nairobi, 1916 (*M. de Rothschild*) (MNHN, Paris); 1 ♀, Menengai, 6600 ft [2010 m], 7.v.1949 (R. A. Maas Geesteranus); 1 ♀, Teita distr., Wundangi, forest glades, 1400 m, 16-17.ix.1974 (R. de Jong) (RNH, Leiden). Zambia: 2 ♀, NW. of Kafue River, 23.viii.1913 (B. Russell) (UM, Oxford). Malawi: 1 ♂, Nkudsi Lake shore, 16.v.1970 (C. G. M. Schulten); 1 ♀, Limbe, 16.v.1968 (C. G. M. Schulten) (ITZ Amsterdam). Tanzania: 1 ♀, Lake Province, Old Shinyanga, 8.iv.1958 (O. W. Richards) (BMNH); 1 ♀, near Meru, 13 miles [21 km] N. of M'bagaris Village, 13.ii.1911 (BMNH); 4 ♀, Kilimandjaro (N. L. Abbott) (USNM). South Africa: 1 ♂, Transvaal, Soutpansberg, vii. (G. A. J. Rothney, ex H. Rolle) (UM, Oxford); 1 ♂, Kosmos, 18.ii.1974 (A. & T. Simon Thomas). (ITZ, Amsterdam).

The two specimens from Malawi both contained Strepsiptera. The one from Nkudsi had 3 ♂ puparia, 2 under the centre of tergite 4 and 1 under the centre of tergite 5; the one from Limbe had 2 ♂ empty puparia under the right of tergite 3 and under the left of tergite 4.

### *Belonogaster leonina* sp. n.

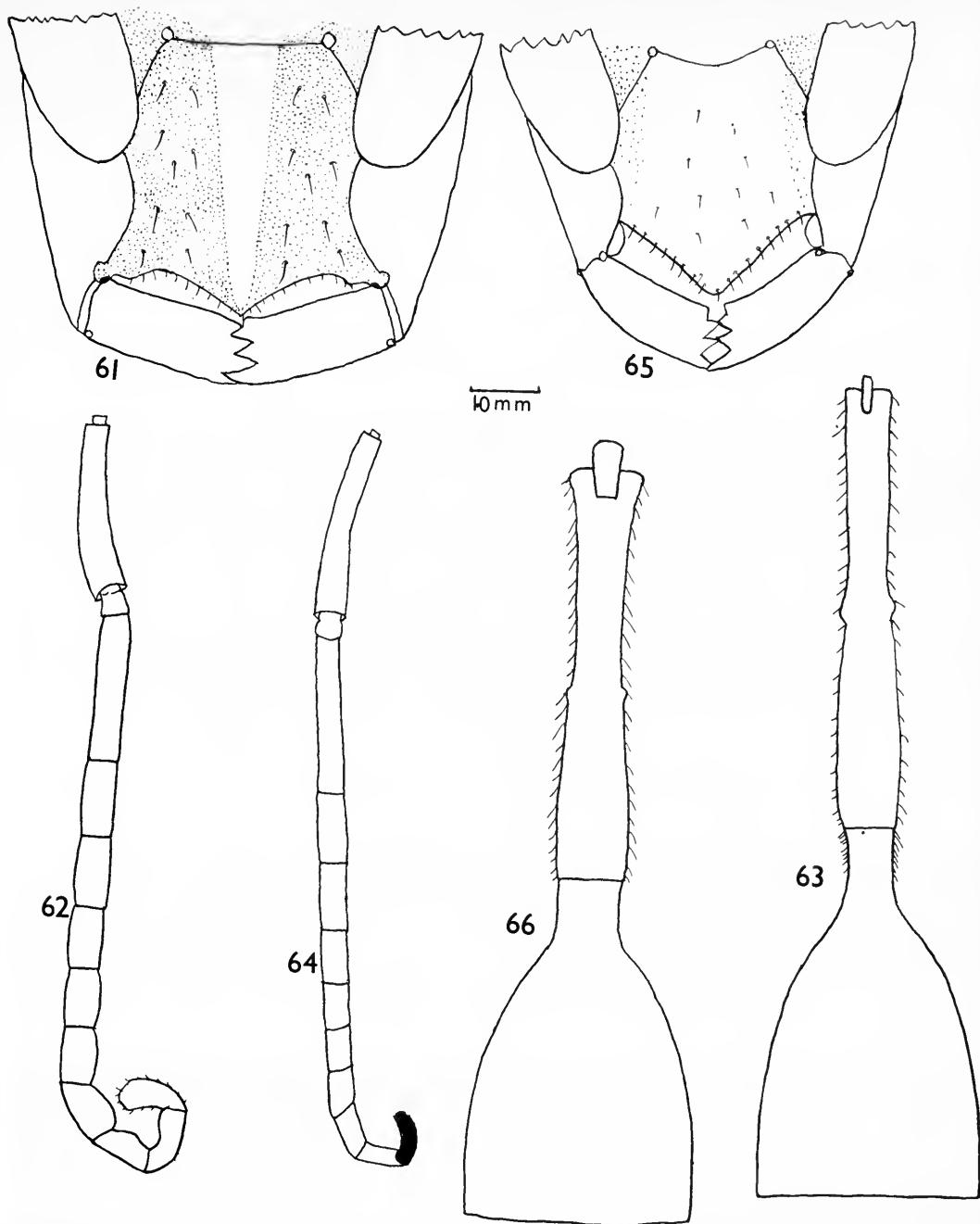
(Figs 63-65)

MALE. Head ferruginous; mandibles yellowish; sides of clypeus more or less, inner orbits, yellow; frons to just behind the ocelli black; antennal segments 3-8 usually blackish above, 10-11 yellowish brown (more ferruginous in the holotype), 12 shining, usually black, at least in greater part. Mesosoma dark ferruginous, mesoscutum more or less blackened. Legs ferruginous, tarsi more or less blackened, last segment and sometimes third and fourth more or less pale. Gastral petiole and basal part of segment 2 ferruginous, rest of gaster black. Wings light brown, tips not darkened, length 16.0 mm.

Clypeus (Fig. 65) not much produced below, projecting a little beyond the lateral lobes but centrally just obtusely pointed or just rounded, surface much flattened, coarsely reticulate without white tomentum and with very short dark bristles; frons dull, reticulate, not punctured with short outstanding black bristles; gena a little wider than eye, surface very finely reticulate, a little shining with a few fine punctures; base of submentum with dense group of short stout bristles; antennal (Fig. 64) segment 3 clearly longer than 4 + 5, 4 and 5 about 2.5 times as long as broad, 8 rather less than twice as long as broad, segment 12 rather short and flattened, shining, normally black, end rounded, dorsal edge slightly curved, ventral edge almost straight, 11 cylindrical, 10 slightly, 9 more strongly convex beneath, proximal segments without raised lines beneath. Mesoscutum and humeri granulate, scarcely punctured, tomentum brown, close but not conspicuous, no outstanding hairs; mesopleuron usually with rather more distinct punctures posteriorly; propodeum dull, granulate with traces of striae especially below, with moderately long black hairs, posterior depression one-third as long as propodeum, impressed line for two-thirds its length, anterior depression deep, fairly large. Last segment of fore tarsus elongate; mid and especially hind femora with black outstanding hairs beneath; hind tibia with a few black bristles beneath. Gastral petiole rather long and thin, with rather sparse hairs below, spiracles prominent, posterior part only slightly widened; stalk of second gastral segment 2.0-2.5 times as long as broad; gaster posteriorly with moderately dense greyish tomentum and a few protruding, hair-like black bristles.

FEMALE. Head ferruginous; frons black to just behind the ocelli; antennal segments 3-8 more or less blackened above. Mesosoma dark ferruginous, sometimes partly blackened, especially mesoscutum. Legs ferruginous, tarsi black, fifth segment ferruginous. Gaster black or blackish. Wings brown, tips not darkened, length 16.5-19.0 mm.

Clypeus acute below, greater part of surface dull and granulate, a few black bristles on lower quarter.



Figs 61–66 *Belonogaster*. 61, *B. leonhardii* du Buysson, ♂, clypeus. 62, *B. grisea* (F.), ♂, left antenna. 63–65, *B. leonina* sp. n. (63) ♀, gastral tergites 1–2; (64) ♂, left antenna; (65) ♂, clypeus. 66, *B. barbata* sp. n., ♀, gastral tergites 1–2.

Frons dull, granulate, hardly punctured with short, outstanding, black bristles. Gena about as wide as eye in profile, rather dull, finely reticulate with fine punctures especially below. Submentum with dense short black bristles at base. Antennal segment 3 distinctly longer than 4 + 5, 4 rather more than, 5 rather less than 1.5 times as long as broad, 8 a little longer than broad. Mesosoma as in the male but mesoscutum with some sparse outstanding short hairs. Legs as in male. Gastral petiole (Fig. 63) long and narrow, little widened



posteriorly, spiracles distinctly protruding, with silvery tomentum above and white hairs beneath; second gastral tergite (Fig. 63) with its stalk 2.0–2.5 times as long as broad, gaster posteriorly with rather dense silvery tomentum and a few protruding pale bristles.

Holotype ♂, **Sierra Leone**: Mattru, 8.x.1912 (*J. J. Simpson*) (BMNH).

Paratypes. **Congo**: 1 ♀, 4 ♂, Dimonika, 20.i.1977 (*Grillot & Morin*) (MNHN, Paris); 2 ♀, 21.i.1977 (*Grillot & Morin*); 4 ♀, 7 ♂, 28.i.1977 (*Grillot & Morin*); 1 ♀, 25.iii.1977 (*Grillot & Morin*); 1 ♀, 15.v.1977 (*Grillot & Morin*); 5 ♂, 16.v.1977, (*Grillot & Morin*); 4 ♀, 7 ♂, 18.v.1977, (*Grillot & Morin*); 16 ♀, 9 ♂, 18–30.i.1977, (*S. Kelner-Pillault*) (MNHN, Paris); 1 ♂, 1 ♀, 13.iv.1969 (*Grillot*); 2 ♂, 2 ♀, Piste de Drontia Pongga, 20.i.1977 (*S. Kelner-Pillault*); 1 ♂, Les Saras, Girard, 27.i.1977 (*Grillot & Morin*); 3 ♂, 2 ♀, Mataba, 22.i.1977 (*Grillot & Morin*); 1 ♂, Bouloungai, 17.v.1977 (*Grillot & Morin*); 2 ♂, Djoumonna, Yaka Yaka, 3.ii.1977 (*G. Morin*); 1 ♀, Foulakari, 8.i.1977 (*S. Kelner-Pillault*); 1 ♀, Masa, 6 i.1976 (*G. Onoré*); 1 ♀, Kintele, 15.i.1977 (*G. Onoré*); 1 ♀, N. Congo, route Odzala, Mbomo, 9.ii.1977 (*S. Kelner-Pillault*) (MNHN, Paris). **Gabon**: 4 ♂, 13 ♀, Mts de Cristal, Muni, 400 m, 15–31.x.1969 (*A. Villiers*); 1 ♂, Komo, Mts de Cristal, 1–15.x.1969 (*A. Villiers*) (MNHN, Paris). **Uganda**: 1 ♀, 3–4 miles [5–6 km] NE. of Entebbe, 3800 ft [1160 m], near Lake Sebogwavos, 12–13.ii.1912 (*C. A. Wiggins*); 1 ♀, about 3 miles [5 km] NNE. of Entebbe, 3800 ft [1160 m], 13.vi.1912 (*C. A. Wiggins*); 1 ♀, about 2 miles [3 km] ENE. of Entebbe, 3800 ft [1160 m], 21.vi.1912 (*C. A. Wiggins*) (UM, Oxford).

### *Belonogaster barbata* sp. n.

(Fig. 66)

**FEMALE.** Head ferruginous, frons black to just behind the ocelli, also a small oblique black spot behind each eye; antenna with scape ferruginous somewhat darkened dorsally, 2–11 black, somewhat ferruginous-blotched beneath. Mesosoma ferruginous, sides and central stripe of mesoscutum blackened. Legs ferruginous, tibiae and tarsi black. Gaster ferruginous, some darker blotches posteriorly. Wings dark reddish brown, length 19.5 mm.

Clypeus acute below, lower half with large punctures, distinctly convex, moderately dull; finely reticulate with close pale tomentum and numerous short black bristles all over; frons dull reticulate with rather numerous not very small punctures, short outstanding black bristles and rather close pale brown tomentum. Gena slightly wider than eye in profile, rather dull, finely reticulate with moderately numerous small punctures below. Antennal segment 3 clearly longer than 4 + 5, 4 1.5 times as long as broad, 5 shorter, 8 quadrate. Mesoscutum with no outstanding hairs or bristles, a few indistinct punctures at sides, with inconspicuous pale tomentum; humeri with numerous short black bristles arising from small punctures and close pale tomentum; mesopleuron reticulate, slightly shining, with numerous small punctures and slight tomentum; scutellum and metanotum with short outstanding black bristles; propodeum rather weakly punctate-striate with not very dense silvery tomentum and numerous depressed short black bristles, posterior depression about one-quarter as long as propodeum, impressed line to mid-point, anterior depression large and deep. Fifth segment of fore tarsus elongate; mid and especially hind femur with short black bristles beneath, especially near base; hind tibia with short oblique black bristles beneath especially towards apex. Gastral petiole (Fig. 66) rather short and stout, spiracles not very prominent, with numerous short recumbent black bristles above, more semirecumbent below; stalk of second gastral tergite 1.5 times as long as broad, gaster posteriorly with close pale tomentum and no protruding black bristles.

**MALE.** Not seen.

Holotype ♀, **Congo**: Voka, 19.xi.1975 (*G. Onoré*) (MNHN, Paris).

### *Belonogaster brevitarsus* sp. n.

(Figs 67, 68)

**MALE.** Head ferruginous, mandibles, sides of clypeus and inner orbits to near middle of ocular sinus, creamy white, frons a little darkened, antennal segments 1–8 darkened above. Mesosoma ferruginous, pronotum dorsally, mesoscutum and propodeum slightly, darkened. Legs ferruginous, mid and hind tarsi black. Gaster black, petiole and stalk of second tergite black. Wings light brown, length 16.5 mm.

Clypeus below rounded, very obtuse, surface with silvery hairs, especially at sides; frons with weak punctures and outstanding black hairs; gena about half as wide as eye in profile, finely granulate; submentum with a tuft of long black bristles at base; antennal segment 3 as long as 4 + 5, 4 and 5 a little more than twice as long as broad, 8 about 1.5 times as long as broad, segment 12 a little flattened, broadened to the



rounded apex, curved both dorsally and ventrally, underside from tip to mid point with a black line, 11 and 10 about as long as 5, 11 very strongly convex beneath, 10 beneath with a small but conspicuous knob, 9 with a small knob beneath, 4-8 with a raised line. Mesoscutum with large shallow punctures almost hidden by dense silvery tomentum and short outstanding black hairs; propodeum with angles weakly punctate-striate with appressed silvery hairs and long outstanding black hairs, posterior depression one-quarter as long as propodeum, no impressed line or anterior depression. Hind femur with dense outstanding white pile beneath, also scattered longer fine black bristles; hind tibia without dense long hairs beneath; fore tarsus widened, last segment short oval (Fig. 68); mid tarsus (Fig. 68) flattened and widened, segment 4 much broader than long. Gaster with petiole moderately slender, distinctly widened to apex, spiracles moderately protruding, numerous moderately long, oblique hairs; stalk of second gastral tergite 2.5-3.0 times as long as broad, gaster posteriorly with dense silvery tomentum and short protruding black bristles.

**FEMALE.** Head ferruginous, flagellum blackened above. Mesosoma ferruginous, mesoscutum and dorsal side of pronotum blackish. Legs ferruginous, tarsi and mid and hind tibiae black. Wings light brown, length 16.5 mm.

Clypeus acute below, finely reticulate, a little shining below where there are large punctures and short outstanding black bristles; frons with fine punctures and short outstanding black bristles; gena rather more than half as wide as eye in profile, granulate with scattered punctures; base of submentum with some short black bristles; antennal segment 3 as long as 4 + 5 + half 6, 4 just, 5 distinctly less than twice as long as broad, 8 quadrate. Mesoscutum granulate, often also punctured, with silvery tomentum; scutellum and metanotum indistinctly punctured; mesopleuron and propodeum inconspicuously punctured, propodeum with weak striae on the angles and moderately long outstanding black hairs, posterior depression one-third as long as propodeum, impressed line weak, anterior depression very weak. Last segment of fore tarsus (Fig. 67) distinctly short; hind femur with moderately numerous black bristles beneath. Gaster with petiole slender, little widened posteriorly, spiracles rather prominent, short silvery appressed hairs and some longer outstanding ones; stalk of second gastral tergite 3-4 times as long as broad; gaster posteriorly with dense silvery tomentum and some protruding longer black hairs.

**Holotype** ♂, **Uganda:** Mabira forest, Chagwe, 3500-3800 ft, [1070-1160 m], 16-25.vii.1911 (*S. A. Neave*) (BMNH).

**Paratypes.** **Uganda:** 1 ♂, 5 ♀, same data as holotype; 1 ♀, shores of Lake Wamala (Isolt), 3800 ft [1160 m], 7-8.i.1912 (*S. A. Neave*) (BMNH); 1 ♂, Buamba Forest, Semliki Valley, 2300-2800 ft [700-850 m], 3-7.xi.1911 (*S. A. Neave*) (BMNH). **Kenya:** 1 ♂, Rabai, 39°34'E, 3°55'S, v.1928 (*V. G. L. van Someren*) (BMNH). **Zaire:** 1 ♀, Shaba province (Katanga), R. Lufira, 3500 ft [1070 m], 10.ix.1907 (*S. A. Neave*) (UM, Oxford) (probably this species, but in bad condition). **Rwanda:** 1 ♀, Kigali, 16.xii.1979 (*H. J. Freijen*) (ITZ, Amsterdam).

### *Belonogaster saussurei* Kirby

(Fig. 69)

*Belonogaster saussurei* Kirby, 1881: 649; Forbes, 1903: 256, pl. 16, fig. 8. **LECTOTYPE** ♂, SOUTHERN YEMEN: Socotra (*Balfour*) (BMNH), here designated [examined].

*Belonogaster tricolor* Taschenberg, 1883: 175. Syntypes 2 ♀, SOUTHERN YEMEN: Socotra (depository unknown).

**FEMALE.** Head ferruginous, clypeus a little yellow tinged. Mesosoma black, pronotum, scutellum, metanotum, posterior margin of propodeum, centre of mesosternum, ferruginous. Legs ferruginous, narrow apical band of tergite 2, tergites 3-4, black; transverse comma-shaped pale yellow mark on black band of tergite 2; sternites ferruginous, apical band of sternite 2, sternites 3-4 black, sternite 2 with two small yellow spots. Wings purplish black, costa to pterostigma reddish brown, length 17.0-20.0 mm.

Clypeus acute below, finely reticulate with numerous scattered large punctures bearing brown bristles, almost no tomentum; frons dull, reticulate, closely punctured in front and at sides, bearing outstanding black bristles, a little silvery tomentum; gena almost as wide as eye in profile, finely reticulate, more shining below, numerous rather fine punctures; base of stipes and submentum with a few pale bristles; antenna with segment 3 much longer than 4 + 5, 4 and 5 very little longer than broad, 8 quadrate. Mesoscutum and humeri dull, reticulate with numerous rather small outstanding bristles and not very close brown tomentum, mesopleuron similar but rather more punctured; scutellum and metanotum punctured with black bristles at sides, former with a strong impressed line; propodeum as in ♂ but anterior depression larger. Last segment of fore tarsus elongate; fore, mid and to less extent hind femur beneath with outstanding short pale pile, no bristles; hind tibia with a few pale bristles. Gastral petiole rather long and narrow, gradually and little

widened posteriorly, spiracles moderately protuberant, with sparse pale tomentum and a few short pale bristles; stalk of second gastral tergite 2.5 times as long as broad, gaster posteriorly with moderately dense pale tomentum but no bristles.

**MALE.** Head light ferruginous; most of mandibles, face, up to level of centre of ocular sinus, except a feeble central stripe on clypeus, scape beneath, spot on malar space which are yellow. Mesosoma black, pronotum, scutellum, metanotum, centre of mesosternum, posterior margin of propodeum, ferruginous. Legs ferruginous. Gaster ferruginous, narrow apex of tergite 2 and whole of 3-4, blackish; tergite 2 with two large transverse pale yellow comma-shaped spots on black area; sternite ferruginous, posteriorly narrowly blackish with irregular pale yellow band, sternites 3-4 darkened. Wings dark brown, costa more reddish, length 15.5-18.0 mm.

Clypeus acute below, shining, very feebly reticulate with scattered punctures bearing short pale bristles, mainly at sides, a band of short silvery tomentum on each side; frons dull, reticulate, with scattered punctures in front and at sides, very short outstanding black bristles and a little silvery tomentum; gena a little wider than half the eye-width in profile, dull, finely reticulate with a few scattered punctures; base of submentum with a small tuft of black bristles; antenna (Fig. 69) with segment 3 about as long as 4 + 5, 4 and 5 about 2.5 times as long as broad, 8 twice as long as broad, 12 slightly flattened, a little curved, mainly above, almost straight below, tip rounded, a little longer than 8, 11 with a strong protuberance beneath, 8-10 with weaker but longer ones, 5-7 with a weak raised line beneath. Mesoscutum and mesopleuron distinctly and moderately closely punctured, humeri weakly punctured; mesoscutum with sparse greyish tomentum, humeri without outstanding bristles; scutellum and metanotum punctured with short black bristles at sides, former with a strong impressed line; propodeum quite strongly punctate-striate, punctured at sides, with sparse brown tomentum and close short outstanding black bristles, posterior depression not quite half as long as propodeum, impressed line strong, anterior depression small, deep. Last segment of fore tarsus elongate; femora beneath with feeble outstanding pile, no bristles, hind tibia with no bristles. Gastral petiole rather short and thick, spiracles moderately prominent, petiole very little widened posteriorly, with close pale tomentum but no bristles; stalk of second gastral tergite 2.5 times as long as broad or rather less, gaster posteriorly with not very dense pale tomentum but no bristles.

**DISTRIBUTION** (8 ♂, 40 ♀). **Southern Yemen** (Socotra, rather common up to 1500 ft [460 m], 18.i. to 30.iv. also a few in viii; 2 ♀, Aden, Kharmaksar, 13.iii.1967 (*K. M. Guichard*)).

Kohl (1906: 223) records *saussurei* from Socotra, the small island of Semha (ca 12°20'N, 52°5'E), and from Ras Farták in Southern Yemen. He seemed to be a little doubtful about the correctness of these records; it is possible they were founded on specimens of *B. guichardi*.

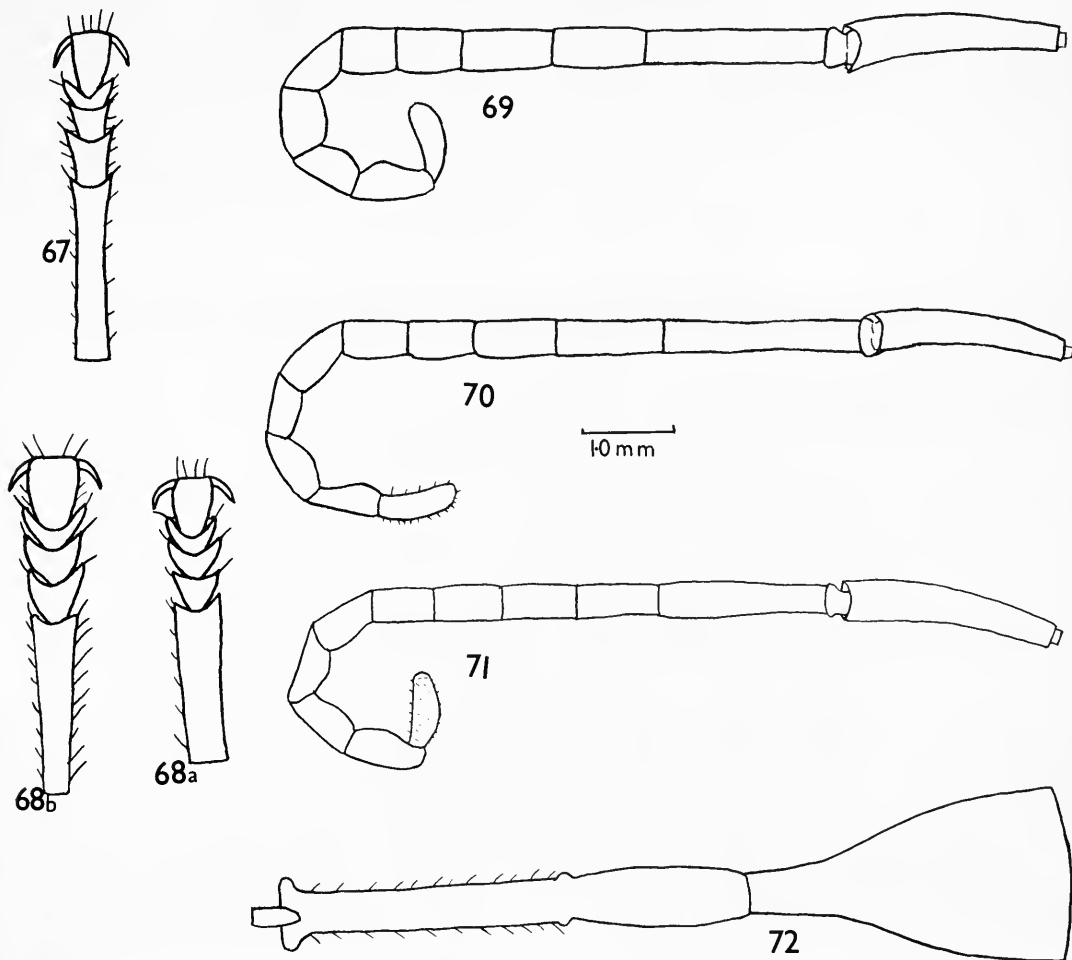
### *Belonogaster guichardi* sp. n.

(Fig. 70)

**MALE.** Light ferruginous, gastral tergite 2 narrowly apically, tergite 3 except narrow apex, more than basal half of tergite 4, most of sternites 3-4, black; broad sides of clypeus, inner orbits from bottom of sinus, spot between antennae, creamy white. Tergite 2 with narrow transverse spots at apex, apical band of sternite 2, pale yellow; mid coxa partly yellow beneath. Wings dark purplish brown, veins reddish, length 18.0 mm.

Clypeus acute below, a little shining, hardly reticulate with scattered large punctures, sides with not very dense silvery tomentum, punctures on discal stripe with black bristles; frons with small indistinct punctures, very finely reticulate with short outstanding black bristles; gena about two-thirds as wide as eye in profile, finely reticulate with scattered small punctures; base of submentum with a small tuft of outstanding bristles; antennal segment 3 (Fig. 70) hardly longer than 4 + 5, 4 2.5 times as long as broad, 5 a little shorter, 8 about 2.33 times as long as broad, 12 about as long as 9, strongly flattened, curved above, straight below, tip rounded, 9-11 with ventral prominences which are curved beneath (less so on 9). Thorax with fine, not very conspicuous punctures and very inconspicuous tomentum; propodeum more strongly punctured, angles punctate-striate, tomentum inconspicuous, outstanding black bristles short and not very dense, posterior depression about half as long as propodeum; impressed line strong, anterior depression large, elongate. Last segment of fore tarsus elongate; hind femur with white tomentum beneath but no bristles. Gastral petiole moderately long, distinctly widened at apex, spiracles moderately protuberant, surface with sparse pale tomentum and a few short bristles; stalk of second gastral tergite 2.5 times as long as broad, gaster posteriorly with not very dense pale tomentum and some obliquely outstanding pale bristles.

FEMALE. Ferruginous; spot on lateral lobes of clypeus, elongate subapical transverse spots on gastral tergite 2, two small subapical spots on sternite 2, yellow; narrow apical area on gastral tergite 2, large basal part of tergites and sternites 3-4, black. Wings dark purplish brown, veins red-brown, length 18.0-21.0 mm.



Figs 67-72 *Belonogaster*. 67, 68, *B. brevitarsus* sp. n. (67) ♀, fore tarsus; (68) ♂, fore (a) and mid (b) tarsus. 69, *B. saussurei* Kirby, ♂, left antenna. 70, *B. guichardi* sp. n., ♂, left antenna. 71, *B. abyssinica* du Buysson, ♂, left antenna. 72, *B. arabica* Giordani Soika, ♂, gastral tergites 1-2.

Clypeus acute below, very weakly reticulate with scattered large punctures bearing brown bristles; frons with numerous rather small punctures, interstices finely reticulate with short outstanding bristles; gena about as wide as eye in profile, finely reticulate with numerous moderately large punctures which on dorsal part bear short black bristles; base of stipes and submentum with moderately long black bristles; antenna with segment 3 as long as 4 + 5 + 6, 4 and 5 only a little longer than broad, 8 quadrate. Thorax with numerous, quite distinct, fine punctures and very inconspicuous brownish tomentum; propodeum as in ♂ but anterior depression smaller. Last segment of fore tarsus elongate; hind femur with dense silvery tomentum beneath. Gastral petiole rather long, distinctly widened at apex, spiracles little protuberant, tomentum not close, few short bristles; stalk of second gastral tergite 2.5 times as long as broad, gaster posteriorly with dense silvery tomentum and some obliquely projecting brown bristles.

Holotype ♂, **Oman**: Dhofar, Ayun Pools, 700 m, 10.x.1977 (*K. M. Guichard*) (BMNH).

Paratypes. **Oman**: 1 ♂, 13 ♀, same data as holotype; 1 ♀, Wadi Sayk, 26.ix.1977 (*K. M. Guichard*); 2 ♀, Qara Hills, north slopes, 670 m, 22.ix.1977 (*K. M. Guichard*) (BMNH).

This species, *B. saussurei*, *B. abyssinica*, *B. adenensis*, *B. arabica* and *B. filiformis* are all very closely similar and the females in some cases scarcely separable but the males seem to show small differences, especially in the antennae, and the distributions are often such that it is not easy to treat any of them as subspecies.

*Belonogaster abyssinica* du Buysson

(Fig. 71)

*Belonogaster abyssinicus* du Buysson, 1906: 190; 1909: 223, 263, pl. 4, fig. 4. LECTOTYPE ♀, ETHIOPIA: 'Abyssinie', 1882 (*Raffray*) (MNHN, Paris), here designated [examined].

FEMALE. Head ferruginous, including antennae, frons and area round the foramen black. Mesosoma black; ventral corner of pronotum, hind margin of scutellum, metanotum, posterior margin of propodeum, propleuron, reddish. Legs blackish brown, coxae reddish tinged. Gaster blackish, petiole and stalk of tergite 2 ferruginous; rarely two small yellow spots before apex of tergite 2. Wings dark purplish brown, length 14.0–20.0 mm.

Clypeus acute below, very finely reticulate with numerous quite large punctures and some black bristles; frons strongly reticulate with close small punctures and only on the vertex black, outstanding hairs, a strong impressed line from median ocellus forwards; gena not quite as broad as eye in profile, finely reticulate, more shining below, with numerous fine punctures; base of stipes and submentum with numerous outstanding black bristles; antennal segment 3 much longer than 4 + 5, 4 and 5 only a little longer than broad, 8 quadrate. Mesoscutum and humeri dull, reticulate with quite close punctures especially on the mesoscutum, feeble brownish tomentum and a few outstanding hairs; mesopleuron similar; scutellum closely and rather more strongly punctured, central impressed line weak; metanotum similar but no impressed line though central band less punctured; propodeum strongly punctate-striate, more punctured at sides, with very feeble pale tomentum and numerous short outstanding dark hairs, posterior depression not quite half as long as propodeum, impressed line complete but not strong, anterior depression deep and rather large. Fore tarsus with last segment elongate; fore and mid femur beneath with outstanding white pile, less distinct on hind femur which has a very few fine bristles near base beneath. Gastral petiole rather long and thin, regularly but little widened posteriorly, very little tomentum and a few short bristles, spiracles hardly protruding; second gastral tergite with stalk 2.5 times as long as broad; gaster posteriorly with short and not very close silvery tomentum, no bristles.

MALE. Head ferruginous; frons black; face yellow with a wide central stripe ferruginous except for a yellow spot above the antennal sockets. Mesosoma black, propodeum below and mesosternum more or less ferruginous. Legs ferruginous, mid coxa beneath, mid femur anteriorly, trace on anterior basal half of hind femur, yellow. Gaster ferruginous, posterior third of tergite 2 and tergites 3–4 black. Wings brown, length 17.0 mm.

Clypeus acute below but not very strongly projecting, numerous moderately strong punctures and not very dense silvery hairs; frons dull, finely reticulate with moderately dense coarse punctures and outstanding brownish hairs; gena as wide as eye in profile, dull, finely reticulate with scattered rather fine punctures; antennal segment 3 (Fig. 71) distinctly longer than 4 + 5, 4 and 5 about 2.5 times as long as broad, 8 a little more than twice as long as broad, 12 flattened, a little curved above, almost straight below, a little longer than 9, 10 and 11 only feebly projecting beneath. Mesoscutum and humeri with fairly distinct fine hairs, with small distinct punctures. Mesopleuron rather more distinctly punctured and very finely reticulate; propodeum dull, strongly and moderately closely punctured, traces of striae dorsally, hairs long at sides, not very dense, posterior depression half as long as propodeum, impressed line weak, anterior depression transverse, moderately deep. Fore tarsus with last segment elongate; hind femur with pale tomentum but no bristles beneath. Gastral petiole moderately long, little widened posteriorly, spiracles hardly projecting; second gastral tergite with stalk 2.5 times as long as broad; gaster posteriorly with fine inconspicuous pale tomentum and no protruding bristles.

DISTRIBUTION. (11 ♀, 4 ♂). Ethiopia (unlocalized, 4 ♂, 9 ♀, including lectotype (MNHN, Paris); 1 ♀, High Simien, 30.x.1911 (*R. J. Stordy*) (BMNH)), Djibouti (1 ♀, Menabella, 26.vi.1903 (*A. Bonoure*) (MNHN, Paris)).

*Belonogaster arabica* Giordani Soika stat. n.

(Figs 72, 73)

*Belonogaster grisea* subsp. *arabicus* Giordani Soika, 1958: 484. Holotype ♀, SOUTHERN YEMEN: Dhala, 4800 ft [1460 m], 14.ix.1937 (*H. Scott, E. B. Britton*) (BMNH) [examined].

**FEMALE.** Light ferruginous; lateral lobes of clypeus yellowish; gastral tergites 2–4 a little darker, tergite and sternite 2 with narrow transverse yellow spots. Wings light reddish brown, tips dark fuscous, length 17.0–21.5 mm.

Tomentum everywhere very short and sparse, reddish. Clypeus acute below with numerous scattered large punctures, dorsal two-thirds dull, finely granulate; frons with numerous small punctures and short outstanding black bristles, occiput with outstanding black bristles, mainly at sides; gena distinctly wider than eye in profile, almost whole surface with scattered small punctures; base of submentum with a few outstanding brown bristles; antenna with segment 3 not quite as long as 4 + 5 + 6, 4 and 5 both a little longer than broad, 8 just longer than broad. Mesoscutum and humeri and mesopleuron with numerous small punctures, rather closer and coarser on the scutellum and especially the metanotum; propodeum punctured with a few striae on the angles below, posterior depression a little more than one-quarter as long as propodeum, impressed line strong, anterior depression large but only centre deep. Fore tarsus with last segment elongate; mid and hind femora with close white tomentum but very few bristles beneath. Gastral petiole long and rather narrow, little widened posteriorly, spiracles hardly protruding; stalk of second tergite 2 or more often 2.5 times as long as broad; gaster posteriorly with pale reddish tomentum and a few protruding reddish bristles.

**MALE.** Light ferruginous; more than dorsal half of mandibles, broad sides of clypeus, inner orbits to bottom of ocular sinus, spot between the antennal sockets, narrow spots at apex of gastral tergite and sternite 2, yellow. Wings reddish brown, tips dark fuscous, length 18.0–20.0 mm.

Clypeus quite strongly pointed and acute below with scattered large punctures on lower half, long silvery pubescence on the yellow areas; frons with numerous small punctures and outstanding short black hairs, occiput also with a few black bristles; gena a little wider than eye in profile, dull with a few small punctures below; base of submentum with a few outstanding black bristles; antennal segment 3 hardly longer than 4 + 5, segments 4 and 5 2.5 times as long as broad or rather more, 8 rather more than twice as long as broad, 12 about as long as 9, moderately flattened, curved above, nearly straight below, tip rounded, dull, 9–11 (Fig. 73) in dorsal view narrow, with a strong rounded hump beneath, 5–8 with a raised line beneath. Mesosoma and legs as in ♀. Gastral petiole (Fig. 72) rather wider at base than in ♀ and less widened at apex, spiracles more projecting, stalk of second tergite twice as long as broad.

**DISTRIBUTION** (15 ♀, 4 ♂). **Southern Yemen** (2 ♀, 4 ♂, Dhala, 4800–5500 ft [1460–1680 mm], 14.ix.1937 (*H. Scott, E. B. Britton*) (BMH)); 1 ♀, Hadhramaut, Mahymud, 26.xi.1934 (*W. H. Ingram*) (BMNH)), **Yemen** (11 ♀, Ghaiman, ca 9 miles [14.5 km] SE. of Sana's, 8000–9000 ft [2440–2745 m], 17.ii.1938 (*H. Scott, E. B. Britton*) (BMNH)), **Saudi Arabia** (1 ♀, Khamis, Wadi Morba, 17.iv. (*W. Büttiker*) (BMNH)).

The female is hardly distinguishable from that of *B. filiformis* but the males seem to be distinct.

### *Belonogaster longitarsus* sp. n.

(Figs 74–76)

**MALE.** Ferruginous; mandibles, broad stripes at sides of clypeus, inner orbits, pale yellow; mesosternum, fore and mid coxae beneath, mid and hind femora and tibiae with antero-ventral stripes, suffused spots on gastral tergite 2, yellow; antennal segments 1–8 above, tarsi, darkened; wings brownish hyaline, tips hardly darker, length 15.0 mm.

Clypeus acute below, surface very finely reticulate, a little shining, a band of silvery pubescence on each side, a few short black bristles, scattered especially on the central stripe and on upper half; frons dull, reticulate with a few small punctures and fairly numerous short, outstanding black bristles; gena a little more than half as wide as eye in profile, finely reticulate, not punctured; antennal segment 3 distinctly longer than 4 + 5, 4 and 5 about 2.5 times as long as broad, 8 about 2.25 times as long as broad, segment 12 (Fig. 75) moderately curved and flattened, tip rounded, as long as 9, 10–11 with strong prominences beneath, 7–9 with raised lines beneath. Humeri and mesoscutum with not very dense silvery tomentum and sparse fine punctures, mesopleuron similar but rather more punctured; scutellum with a weak central line, it and metanotum clearly punctured; propodeum with weak striae and punctures but quite distinct silvery tomentum and close short brownish hairs, posterior depression one-third as long as propodeum, impressed line hardly developed, anterior depression small and shallow. Last segment of fore tarsus elongate; femora beneath with sparse tomentum and sparse short black hairs. Gastral petiole long and slender, spiracles prominent, distal part scarcely widened and almost as long as the prespiracular part; stalk of second gastral tergite a little more than twice as long as broad; gaster posteriorly with not very dense silvery tomentum and a few projecting hairs, some of which are dark.

FEMALE. Ferruginous; antennae above and tarsi above, darkened; gastral tergite 2 often with 2 yellow spots; wings brown or light brown, tips sometimes a little darkened, length 15.0–21.0 mm.

Clypeus acute below, very finely reticulate with scattered moderate-sized punctured, dull, very little tomentum, a few pale bristles; frons dull, reticulate, rather close moderate-sized punctures and not close outstanding blackish bristles, little tomentum; gena a little more than half as wide as eye in profile, finely reticulate, a little shining with scattered punctures; base of submentum with very few bristles; antennal segment 3 much longer than 4 + 5, 4 and 5 a little longer than broad, 8 a little shorter than broad. Mesoscutum and humeri with a few fine short hairs, a few inconspicuous punctures and moderately close, very fine brownish tomentum, mesopleuron similar but more distinctly punctured, scutellum with a very feeble central line, it and metanotum more strongly punctured; propodeum weakly punctured or punctate-striate, dull, reticulate with some pale tomentum and short not very close outstanding black hairs, posterior depression a little less than half as long as propodeum, impressed line very feeble, anterior depression small but deep. Last segment of fore tarsus (Fig. 74) elongate, femora beneath with fine tomentum and rather sparse short bristles. Gastral petiole rather long and slender, spiracles projecting, posterior part little widened; stalk of second gastral tergite 2.5 times as long as broad, gaster posteriorly with rather close silvery tomentum and a few scattered pale bristles.

Holotype ♂, **Uganda**: banks of Victoria Nile near Masindi Port, 3400 ft [1040 m], 20–22.xii.1911 (S. A. Neave) (BMNH).

Paratypes. **Zambia**: 1 ♀, Zambesi Victoria Falls, 3000 ft [915 m], 15.ix.1905 (G. B. Longstaff) (stalk of second gastral tergite only 1.5 times as long as broad) (UM, Oxford). **Kenya**: 2 ♀, Mombasa, Kilindini, 22.ix.1905 (C. A. Wiggins) (UM, Oxford). **Uganda**: 1 ♀, same data as holotype (BMNH); 1 ♀, Tero Forest, SE. Buddu, 3800 ft [1160 m], 26–30.ix.1911 (S. A. Neave); 1 ♀, between Mitiana and Entebbe, 3800 ft [1160 m], 9–11.i.1912 (S. A. Neave); 1 ♀, Entebbe, i.1913 (C. C. Gowdey) (BMNH). **Zambia**: 1 ♀, Feira, 3.iv.1911 (F. V. Bruce-Miller) (BMNH). **Mozambique**: 2 ♀, Beira, 11 and 13.x.1939 (Dr. A. H. Newton) (BMNH). **South Africa**: 1 ♀, Transvaal, Merensky Dam, Tzaneen, 18.ii.1968 (Paul J. Spangler) (USNM); 1 ♀, Cape Province, East London, 24.iii.1914 (G. B. Longstaff) (UM, Oxford); 1 ♀, Natal, Durban, iv.1896 (F. N. Brown) (UM, Oxford). **Angola**: 1 ♀, Bruco, 26.ii.–2.iii.1972 (Southern African Exped.) (BMNH). **Tanzania**: 1 ♀, Kilimandjaro, SE. slopes, Kilema, 1440 m, iii.1912 (Alluaud, Jeannel) (MNHN, Paris).

A nest with four females from Kenya: Mombasa, Kilindi district, 23.x., is in UM, Oxford. Comb with a 6.0 mm peduncle probably removed from a twig. Two closed white cocoon-caps with a little carton network on the white silk; dome very convex, 7.0 mm diameter, cell 23.0 mm long. Four rather short open cells and 22 very short ones with dead 1st or 2nd instar larvae. Carton light brown.

### *Belonogaster adenensis* Giordani Soika stat. n.

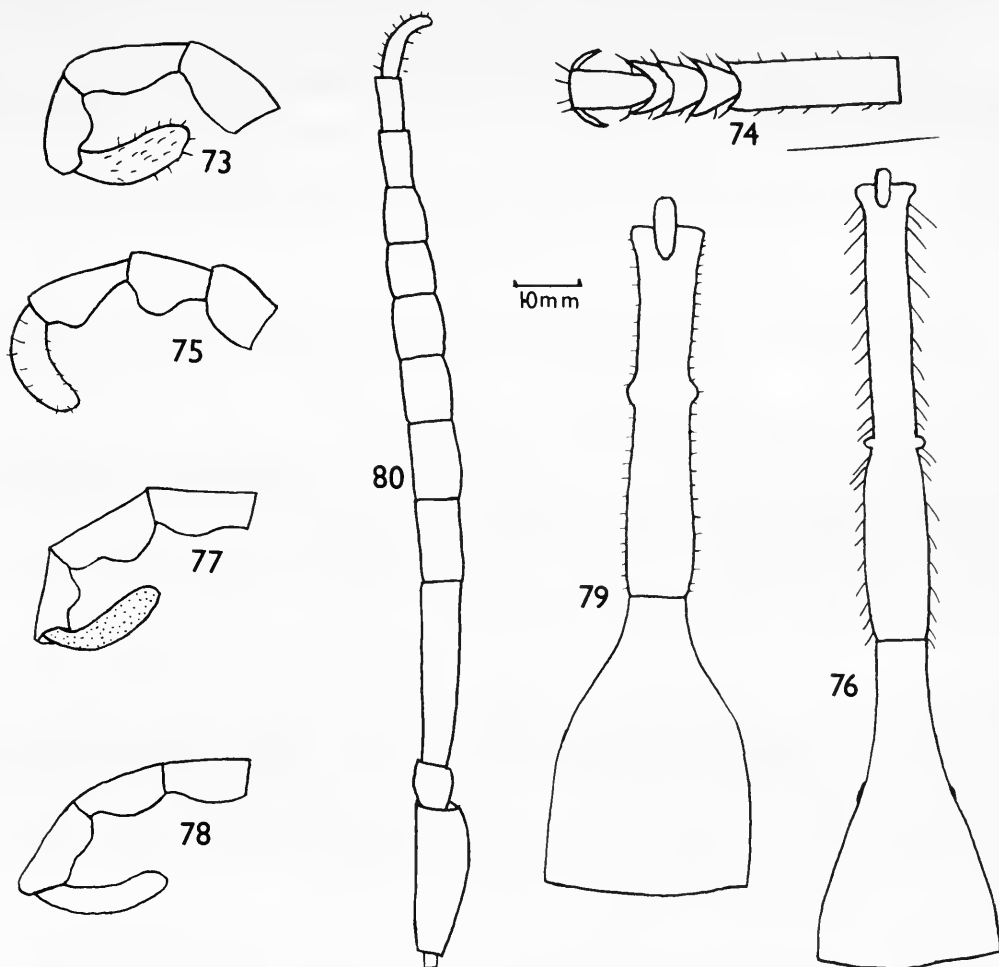
(Fig. 77)

*Belonogaster abyssinicus* subsp. *adenensis* Giordani Soika, 1957: 484.

There are two subspecies and the colours are described under each of them.

MALE. Clypeus acute below, surface slightly convex, slightly reticulate with a few large punctures below, with dense short silvery pubescence and on the upper half a very few short black bristles; frons dull, reticulate with fairly numerous small punctures in front and short outstanding black bristles; gena not quite as wide as eye in profile, reticulate, scarcely punctured; base of submentum with a tuft of black bristles; antenna with segment 3 clearly longer than 4 + 5, 4 and 4 about 2.5 times as long as broad, 8 just over twice as long as broad, 12 (Fig. 77) about as long as 7, distinctly flattened but not very wide, well curved above, nearly straight below, tip rounded, with tomentum rather than short hairs, 9–11 with strong rounded protuberances beneath, 5–8 with raised lines beneath. Mesoscutum scarcely punctured, humeri with some very fine punctures, mesopleuron more distinctly punctured, whole with dense appressed brownish tomentum; propodeum with quite strong punctures, angles more punctate-striate, with short black bristles and very short tomentum, posterior depression to mid point, impressed line complete, anterior depression large, elongate. Last segment of fore tarsus elongate; hind femur with inconspicuous white tomentum but no bristles beneath. Gastral petiole moderately long and stout, little widened posteriorly, spiracles little projecting, little tomentum, bristles very short; stalk of gastral tergite 2 about twice as long as broad, gaster posteriorly with inconspicuous pale tomentum and some fine black hairs, but no real bristles.

FEMALE. Not structurally distinct from *B. arabica* (p. 96).



Figs 73–80 *Belonogaster*. 73, *B. arabica* Giordani Soika, ♂, left antenna, segments 9–12. 74–76, *B. longitarsus* sp. n. (74) ♀, fore tarsus; (75) ♂, left antenna, segments 9–12; (76) ♂, gastral tergites 1–2. 77, *B. adenensis* Giordani Soika, ♂, left antenna, segments 9–12. 78, *B. filiformis* (de Saussure), ♂, left antenna, segments 9–12. 79, 80, *B. brevipetiolata* de Saussure. (79) ♀, gastral tergites 1–2; (80) ♂, left antenna.

***Belonogaster adenensis adenensis* Giordani Soika**

*Belonogaster abyssinicus* subsp. *adenensis* Giordani Soika, 1957: 484. Holotype ♀, SOUTHERN YEMEN: Jebel Jihaf, 7100 ft [2165 m], ix.1937 (*H. Scott, E. B. Britton*) (BMNH) [examined].

**FEMALE.** Light ferruginous; sides of clypeus more or less yellow, gastral tergites 3–4 black. Wings yellow-brown, tips widely dark fuscous, length 17.0–20.0 mm.

**MALE.** Light ferruginous; mandibles except narrow ventral margin, clypeus except pitchy ventral margin and narrow central stripe, inner orbits to centre of ocular sinus, spot between antennal sockets, light yellow to creamy white; small spot beneath tip of fore coxa, yellow; gastral tergite 2 with two narrow, somewhat comma-shaped transverse spots not quite forming a band, sternite 2 with a narrow apical band, yellow. Wings brown, tips a little darker, length 18.5 mm.

**DISTRIBUTION.** Southern Yemen (2 ♀ (including holotype), 4 ♂, Jebel Jihaf, 7100 ft [2165 m], ix.1937 (*H. Scott, E. B. Britton*); 1 ♂, 1 ♀, Jebel Jihaf, Wadi Lejjij, 7000 ft [2135 m], 1.x.1937 (*H. Scott, E. B. Britton*); 7 ♀, Dhala 4800–5500 ft [1460–1680 m], 12–15.ix.1937 (*H. Scott, E. B. Britton*)), Yemen (1 ♀, Sana'a, 7000 ft [2135 m],

ii.1938) (*H. Scott, E. B. Britton*); 1 ♀, vi.1938 (*Dr P. W. R. Petrie*); 2 ♂, 2 ♀, ix.-xi.1937 (*Dr C. Rathjens*) (BMNH).

*Belonogaster adenensis somaliensis* subsp. n.

FEMALE. Light ferruginous; sides or even the whole clypeus, yellow; mesosoma and gastral tergites 4-5, black. Wings yellow-brown, tips widely dark fuscous, length 20.0 mm.

MALE. Ferruginous; most of mandibles, face level of centre of ocular sinus except narrow central stripe on clypeus, streak beneath fore femur, most of mid coxa beneath, creamy white; mesosoma black, pronotum, scutellum and metanotum, mesosternum anteriorly, ferruginous; gaster ferruginous, tergites 3-4 black, transverse preapical spots of tergite and sternite 2, yellow. Wings reddish brown, tips widely black, length 18.0 mm.

Holotype ♀, **Somali Republic**: 1898 (*Miss P. Gillet*) (BMNH).

Paratypes. **Somali Republic**: 1 ♀, same data as holotype; 2 ♀, Hargeisa, iii.1949 (*K. M. Guichard*) (BMNH) (both with large rounded yellow spots before apex of tergite 2); 1 ♂, Erigavo, 20.iv.1952 (*E. J. van Ingen*) (BMNH); 1 ♂, 9 ♀, Afgoi, ix.1977 (*M. Olmi*) (BMNH); 1 ♀, unlocalized, 1881 (*C. Révoil*) (MNHN, Paris). **Ethiopia**: 2 ♀, unlocalized (*Schimper*) (MNHN, Paris).

*Belonogaster filiformis* (de Saussure)

(Fig. 78)

*Raphigaster filiformis* de Saussure, 1853: 18, pl. 2, fig. 4, LECTOTYPE ♀, SAUDI ARABIA ('Arabie, Djedda'): 1839 (*Botta*) (MNHN, Paris), here designated [examined].

*Belonogaster filiformis* (de Saussure) Kohl, 1894: 335.

There are 2 ♀ in MNHN, Paris from Saudi Arabia, both marked 'Type Djedda', and I have labelled one lectotype.

FEMALE. Light reddish brown; apex of gastral tergite 2 and sternite 2 with two transverse yellow spots. Wings yellow-brown with tips fuscous, length 19.0 mm.

The female seems not to be clearly distinguishable from that of *B. arabica* Giordani Soika (p. 96) but the distribution is rather different, the present species being more western. The males, however, differ in their antennae, that of *filiformis* having segment 12 shorter and more flattened and segments 10-11 more convex beneath; the mid and hind femora also have dense white recumbent pubescence beneath.

MALE. Light ferruginous; greater part of mandible, broad sides to clypeus, inner orbit to middle of ocular sinus, spot between antennal sockets, creamy white; traces of stripe beneath fore femur, traces of narrow transverse preapical spots on gastral tergite and sternite 2, yellow; narrow apical part of gastral tergite 2, black, tergites 3-4 sometimes darkened. Wings light brown, tips slightly darkened, length 17.0-18.5 mm.

Clypeus acute below, finely reticulate, not very dull, with scattered not very large punctures, with close silvery hairs, mainly on the sides and scattered short outstanding black bristles, mainly on the disk; frons dull, reticulate with sparse outstanding black bristles; gena not quite as wide as eye in profile, finely reticulate with scattered small punctures; apparently few bristles at base of submentum; antennal segment 3 a little longer than 4 + 5, 4 and 5 about 2.5 times as long as broad, 8 a little more than twice as long as broad, 12 (Fig. 78) about as long as 9, a little flattened and curved (even below), tip rounded, surface with a number of very short hairs, 10 and 11 with strong prominences beneath, 9 with a smaller prominence, apex of 5 beneath to 8 with raised lines. Mesoscutum and humeri finely reticulate with inconspicuous fine punctures and dense rather long pale tomentum, mesopleuron more distinctly punctured, scutellum with a central impressed line, it and especially metanotum more strongly punctured, propodeum quite strongly punctured with weak striae on angles, with dense fine tomentum and outstanding short, mainly black hairs. Last segment of fore tarsi elongate; mid and hind femur with dense white tomentum beneath. Gastral petiole rather long, not very slender, not much widened posteriorly, spiracles little protruding, surface rather dull with pale tomentum and very short hairs; stalk of second gastral tergite 2.5 times as long as broad, gaster posteriorly with close fine tomentum but no bristles.

DISTRIBUTION. **Saudi Arabia** (lectotype ♀ and paralectotype ♀, Jidda (MNHN, Paris), 1 ♀, At Ta'if, 12.vii.1934 (*H. St. J. B. Philby*), 3 ♀, 18.vi.1946 (*A. R. Waterston*), 1 ♀, between At Ta'if and Bisha, 24-25.vi.1962 (*G.*



*Popov*), 1 ♀, Mibrata, at foot of Asir escarpment, east of Jizan, 3000 ft [915 m], 3.xii.1936 (*H. St. J. B. Philby*), 1 ♀, 2 ♂, Abah, Asir, 8000 ft [2440 m], 22.viii.1944 (*A. R. Waterston*), 1 ♂, 1 ♀, Ktubu, 1902 (*G. W. Bary*) (BMNH).

*Belonogaster tessmanni* von Schulthess

*Belonogaster tessmanni* von Schulthess, 1910: 45. Syntypes ♂ ♀, GUINEA-BISSAU: 'Spanish Guinea, Helleborg, Benitogebiet, 1906-07' (MNHU, Berlin, EI, Zurich; not found).

This species was described by von Schulthess from a ♂ and at least 2 ♀ collected by G. Tessmann in Guinea-Bissau. At least one specimen was stated to be in the Berlin Museum, but MNHU, Berlin seem not to have it now. The other von Schulthess' types of *Belonogaster* are EI, Zürich but Professor W. Sauter tells me that though there is a space and a label for a specimen there, the actual syntype is absent—possibly lent to someone and not returned. Although the original description is quite detailed I have not been able to identify this species with any certainty, though it is probably distinct.

**Descriptions of Malagasy species**

Although I have included the one species from the Comoro Islands in the key to the continental African species, I am treating the Madagascan species separately. As far as I can make out, there are no species common to the two regions; most of the Madagascan species have a peculiar facies and several species have some part of the body blue-green, as do some of the wasps of genus *Ropalidia* Guérin-Méneville. Such a colour is otherwise unknown in social wasps. I suspect that the wasp fauna of Madagascar is very imperfectly known. Some species seem to be quite variable and perhaps if more specimens were available it would be possible to recognize more species.

*Belonogaster brevipetiolata* de Saussure

(Figs 79, 80)

*Belonogaster brevipetiolatus* de Saussure, 1891: 98, pl. 4, fig. 1. ? Syntypes 2 ♀, MADAGASCAR: unlocalized (MNHN, Paris) [examined].

These two females are said to have been determined by de Saussure and may indeed be syntypes but they have no locality data. The species was described from Fianarantsoa (pays des Betsileo), near Andrangoloakā (eastern limits of Imerinā province) and S. Coast, Nosibé. Judging by collections it is a relatively common species.

**FEMALE.** Dark blackish brown; head ferruginous, narrow dorsal area on clypeus, frons and vertex, underside of head, antennae, black. Wings light brownish hyaline, length 17.0–20.5 mm.

Clypeus acute below, dull, finely reticulate, a few quite large punctures on the lower quarter which also has a few pale bristles, surface generally with relatively long, appressed silvery hairs; frons dull, very finely granulate with some fine punctures bearing brown outstanding bristles in front, appressed pale hairs as on clypeus but shorter; gena not quite as wide as eye in profile, dull finely reticulate with scattered rather fine punctures, especially below; base of submentum and stipes with a number of moderately long brown, pale tipped bristles; antennal segment 3 much longer than 4 + 5, 4 and 5 a little longer than broad, 8 not quite as long as broad. Mesoscutum, humeri and mesopleuron dull, finely granulate with a moderate number of rather fine inconspicuous punctures with rather close brown tomentum, scutellum and metanotum rather more closely punctured, both with a smooth impressed line; propodeum dull, granulate, not very strongly punctate-striate above with pale brown tomentum, very few outstanding hairs, posterior depression one-quarter as long as propodeum, impressed line short and weak, anterior depression small but very deep. Last segment of fore tarsus short; hind femora with tomentum and a few short bristles beneath. Gastral petiole (Fig. 79) short (about as long as hind trochanter + femur), rather stout, widening very gradually to apex, spiracles moderately prominent; stalk of second gastral tergite half as long as broad, gaster posteriorly with very fine inconspicuous tomentum, no bristles.

**MALE.** Blackish brown, head ferruginous, frons, vertex and underside of head black; antennae black, segments 10–12 light brown; sides of clypeus and inner orbit somewhat whitish. Wings very light brownish hyaline, length 15.0 mm.

Mandibles broad, parallel-sided, dense pale hairs at base. Clypeus moderately transverse, scarcely at all produced below (angle *ca* 160°), dull, reticulate, a few scattered punctures and dense short silvery hairs; frons dull with close, moderately large punctures and quite long, outstanding pale brown bristles; OOL shorter than distance between outer edges of posterior ocelli; gena rather less than half the width of the eye in profile, dull, not punctured; base of stipes and submentum beneath with numerous rather short hairs; antenna (Fig. 80) with segment 3 a little shorter than 4 + 5, 4 and 5 2.5 times as long as broad, 8 a little more than twice as long as broad, segment 12 long, narrow cylindrical, rather strongly curved, tip rounded, many quite long hairs, the segment rather longer than 9, 10–11 cylindrical, 10 with apex emarginate beneath, no raised lines. Mesoscutum and humeri with numerous long outstanding hairs, a little shining, reticulate with numerous moderately large punctures, close brownish tomentum; mesopleuron similar; scutellum with practically no impressed line, it and metanotum like mesoscutum; propodeum dull, reticulate with scattered moderate punctures and rather sparse long fine hairs; posterior depression one-quarter as long as propodeum, no impressed line, anterior depression small but deep. Last segment of fore tarsus hardly shortened, hind femur beneath with dense rather short white hairs with a few longer protruding ones. Gastral petiole rather long and narrow, little widened posteriorly, spiracles strongly protruding; stalk of second tergite not quite as long as broad, gaster posteriorly with dense greyish pubescence and no bristles.

DISTRIBUTION (16 ♀, 11 ♂). Ambohinimbo Forest, Bay of Antongil, Betsileo, Fampanambo, Tamatave, Tananarivo.

In MNHN, Paris are 3 nests, the cells of which are arranged thread-like, hanging from a leaf. Two of them have jet-black stripes and the largest is 15.5 cm long.

### *Belonogaster guerini* (de Saussure)

(Fig. 81)

*Raphigaster guerini* de Saussure, 1853: 17, pl. 2, fig. 3. ?Holotype ♀, MADAGASCAR (coll. Gribodo, apparently ex coll. Guérin-Méneville) (MCSN, Genoa) [examined].

*Belonogaster guerini* (de Saussure) Smith, 1857: 94.

This species was described, apparently, from a single female in the collection of Guérin-Méneville; this collection was dispersed on the death of its owner. A female in the Gribodo collection appears to be the holotype. The species is the largest in the genus and is, I think, peculiar to Madagascar; records by du Buysson (1909: 225) and Bequaert (1918: 332) from continental Africa or even from the Comoro Is., were probably based on other species. The long series in MNHN, Paris are all this species and all are from Madagascar.

Some specimens of *B. dubia* in early collections were identified as *B. guerini*, especially females in which the yellow stripes on the face are reduced. True *B. guerini* has a longer stalk to the second gastral sternite, no bristles on the gaster posteriorly, the sides of the propodeum finely granulate (not punctured) and the mesothorax generally more finely sculptured and less bristly.

FEMALE. Ferruginous; antennal segment 3 darkened dorsally. Wings light brown, length 28.0–29.5 mm.

Clypeus acute below, lower quarter finely reticulate, shining with many large punctures and brown bristles, upper three-quarters dull, very closely and finely punctured and reticulate with few large punctures and black bristles, almost no silvery tomentum; frons finely reticulate with scattered small punctures and outstanding black bristles, sparse silvery tomentum; gena almost as wide as eye in profile, finely reticulate, more shining below where there are scattered small punctures; base of submentum and stipes with rather short, stout black bristles; antenna with segment 3 distinctly longer than 4 + 5, 4 twice as long as broad, 5 rather shorter, 8 a little longer than broad. Mesoscutum finely but strongly reticulate, dull with numerous small punctures and sparse silvery tomentum, humeri and mesopleuron similar but with sparser reticulation and denser tomentum; scutellum and metanotum similar but more punctured, former with no impressed line; propodeum dull, finely reticulate, strong striae on angles with sparse white tomentum and no hairs, posterior depression one-third as long as propodeum, impressed line strong, complete, anterior depression very small. Last segment of fore tarsus elongate; femora beneath with pale tomentum and scattered short pale bristles. Gastral petiole not long, moderately stout and thickened posteriorly, spiracles moderately projecting, no hairs; stalks of second gastral tergite 2.5–3.5 times as long as broad; gaster posteriorly with very close white or pale brown tomentum, no protruding bristles.

MALE. Rather dark ferruginous; most of mandibles, wide sides of clypeus, inner orbits, spot above antennal

sockets, white. Antennae black, ferruginous beneath except on segment 12. Wings reddish brown, length 27.0 mm.

Mandibles broad, parallel-sided with 3 blunt teeth and dorsally a very broad straight-edged lobe. Clypeus not produced dorsally but with a feebly curved lower margin, sides with dense silvery hairs and whole surface with sparse black bristles; frons dull, very finely reticulate, on each side with a patch of rather small bristles bearing punctures; gena two-thirds as wide as eye in profile, finely reticulate, not punctured; antenna (Fig. 81) thinning to apex, segment 3 about as long as 4 + 5, 4 a little longer than 5, about 2.5 times as long as broad, 8 fully twice as long as broad, 12 moderately flattened, black, curved, slightly widened to apex, rounded truncate, shining beneath, a little longer than 11, 9–11 cylindrical with no projections beneath, 8–9 with very weak raised lines beneath. Thorax dull, very finely reticulate, with sparse pale tomentum, scarcely punctured except on scutellum, metanotum and mesopleuron where rather weakly and not very closely punctured; propodeum with very few punctures and some weak striae on lower half, posterior depression one-quarter as long as propodeum, impressed line weak but complete, anterior depression very transverse but quite deep. Last segment of fore tarsus elongate; fore and mid femora with rather long tomentum beneath, hind femur with weak tomentum beneath. Gastral petiole quite long, distinctly thickened on apical part; stalk of second gastral tergite rather less than twice as long as broad, gaster posteriorly with pale, not very dense tomentum and no protruding bristles.

**DISTRIBUTION** (22 ♀, 5 ♂). **Madagascar**: Antanambe, Bay of Antongil, Fort Dauphin, Diego-Suarez, Montagne d'Ambre, Nossi Bé, Tamatave, Vohémar.

A small nest collected by D'E. de Charmoy was long oval with 17 small cells and 12 long ones—up to 47.0 mm long. The peduncle was broken off. The carton was light brown and the cocoon was slightly domed over the cell.

### *Belonogaster madecassa* (de Saussure)

(Figs 82, 83)

*Raphigaster madecassus* de Saussure, 1853: 16, pl 2, fig. 7. Holotype ♀, MADAGASCAR (coll. Gribodo, probably ex coll. Guérin-Méneville) (MCSN, Genoa) [examined].

*Belonogaster madecassus* (de Saussure) Smith, 1857: 94.

*Belonogaster longestylus* de Saussure, 1891: 97. LECTOTYPE ♀, MADAGASCAR (coll. de Saussure) (MHN, Geneva), here designated [examined]. **Syn. n.**

De Saussure described this species from a female in the collection of Guérin-Méneville on whose death the specimens were dispersed. It seems probable that a specimen in the Gribodo collection at Genoa which has been labelled 'lectoholotype' by Dr Giordani Soika is in fact the holotype. *B. longestylus* was thought by de Saussure to be very similar to *madecassa* but he gave it a new name because the type of *madecassa* was no longer available to him for comparison. The new name was founded on two females from Madagascar, one collected by Hildebrandt and in the MNHU, Berlin and there apparently missing, one collected by Sikora and in the Saussure collection. A female amongst the Saussure material in MHN, Geneva, labelled *longestylus*, may perhaps be a syntype; I have labelled it lectotype. It seems to be the same species as *madecassa* though it varies somewhat in colour and in length of the stalk of the second gastral tergite. The specimens in MNHN, Paris were labelled by du Buysson '*hildebrandti*' but they differ from the description of that species.

**FEMALE.** Yellowish ferruginous, gaster blackish ferruginous, sometimes with traces of yellow apical bands produced up along the sides on tergites 2–4; head except frons and antennae yellowish. Fore coxa yellow beneath. Wings very pale brown, tip concolorous, length 13.0–14.0 mm.

Clypeus acute below, finely reticulate with scattered small punctures, pubescence inconspicuous; frons duller, not obviously punctured with very short hairs; gena about two-thirds as wide as eye in profile, a little shining, finely reticulate; base of submentum and stipes without outstanding bristles; antennal segment 3 much longer than 4 + 5, 4 and 5 rather less than 1.5 times as long as broad, 8 a little longer than broad. Thorax finely granulate with inconspicuous pale tomentum, mesopleuron weakly punctured; propodeum granulate, no punctures or striae but silvery tomentum and short outstanding hairs, posterior depression not quite half as long as propodeum, impressed line very weak, anterior depression almost obsolete. Last segment of fore tarsi rather short, mid and hind femora with a few short pale bristles beneath. Gastral petiole

(Fig. 82) rather long, a little thickened posteriorly, with long and moderately dense hairs beneath, spiracles little protruding; stalk of second gastral tergite 3.5–4.0 times as long as broad, gaster posteriorly with rather dense pale tomentum but no protruding bristles.

**MALE.** Yellowish ferruginous, head yellower beneath; legs and gaster beneath rather yellower. Wings almost hyaline, length 11.0 mm.

Clypeus gently curved below, surface dull with rather long moderately dense white hairs; mandibles with 4 small apical teeth; eyes much closer at the clypeus than at the ocelli, somewhat swollen below; frons duller with quite dense pale hairs; gena rather less than half as wide as eye in profile, rather retreating, a little shining; antennae (Fig. 83) thin, spirally rolled, segment 3 about as long as 4 + 5, 4 and 5 about 3 times as long as broad, 8 a little more than twice as long as broad, 12 short, not quite as long as 8 flattened, a little widened to apex with a few hairs, tip narrowly black 8–11 with a flat protruding area beneath. Thorax very finely granulate, not punctured, with fine pale but not dense tomentum; propodeum finely granulate with pale hairs, posterior depression not quite half as long as propodeum, impressed line weak, anterior depression very weak. Fore tarsi a little shortened, mid tarsi distinctly shortened and widened; femora beneath with only pale tomentum. Gastral petiole not very long; a little thickened posteriorly, stalk of second gastral tergite 4.5 times as long as broad, gaster posteriorly with fine pale tomentum but no bristles.

**DISTRIBUTION** (26 ♀, 1 ♂). **Madagascar:** Baie d'Ampasindava (Pointe d'Ankify), Diego-Suarez, Joffreville, Valley of Fanjahira, Isaka, Fort Dauphin, Tamatave, Ste. Marie de Madagascar, Vohémar.

### *Belonogaster keiseri* sp. n.

(Fig. 84)

**MALE.** Head light ferruginous; malar space and gena, ocular sinus, pale yellow; clypeus and supraclypeal area, greater proximal part of mandibles, blackish, central stripe of clypeus and supraclypeal area brown; antenna light ferruginous, segments 1–2 and base of 3 a little blackened, 9–12 a little yellowish, distal quarter of 12 blackened. Mesosoma ferruginous, band across pronotal keel, lateral sclerites of scutellum, most of metanotum, valves and large posterior area of propodeum, posteroventral mesopleural spot, pale yellow; anterior margin of propodeum narrowly blackened. Legs blackish brown, fore tibia and tarsus blacker, fore coxa posteriorly, fore femur with dorsal and posterior streak, anterior streak of mid femur, anterior streak of mid tibia and tarsus, creamy yellow. Gaster blackish ferruginous. Wings hyaline, venation pale ferruginous, length 11.5 mm.

Mandibles parallel-sided with four teeth, dorsal one a little shorter; clypeus nearly flat, distinctly projecting below in an obtuse, more or less rounded angle, dull, finely reticulate with a few obsolescent punctures with short dense outstanding white hairs, a little denser at sides below; supraclypeal area transversely convex centrally with a shallow furrow on each side; frons slightly convex on each side and depressed in centre, dull, finely reticulate with some silvery tomentum and sparse outstanding hairs; gena strongly receding with no margin, a little less than half as wide as eye in profile; antenna with segment 3 much longer than 1 + 2 but not quite as long as 4 + 5, 4 and 5 3.5 times as long as broad or nearly so, 8 a little more than 2.5 times as long as broad, 9–12 considerably longer and thinner, 12 narrow, considerably flattened and curved, as long as 11 which is cylindrical, distal part of 5 and 6–10 beneath with raised lines, stronger on 9–10; segments dull with fine tomentum, rounded tip of 12 shining. Mesosoma dull, finely granulate, not punctured, with fairly close silvery tomentum, dorsally with moderately long not very close outstanding hairs; posterior depression of propodeum not quite half as long as propodeum, impressed line weak, anterior depression transverse, shallow. Tarsi (Fig. 84) with fore pair moderately elongate, distal segments of mid pair shortened, hind pair very elongate; femora with short rather close white hairs beneath. Gastral petiole long and slender, little widened posteriorly, spiracles little protruding, shining with rather numerous longish hairs beneath; stalk of second gastral tergite 4 times as long as broad, posterior tergites finely reticulate, a little shining with rather inconspicuous brownish tomentum.

**FEMALE.** Not seen.

**Holotype** ♂, **Madagascar:** Diego-Suarez, Joffreville, 25.v.1958 (*F. Keiser*) (RNH, Leiden).

### *Belonogaster bicolor* de Saussure

*Belonogaster bicolor* de Saussure, 1900: 207, 208. **LECTOTYPE** ♀, **MADAGASCAR** (MHN, Geneva), here designated [examined].

This species was described from an unknown number of females collected by Voeltzkow in Madagascar. It is not clear where the material was deposited but a female under the name *bicolor* at Geneva seems to be part of de Saussure's material and is here made lectotype.

**FEMALE.** Head light ferruginous, antennal scape greenish black. Mesosoma light ferruginous, proepisternum ferruginous, coxa, trochanter and femur greenish black; mid and hind coxae, trochanters and femora greenish black; fore tibia greenish, all other tibiae and all tarsi light yellowish brown. Gaster black, tergites and sternites 2–6 progressively more reddish. Wings light brownish hyaline, length 20·0–22·0 mm.

Clypeus acute below, lower quarter shining with close large punctures and short pale bristles, upper part duller with close granulation and sparse pale tomentum; frons dull, granulate with small punctures bearing black outstanding bristles in front, tomentum white, not dense; gena a little more than half as wide as eye in profile, dull, granulate, unpunctured except on malar space which is more shiny; base of submentum and stipes with dense long, black bristles; antennal segment 3 much longer than 4 + 5, 4 more than 1·5 times, 5 less than 1·5 times as long as broad, 8 distinctly less than 1·5 times as long as broad. Mesoscutum and humeri dull, coarsely granulate, unpunctured with short, not very close, outstanding black hairs; mesopleuron with some sparse, shallow punctures; scutellum and metanotum granulate with a few weak punctures, former with a short raised line in front; propodeum granulate with traces of striae below with sparse white tomentum and moderately numerous, long black hairs; posterior depression half as long as propodeum, impressed line strong, complete, anterior depression small, deep. Fore tarsus with fifth segment elongate; hind femur with dense tomentum and many rather long black and white bristles beneath. Gastral petiole rather long, distinctly thickened on apical third, many long hairs on basal half, spiracles moderately protruding; stalk of second gastral tergite 3·5–4·0 times as long as broad, gaster posteriorly with dense silvery tomentum but no bristles. The stalk is a little shorter than in *B. prasina*.

**MALE.** Not seen.

**DISTRIBUTION.** **Madagascar:** 2 ♀ including lectotype (one Saussure coll., other coll. by *Sikora*) (MHN, Geneva); 1 ♀, Nossi Bé (Saussure coll.) 1 ♀, unlocalized (BMNH); 1 ♀, Tananarive (RNH, Leiden); 1 ♀, Mont d'Ambu, 1904 (*Bourgoin*) (MNHN, Paris).

### *Belonogaster apicalis* de Saussure

(Figs 85, 86)

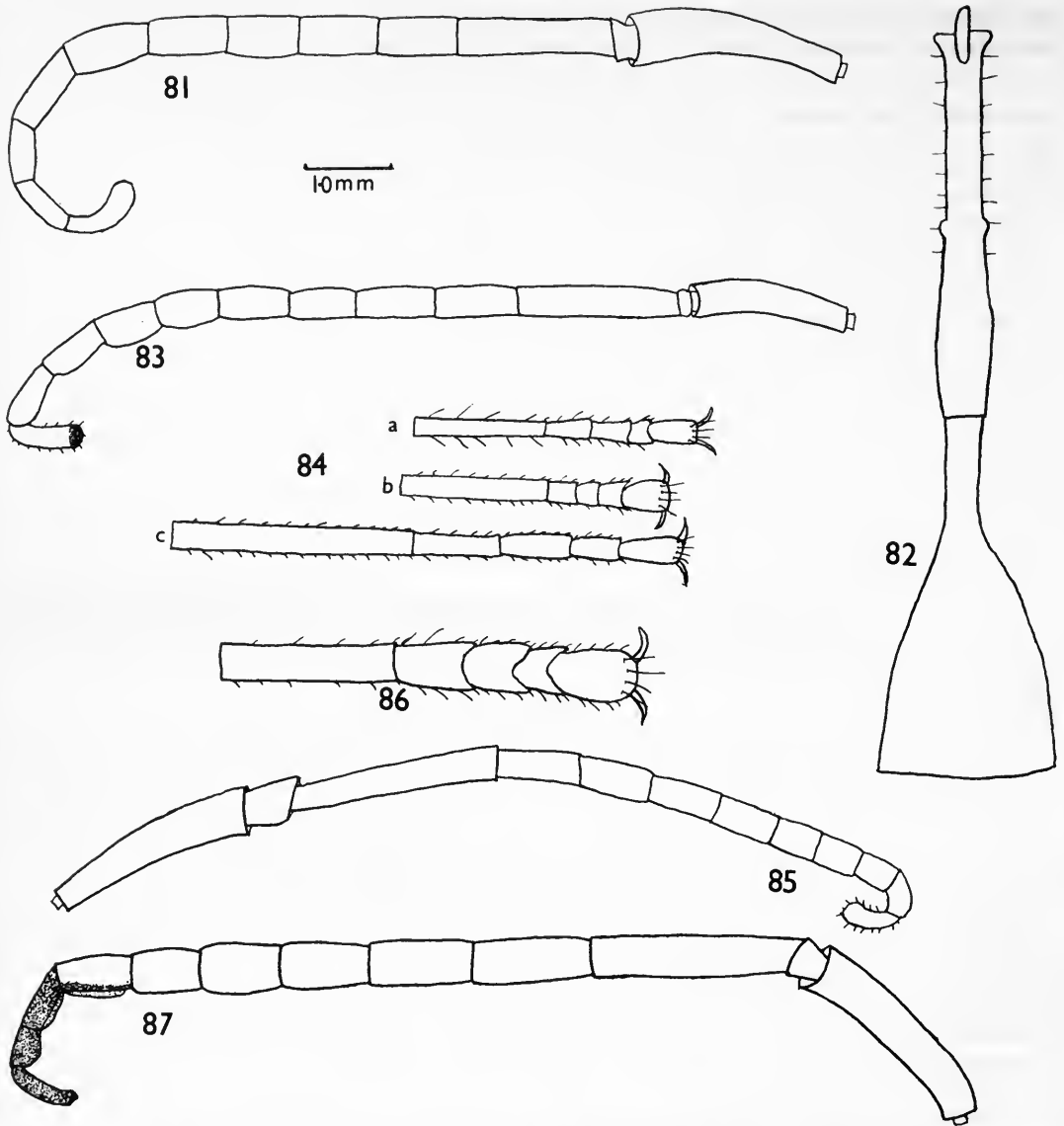
*Belonogaster apicalis* de Saussure, 1900: 207, 208. LECTOTYPE ♀, MADAGASCAR (MHN, Geneva), here designated [examined].

**FEMALE.** Black; mandibles pitchy; ventral quarter of clypeus dark ferruginous; antenna ferruginous, segments 1 and 2–3 above, blackened; tarsi more or less reddened. Stalk of second gastral tergite more or less ferruginous. Wings dark grey, large tips light red-brown, length 18·5 mm.

Mandibles with four teeth, dorsal one very short; clypeus acute below, lower quarter shining with close large punctures, above dull, closely granulate with close brownish tomentum and long outstanding brown, hair-like bristles; frons closely granulate with close brownish tomentum and outstanding blackish hairs; gena slightly more than half as broad as eye in profile, with close brownish pale tomentum and below granulate with some small punctures. Antenna with segment 3 distinctly longer than 4 + 5, 4 about 1·75 as long as broad, 5 less than 1·5 times as long as broad, 8 just longer than broad. Mesoscutum and humeri dull, finely granulate, no punctures, apparently brownish tomentum and outstanding brown hairs; scutellum with no mid line, it and metanotum like the mesoscutum; mesopleuron granulate with indistinct punctures; propodeum very closely and strongly reticulate (almost punctured) with tomentum and outstanding hairs, posterior depression one-third as long as propodeum, impressed line very weak, anterior depression almost obsolete. Fifth segment of fore tarsus elongate; hairs beneath fore coxa mainly pale; mid and hind femora beneath with close tomentum and short outstanding hairs. Gastral petiole rather long, base rather narrow, apex considerably widened, spiracles moderately protruding; stalk of second gastral tergite three times as long as broad; gaster posteriorly with close fine tomentum.

**MALE.** Ferruginous; antennal segment 1 and 9–12 more or less darkened; frons sometimes black; gena sometimes darkened. Mesoscutum a little darkened. Mid femur dorsally and posteriorly and hind femur blackened. Gaster dark ferruginous to black, stalk of second gastral tergite paler ferruginous. Mandibles (base sometimes black), clypeus except central stripe, inner orbits, spot between the antennal sockets, white; ventral margin of clypeus pitchy or black. Wings light brownish, length 19·0–20·0 mm.

Mandibles parallel-sided, dorsal tooth very short. Clypeus obtusely projecting below, tip just rounded,



**Figs 81–87** *Belogaster*. 81, *B. guerini* (de Saussure), ♂, left antenna. 82, 83, *B. madecassa* (de Saussure). (82) ♀, gastral tergites 1–2; (83) ♂, left antenna. 84, *B. keiseri* sp. n., ♂, fore (a), mid (b) and hind (c) tarsus. 85, 86, *B. apicalis* de Saussure, ♂. (85) left antenna; (86) fore tarsus. 87, *B. prasina* de Saussure, ♂, left antenna.

slightly transversely convex, very finely reticulate, slightly shining, some black bristles on central stripe, tentorial pits prominent, subantennal plate rather prominent with sides well defined; mandibles bare except for a small patch of short silvery hairs, sides of clypeus with moderately long outstanding silvery hairs; frons dull, reticulate with a few outstanding brown hairs; eyes a little swollen, gena receding about one-third of width of eye in profile. Antenna (Fig. 85) with segment 3 just longer than 1, about 6 times as long as broad, a little longer than 4 + 5, 4 a little more than, 5 a little less than 2.5 times as long as broad, 8 just more than twice as long as broad, 12 with fine hairs, moderately shining, a little flattened, slightly curved, end rounded truncate, about as long as 10, 11 somewhat thinner than 10, 10 a little thinner than 9, 10 and 11 with a raised shining line beneath, 6–9 with a raised line beneath. Humeri and mesoscutum dull, finely reticulate with a few indistinct punctures; humeri with not very dense oblique brownish bristles and quite dense silvery

tomentum, mesoscutum with fairly close short pale brown tomentum; scutellum and metanotum with some short outstanding black bristles; propodeum dull, reticulate with silvery tomentum and short hairs; posterior depression shallow, one-third as long as propodeum, impressed line weak or in second male strong, anterior depression almost obsolete. Mesosternum and coxae with pale tomentum and hairs; fore tarsus (Fig. 86) with last segment rather short and broad, mid tarsus rather less so; femora beneath with close silvery tomentum but no bristles. Gastral petiole moderately long, basally narrow but part behind spiracles rather broad, with silvery tomentum and short hairs beneath, spiracles moderately protruding; stalk of second gastral tergite 2.5 times as long as broad, gaster posteriorly with fine pale tomentum but no bristles; last sternite obtusangulately emarginate with a fringe of brownish bristles.

**DISTRIBUTION.** **Madagascar:** lectotype ♀ (MHN, Geneva) (not in good condition); 2 ♂, Tananarivo (RNH, Leiden).

*Belonogaster prasina* de Saussure

(Figs 87–89)

*Belonogaster prasinus* de Saussure, 1891: 92, pl. 19, fig. 5. **LECTOTYPE** ♂, **MADAGASCAR** (Scott-Elliott) (coll. de Saussure, MHN, Geneva), here designated [examined].

This species was described from Madagascar: 'forêts à l'est de l'Antsihanaka' (1 ♀ coll. Oberthür), Nossi Bé (variety), and several of both sexes collected in the environs of Fort Dauphin by Scott-Elliott (coll. de Saussure). There are in MNHN, Paris 5 ♂ collected by Scott-Elliott, three of which are labelled *prasinus*; one of these has been labelled lectotype.

**FEMALE.** Head yellow, large spot on dorsal half of clypeus, spot between antennal sockets, frons, blue-green. Pronotum dorsally blue-green, front and lower angles, yellow; front of mesoscutum with a blue-green patch on either side, mesosoma otherwise yellow or yellow-brown. Legs yellow to yellow-brown with mid and hind femora mainly blue-green. Gaster yellow-brown, petiole, basal two-thirds of second tergite, small basal area on tergites 3 and 4, basal two-thirds of sternite 2, blue-green. Wings yellowish hyaline, length 16.5–21.0 mm, mean (24 specimens) 19.0 mm.

Mandibles not specially broad; clypeus acute below, ventral half especially but the whole with moderate-sized punctures and scattered pale bristles, moderately shining, very fine reticulate, sparse pale tomentum; frons dull, finely granulate, punctures hardly discernible, some outstanding white hairs; gena about two-thirds as wide as eye in profile, slightly shining, very finely reticulate with scattered fine punctures below; base of submentum and stipes with a few pale bristles; antenna with segment 3 a little longer than 4 + 5, 4 nearly 1.5 times as long as broad, 5 nearly 1.25 times, 8 just longer than broad. Mesoscutum and humeri rather finely granulate, no punctures, sparse white tomentum; mesopleuron with scattered small punctures and sparse pale tomentum; scutellum and metanotum dull, granulate with weak punctures, former with a weak impressed line on posterior half; propodeum hardly punctured, striate, especially below, numerous short pale hairs and a little pale tomentum, posterior depression one-third as long as propodeum, impressed line strong and complete, anterior depression very small, deep. Proepisternum and fore coxae with white bristles; last segment of fore tarsi hardly shortened; hind femur with pale tomentum and scattered not very long pale hairs beneath. Gastral petiole (Fig. 89) long, distinctly widened on apical third, spiracles not prominent, hairs on basal half rather short and not very numerous; stalk of second gastral tergite 3 times as long as broad; gaster posteriorly with not very dense white tomentum but no bristles.

**MALE.** Head yellow, antennae more orange, with segments 10–12 black, 7–9 partly black beneath; frons in large central area blue-green, mesosoma yellow, humeri, part of mesoscutum, scutellum, faint cloud on propodeum, blue-green. Legs pale yellow-brown, hind femora a little darker, fore tarsi whitish, darkened blackish above. Gaster light yellow-brown, petiole with basal three-quarters, segment 2, base of tergites 3–4, blue-green. Wings yellow-brown hyaline, length 17.5–18.0 mm.

Mandibles moderately broad with white tomentum on basal half; clypeus (Fig. 88) gently rounded below, protruding a little beyond the lateral lobes, sides and orbits whitened with dense silvery tomentum, surface dull, rather flattened, hardly punctured; frons finely granulate, hardly punctured, a moderate number of outstanding white hairs; gena one-third as wide as eye in profile, dull, very finely granulate, not punctured; antennal (Fig. 87) segment 3 nearly as long as 4 + 5, 4 short, longer than, 5 just shorter than 2.5 times as long as broad, 8 2.5 times as long as broad, 12 shining black, a little curved, hardly flattened, about as long as 10, end rounded, a few very short hairs, 10 and especially 11 with an elongate hump beneath, 9 with a raised line beneath, 6–8 with weak raised lines. Mesoscutum and humeri dull, finely granulate, not punctured, rather sparse pale tomentum, humeri with some very short outstanding hairs; mesopleuron similar;



scutellum and metanotum with some very weak punctures, former with a weak central line; propodeum dull, finely granulate, some very weak striae below, sparse tomentum and moderately numerous outstanding short pale hairs, posterior depression not quite half as long as propodeum, impressed line strong, complete, anterior depression very small, deep. Proepisternum and fore coxae with silvery hairs; fore and mid tarsi distinctly short and broad; hind femur with weak tomentum and no bristles beneath. Gastral petiole long, distinctly widened in posterior third, spiracles a little projecting, basal half with numerous very short hairs; stalk of second gastral tergite 3 times as long as broad; posterior part of gaster with close fine yellowish tomentum but no bristles.

**DISTRIBUTION. Madagascar:** 5 ♂ (including lectotype), near Fort Dauphin, (*Scott-Elliott*); 1 ♀, 'Madagascar' (*Sikora*); 1 ♀ (no other data) (MHN, Geneva); 1 ♀, Joffreville, 11.v.1958 (*F. Keiser*); 1 ♀, Tam [?atave], Perinet, 13.iv.1958 (*F. Keiser*) (RNH, Leiden); 1 ♀, east, near Fort Dauphin, 1901 (*Alluaud*); 1 ♀, Valley of Ambolo, Col of Sakavalana, 1901 (*Alluaud*); 2 ♀, Isle Sainte Marie, 1898 (*R. Oberthür*); 3 ♀, Bay of Antongil, 1898 (*A. Moquerys*); 1 ♀, Légon, 1903 (MNHN, Paris); 1 ♂, Fort Dauphin, 1891; 1 ♂, Ft Dauphin 500 m, 15.iv.1968 (*K. M. Guichard*); 1 ♂, Fort Dauphin, Mandena, 100 m, 14–18.iv.1968 (*K. M. Guichard, P. Dechappe*); 13 ♀, Tulear Province, Zombitsy Forest, 300 m, 22.iii.1968 (*K. M. Guichard, P. Dechappe*); 1 ♀, Valley of Sambirano, 1934 (*Mellis*) (BMNH).

The species varies considerably in the extent and the shade of the blue-green markings. It also varies in size; the 9 ♀ in MNHN, Paris have wing-length 17.0–21.0, mean 19.1 mm, whereas the 15 ♀ in BMNH have wing-length 16.5–20.0, mean 18.8 mm.

There are two females in MNHN, Paris in bad condition, one headless, which were apparently identified by du Buysson as *B. longestylus*, though they do not at all agree with the original description. They seem to be a form of *B. prasina*, though the stalk of the second gastral tergite is rather longer compared with its width and the background colour is blackish brown rather than yellow-brown.

#### *Belonogaster maromandia* sp. n.

**FEMALE.** Ferruginous; frons, sometimes gena dorsally, thorax usually more or less, gastral petiole and stalk of second tergite, sometimes some suffusion of gaster posteriorly, coxae and femora (more or less), blackened, the black somewhat greenish especially on gena, pronotum and pleuron. Wings reddish brown, tips if anything, paler, length 16.5 mm.

Mandibles with three acute ventral teeth and a much shorter and blunter dorsal one; clypeus acute below, surface dull, finely reticulate with moderately close and large punctures, mainly on disk, bearing short brown or paler bristles, rather dense whitish tomentum; frons dull, finely reticulate with sparse fine punctures and on disk short outstanding brown bristles and whitish tomentum; gena slightly more than half as wide as eye in profile, dull reticulate, margin weak; antennal segment 3 a little longer than 4 + 5, 4 nearly twice, 5 rather more than 1.5 times as long as broad, 8 rather longer than broad. Mesoscutum dull, reticulate, with sparse fine punctures, especially at sides, and fine close brown tomentum; humeri and mesopleuron similar but punctures more numerous and tomentum paler; scutellum and metanotum with numerous punctures and short outstanding bristles; propodeum dull, strongly reticulate, a few striae on the angles, especially ventrally, with close pale tomentum and not very close outstanding brown bristles, posterior depression rather less than half as long as propodeum, impressed line strong to mid point, anterior depression weak, transverse. Last segment of fore tarsus elongate; longer bristles of fore coxa and mesosternum light brown; mid and hind femora with short white bristles and whitish tomentum beneath. Gastral petiole rather long, slender, spiracles little prominent, distal part a little widened but slightly narrowed to apex, tomentum close and pale, short outstanding hairs numerous; stalk of second gastral tergite nearly 3 times as long as broad, gaster posteriorly with close pale tomentum and short obliquely projecting pale bristles.

**MALE.** Not seen.

Holotype ♀, **Madagascar:** Province de Amalalava, Maromandia, 1923 (*Decary*) (MNHN, Paris).

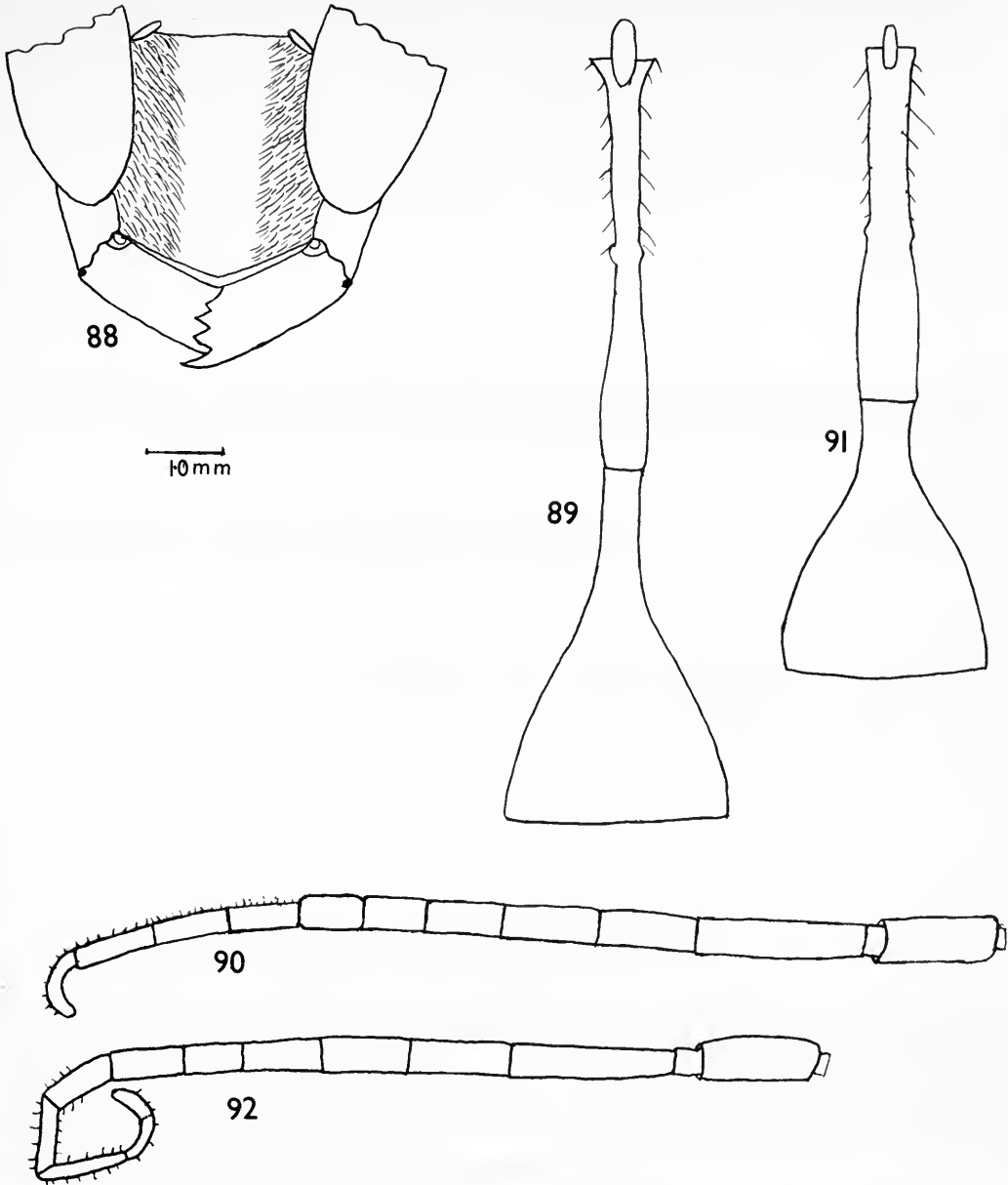
Paratype. 1 ♀ with same data.

#### *Belonogaster hildebrandti* de Saussure

(Fig. 90)

*Belonogaster hildebrandti* de Saussure, 1891: 95, pl. 17, fig. 11. LECTOTYPE ♀, MADAGASCAR (MNHU, Berlin), here designated [examined].





**Figs 88–92** *Belonogaster*. 88, 89, *B. prasina* de Saussure. (88) ♂, clypeus; (89) ♀, gastral tergites 1–2. 90, *B. hildebrandti* de Saussure, ♂, left antenna. 91, 92, *B. eumenoides* de Saussure. (91) ♀, gastral tergites 1–2; (92) ♂, left antenna.

This species was described from male and female specimens in MNHU, Berlin collected in the central region of Madagascar. In MNHU under this name are 2 ♂, 2 ♀ labelled Madagascar. The males are in very bad condition and I have labelled one of the females as lectotype. The only other specimens I have seen are 1 ♂, 1 ♀ in BMNH; the specimens under this name in MNHN, Paris, do not agree with the description and seem to me to be *B. madecassa*.

**FEMALE.** Head ferruginous, mandibles, ventral third and sides of clypeus, malar space, yellow or yellow-tinged; frons, scape and antennal segments 2–9 above, black. Mesosoma yellowish ferruginous, humeri

except front margin, mesoscutum, dorsal side of propodeum, blackish. Fore coxae yellowish, mid coxae blackish ferruginous, hind coxae black; femora black, tip of front pair yellow; tibiae yellow, hind pair narrowly black at apex; fore and mid tarsi dark ferruginous, hind tarsi black. Gaster with petiole, anterior two-thirds of tergite 2, small basal area of tergites 3–5, black, the rest yellow but the yellow of 3–5 narrowly interrupted near apex; sternite 2 with base dark. Wings pale reddish brown, length 12.0 mm.

Clypeus acute below, surface finely reticulate and apparently with many large punctures and dense moderately long, pale hairs; frons granulate without punctures or outstanding bristles; gena half as wide as eye in profile, shining, finely reticulate, not punctured; antennal segment 3 distinctly longer than 4 + 5, 4 1.5 times as long as broad, 5 rather less, 8 just longer than quadrate. Mesoscutum dull granulate, not punctured, short pale rather dense tomentum, mesopleuron, scutellum and metanotum similar; propodeum dull, granulate with dense long pale tomentum and some outstanding pale hairs, no punctures or striae, posterior depression one-third as long as propodeum, no impressed line, anterior depression very small. Last segment of fore tarsus elongate; femora with a few pale bristles beneath. Gastral petiole long, rather narrow, little widened at apex, spiracles little projecting, numerous appressed and some outstanding hairs; stalk of second gastral tergite about twice as long as broad, gaster posteriorly with fairly close pale tomentum but no bristles.

**MALE.** Light ferruginous; mandibles, wide sides of clypeus, spot between antennal sockets, upper orbits, white; stripes on coxae, femora and tibiae more or less whitish; propodeal valves whitish; second gastral tergite with sides and apex rather narrowly whitish, 3–4 similar but much less distinctly, sternite 2 with a whitish apical band. Mid tibia and tarsi darkened, hind tarsi and dorsal side of hind tibiae black. Wings hyaline, venation brown, length 12.0 mm.

Mandibles parallel-sided with three acute teeth and a much shorter dorsal one; clypeus obtusely and not very much protruding, almost a little truncate, surface dull, very finely granulate, base of mandibles and sides of clypeus with short outstanding white hairs; anterior tentorial pits and sides of subantennal area rather distinct; frons granulate with some outstanding hairs and silvery tomentum; eyes a little swollen, gena hardly one-third as wide as eye in profile, finely reticulate; antenna (Fig. 90) with segment 3 a very little shorter than 4 + 5, 4 nearly 4 times as long as broad, 5 rather shorter, 8 nearly 2.5 times as long as broad, 9–12 somewhat more slender, 12 subcylindrical, slightly curved, end rounded, about as long as 11, 8–12 shining beneath, no segment projecting. Mesoscutum and humeri finely granulate, very indistinctly punctured, with long pale brown tomentum; propodeum granulate with not very close pale tomentum and short outstanding pale hairs below; posterior depression nearly half as long as propodeum, impressed line hardly developed, anterior depression very small. Last segment of fore and mid tarsus a little widened; mid and hind tibiae with a little tomentum but very few hairs beneath. Gastral petiole rather long and slender, spiracles a little projecting, petiole little widened posteriorly, a little tomentum and some short outstanding hairs; stalk of second gastral tergite a little more than twice as long as broad; gaster posteriorly with close silvery tomentum and no bristles.

**DISTRIBUTION.** **Madagascar:** 2 ♂, 2 ♀ (including the ♀ lectotype) (MNHU, Berlin); 1 ♂, 1 ♀, **Betsileo**, 1882 (*Rev. W. D. Cowan*) (BMNH).

### *Belonogaster eumenoides* de Saussure

(Figs 91, 92)

*Belonogaster eumenoides* de Saussure, 1891: 94. **LECTOTYPE** ♀, **MADAGASCAR**, Andrangoloakā (MHN, Geneva), here designated [examined].

?*Belonogaster pomicolor* de Saussure, 1900: 209. Syntypes ♂ ♀, **MADAGASCAR** (not located).

?*Belonogaster ornatus* de Saussure, 1900: 209. Syntypes ♂ ♀, **MADAGASCAR** (not located).

?*Belonogaster malagassus* de Saussure, 1900: 210. Syntypes ♂ **MADAGASCAR**: Nossi Bé (not located).

**FEMALE.** Colour variable. Dark ferruginous; mandibles and face sometimes yellow; propodeal valves yellowish; antennal segments 1–2, legs more or less, gaster, blackened, gastral petiole black. Wings very pale fuscous, length 12.5–15.0 mm. *Or* black, mandibles, malar space, face below antennal sockets, ocular sinus, yellow; antennal segments 3–11 and gena, ferruginous; pleuron, sternum, side of propodeum more or less, fore tarsi, ferruginous; large base of gastral petiole, base of stalk of second tergite, blue-green. Wings light brown, length 11.5–12.0 mm. Two further females are almost entirely ferruginous, wing-length 12.5–14.5 mm, stalk of second gastral tergite unusually short, 1–2 times as long as broad.

Mandibles parallel-sided with acute teeth; clypeus acute below, finely reticulate, lower third more shining with large punctures, scattered brown bristles and fine pale tomentum; frons granulate, some indistinct punctures, many short brown outstanding bristles; gena a little more than half as wide as eye in profile, dull,

finely reticulate; base of submentum and stipes with a few long bristles; antenna with segment 3 much longer than 4 + 5, 4 not quite 1.5 times as long as broad, 5 about 1.25 times as long as broad, 8 quadrate. Mesoscutum, humeri and mesopleuron finely granulate with numerous small shallow punctures and fairly close pale tomentum; scutellum and metanotum similar but without punctures, former with an impressed line on front half; propodeum granulate with some weak striae on angles, close pale tomentum and numerous pale outstanding hairs, posterior depression one-quarter as long as propodeum, impressed line short but strong, anterior depression scarcely developed. Last segment of fore tarsus short, femora beneath with rather close tomentum but no bristles. Gastral petiole (Fig. 91) rather long and narrow, little widened posteriorly, spiracles not projecting, with sparse tomentum and no bristles; stalk of second tergite usually 2.5 times as long as broad, gaster posteriorly with close pale tomentum but no bristles.

**MALE.** Light ferruginous-brown, mandibles, malar space, narrow genal streak next to eye, wide stripes from centre of ocular sinus to bottom of clypeus, whitish yellow; spot between antennal sockets, antennal segments 1–2, basicostal plate, anterior streaks on fore and mid femur, anterior streak on all tibiae, narrow end and sides of tergite 2, narrow end of sternite 2, broad streaks beneath coxae, meso-metasternum broadly, ventral points of pronotum, creamy white; mid and hind tibiae blackish brown above. Wings light brown, length 12.0 mm.

Structurally like the ♀; antenna (Fig. 92) with segment 12 long, narrow, cylindrical, curved, with a trace of a division rather before the middle, as long as segment, 9, 6–10 with a feeble raised line beneath, 9–11 not shining beneath; few punctures at sides of mesoscutum, many on mesopleuron. Gastral petiole less widened posteriorly than in *B. hildebrandti*, stalk of second tergite twice as long as broad.

**DISTRIBUTION.** **Madagascar:** 7 ♀ (including lectotype), 1 ♂, Andragoloakã (MHN, Geneva); 4 ♀, Annanarivo (MHN); 16 ♀, Betsileo (*Rev. W. D. Cowan*) (BMNH); 1 ♀, Fort Dauphin, Mandena, 100 m, 14–18.iv.1968 (*K. M. Guichard, P. Dechappe*); 1 ♀, Fort Dauphin, 500 m, 15.iv.1968 (*K. M. Guichard*) (BMNH); 1 ♂, 1 ♀, 'Madagascar', (de Saussure coll.) (MNHN, Paris); 1 ♀, Antanambe; 4 ♀, Nossibé, 12.iii.1952 (*V. J. Tipton*) (USNM, Washington).

Two further females from Madagascar: Fort Dauphin, v.1937 (*A. Seyrig*) (MNHN, Paris), described below, are perhaps a form of this species.

**FEMALE.** Light ferruginous, face and lower gena yellowish, scape and frons greenish black; humeri, mesoscutum, dorsal area on propodeum, greenish black; fore leg with femur and tibia green; basitarsus black; mid and hind legs green, tarsi with segments 2 or 3 to 5 ferruginous. Gaster with petiole and stalk of second tergite green, gaster posteriorly blackish, tergite 2 preapically with two almost joining comma-shaped, pale yellow spots; apical part of tergites 3–4 and whole of 5–6, ferruginous. Wings hyaline, venation ferruginous, length 12.0 mm.

Structurally similar, but stalk of second gastral tergite only twice as long as broad. Thoracic sculpture rather weaker.

There are in the MNHN, Paris, two small nests of the usual type from Tamatave, associated with this species.

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# The taxonomy and phylogeny of the genus *Polyura* Billberg (Lepidoptera: Nymphalidae)

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## Synopsis

The relationship of *Polyura* to the other Old World Charaxinae is discussed, and a phylogeny of the 26 species is constructed using 38 listed characters, convergences for three characters being postulated. The distribution of the genus is assessed and compared with the constructed phylogeny. A key to the 100 specific

and subspecific taxa is given, together with a taxonomic revision of each species and subspecies, while existing bionomic and early stage information is included as an aid to future workers. One new subspecies is described, 78 lectotypes designated and 21 new synonyms established.

## Introduction

The 26 species of the largely Indo-Australian genus *Polyura* Billberg have rarely been dealt with collectively; more usually one or two species have been investigated in isolation. The most notable exception (Rothschild & Jordan, 1898; 1899) dealt comprehensively with the group under the invalid name *Eulepis* Scudder (see p. 126).

*Polyura* has much in common with the largely Afrotropical genus *Charaxes* Ochsenheimer, and the two have often been considered congeneric, whilst together with *Palla* Hübner and *Euxanthe* Hübner they form the prionopterous (i.e. having the costal edge of the forewing serrate and thickened) Old World section of the Charaxinae. *Charaxes* can be divided into two groups on the basis of the relationship between the number of scale rows and the costal serrations at the centre of the underside of the forewing edge (Rothschild & Jordan, 1898: 552, 553), the apomorphic condition being approximately two scale-rows to each serration, other species having one scale-row to each serration. This latter, plesiomorphic condition is shared by *Polyura*, *Euxanthe* and *Palla*. A synapomorphy having not been found for *Charaxes* as it now stands, it can be seen that *Polyura* is just as likely to be a sister to the more specialized group of *Charaxes* species. However, for reasons outlined below, I believe *Polyura* possesses sufficient specializations to justify its separation from *Charaxes* at the generic level, and it can therefore be shown that *Charaxes* in its present usage is paraphyletic. As can be seen below, I regard *Polyura* as monophyletic, having its sister group within *Charaxes*.

Adults of *Polyura*, like *Charaxes*, are fast-flying butterflies; the males are highly territorial and exhibit patrolling, fighting and hill-topping behaviour. They are attracted to faeces and carrion, while both sexes are attracted to fermenting fruit and exuding plant sap. Where possible, fairly comprehensive behavioural notes have been incorporated into the systematic section, appearing under each subspecies. This is also true for early-stage information and a list of all recorded food plants is included. Bionomic and early-stage information, while not being comprehensive enough to assist much in the present task, is included here to aid and perhaps stimulate future workers to fill in the blanks, which are numerous. Such information may one day help to solve taxonomic problems which no amount of puzzling over dried museum specimens can.

The systematic section also includes a selective synonymy under species and subspecies headings. Under the subheading 'Size' is listed the mean length, in millimetres, of a straight line between the base and apex of the forewing ( $\bar{x}$ ) and the standard deviation of this measurement for the chosen sample (s). Measurements of fewer than six specimens are given in full without mean or standard deviation. Distributions give details of localities for material in the British Museum (Natural History), unless otherwise stated, and give alternative spellings or untraced localities in square brackets. Numbers of specimens studied are to be found following on from the distribution information. Type-material examined is noted under the relevant section giving verbatim quotes from the data labels. In each case the end of a label is marked by an oblique stroke (/).

The following abbreviations for depositories are utilized throughout the sections below.

AM, Sydney	The Australian Museum, Sydney.
BMNH	British Museum (Natural History), London.
MHN, Geneva	Muséum d'Histoire Naturelle, Geneva.
MNHN, Paris	Muséum National d'Histoire Naturelle, Paris.
MNHU, Berlin	Museum für Naturkunde der Humboldt-Universität, Berlin
RNH, Leiden	Rijksmuseum van Natuurlijke Historie, Leiden.
UM, Oxford	University Museum, Oxford.
ZSBS, Munich	Zoologische Sammlung des Bayerischen Staates, Munich.

## Acknowledgements

I would like to thank my colleagues at the British Museum (Natural History) for their support and comments, particularly Mr R. I. Vane-Wright, Mr P. R. Ackery, Mr J. Huxley, Dr R. W. Crosskey, and Mr A. C. Pont. In addition Dr J. D. Holloway, (Commonwealth Institute of Entomology), provided valuable advice. I would also like to thank my many friends and correspondents who assisted, in particular Mr R. A. Carver (Papua New Guinea); Dr I. F. B. Common for his help while I was studying the C.S.I.R.O. collections in Canberra; the Curator of the Hope Entomological Collections, University Museums, Oxford; Mr B. D'Abrera (Melbourne) for his information on behaviour and early stages; Dr R. de Jong, Rijksmuseum van Natuurlijke Historie, Leiden, for the loan of type-specimens; Messrs G. Dennis and B. Macfarlane (Honiara) for their help while in the Solomon Islands; Mr J. Plantrou (La Celle St Cloud, near Paris) for transparencies of *P. athamas* from Sulawesi; Fr A. Sacco (Vanuatu) for his information on *P. sacco*; Mr C. G. Treadaway (Frankfurt); and Dr P. Viette, Muséum National d'Histoire Naturelle, Paris. I would similarly like to thank the Photographic Unit, British Museum (Natural History), for the photographs reproduced in this paper.

## Phylogeny

It has not been possible to produce a complete, strictly dichotomous tree for *Polyura* due to limitations imposed by the lack of data in many areas. In particular the lack of bionomic and early-stage information has meant that the study has had to be restricted to those characters readily observed on dead imagines. The published cladogram is, then, the best which I could achieve with the available information, and I hope that the areas which remain unresolved may stimulate future workers to complete the picture.

For a list of definitions of the terms referred to in this discussion see Vane-Wright (1979: 43).

## Characters

A study based on the proposals put forward by Hennig (1966) must have as its starting point some reference group for the organisms under consideration, and this reference group should be the sister-group of the species in question; only by examining the characters under consideration in both groups can decisions be reached as to the relative degree of specialization in each character state.

In the present study it was clear from the beginning that the sister-group of *Polyura* would be found within *Charaxes*, for *Polyura* and *Charaxes* together form a monophyletic group. However, as is noted above, *Charaxes* is not monophyletic, but the sister-group of *Polyura* is likely to be within that group of *Charaxes* having one scale row to each serration on the costal edge (Leptodontiae, Poulton, 1926: 572), and this includes the species numbered from 56 to 119 in van Someren's synoptic list (1975: 114–117), and all species of Oriental *Charaxes*.

A survey of possible characters was made including an examination of the male and female genitalia, but these were found to be of little assistance. The male genital armature of *P. gilolensis* is illustrated (Fig. 1), and the majority of species depart little from this. There are differences, but also a great deal of intraspecific variation which is not dependent on geographical distribution. For example, the uncus may be simple or slightly bifid in two males of the same species from the same locality. Many slight differences in morphology are of this sort, others are often not sufficient to be able to satisfactorily discover apomorphies. Likewise the female genitalia show little that can usefully be utilized. A study of the venation again revealed little, but pattern, particularly that of the underside, was found to be very useful, and comparison was made utilizing the Nymphalid ground plan of Schwanwitsch (1924: pl. 1, fig. 1) in order to assist in establishing homologies. This figure is also reproduced by Vane-Wright & Huggins (1972: fig. 17) and Vane-Wright (1979: fig 27). Fig. 2 shows the wing pattern of the underside of *Polyura epigenes* with the pattern elements labelled according to Schwanwitsch.

Recently it has been common to refer to these pattern elements in the following manner, E<sup>1</sup> for the first externalis, M<sup>1</sup> for the first medialis etc., whereas Schwanwitsch originally referred to

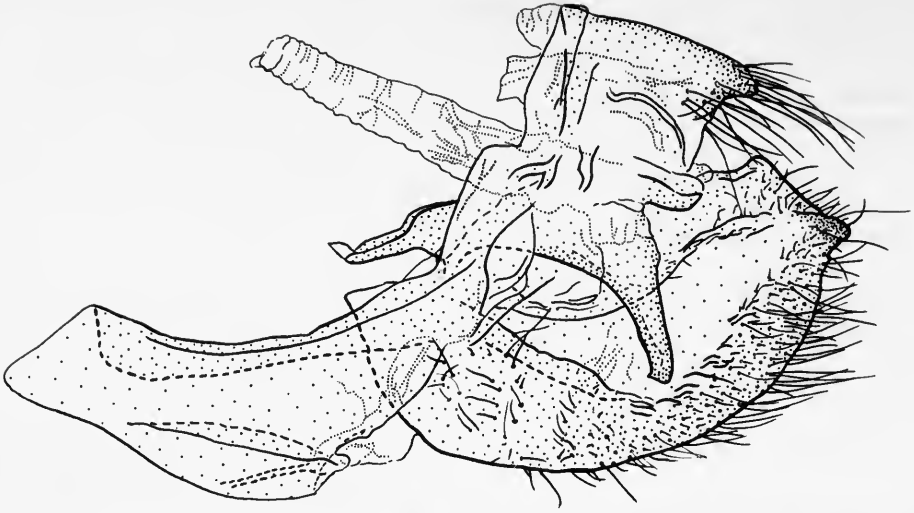


Fig. 1 *Polyura gilolensis gilolensis* (Butler), ♂ genitalia, lateral view, aedeagus and right valve removed.

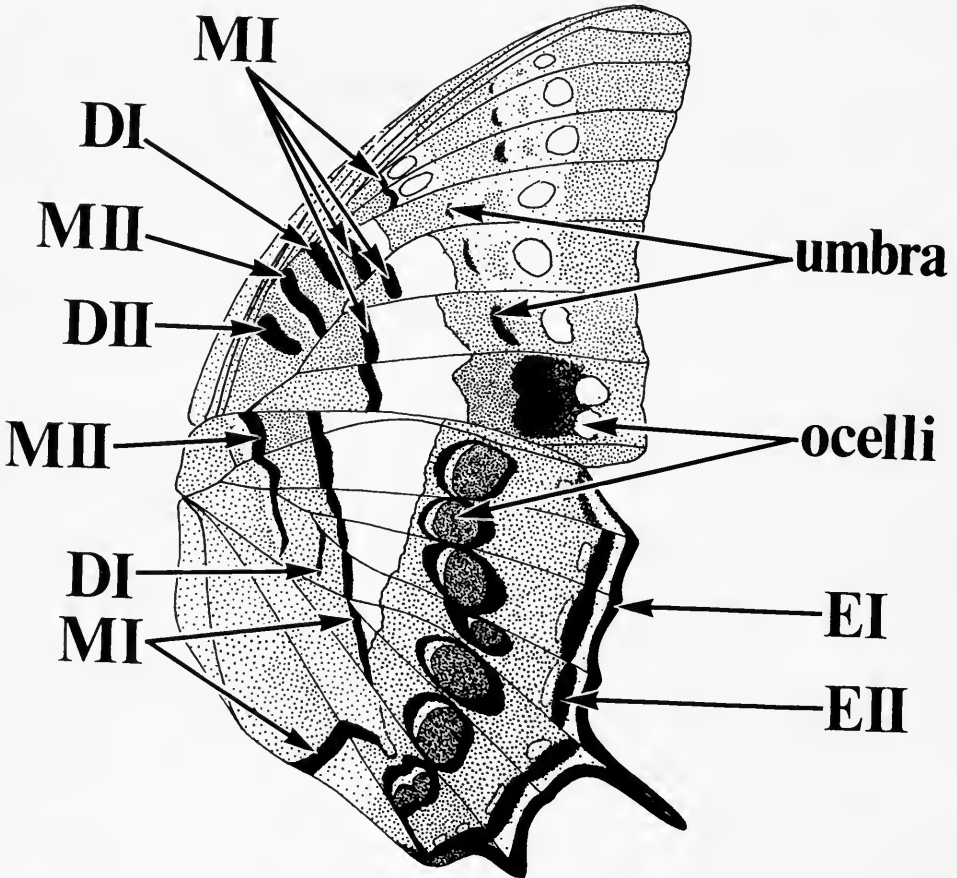


Fig. 2 *Polyura epigenes* (Godman & Salvin) ♀; pattern of underside with pattern elements labelled according to Schwanwitsch (1924).

them as EI, MI etc. changing, for no reason which has been disclosed, to this later method. I have decided here to revert to the original notation in order to avoid confusion with the abbreviations for veins e.g.  $M_1$ ,  $M_2$ ,  $R_5$  etc.

*Polyura* is accepted here as a monophyletic group and is separable from *Charaxes*, which contains the presumed sister-group of *Polyura*, on the basis of two characters.

A. All species of *Polyura* show a reduction in the number of pattern elements present in *Charaxes*. The basal element (B) is present in *Charaxes*, but is lost in all species of *Polyura* (the apomorphic condition). In addition, all species of *Polyura* show at least a reduction in the extent of DII in the hindwing. Indeed, only one species exhibits it at all, and this is the 'primitive' *P. gamma*.

B. All species of *Charaxes* have the hindwing cell closed by a non-tubular vein, and although this vein is small it is always present. *Polyura* species have the hindwing cell completely open, and I consider this character state to be apomorphic.

Below is a list of 38 characters which have been used in the construction of the cladogram. The presumed apomorphic state for each is indicated throughout by the first sentence of each section. In addition, a brief note gives a reason for ascribing this polarity.

1. First eight segments of the antennal club yellow. In the great majority of *Polyura* species, and in *Charaxes*, no more than the first four antennal club segments are light coloured in contrast to the rest of the antenna.

2. MI in cell  $Cu_{1a}$  of the hindwing underside parallel with  $Cu_{1b}$  or forming a small angle with it. Specimens of *Charaxes* generally have this section of MI either straight and forming a large angle or a right-angle with  $Cu_{1b}$ , or are sigmoid, with the section nearest vein  $Cu_{1b}$  in this cell at right-angles to it. *Polyura gamma* has this line more or less at right-angles to  $Cu_{1b}$ , whilst all other species, with the exception of *P. delphis*, have MI parallel or at a small angle. In *P. delphis* this line is often obliterated entirely, but when present it is often curved to form a semicircle; this is not surprising, considering the propensity for other portions of MI and MII to join to become circles in this species.

3. DII absent on the hindwing underside. *P. gamma* is the only *Polyura* species to retain DII in the hindwing. All species of *Charaxes* show DII in this region.

4. Hindwing underside with MII not extended into cell 2A. In all species of *Polyura* except *P. gamma*, the above holds true, but in *P. gamma*, and even more so in *Charaxes*, MII curves to enter cell 2A.

5. Strongly sexually dimorphic. Although many species of *Charaxes* are sexually dimorphic, this is not normally true of the section of the genus which is considered most likely, on present evidence, to be the sister-group of *Polyura*. Only one species of *Polyura*—*P. epigenes*—is strongly sexually dimorphic, and this character is therefore considered autapomorphic for that species.

6. Male genital valves each bearing two heavily sclerotized hooks. The common condition for species of *Charaxes* and *Polyura* is for the valve to bear only one, posterior, sclerotized hook.

7. Postdiscal spots of the hindwing underside forming a complete series, all elements being round and distinct, and surrounded by black. In the great majority of *Polyura* species these ocelli are either radically different (i.e. chevron-shaped or otherwise modified in the *eudamippus*- or *athamas*-groups) or are atrophied or missing in part. Only two species have a complete row of distinct, uniformly coloured, rounded ocelli on the underside. Of these, *P. gilolensis* differs in that each ocellus is not surrounded by black, but as is the case in the rest of the *pyrrhus*-group to which it belongs, it has a continuous black line proximally bordering the ocelli. This leaves *P. epigenes* as the only species satisfying in all details the criteria for the character state indicated above. It is possible that this could be regarded as an apomorphic transformation series between *P. epigenes* and *gilolensis*, but in any case it can be regarded as apomorphic, and is therefore a presumed reversion to the nymphalid ground plan (see above), for if this were not the case, then character states 8 and 13 would have to have arisen twice, and character state 10 would have to have arisen three times.

8. The anal veins (2A and 3A) of the hindwing underside overlaid with black scales, to form

two distinct black lines. This character state is present only in nine species of *Polyura*, and in no other Charaxine.

9. Rufous postdiscal ocelli are present on the hindwing upperside. In species of *Charaxes* and all but one of the species of *Polyura* postdiscal ocelli do not appear on the upperside of the hindwing.

10. DI on the hindwing underside fused with MI, or absent. In *Charaxes* DI is always present as a black line at the end of the discal cell of the hindwing.

11. MI on the hindwing underside forms a gentle curve to end on the anal margin. In *Charaxes* and in all species of *Polyura* except *P. clitarchus*, MI, where continuous, is irregular and zig-zagged.

12. MI absent from cell  $Cu_{1a}$ , but present in cell  $Cu_{1b}$  on forewing upperside. In most species of *Polyura* and *Charaxes* MI is present in both cells. In some species of *Polyura* it is present in cell  $Cu_{1a}$  and absent from cell  $Cu_{1b}$ , or absent from both cells, but this is not constant intraspecifically. One species of *Polyura*, *P. clitarchus*, constantly exhibits the character state described, for which it can be regarded as an autapomorphy.

13. Underside with MI, MII, DI and DII of both wings, and the black lines on the anal veins of the hindwing extremely thick. The normal condition for species of *Charaxes* and *Polyura* is to have these pattern elements quite narrow, usually not more than 0.5 mm thick. In the thickened state, regarded as apomorphic, the black lines on the anal veins are 1.5 to 2.0 mm wide, whilst DII on the forewing may be up to 4.0 mm thick.

14. The hindwing underside with postdiscal ocelli complete, not obliterated or reduced in cells  $R_1$  to  $M_2$ , the umbra forming a continuous black line proximal to the ocelli. Species of *Charaxes* normally have the postdiscal ocelli of the underside suppressed, whilst most species of *Polyura* show some reduction in cells  $R_5$  and  $M_1$ , and often in cells  $R_1$  and  $M_2$ . In the *eudamippus*- and *athamas*-groups, where there is little or no reduction of the ocelli in these cells, they are radically different in shape and structure. Only two species have a complete row of distinct, rounded postdiscal ocelli on the underside: one of these, *P. epigenes* having each ocellus completely surrounded by a black line, and the other, *P. gilolensis* conforming to the presumed apomorphic character state, which is therefore a presumed reversion to the nymphalid ground plan (see character 7).

15. Forewing underside with DII in the discal cell reduced to one or more spots, or absent. In *P. gamma*, *epigenes*, the *pyrrhus*-group, *cognata* and *dehanii*, DII forms a strong bar in the discal cell, the presumed plesiomorphic condition, whilst in the species of *Charaxes* which form the presumed sister-group of *Polyura*, DII forms a thin line, and although this may be suppressed or interrupted in part, it does not form rounded spots.

16. MI and MII of underside fused to form circles in cells  $Cu_{1a}$  of the forewing, and on the hindwing costal margin. This character state is unique to *P. dolon*, not being found in *Charaxes* or in other *Polyura*, and can therefore be considered an autapomorphy of this species.

17. Postdiscal ocelli of the hindwing underside yellow in cells  $R_1$  to  $M_2$ , and red thereafter. As in 16, this character state is unique to *P. dolon*, not being found in *Charaxes* or in other species of *Polyura*, and is therefore considered autapomorphic.

18. Forewing underside with very well-defined bands of like colour on the outer margin and postdiscally, proximally bordering the umbra. Most species of *Polyura* and species of *Charaxes* have no clearly defined bands at either of these sites, and certainly no band which corresponds with that on the outer margin.

19. Forewing underside with a well defined 'Y'-shape formed from MI, MII and DI, and the brown bands which these elements contain. The 'tail' of the 'Y' runs from cell  $Cu_{1b}$  to cell  $M_3$ , one 'arm' continuing along the end of the discal cell, and the other along vein  $M_3$ . This character state is found only in the *eudamippus*-group, and can therefore be considered apomorphic. Two species of this group linked with other members of the group by characters 21, 22, 25 and 26—*P. nepenthes* and *dolon*—do not have the second arm produced along vein  $M_3$ . On the grounds of parsimony this is regarded as a secondary loss (see character 26).

20. Underside of the hindwing possessing a costal band. Species of *Charaxes* and all species of *Polyura* except *P. posidonius* have no costal bar on the hindwing.



21. Forewing underside with MII split to form many small black spots in the discal cell. In *Charaxes* and in all but one species of *Polyura*, *P. posidonius*, MII is present as a black bar.

22. Underside of forewing with a brown costal band. Species of *Charaxes* and most species of *Polyura* are without a costal band on the forewing.

23. Postdiscal ocelli of the hindwing underside forming rufous lunules posteriorly, but anteriorly becoming a continuous bar. *Charaxes* and all species of *Polyura* except *P. narcaea* do not exhibit this character state.

24. Forewing upperside with a complete row of postdiscal and submarginal spots. In the majority of species of *Polyura* which have a series of postdiscal spots on the forewing upperside there is no similar submarginal series of spots. In the *eudamippus*-group, however, this does occur and this character state is considered synapomorphic for this group.

25. Hindwing underside with a complete series of postdiscal ocelli forming well-delineated chevrons, normally partly blue-centered, often yellow, and overlying a yellow band. This character state is unique to three species of *Polyura* and is not found in any species of *Charaxes*.

26. Oblique stroke of the 'Y' which would run along vein  $M_3$  of the forewing underside lost (see character 19). If this is regarded as a secondary loss then it can be considered to be an apomorphic character state.

27. MI, MII and DI (which form the reduced 'Y'-pattern mentioned in characters 19 and 26) thickened and interrupted at the veins. This character state is unique to *P. nepenthes*, and is absent from species of *Charaxes*.

28. MI is absent from cells 2A and 3A of the hindwing underside. In species of *Charaxes* and in all *Polyura* species except *P. dolon*, MI is present, lying across vein 2A of the hindwing underside.

29. Underside with areas of dark grey-green or grey-brown pigment. These occur as one area on the outer margin and submargin of the forewing (becoming more diffuse proximally), and a second area on the hindwing between the postdiscal ocelli, reaching almost as far as the externae, with a pale area underlying the postdiscal ocellus in cell  $R_5$ , and often, to a lesser extent, in cell  $M_1$ . The majority of species of *Polyura* and all the species of *Charaxes* lack these markings.

30. Hindwing underside with the postdiscal ocelli in cells  $R_5$  and  $M_1$  completely obliterated, except for a white patch in cell  $R_5$ . This character state is found in only two species of *Polyura* and never in *Charaxes*.

31. Hindwing tails strongly curved. Only *P. dehanii* possesses this character state, unique amongst the Charaxinae.

32. Forewing underside with a black costal band, running along the costal vein from the base to MI just beyond the end of the discal cell. This is found only in *P. cognata* and differs from the brown costal band of *P. narcaea*, *eudamippus* and *dolon* in colour, structure and extent, and so is probably not homologous. Other species lack such a band.

33. Submarginal ocelli of the forewing underside forming strongly delineated chevrons. This character state is unique to the *athamas*-group and is not present in other species of *Polyura* or *Charaxes*.

34. Postdiscal ocelli of the hindwing underside present in each cell, forming red lunules, delineated distally with black. This character state is unique to the *athamas*-group, and is not present in species of *Charaxes* or in other species of *Polyura*. In *P. posidonius* the ocelli appear superficially similar, but are not delineated with black distally, and are more 'ragged'.

35. MI and MII of the underside displaced basally. *P. arja*, *athamas*, *agraria*, *hebe*, *moori* and *jalyus* have MI and MII of the underside displaced basally relative to other species of *Polyura*, and to one another. The displacement of these pattern elements can be regarded as a transformation series.

36. Wing shape very elongate. Only *P. agraria* has the shape of the wings much more elongate than in any other species of *Polyura* or *Charaxes*.

37. Postdiscal ocelli of the hindwing underside present in each cell, forming red lunules delineated distally with black, and arranged in a gentle curve. This is true of *P. jalyus*, but in other species of *Polyura* the postdiscal ocelli of the underside are normally displaced proximally from cells  $R_1$  to  $M_2$ . This is the only species where this occurs in the *athamas*-group, and

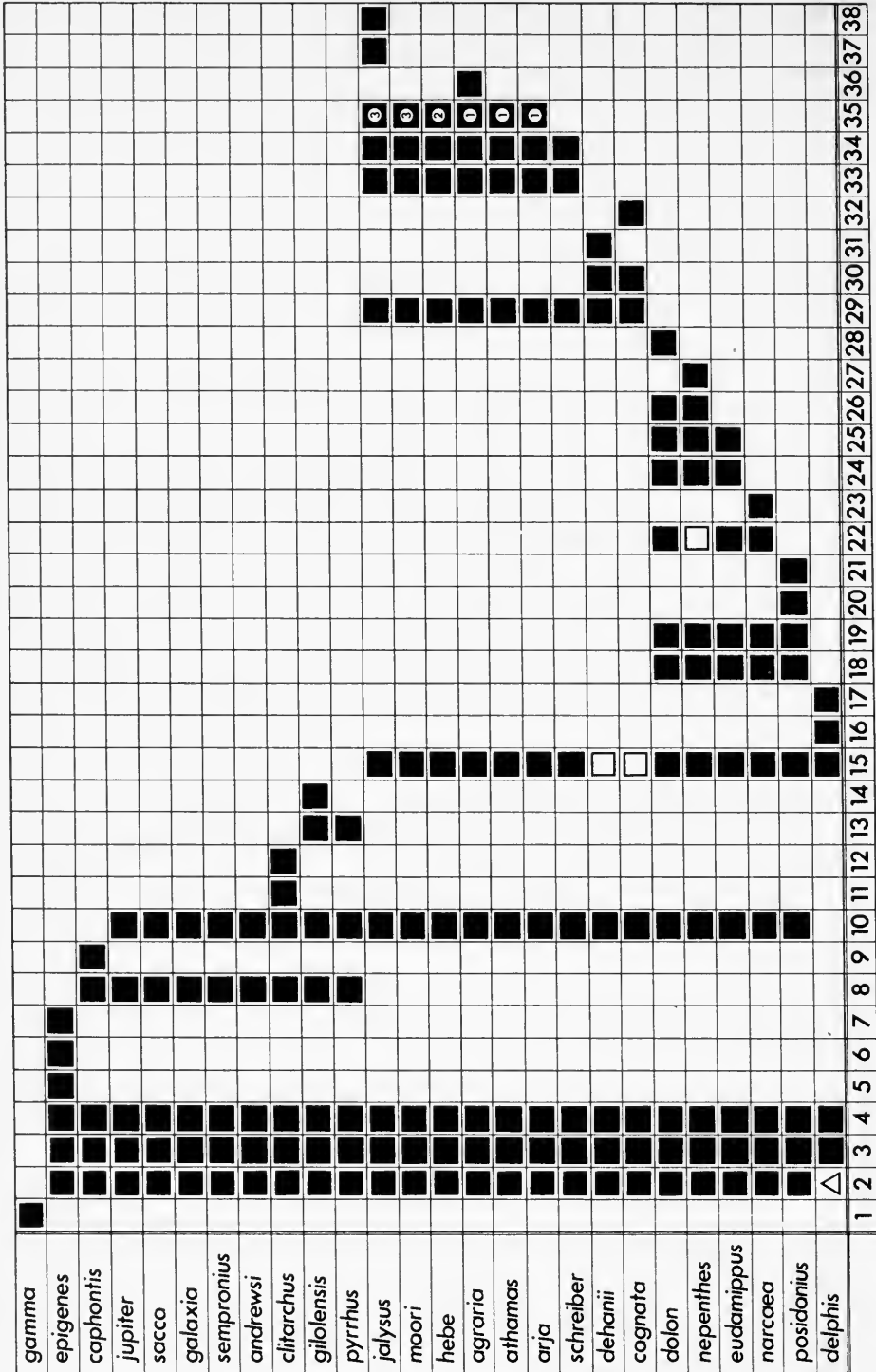
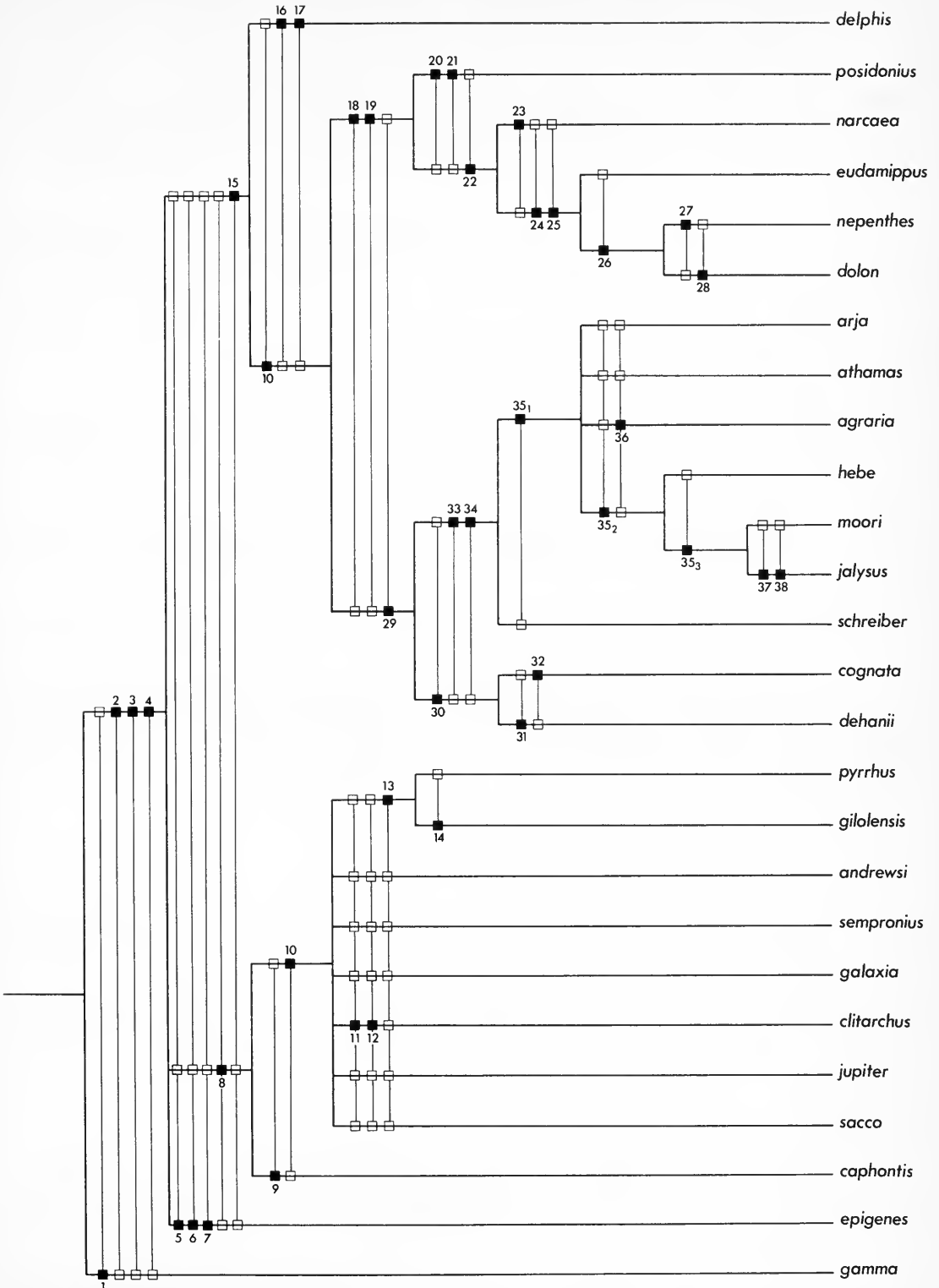


Fig. 3 Character matrix for the species of *Polyura*. The numbers along the bottom row refer to characters which are fully discussed in the text. Black squares indicate apomorphies, numbered black squares indicate apomorphic transformation series, white squares indicate probable secondary loss, and the triangle indicates an alternative character state whose relationship with other character states remains unclear (see under character 2 in the text).



**Fig. 4** Cladogram derived from the character matrix for the species of *Polyura*. Numbered black squares indicate apomorphies, and white squares the plesiomorphic condition for each character.

although a similar alignment of ocelli may occur in the *eudamippus*-group, in this case they are of radically different structure (see character 34).

38. Forewing underside with DII absent. Only *P. jalysus* has lost DII in this region, other species of *Polyura* and *Charaxes* possessing it.

### Derivation of cladogram

In any analysis of a group of butterflies of the size of *Polyura* there are likely to be convergences which produce inconsistencies in the character matrix (Fig. 3). The problem is to construct the most likely cladogram from the available evidence. The following are apparent convergences unveiled by an examination of the character matrix.

If character 10 is accepted as it stands, it proves inconsistent with characters 8 and 15. However, characters 8 and 15 can be accommodated if character 10 is assumed, on the grounds of parsimony, to have arisen twice as indicated on the cladogram. Likewise, if character 15 is accepted without question, it proves inconsistent with characters 10 and 29, but if on the grounds of parsimony *P. dehanii* and *cognata* are assumed to have secondary loss of character 15, characters 10 and 29 can be accommodated. Character 22 is apparently synapomorphic for *P. dolon*, *eudamippus* and *narcaea*. However, this proves inconsistent with characters 24, 25 and 26, and on the grounds of parsimony, secondary loss of character 22 can be assumed for *P. nepenthes*.

Unfortunately I have been unable to resolve adequately the *pyrrhus*-group, *P. arja*, *athamas* and *agraria*, or *P. epigenes*, and I have been unable to find autapomorphies for many species in the *pyrrhus*- or *athamas*-groups, although all but *P. agraria* are readily separable (see the systematic section).

In this paper I have chosen to recognize three species-groups, which are: the *pyrrhus*-group, being all those butterflies possessing character 8, i.e., *P. pyrrhus*, *gilolensis*, *andrewsi*, *sempronius*, *galaxia*, *clitarchus*, *jupiter*, *sacco* and *caphontis*; the *athamas*-group, being all those species possessing characters 33 and 34, i.e., *P. athamas*, *arja*, *agraria*, *hebe*, *moori*, *jalysus*, and *schreiberi*; the *eudamippus*-group, being all those species possessing characters 18 and 19, i.e., *P. eudamippus*, *posidonius*, *narcaea*, *nepenthes* and *dolon*.

### Distribution

Fig. 5 is a matrix listing species in the phyletic order chosen for the character matrix against selected key localities arranged in geographical sequence. The arrangement of these localities is largely a compromise, there being no adequate method of listing linearly, in spatial terms, localities within such a vast area as the Asian and Australian regions. Nevertheless, it is still possible to list localities with some regard to their geographical sequence, and this is attempted here.

As can be seen, there is a grouping roughly following a downward sloping diagonal line in the figure, which indicates that evidence from distribution supports the phyletic sequence of species chosen.

*P. andrewsi* from Christmas Island falls outside the general grouping. Christmas Island is geographically nearer to Java and the *athamas*-group, whereas the obvious affinities of *P. andrewsi* lie with the Australasian *pyrrhus*-group. It is also part of the Australian, rather than the South-East Asian plate and, when *P. andrewsi* reached it, was likely to have been closer to Australia than to Java, or the volcanic Lesser Sunda Islands, which are of relatively recent origin, and were then probably much smaller than they are today. Indeed, the probability that species have dispersed from Australia to Christmas Island becomes more likely the earlier that this dispersion is suspected as having taken place.

*Euploea core corrina* occurs in both Christmas Island and Australia whilst a separate subspecies—*E. core mazares*—occurs on Java (Ackery & Vane-Wright, in prep.). Also a number of butterfly species from the Cocos Islands have affinities with Australian species rather than species from the Sunda Islands (J. D. Holloway, pers. comm.).

When more is known about the geological history of the region, and about the biology and

	FIJI	NEW CALEDONIA	NEW HEBRIDES	SOLOMON IS	AUSTRALIA	BISMARCK ARCHIPELAGO	NEW GUINEA	EWAB IS	TIMOR	LESSER SUNDA IS	BALI	MOLUCCAS	SERAM	AMBON	BUBU	BATJAN	SULAWESI	PHILIPPINES	PALAWAN	BORNEO	NATUNA IS	JAVA	CHRISTMAS I.	SUMATRA	NIAS	MALAY PENINSULA	ANDAMAN IS	INDO-CHINA	HAINAN	TAIWAN	CHINA	BURMA	N INDIA	S INDIA	SRI LANKA	
<i>gamma</i>		•																																		
<i>epigenes</i>			•																																	
<i>caphonifis</i>		•																																		
<i>jupiter</i>								•																												
<i>sacco</i>									•																											
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<i>nepenthes</i>																																				
<i>eudamippus</i>																																				
<i>narcaea</i>																																				
<i>posidonius</i>																																				
<i>delphis</i>																																				

Fig. 5 Chart showing distribution of species of *Polyura*; the black spots indicate the presence of a species.

behaviour of the species concerned, then it may one day be possible to put a minimum date on the arrival of *P. andrewsi* on Christmas Island, and from this a minimum date for the split between the Australasian and the Asian species of *Polyura*.

## Systematics

### *POLYURA* Billberg

*Polyura* Billberg, 1820: 79. Type-species: *Papilio pyrrius* Linnaeus, by subsequent designation (Scudder, 1875: 255).

*Eulepis* Scudder, 1875: 170. Type-species: *Papilio athamas* Drury, by original designation. [Junior homonym of *Eulepis* Billberg (1820: 80).]

*Murwareda* Moore, [1896]: 263. Type-species: *Charaxes dolon* Westwood, by original designation.

*Pareriboea* Roepke, 1938: 346. Type-species: *Papilio athamas* Drury, by subsequent designation (Hemming, 1964: 126). [Invalid under Article 13b of the ICZN code, 1964.]

The generic nomenclature of the butterflies now contained in the genus *Polyura* was confused for many years. *Eulepis* was utilized by, among others, Rothschild & Jordan in the most definitive work on the genus to date, and *Eriboea* Hübner (a synonym of *Charaxes*) has been used by several other authors, including Fruhstorfer (1914). The situation was much clarified by Hemming (1934: 95) and a fuller account by him (Hemming, 1967: 167, 176) is briefly summarised below.

*Eulepis* Scudder is a junior homonym of *Eulepis* Billberg, an unrequired replacement name for the Riodinid genus *Nymphidium* Fabricius. When introducing *Eulepis*, Billberg included the name *athamas*, a manuscript name and therefore unavailable for citation as a type-species. Scudder mistakenly took this to be *Papilio athamas* Drury, and thus *Eulepis* to be a Charaxine genus.

Röber ([1909]: 169) realized Scudder's mistake and picked *Eriboea* as an alternative to *Eulepis* Scudder. He advanced the erroneous argument that *Papilio athamas* Drury was the type-species of *Eriboea*, whereas the true type-species is *Papilio etheocles* Cramer (by selection of Scudder, 1875: 166), a taxon currently referred to *Charaxes*.

The butterflies of the genus *Polyura* are closely allied with those of *Charaxes* but possess a non-tubular vein at the end of the hindwing discal cell, and have the number of pattern elements present on both sets of wings reduced, B being absent, and DII either absent or reduced.

RANGE. From India extending throughout South East Asia and China, through the Indonesian Islands, New Guinea and the Solomons to the Philippines, New Caledonia, Vanuatu, Fiji and Australia.

#### Key to species and subspecies

- |      |   |    |
|------|---|----|
| 1    | DI in hindwing underside at distal end of discal cell . . . . .   | 2  |
| –    | DI in hindwing underside absent or fused with MI . . . . .  | 11 |
| 2(1) | Postdiscal ocelli in hindwing underside complete. Strongly sexually dimorphic. Valve with two strongly sclerotized hooks . . . . .  | 3  |
| –    | Cells $R_5$ , $M_1$ , and sometimes $R_1$ and $M_2$ of hindwing underside with postdiscal spots atrophied or of different colour (except <i>gilolensis</i> ) to postdiscal spots in remaining cells. No strong sexual dimorphism. Valve with one strongly sclerotized hook . . . . .  | 4  |
| 3(2) | Male forewing upperside with yellow discal spot. <i>epigenes epigenes</i> (Godman & Salvin) (p. 134)  |    |
| –    | Male forewing upperside without discal spots . . . . . <i>epigenes monochroma</i> (Niepelt) (p. 135)  |    |
| 4(2) | MI in cell $Cu_{1a}$ of hindwing underside parallel with $Cu_{1b}$ or forming small angle with it . . . . .   | 5  |
| –    | MI in cell $Cu_{1a}$ of hindwing underside absent or forming an arc meeting $Cu_{1b}$ at a large angle  |    |
| 5(4) | Upperside with yellow discal bands very narrow . . . . . <i>caphontis caphontis</i> (Hewitson) (p. 135)   |    |
| –    | Upperside with yellow discal bands broad . . . . . <i>caphontis nambavatua</i> subsp. n. (p. 136)   |    |
| 6(4) | Hindwing outer margin strongly dentate. Upperside ground colour yellow with black apices to the forewings. Underside with MI and MII joined to form circular spots in several cells, all of which are centered with blue. No more than the first four antennal segments yellow. Uncus slightly produced posteriorly . . . . . | 7  |

- Hindwing outer margin slightly dentate. Upperside ground colour black-brown with yellow bands and spots. First eight antennal segments yellow. Uncus very blunt *gamma* (Lathy) (p. 133)
- 7(6) Forewing upperside with disco-basal patch normally extending as far towards the apex in cell  $M_1$  as in cell  $M_2$  . . . . . 8
- Forewing upperside with disco-basal patch extending much further towards the apex in cell  $M_2$  than in cell  $M_1$  . . . . . 9
- 8(7) Disco-basal patch in cell  $M_1$  of the forewing upperside normally containing a black blotch. Hindwing underside often with round spot in cell  $R_1$ . India, Bangladesh, Burma and Thailand *delphis delphis* (Doubleday) (p. 190)
- Black apex in forewing upperside very restricted. Disco-basal patch in cell  $M_1$  normally without a black blotch. Hindwing underside without a round spot in cell  $R_1$ . Palawan *delphis nivea* (Rothschild) (p. 192)
- 9(7) Subapical white spot of forewing upperside normally absent or occasionally reduced. Malaya, Singapore, Sumatra and Borneo *delphis concha* (Snellen van Vollenhoven) (p. 191)
- Subapical white spot of forewing upperside normally clearly defined . . . . . 10
- 10(9) Submarginal blue-grey lunules of hindwing upperside lacking any white pupil. Nias *delphis othonis* (Fruhstorfer) (p. 191)
- Submarginal blue-grey lunules of hindwing upperside with a white pupil *delphis cygnus* (Rothschild) (p. 192)
- 11(1) Underside forewing with DII in discal cell a thick bar . . . . . 12
- Underside forewing with DII reduced to one or more spots or absent . . . . . 39
- 12(11) Cells  $R_5$  and  $M_1$  of hindwing underside with postdiscal spots absent, but replaced by a white spot in cell  $R_5$ . Hindwing anal veins not covered by black lines beneath . . . . . 13
- Cells  $R_5$  and  $M_1$  of hindwing underside with postdiscal spots present. Hindwing anal veins black beneath . . . . . 15
- 13(12) Hindwing tails straight or barely curved. Wings above black with well-defined bands and spots. Postdiscal band bordered by structural blue scales above. Hindwing underside with postdiscal spots crimson. Uncus slightly bifid . . . *cognata* (Snellen van Vollenhoven) (p. 157)
- Hindwing with curved 'pincer'-like tails. Wings black with diffuse yellow-white band above. Hindwing underside with maroon postdiscal spots. Uncus very square . . . . . 14
- 14(13) Forewing underside with postdiscal spots strongly marked in each cell from the costal margin to cell  $Cu_{1b}$  . . . . . *dehanii dehanii* (Westwood) (p. 156)
- Forewing underside with postdiscal spots strongly marked from cells  $R_4$  to  $M_3$ , very faint in cells  $Cu_{1a}$  and  $Cu_{1b}$  . . . . . *dehanii sulthan* (Hagen) (p. 156)
- 15(12) Forewing upperside with white or yellow-white discal band clearly defined and not extending to wing base . . . . . 16
- Forewing upperside with white or yellow-white discal band with diffuse margins, often forming a patch, diffuse scaling extending into wing base . . . . . 22
- 16(15) Hindwing upperside with submarginal spots yellow, semi-lunar and well defined. Admarginals red-orange . . . . . *sacco* Smart (p. 140)
- Hindwing upperside with submarginal spots white or blue and sometimes ill-defined. Admarginals generally restricted and blue . . . . . 17
- 17(16) Hindwing upperside with glaucous scaling distal to discal band connecting with admarginals at tornus, and normally at vein  $Cu_{1b}$  . . . . . 18
- Hindwing upperside with glaucous scaling on distal edge of discal band not normally joined to admarginals . . . . . 19
- 18(17) Forewing upperside with pronounced glaucous scaling distal to discal band *jupiter glauca* (Joicey & Talbot) (p. 143)
- Forewing upperside with discal band without associated glaucous scaling distally . . . . . 20
- 19(17) Upperside with discal bands dark yellow . . . . . *jupiter keiana* (Rothschild) (p. 144)
- Upperside with discal bands pale yellow or cream . . . . . 21
- 20(18) Discal spot in cell  $M_2$  of forewing upperside extremely small—less than quarter the size of that in cell  $M_3$  . . . . . *jupiter jupiter* (Butler) (p. 142)
- Discal spot in cell  $M_2$  of forewing upperside only half the size of that in cell  $M_3$  . . . . . *jupiter watubela* (Rothschild) (p. 144)
- 21(19) Underside with forewing ground colour pale rufous, hindwing rufous-grey *jupiter admiralitatis* (Rothschild) (p. 145)
- Underside with forewing ground color ochreous yellow, hindwing grey-green *jupiter attilla* (Grose-Smith) (p. 145)

- 22(15) Forewing upperside with discal band ill-defined and diffused with brown scales  
*andrewsi* (Butler) (p. 147) 23
- Forewing upperside with discal band or patch readily distinguished . . . . . 23
- 23(22) Forewing upperside with proximal white spots in cells  $M_2$  and  $M_3$  absent as distinct elements, fused with discal patch. Forewing underside with no black bars in cells  $Cu_{1a}$  and  $Cu_{1b}$  . . . . . 24
- Forewing upperside normally with proximal white spots in cells  $M_2$  and  $M_3$  not present, or having separate identity from discal patch. Forewing underside with black bars in cells  $Cu_{1a}$  and  $Cu_{1b}$  . . . . . 25
- 24(23) Underside. Forewing with DII in discal cell broad. Hindwing with submarginal black spots and orange admarginals very strongly marked . . . . . *sempronius sempronius* (Fabricius) (p. 153)
- Underside. Forewing with DII in discal cell narrow. Hindwing with submarginal black spots and orange admarginals faint . . . . . *sempronius tiberius* (Waterhouse) (p. 155)
- 25(23) Hindwing underside with postdiscal ocelli similar in each cell . . . . . 26
- Hindwing underside with cells  $R_5$  and  $M_1$  having postdiscal ocelli atrophied or of different colour to other postdiscal ocelli . . . . . 28
- 26(25) Upperside with hindwing submarginal spots without centres. Underside with hindwing discal band not normally reaching beyond vein  $M_2$ . Male upperside with discal spot of cell  $M_2$  in forewing normally much smaller than that of cell  $M_3$   
*gilolensis obiensis* (Rothschild) (p. 139)
- Upperside with hindwing submarginal spots white-centered. Underside with hindwing discal band reaching from costal margin to cell  $Cu_{1a}$ . Male upperside with forewing with discal spots in cells  $M_2$  and  $M_3$  of similar size . . . . . 27
- 27(26) Hindwing upperside with glaucous outer margin of discal band joining admarginal bars at veins  $Cu_{1a}$ ,  $Cu_{1b}$  and at tornus . . . . . *gilolensis gilolensis* (Butler) (p. 139)
- Hindwing upperside with glaucous outer margin of discal band joined to admarginals only at tornus . . . . . *gilolensis buruana* (Rothschild) (p. 140)
- 28(25) Hindwing underside with MI forming a curve and incorporating transverse bar across vein 2A . . . . . *clitarchus* (Hewitson) (p. 146)
- Hindwing underside with MI forming a jagged line, often not joining transverse bar across 2A . . . . . 29
- 29(28) Forewing upperside with discal patch extended via blue-grey scaling to base of wing. Very little pale scaling in discal cell . . . . . 30
- Forewing upperside with discal patch extended to base with yellow or white scales. Patch extends strongly into discal cell . . . . . 31
- 30(29) Forewing upperside with discal band not reaching discal cell, discal spots in cells  $M_2$  and  $M_3$  separate from discal band . . . . . *pyrrhus pyrrhus* (Linnaeus) (p. 138)
- Forewing upperside with discal band reaching into discal cell, discal spots in cells  $M_2$  and  $M_3$  joined to discal band . . . . . *pyrrhus bandana* (Rothschild) (p. 138)
- 31(29) Upperside with submarginal spots of forewing apex large, disco-basal patch within a few millimetres of submarginal spots in cell  $Cu_{1b}$  . . . . . 32
- Upperside with submarginal spots small or medium sized, disco-basal patch ending more than 10 millimetres from submarginal spots in cell  $Cu_{1b}$  . . . . . 34
- 32(31) Forewing upperside with discal spot in cell  $M_2$  normally less than half the size of that in cell  $M_3$ . Distal glaucous scaling of disco-basal patch often within 5 mm of submarginal spots in cell  $Cu_{1b}$ . Sumbawa . . . . . *galaxia jovis* (Staudinger) (p. 149)
- Forewing upperside with discal spot in cell  $M_2$  normally half the size of that in cell  $M_3$ . Distal glaucous scaling of disco-basal patch often within 2 mm of submarginal spots in cell  $Cu_{1b}$  . . . . . 33
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- Glaucous scaling distal to discal band of hindwing upperside normally extended strongly from cell  $M_1$  into cell  $R_5$ . Flores and Kalao . . . . . *galaxia kalaonica* (Rothschild) (p. 150)
- 34(31) Forewing upperside with disco-basal patch extensively glaucous distally. Alor  
*galaxia alorana* (Rothschild) (p. 151)
- Forewing upperside with disco-basal patch not glaucous distally, or only slightly so . . . . . 35
- 35(34) Forewing upperside with discal spots in cells  $M_2$  and  $M_3$  suppressed, normally absent. Specimens from Tanimbar Is . . . . . *galaxia seitzi* (Rothschild) (p. 152)
- Forewing upperside with discal spots present in cells  $M_2$  and  $M_3$  . . . . . 36



- 36(35) Upperside with pale markings cream . . . . . 37  
 – Upperside with pale markings yellow . . . . . 38
- 37(36) Forewing upperside with submarginal spots small, often absent or almost obliterated in cells  $M_1$  and  $Cu_{1b}$ , that of cell  $M_2$  normally 1.0 mm deep in male, 1.5 mm in female. Wetar and Timor . . . . . *galaxia galaxia* (Butler) (p. 148)  
 – Forewing upperside with submarginal spots large, present in cells  $M_1$  and  $Cu_{1b}$ , that of cell  $M_2$  normally 1.5 to 2.0 mm deep in male, 2.0 to 2.5 mm in female. Romang, Kisar, Leti and Moa . . . . . *galaxia lettiana* (Rothschild) (p. 151)
- 38(36) Hindwing upperside with admarginals often extended beyond cell  $M_1$ . Submarginal spots large, white in female. Sermatta and Dammer . . . . . *galaxia antigonus* (Fruhstorfer) (p. 151)  
 – Hindwing upperside with admarginals not extended beyond cell  $M_1$ . Submarginal spots small, blue in female. Babar . . . . . *galaxia babberica* (Fruhstorfer) (p. 152)
- 39(11) Forewing underside with submarginal spots chevron-shaped. Uncus sharply pointed . . . . . 40  
 – Forewing underside with submarginal spots not chevron-shaped. Uncus blunt, slightly bifid . . . . . 80
- 40(39) Hindwing underside with MI present in cell  $M_1$  . . . . . 41  
 – Hindwing underside with MI not present in cell  $M_1$ , but proximal to it . . . . . 47
- 41(40) Forewing upperside lacking any subapical or postdisical spot, and with discal white spots in cells  $R_5$  and  $M_1$  forming a stepped continuation of the discal band. S. India . . . . . *schreiber wardii* (Moore) (p. 160)  
 – Forewing upperside normally with a white subapical spot, and a similarly coloured post-disical spot in cell  $M_1$ . Discal band does not normally extend beyond vein  $M_2$  . . . . . 42
- 42(41) Discal band of forewing upperside very dentate along the distal edge, and normally extending to vein  $M_2$ . Underside with black markings broad. Assam, Nagaland, Burma, Thailand and Vietnam . . . . . *schreiber assamensis* (Rothschild) (p. 161)  
 – Male with discal band of forewing upperside fairly straight along distal edge, not dentate, and not normally extending beyond vein  $M_3$ . Both sexes with black markings of the underside normal . . . . . 43
- 43(42) Underside with ground colour off-white, discal band of fore- and hindwings, outer margin and submarginal area of forewing, and postdisical area of hindwing very green . . . . . 45  
 – Underside with ground colour pinkish beige, discal band of fore- and hindwings, outer margin and submarginal area of forewing, and postdisical area of hindwing brown or greenish brown . . . . . 44
- 44(43) Upperside with forewing discal band broadest at vein  $Cu_{1b}$ . Borneo . . . . . *schreiber malayica* (Rothschild) (p. 164)  
 – Upperside with forewing discal band at its widest, in the male, just above vein  $Cu_{1b}$ , in cell  $Cu_{1a}$ , female widest at vein  $Cu_{1b}$  . . . . . 46
- 45(43) Forewing upperside with structural blue associated with discal band present. Underside with triangular green area in cells  $M_2$  and  $M_3$  above discal band small *schreiber niasica* (Butler) (p. 163)  
 – Upperside with no structural blue associated with the discal band. Underside with triangular green area in cells  $M_2$  and  $M_3$  above discal band very large *schreiber bilarensis* Jumalon (p. 165)
- 46(44) Both sexes small, males average approximately 38.0 mm in forewing length, females approximately 44.0 mm. Java . . . . . *schreiber schreiber* (Godart) (p. 160)  
 – Both sexes large, males average approximately 43.0 mm in forewing length, females approximately 48.5 mm. Malay Peninsula, Singapore, Sumatra, Bangka and Belitung . . . . . *schreiber tisamenus* (Fruhstorfer) (p. 162)
- 47(40) Hindwing upperside with discal band ill-defined proximally, often reached to wing base . . . . . 48  
 – Hindwing upperside with discal band well defined, never extending to wing base . . . . . 68
- 48(47) Upperside with discal bands covering almost the entire surface of the wings except for the forewing apex and marginal band in the hindwing which, where it occurs, is of fairly even width. Hindwing upperside admarginals normally orange . . . . . 49  
 – Hindwing upperside with discal band diffuse distally, often with a large black area at the tornus. Black marginal band normally of uneven width, admarginals yellow and sometimes ill-defined . . . . . 51
- 49(48) Upperside of forewing with discal cell normally black or brown, hindwing with disco-basal patch not extending along the veins to connect with the admarginals, and leaving a clear black band between it and the admarginals. Vietnam, West Malaysia and Sumatra . . . . . *jalyus jalyus* (Felder & Felder) (p. 188)  
 – Upperside of forewing with discal cell normally partly pale greenish yellow, hindwing with disco-basal patch at least partly extended along the veins towards the admarginals, and restricting the black band between it and the admarginals . . . . . 50

- 50(49) Upperside of hindwing with disco-basal patch extended along the veins to connect with the admarginals, and isolating black scaling to area immediately surrounding the submarginal spots. Burma and Thailand. . . . . *jalyus ephebus* (Fruhstorfer) (p. 189)
- Upperside of hindwing with disco-basal patch extended along the veins, but often not connecting with the admarginals restricting, but not isolating the submarginal black scaling to each cell. Borneo . . . . . *jalyus triphonus* (Fruhstorfer) (p. 189)
- 51(48) Hindwing underside discal band slightly narrower anteriorly than on upperside . . . . . 52
- Hindwing underside discal band much narrower than on upperside . . . . . 57
- 52(51) Male forewing upperside with outer margin of discal band very irregular and strongly extended along veins  $Cu_{1b}$  and 2A. Underside with submarginal area of outer margin of forewing and postdiscal area of hindwing distally olive-green. Nias *moori kaba* (Kheil) (p. 186)
- Male forewing upperside with outer margin of discal band less irregular and if produced along veins  $Cu_{1b}$  and 2A then only slightly so. Underside with submarginal area of outer margin for forewing and postdiscal area of hindwing greenish brown . . . . . 53
- 53(52) Subapical spot of forewing upperside normally between 3 and 4 mm across. Sikkim, Assam, Nagaland and Burma . . . . . *moori sandakana* (Fruhstorfer) (p. 185)
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- Disco-basal patch of male hindwing upperside not normally extended along vein  $M_1$  to join admarginals . . . . . 55
- 55(54) Male small, forewing length approximately 31 mm. Bali . . . . . *moori chalazias* (Fruhstorfer) (p. 187)
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- 66(65) Underside with black lines finely marked. Bawean . . . . . *hebe baweanica* (Fruhstorfer) (p. 183)
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*athamas andamanica* (Fruhstorfer) (p. 168)
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- 71(70) Hindwing underside with postdiscal lunule in cell  $R_1$  surrounded by a large, dense black patch which extends substantially above vein  $R_1$ . Nias *athamas kannegieteri* (Lathy) (p. 169)
- Hindwing underside with postdiscal lunule in cell  $Sc + R_1$  surrounded by thin black lines which extend only slightly above vein  $R_1$  . . . . . 72
- 72(71) Hindwing elongate, outer margin fairly straight. Philippines *athamas acuta* (Rothschild) (p. 171)
- Hindwing shape normal, outer margin distinctly convex . . . . . 73
- 73(72) Forewing underside normally with DII present as two distinct black spots in the discal cell. Sri Lanka, India, Bangladesh, Burma, China, Taiwan, Hainan, Vietnam, Laos, Thailand and West Malaysia . . . . . *athamas athamas* (Drury) (p. 166)
- Forewing underside normally with DII present as one distinct spot in the discal cell. Occasionally there is an indication of a second spot . . . . . 74
- 74(73) Hindwing upperside with admarginals normally completely suppressed, except at the tornus, where a small residual yellow spot often remains. Tails normally with almost no blue scaling. Sumatra, Borneo and Natuna Is . . . . . *athamas ureaus* (Rothschild) (p. 169)
- Hindwing upperside with admarginals normally orange, or if suppressed not so at the tornus. Tails blue-centred . . . . . 75
- 75(74) Forewing upperside with subapical spot in cell  $R_5$  normally absent, orange admarginals normally present at the middle of the cells. Palawan *athamas palawanica* (Rothschild) (p. 170)
- Forewing upperside with subapical spot in cell  $R_5$  normally present, admarginals in male somewhat suppressed, normally slightly apparent below vein  $M_2$ . Java . . . . .  
*athamas attalus* (Felder & Felder) (p. 171)
- 76(69) Forewing upperside with subapical spots in cells  $R_4$  and  $R_5$ . India and Burma . . . . .  
*agraria agraria* (Swinhoe) (p. 173)
- Forewing upperside with a subapical spot in cells  $R_5$  and occasionally in cell  $M_1$ , but not in cell  $R_4$  . . . . . 77
- 77(76) Forewing upperside with one postdiscal spot in cell  $M_1$  only . . . . . 78
- Forewing upperside with postdiscal spots in cells  $R_5$  and  $M_1$  . . . . . 79
- 78(77) Hindwing underside with discal band ending in cell  $Cu_{1b}$ . Java and Madura . . . . .  
*agraria fruhstorferi* (Röber) (p. 173)
- Hindwing underside with discal band of female narrowing at cell  $Cu_{1b}$ , and then broadening out to end on the anal margin. Sulawesi . . . . . *agraria piepersiana* (Martin) (p. 174)
- 79(77) Upperside forewing with postdiscal spot in cell  $R_5$  normally at least half the size of that in cell  $M_1$ . Hindwing with submarginal spots normally small. Sawu, Timor, Wetar and Leti . . . . .  
*agraria alphius* (Staudinger) (p. 175)
- Upperside forewing with postdiscal spot of cell  $R_5$  normally less than half the size of that in cell  $M_1$ . Hindwing with submarginal spots normally large. Bali, Lombok, Sumbawa, Sumba, Alor, Flores, Adonara, and Pantar . . . . . *agraria sumbaensis* (Swinhoe) (p. 174)
- 80(39) Hindwing underside with maroon band along costal margin . . . . . *posidonius* (Leech) (p. 193)
- Hindwing underside without band along costal margin . . . . . 81
- 81(80) Forewing underside without brown band running along costal margin . . . . . 82
- Forewing underside with brown band running along costal margin . . . . . 83

- 82(81) Forewing upperside with submarginal spots and proximal chevrons in cell  $Cu_{1b}$ , joined to chevron in cell  $Cu_{1a}$  and to disco-basal patch along veins  $Cu_{1b}$  and 2A. Laos, Thailand, Burma, Vietnam, S. and W. China and Hainan . . . . . *nepenthes nepenthes* (Grose-Smith) (p. 207)
- Forewing upperside with submarginal spots and proximal chevrons in cell  $Cu_{1b}$ , not joined to chevron in cell  $Cu_{1a}$  and only joined to the disco-basal patch along vein 2A. E. China . . . . . *nepenthes kiangsiensis* (Rousseau-Decelle) (p. 208)
- 83(81) Forewing underside with MI, MII and DI stopping at end of discal cell, not forming a 'Y' . . . . . 84
- Forewing underside with MI, MII and DI forming a well-defined 'Y' . . . . . 88
- 84(83) Hindwing upperside with admarginals yellow, any blue scaling at veins is almost undetectable . . . . . 85
- Hindwing upperside with admarginals distinctly blue towards the veins . . . . . 86
- 85(84) Hindwing upperside submarginal spots small and pale, yellow lunules proximal to them normally distinct in each cell. N. central India . . . . . *dolon dolon* (Westwood) (p. 209)
- Hindwing upperside with submarginal spots larger, and a deep purple, yellow lunules proximal to them becoming obscured towards the wing apex, rarely seen above vein  $M_2$ . Sikkim and western Assam . . . . . *dolon centralis* (Rothschild) (p. 210)
- 86(84) Upperside with light markings pale yellowish green. North East Frontier Agency of India, NE. Burma and China . . . . . *dolon carolus* (Fruhstorfer) (p. 211)
- Upperside with light markings greenish yellow . . . . . 87
- 87(86) Hindwing upperside with tails blue with a distinct black border. Submarginal purple spots generally small and of uniform colour. Central and eastern Assam, Nagaland and Manipur . . . . . *dolon magniplaga* (Fruhstorfer) (p. 210)
- Hindwing upperside with tails almost completely blue, rarely is there a distinct black border. Submarginal purple spots large, sometimes white-centred. Central and southern Burma, Thailand and Laos . . . . . *dolon grandis* (Rothschild) (p. 211)
- 88(83) Hindwing underside with a chevron-shaped postdiscal spot in each cell. Forewing upperside with submarginal and postdiscal spots present . . . . . 89
- Hindwing underside with postdiscal band simplified, having no chevron-shaped spots in anterior half. Forewing upperside with one row of spots only . . . . . 97
- 89(88) Hindwing upperside with brown basal band present, strongly in male, less so in female . . . . . 90
- Hindwing upperside with no basal band, or only a very slight trace of one . . . . . 94
- 90(89) Hindwing upperside with admarginals completely blue or glaucous except at tornus which is yellow. Taiwan . . . . . *eudamippus formosana* (Rothschild) (p. 204)
- Hindwing upperside with admarginals glaucous distally, yellow proximally and at tornus, or completely pale yellow . . . . . 91
- 91(90) Forewing underside with two large black spots beyond the bar at the end of the discal cell, and distal to these, to further elongate spots. S. China (northern Guangdong Province) . . . . . *eudamippus kuangtungensis* (Mell) (p. 203)
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- 92(91) Hindwing upperside with black submarginal band very broad . . . . . 93
- Hindwing upperside with black submarginal band very narrow, forming a series of conjoined ocelli. Hainan . . . . . *eudamippus whiteheadi* (Crowley) (p. 203)
- 93(92) Underside with yellow bands broad, outer margin of postdiscal yellow band of forewing highly dentate. Okinawa . . . . . *eudamippus weismanni* (Fritze) (p. 205)
- Underside with yellow bands narrower, outer margin of postdiscal yellow band of forewing fairly straight. W. central China . . . . . *eudamippus rothschildi* (Leech) (p. 202)
- 94(89) Upperside forewing with tail of Y-marking not extending below vein  $Cu_{1a}$ , and discal cell mostly pale. Hindwing submarginal band often very narrow. Specimens from N. India and Bangladesh . . . . . *eudamippus eudamippus* (Doubleday) (p. 119)
- Upperside forewing with tail of Y-marking often extending below vein  $Cu_{1a}$ , or brown coloration from discal cell extending downwards to inner margin. Hindwing submarginal band often broader . . . . . 95
- 95(94) Hindwing underside with postdiscal chevrons only very slightly blue-edged. Yellow admarginal at tornus very large and distinctly joined to postdiscal yellow band. SW. China . . . . . *eudamippus cupidinius* (Fruhstorfer) (p. 202)
- Hindwing underside with postdiscal chevrons distinctly blue-edged. Yellow admarginal at tornus smaller, not normally connected to postdiscal yellow band . . . . . 96
- 96(95) Forewing underside with DII in discal cell very small, sometimes reduced to one small black spot. West Malaysia . . . . . *eudamippus peninsularis* (Pendlebury) (p. 206)

- Forewing underside with DII in discal cell forming two fairly large black spots  
*eudamippus nigrobasalis* (Lathy) (p. 200)
- 97(91) Forewing upperside with submarginal spots extending upwards into cell  $R_4$ . . . . . 98  
 – Forewing upperside with submarginal spots extending upwards into cell  $R_5$  . . . . . 99
- 98(97) Hindwing tails long. Forewing upperside with submarginal spots in cell  $R_4$  no more than twice the distance from the outer margin than those in cell  $Cu_{1b}$ . Western, central, eastern and south-eastern China . . . . . *narcaea narcaea* (Hewitson) (p. 194)
- Hindwing tails short. Forewing upperside with submarginal spot in cell  $R_4$  more than twice the distance from the outer margin than those in cell  $Cu_{1b}$ . SW. China  
*narcaea menedemus* (Oberthür) (p. 196)
- 99(97) Upperside of forewing with some brown scaling at the base. Hindwing with a distinct brown basal band. Taiwan . . . . . *narcaea meghaduta* (Fruhstorfer) (p. 197)
- Upperside of forewing with no brown scaling extraneous to that of the costal band at the base. Hindwing without a basal band . . . . . 100
- 100(99) Hindwing upperside with dark postdiscal band blue-centered up to cell  $M_2$ . NE. India  
*narcaea aborica* (Evans) (p. 197)
- Hindwing upperside with dark postdiscal band lacking a blue centre above vein  $Cu_{1a}$  . . . . . 101
- 101(100) Hindwing upperside with postdiscal band black and fairly broad. Burma and Vietnam  
*narcaea thawgawa* (Tytler) (p. 198)
- Hindwing upperside with postdiscal band brown and narrow, often becoming obscured in cells  $M_1$  and  $M_2$ . Thailand and Nagaland . . . . . *narcaea lissainei* (Tytler) (p. 198)

### *Polyura gamma* (Lathy)

(Figs 69, 70)

*Charaxes gamma* Lathy, 1898: 226. Holotype ♂, NEW CALEDONIA (BMNH) [examined].

*Eulepis gamma* (Lathy) Rothschild & Jordan, 1898: 566, figs 18, 18a.

*Eriboea aristophanes* Fruhstorfer, 1913: 139; 1914: 729. LECTOTYPE ♂, NEW CALEDONIA [described from 'Shortland Is.'] (BMNH), here designated [examined].

*Eriboea gamma* (Lathy) Fruhstorfer, 1914: 729; Lathy, 1925: 97, pl. 3, fig. 7 (♀ description).

*Polyura gamma* (Lathy) Stichel, 1939: 603; D'Abrera, 1971: 246, fig. [figure caption transposed with *P. epigenes*]; Holloway & Peters, 1976: 302; D'Abrera, 1977: 246, fig.

*Polyura gamma aristophanes* (Fruhstorfer) Holloway & Peters, 1976: 302.

**MALE.** *Upperside.* Ground colour black-brown becoming lighter towards wing bases. All markings creamy white. Forewing with a continuous row of submarginal spots from cell  $R_4$  to cell  $Cu_{1b}$ , that in the last named being double. Two postdiscal spots in cells  $R_5$  and  $M_1$  and a row of discal spots in cells  $M_2$  to  $Cu_{1b}$ , that in  $Cu_{1b}$  being double and forming a short band which may extend to the inner margin. Hindwing with a single submarginal row of spots in each cell. Semi-lunar, partially occluded markings are present proximal to these spots in cells  $M_3$ ,  $Cu_{1a}$  and  $Cu_{1b}$ , and are the remnants of the ocelli. A discal band is present from the costal margin to cell  $M_2$ . *Underside.* Ground colour grey-brown with the same markings as are found on the upperside. In addition there are black markings including MI, DI, MII and DII in the forewing, and EI, EII, MI, DI, MII and DII in the hindwing. The hindwing also possesses a row of postdiscal ocelli of which only the proximal part is present, and which are partially occluded in cells  $R_5$ ,  $M_1$  and  $M_2$ . These are composed of black pupils distally, surmounted proximally by a few structural blue scales, a larger area of red, a semicircle of blue-white and a semicircle of black, in that order.

**FEMALE.** Differs from the male in that the pale bands are broader, the discal band of the hindwing is extended to cell  $Cu_{1b}$ , the lower half together with the postdiscal lunules in cells  $M_3$ ,  $Cu_{1a}$  and  $Cu_{1b}$  becoming rufous orange. Underside paler than male.

**SIZE.** ♂;  $\bar{x}$  = 30.9,  $s$  = 0.9 (8 specimens). ♀; 3 specimens only, 32.0, 35.9, and 33.6.

**DISTRIBUTION.** **New Caledonia:** Voh; Hienghene (Holloway & Peters, 1976: 302); Mt Koghis. The data of specimens labelled 'Shortlands Is.' are almost certainly erroneous. 8 ♂, 3 ♀.

**TYPE-MATERIAL.** *Charaxes gamma* Lathy was described from a single male obtained by H. J. Adams and collected in New Caledonia. A corresponding specimen exists in the BMNH and this holotype bears the following labels; 'N. Caledonia? / B.M. Type No. Rh. 10582 / N. Caledonia. / Holotype (red) / *Charaxes gamma* Lathy HOLOTYPE det. R. L. Smiles 1975'.

*Eriboea aristophanes* Fruhstorfer was described from two males and one female purchased in Paris by Fruhstorfer, and accepted by him as coming from the Solomon Islands. A male and a female now exist in the BMNH. The male bears the following labels; 'Type / Shortland Is. Fruhstorfer / Fruhstorfer Coll. B.M. 1937-285. / Lectotype (purple) / *Eriboea aristophanes* Fruhstorfer, LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype. The female bears the labels; 'Type / Shortlands Is. Fruhstorfer / Fruhstorfer Coll. B.M. 1937-285. / Paralectotype (blue) / *Eriboea aristophanes* Fruhstorfer, PARALECTOTYPE det. R. L. Smiles 1978'.

**BIONOMICS.** This is a rare insect and the specimens that have been studied bear little information. One specimen in the BMNH was collected at 500 m. Holloway & Peters (1976: 281) state that the species is '... commoner in ... the old southern vegetation associations of the laterite on ultrabasic rocks.'

### *Polyura epigenes* (Godman & Salvin)

(Figs 2, 8, 9, 23, 24)

*Charaxes epigenes* Godman & Salvin, 1888: 210.

*Eulepis epigenes* (Godman & Salvin) Rothschild & Jordan, 1898: 568, figs 19, 20.

*Eriboea epigenes* (Godman & Salvin) Fruhstorfer, 1913: 139; 1914: 729.

*Polyura epigenes* (Godman & Salvin) Stichel, 1939: 602; D'Abrera, 1971: 246, fig. [figure caption transposed with *P. gamma*]; 1977: 246, fig.

The only species of *Polyura* to show strong sexual dimorphism.

**MALE.** *Upperside.* Ground colour black with yellow spots in the forewing, and a single row of submarginal blue lunules in the hindwing. *Underside.* Ground colour brown, forewing with a complete row of white submarginal spots—pupils of the remnants of ocelli still semi-complete proximally. White spots proximally bordered with black appear postdiscally in cells  $R_5$  and  $M_1$ , distal to the end of the discal cell in cell  $M_2$  and discally in cells  $M_3$ ,  $Cu_{1a}$  and  $Cu_{1b}$ . DI, MII and DII present in discal cell. MII bordered proximally and DII distally with white. Hindwing with a black marginal line (EI). Between this and EII, which is heavily marked, lies a narrow zone of rufous scales with some blue scaling from  $M_2$  to tornus (the admarginals). Postdiscal spots complete, deep rufous, shaded proximally with blue and black-bordered. MI complete, distally bordered with white; MII from costa to origin of  $Cu_{1b}$  bordered proximally with white. DI present as a bar at end of discal cell.

**FEMALE.** *Upperside.* Differs by the presence of a cream-yellow discal band from  $Cu_{1a}$  to inner margin of forewing and from costal margin of hindwing narrowing to a point at  $Cu_{1b}$ , this lower portion being largely enclosed with diffuse blue scaling. Wing bases olivaceous brown. *Underside.* Ground colour much paler than male. Forewing with white spots and bands larger. Hindwing with white band which corresponds to that on the upperside, with without the associated blue scaling. Externae less pronounced.

**RANGE.** Solomon Islands: Guadalcanal, Tulagi, Bougainville, Shortland Islands, Choiseul, Vella Lavella, Rendova and Santa Isabel.

### *Polyura epigenes epigenes* (Godman & Salvin)

(Figs 8, 9, 23, 24)

*Charaxes epigenes* Godman & Salvin, 1888: 210; Grose-Smith & Kirby, 1888: 5, pl. 3, figs 1-4. LECTOTYPE ♂, GUADALCANAL (BMNH), here designated [examined].

*Polyura epigenes* [*epigenes*] (Godman & Salvin) Stichel, 1939: 602.

Male forewing with yellow spots on discal area and a strong row of yellow submarginal spots.

**SIZE.** ♂; 5 specimens only, 37.3, 37.3, 36.1, 38.4, 39.8. ♀;  $\bar{x}$  = 43.3,  $s$  = 1.9 (10 specimens).

**DISTRIBUTION.** **Tulagi. Guadalcanal:** Aola; Honiara; Koala Ridge; Mt Austin. 5 ♂, 10 ♀.

**TYPE-MATERIAL.** Described from one male and several females, one male and three females of which are in the BMNH and bear the following labels; 'Aola, Guadalcanar I. Woodford. /

Godman-Salvin Coll. 94.-187.'. In addition, the male bears the following labels; 'Lectotype (purple) / B.M. TYPE No. Rh. 10423. *Charaxes epigenes* ♂ G. & S. / *Charaxes epigenes* Godman & Salvin LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype. The three females also bear the following labels; 'Paralectotype (blue) / B. M. TYPE No. Rh. 10424 5 6 *Charaxes epigenes*. ♀ G. & S. / *Charaxes epigenes* Godman & Salvin PARALECTOTYPE det. R. L. Smiles 1978'.

**BIONOMICS.** This is an uncommon butterfly and much of the material is poorly labelled. However, there are records in the BMNH for its capture during April and May. I have captured a male feeding on dog faeces.

*Polyura epigenes monochroma* (Niepelt)

*Charaxes (Eulepsis) (sic) epigenes f. monochromus* Niepelt, 1914: 32, pl. 9, fig. 5. Holotype ♂, BOUGAINVILLE (BMNH) [examined].

*Eriboea epigenes f. monochromus* (Niepelt) Gabriel, 1932: 25.

*Polyura epigenes monochromus* (Niepelt) Stichel, 1939: 602.

Only the male differs from the nominate subspecies, and this by its lack of yellow discal spots in the forewing upperside. Often the submarginal spots of the forewing upperside are deminished.

**SIZE.** ♂; 2 specimens only, 38.0, 39.9, ♀;  $\bar{x}$  = 44.1,  $s$  = 2.8 (12 specimens).

**DISTRIBUTION.** Bougainville: Arawa. Shortland Is. Choiseul I.: south side. Vella Lavella. Rendova. Santa Isabel I. 2 ♂, 12 ♀.

**TYPE-MATERIAL.** Described from a single male. This holotype is now in the BMNH and bears the following labels; 'Holotype (red) / Salomon Archipel. Bougainville. / Original / *Charaxes monochroma* / Joicey Bequest Brit. Mus. 1934-120. / *Charaxes epigenes f. monochromus* Niepelt HOLOTYPE det. R. L. Smiles 1975'.

**BIONOMICS.** There are records in the BMNH for this rare butterfly during January, February, May, June to July and December.

*Polyura caphontis* (Hewitson)

(Figs 7, 22, 71, 72)

*Charaxes caphontis* Hewitson, 1863: 64, pl. 32, figs 14, 15; Butler, 1874: 280; Fruhstorfer, 1902: 354.

*Nymphalis caphontis* (Hewitson) Kirby, 1871: 270.

*Eulepis caphontis* (Hewitson) Rothschild & Jordan, 1898: 564, figs 17, 17a.

*Eriboea caphontis* (Hewitson) Fruhstorfer, 1914: 729, pl. 135b.

*Polyura caphontis* (Hewitson) Stichel, 1939: 603; D'Abrera, 1971: 246, fig.; Robinson, 1975: 329; D'Abrera, 1977: 246, fig..

**MALE, FEMALE.** *Upperside.* Ground colour brown. Forewing with yellow submarginal and postdiscal spots. Hindwing with admarginals red, a yellow submarginal row of spots and a postdiscal row of rufous spots. There is often a discal yellow streak reaching from the costal margin to  $Cu_{1a}$  or beyond. *Underside.* Ground colour rufous in male, grey-brown in female. Forewing submarginal spots white in cells  $Cu_{1a}$  and  $Cu_{1b}$ , obscured to a greater or lesser degree in other cells. Postdiscal white spots in cells other than  $Cu_{1a}$ ,  $Cu_{1b}$  or 2A, which may unite to form a band, variable, sometimes becoming completely obscured. Hindwing with admarginals red; black-centered, blue submarginal ocelli, a postdiscal row of rufous spots in which those in cells  $R_5$  and  $M_1$  are orange, and that in cell  $M_2$  completely absent except for a proximal blue lunule which is also to be found on all other postdiscal spots. DI present at end of discal cell.

**RANGE.** Confined to the islands of Fiji.

*Polyura caphontis caphontis* (Hewitson)

(Fig. 71)

*Charaxes caphontis* Hewitson, 1863: 64, pl. 32, figs 14, 15. Holotype ♀, FIJI [described from 'Australia'] (BMNH) [examined].

MALE, FEMALE. *Upperside*. Yellow discal bands narrow, sometimes disappearing altogether in the hindwing.

SIZE. ♂;  $\bar{x} = 37.1$ ,  $s = 1.2$  (23 specimens). ♀;  $\bar{x} = 42.5$ ,  $s = 1.9$  (7 specimens).

DISTRIBUTION. **Viti Levu I.**: Lami (4 km E. of Suva); Tholoisuva; Korolevu (Robinson, 1975: 329); Suva; Tamavua. **Ovalu I. Taveuni I.**: Waiyevo. 24 ♂, 11 ♀.

TYPE-MATERIAL. Described from one female erroneously believed to have come from Australia. This specimen is now in the BMNH and bears the following labels; 'Holotype (red) / Fiji Is. ex errore Australia Port Denison. Hewitson Coll. 79-69 Charaxes caphontis. / Port Denison Austl. / B.M. TYPE No. Rh. 10422 Charaxes caphontis, ♀ Hew. / Charaxes caphontis Hewitson. HOLOTYPE det. R. L. Smiles 1975'.

BIONOMICS. There are records in the BMNH of capture during February, March, July and November.

### *Polyura caphontis nambavatua* subsp. n.

(Figs 7, 22, 72)

MALE, FEMALE. *Upperside*. Yellow discal bands broad, always present in hindwing, extending to cell  $Cu_{1a}$ . Diffuse green scaling from discal bands to wing bases in forewing much more evident than in *P. c. caphontis*.

SIZE. ♂; 4 specimens only, 38.1, 38.6, 37.9, 38.6. ♀; 4 specimens only, 43.3, 44.5, 45.9, 47.9.

DISTRIBUTION. **Vanua Mbalavu I.**: Nambavatu (Nabavatin).

TYPE-MATERIAL. The type-series is composed of four males and four females each of which bear the label; 'A. S. Corbet coll. B.M. 1948-587.'. The holotype is a male and in addition bears the following labels; 'Holotype (red) / FIJI IS: Nabavatin. 27.vii.1929. / Polyura caphontis nambavatua HOLOTYPE det. R. L. Smiles 1978'. The paratypes bear the following labels; 'Paratype (yellow) / Polyura caphontis nambavatua PARATYPE det. R. L. Smiles 1978'. In addition three female paratypes bear the label; 'FIJI IS: Nabavatin. 27.vii.1929.', the remaining paratypes bear the following labels: one male; 'FIJI IS: Nabavatin, 15.vii.1929', one male; 'FIJI IS: Nabavatin. 19.ix.1929', one male; 'FIJI IS: Nabavatin. 25.vii.1929', one female; 'FIJI IS: Nabavatin. 18.ix.1929'.

### *Polyura pyrrhus* (Linnaeus)

(Figs 10, 25, 73, 74, Map 1)

*Papilio pyrrhus* Linnaeus, 1758: 462.

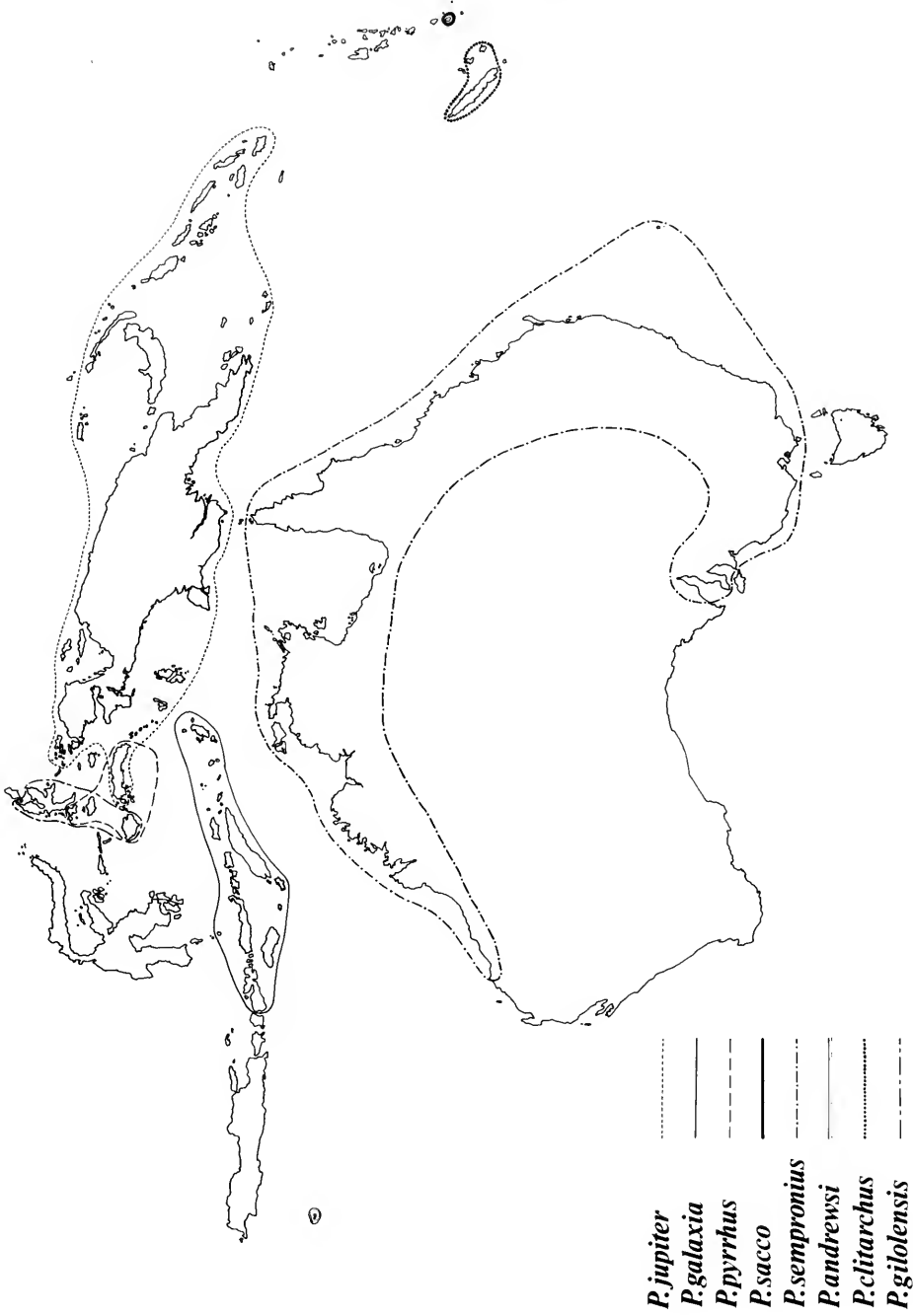
*Eulepis pyrrhus* (Linnaeus) Rothschild & Jordan, 1898: 572, figs 24, 25.

*Eriboea pyrrhus* (Linnaeus) Fruhstorfer, 1914: 726; Talbot, 1920: 405.

*Polyura pyrrhus* (Linnaeus) Stichel, 1939: 593; D'Abbrera, 1971: 244, fig.; Common & Waterhouse, 1972: 277; D'Abbrera, 1977: 244, fig.

MALE, FEMALE. *Upperside*. Ground colour black. Forewing with a row of cream submarginal spots from cells  $R_4$  to  $Cu_{1b}$ . Single postdiscal spots of similar colour present in cells  $R_5$  and  $M_1$ , and cream discal spots in cells  $M_2$  and  $M_3$ . A cream-yellow discal band runs from cell  $Cu_{1a}$  to the inner margin. The area from the proximal side of this band to the wing base is suffused by grey-blue scaling. Hindwing with blue admarginals in cells  $R_5$  to  $Cu_{1b}$ , that in  $Cu_{1b}$  being interrupted by an oval yellow spot. A complete row of white submarginal spots present in cells  $R_1$  to  $Cu_{1b}$ , which may be encircled lightly with blue scaling. A series of postdiscal blue lunules are to be found in cells  $R_5$  to  $Cu_{1b}$ . These are often connected proximally to a cream-yellow discal band by diffuse blue scaling. This band has fairly diffuse margins, and runs from the costal margin, where it is broadest, tapering to vein  $Cu_{1a}$  or thereabouts. The area from this band to the wing base is suffused densely with blue-grey scales. *Underside*. Ground colour yellow-ochre approaching grey in distal areas of the hindwing. Forewing with a complete row of submarginal white spots from cell  $R_4$  to cell  $Cu_{1b}$ . A postdiscal black band distally bordered with lilac runs the entire length of the wing. The pale spots and bands of the discal area correspond with those of the upperside, but are proximally bordered with black (MI, DI and part of MII). MII and DII present in discal cell, some white scaling being present between the two. Hindwing tails blue-centered, admarginals yellow. EII black, proximally surmounted with white





Map 1 Distribution of the *Polyura pyrthus*-group in the Australian Region and part of Indonesia.

diffuse streaks. Postdiscal spots in cells  $R_1$ , and  $M_2$  to  $Cu_{1b}$  crimson centrally, proximally lilac, and the whole enclosed in black. In cells  $R_5$  and  $M_1$  the crimson is replaced by yellow and the distal black by lilac scaling. A white discal band is present which corresponds with that of the upperside, but which is more clearly defined, and is proximally bordered by MI. MII present closer to base, proximally bordered with white. 2A and 3A strongly overlaid with black running distally into a black line which crosses cell 2A—an extension of MI.

RANGE. Buru, Ambon, Seram, Saparua, Batjan and the Banda Is.

*Polyura pyrrhus pyrrhus* (Linnaeus)

(Figs 10, 25, 73)

*Papilio pyrrhus* Linnaeus, 1758: 462; Clerck, 1764: pl. 25, figs 3, 4; Cramer, [1779]: 45, pl. 220, figs A, B; Herbst, 1790: 53, pl. 62, figs 1, 2. Syntype ♂, [AMBON] (University of Uppsala, Uppsala) [colour transparency of upperside examined].

*Papilio cano-maculatus* Goeze, 1779: 88. Syntype[s] (sex?) 'AMERICANUS' (untraced) [not examined]. [Synonymized by Stichel, 1939: 594].

*Paphia pyrrhus* (Linnaeus) Latreille, 1809: 197.

*Polyura pyrrhus* (Linnaeus) Billberg, 1820: 79.

*Charaxes pyrrhus* (Linnaeus) Butler, 1866: 632; Kirby, 1877: 748; Staudinger, 1886: 173; Butler, 1896: 387.

*Nymphalis pyrrhus* (Linnaeus) Kirby, 1871: 270; Pagenstecher, 1884: 187; 1897: 403.

*Charaxes canomaculatus* (Goeze) Kirby, 1877: 748.

*Eulepis pyrrhus pyrrhus* (Linnaeus) Rothschild & Jordan, 1898: 579, fig. 24; Rothschild, 1915a: 134.

*Eriboea pyrrhus pyrrhus* (Linnaeus) Fruhstorfer, 1914: 728; Talbot, 1920: 405.

*Eulepis pyrrhus canomaculatus* (Goeze) Tindale, 1923: 342.

*Polyura pyrrhus* [pyrrhus] (Linnaeus); Stichel, 1939: 593.

*Polyura pyrrhus pyrrhus* (Linnaeus); D'Abrera, 1971: 244, fig.; 1977: 244, fig.

MALE, FEMALE. *Upperside*. Forewing discal band not reaching discal cell, discal spots in cells  $M_2$  and  $M_3$  separate from discal band. *Underside*. MI and MII strongly marked in cells  $Cu_{1a}$  and  $Cu_{1b}$  of the forewing.

SIZE. ♂;  $\bar{x}$  = 47.2, s = 1.4 (40 specimens). ♀;  $\bar{x}$  = 56.2, s = 1.9 (24 specimens).

DISTRIBUTION. **Buru**: Bara; [Gamoe 'Mrapat, Central West Buru]; Kaku Tegalago; [River Tehat]; Leksula. **Ambon**. **Seram**: [Bomfia]; Manusela. **Saparua**. **Batjan**. 61 ♂, 24 ♀.

TYPE-MATERIAL. *Papilio pyrrhus* Linnaeus was described from an undisclosed number of specimens one male of which is now in the collection of Queen Ludovica Ulrica at Uppsala University.

BIONOMICS. There are records in the BMNH for January, February, February to March, April, May, October and November at altitudes between 650 and 1500 m.

*Polyura pyrrhus bandana* (Rothschild)

(Fig. 74)

*Eulepis pyrrhus bandanus* Rothschild, 1898: 581, fig. 25. Holotype ♀ BANDA IS. (BMNH) [examined].

*Eriboea pyrrhus bandanus* (Rothschild) Fruhstorfer, 1914: 728; Talbot, 1920: 406.

*Polyura pyrrhus bandanus* (Rothschild) Stichel, 1939: 598; D'Abrera, 1971: 244; 1977: 244.

FEMALE. *Upperside*. Forewing discal band reaches and extends into discal cell, discal spots in cells  $M_2$  and  $M_3$  not separate from discal band. *Underside*. Black bands generally less pronounced than in nominate subspecies. Forewing with MI and MII not present in cell  $Cu_{1b}$ , reduced to a spot in cell  $Cu_{1a}$ .

SIZE. ♀; 2 specimens only, 58.1 and 55.7.

DISTRIBUTION. **Banda Is.**: Gr. Banda. 2 ♀.

TYPE-MATERIAL. Described from a single female from the Banda Is. This holotype is now in the BMNH and bears the following labels; 'Holotype (red) / Banda / Rothschild Bequest B.M. 1939-1. / *Eulepis pyrrhus bandanus* Roths. HOLOTYPE det. R. L. Smiles 1975'.

BIONOMICS. One female in the BMNH was collected during October, otherwise nothing is known.

***Polyura gilolensis* (Butler) stat. rev.**

(Figs 1, 11, 26, 75–77, Map 1)

*Charaxes gilolensis* Butler, 1869: 14, pl. 5, fig. 6, pl. 6, fig. 3; Oberthür, 1880: 504.*Nymphalis gilolensis* (Butler) Kirby, 1871: 271; Pagenstecher, 1897: 403.*Polyura pyrrius gilolensis* (Butler) Stichel, 1939: 599.

MALE, FEMALE. *Upperside*. Ground colour black. Forewing with a complete series of submarginal spots from cells  $R_4$  to  $Cu_{1b}$ , double in the last. Postdiscal spots in cells  $R_5$  and  $M_1$ . Discal spots separate and distinct from discal band present in cells  $M_2$  and  $M_3$  in male, joined to band in female. Discal band extensive, widest at inner margin and reaching to wing base and  $M_3$ , sometimes intruding into discal cell. All markings of forewing pale yellow, discal band becoming glaucous towards base and discal cell. Hindwing with submarginal spots present from cells  $R_1$  to  $Cu_{1b}$ , glaucous and sometimes white-centered, double in cell  $Cu_{1b}$ . Admarginal bars glaucous, often yellow at centre of cells and, in cell  $Cu_{1b}$ , mainly orange. Discal band extends from base to tornus, pale yellow, becoming glaucous distally. *Underside*. Ground colour ochreous-grey. Forewing submarginal spots as in upperside but connected by a grey, indistinct band. Pale markings lighter than upperside but occupying much the same positions. A black band runs postdiscally from the costal margin to the inner margin. MI present proximal to pale markings in cell  $R_5$  (running beyond this almost to the costal margin), cell  $M_1$  and proximal to the discal band and spots in cells  $M_2$ ,  $M_3$ ,  $Cu_{1a}$  and  $Cu_{1b}$ . DI joined to MI at end of discal cell. MII is present in the discal cell, being proximally outlined with white, also in cells  $Cu_{1a}$  and  $Cu_{1b}$ . DII forms a strong black bar surrounded by white, proximal to MII in the discal cell. Hindwing, admarginal bars mainly yellow-orange, becoming grey-blue towards the veins. Submarginal spots positioned as in upperside, but distally bordered with grey-blue and black. Postdiscal spots complete in every cell, brick red distally, black and proximally grey and black. Discal band white or off white, very narrow and bordered proximally by MI which turns  $90^\circ$  towards the anal margin (here the band may be interrupted), and crosses vein 2A, which together with 3A is strongly overlaid with black. MII lies basally to this and is bordered proximally by a white band.

Abdomen often grey, and no white examples have been seen.

***Polyura gilolensis gilolensis* (Butler)**

(Figs 11, 26, 75)

*Charaxes gilolensis* Butler, 1869: 14, pl. 5, fig. 6, pl. 6, fig. 3. LECTOTYPE ♂, BATJAN (BMNH), here designated [examined].*Eulepis pyrrius gilolensis* (Butler); Rothschild & Jordan, 1898: 584, fig. 28.*Eriboea pyrrius gilolensis* (Butler); Fruhstorfer, 1914: 728.*Polyura pyrrius gilolensis* (Butler); D'Abbrera, 1971: 245; 1977: 245.

MALE. *Upperside*. Forewing with discal spots in cells  $M_2$  and  $M_3$  of similar size. Hindwing with glaucous part of discal band joining admarginal bars at veins  $Cu_{1a}$  and  $Cu_{1b}$  as well as at tornus. Submarginal spots, of both sexes, white centred.

MALE, FEMALE. *Underside*. Hindwing with discal band reaching from costal margin to cell  $Cu_{1a}$ .SIZE. ♂;  $\bar{x}$  = 44.9,  $s$  = 1.4 (40 specimens). ♀; 2 specimens only, 51.8, 53.6.DISTRIBUTION. **Batjan, Halmahera** (Gilol). 48 ♂, 2 ♀.

TYPE-MATERIAL. Described from an unspecified number of male specimens collected by A. R. Wallace. There is, in the BMNH, one male which can definitely be ascribed to the type-series, which bears the following labels; 'Lectotype (purple) / Batchian. Hewitson Coll. 79–69 *Charaxes gilolensis*. / C. *Gilolensis* Butler type / B.M. TYPE No. Rh. 10432. / *Charaxes gilolensis* Butler LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype.

BIONOMICS. BMNH specimens of this butterfly were collected during August and August to September.

***Polyura gilolensis obiensis* (Rothschild)**

(Fig. 76)

*Eulepis pyrrius obiensis* Rothschild, 1898: 583, fig. 27. LECTOTYPE ♂, OBI I. (BMNH), here designated [examined].

*Eriboea pyrrhus obiensis* (Rothschild); Fruhstorfer, 1914: 728.

*Polyura pyrrhus obiensis* (Rothschild); D'Abrera, 1971: 244; 1977: 244.

MALE. *Upperside*. Discal spot in cell  $M_2$  normally much smaller than that of cell  $M_3$ . Hindwing with glaucous part of discal cell not normally joined to admarginal bars except at tornus. Submarginal spots without centres. *Underside*. Hindwing with discal band not normally reaching beyond  $M_2$ .

SIZE. ♂;  $\bar{x} = 45.1$ ,  $s = 1.6$  (14 specimens).

DISTRIBUTION. **Obi Is.**: Obi [Obi major], Laiwui. 14 ♂.

TYPE-MATERIAL. Described from five male specimens now in the BMNH and bearing the following labels; 'Laiwui, Obi, Sept. 97. (W. Doherty). / Rothschild Bequest B.M. 1939-1.' In addition one male bears the following labels; 'Lectotype (purple) / *Eulepis pyrrhus obiensis* Rothschild LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype. The remaining four males also bear the following labels; 'Paralectotype (blue) / *Eulepis pyrrhus obiensis* Rothschild PARALECTOTYPE det. R. L. Smiles 1978'.

BIONOMICS. This butterfly is recorded as having been captured during September.

### *Polyura gilolensis buruana* (Rothschild)

(Fig. 77)

*Eulepis pyrrhus buruanus* Rothschild, 1898: 582, fig. 26; Rothschild, 1915: 134. LECTOTYPE ♂, BURU I. (BMNH), here designated [examined].

*Eriboea pyrrhus buruanus* (Rothschild); Fruhstorfer, 1914: 728; van Eecke, 1929: 363.

*Polyura pyrrhus buruanus* (Rothschild) Stichel, 1939: 598.

MALE. *Upperside*. Forewing with discal spots in cells  $M_2$  and  $M_3$  of similar size. Hindwing submarginal spots white-centred. Glaucous outer margin of discal band not joining admarginals except at tornus. *Underside*. Hindwing with pale discal band reaching from costal margin to cell  $Cu_{1a}$ .

SIZE. ♂; 3 specimens only, 44.8, 42.5, 44.5.

DISTRIBUTION. **Buru**: Bara (Rothschild, 1915: 134); [Mnges'Wain]; Leksula; Nal Besi, Fakal; [Bah'Lelé] (van Eecke, 1929: 363); [Mt Mada]. 3 ♂.

TYPE-MATERIAL. Described from two males now in the BMNH and which bear the following labels; 'North Coast of Buru. XI. 97. (W. Doherty). / Rothschild Bequest B.M. 1939-1.' In addition, one male bears the following labels; 'Lectotype (purple) / *Eulepis pyrrhus buruanus* Rothschild LECTOTYPE det. R. L. Smiles 1978', and is designated lectotype. The remaining male bears the following additional labels; 'Paralectotype (blue) / *Eulepis pyrrhus buruanus* Rothschild PARALECTOTYPE det. R. L. Smiles 1978'.

BIONOMICS. There are records in the BMNH for September and November.

### *Polyura sacco* Smart

(Figs 12, 27, 78, Map 1)

*Polyura sacco* Smart, 1977: 56, figs 1 & 2. Holotype ♂, TANA IS. (P. Smart coll.) [2 paratypes, genitalia and photographs of holotype examined].

MALE, FEMALE. *Upperside*. Ground colour black, becoming brown at bases. Forewing with all spots and bands yellow. A complete row of submarginal spots present, also postdiscal spots in cells  $R_5$  and  $M_1$  and a discal band incorporating the spots in cells  $M_2$  and  $M_3$  and ending on the inner margin. Hindwing with marginal bars in each cell orange, bordered faintly with yellow or blue-green scaling. A complete row of yellow lunules present submarginally, a yellow discal band tapers from its commencement on the costal margin until it stops in cell  $Cu_{1b}$ . This band is bordered distally by a light, diffuse blue-green band which is more distinct in the female. The discal bands of the upperside are distinct, well defined marginally and do not extend to the wing bases. *Underside*. Ground colour red-brown with corresponding pale bands as on the upperside. In addition, proximal to the submarginal spots of the forewing, is a thin band of a light structural blue colour, bordered proximally with black which extends from  $R_4$  to  $Cu_{1b}$  or very slightly further. MI, DI

and part of MII border the remaining forewing bands proximally, MI and MII being clearly present in cells  $Cu_{1a}$  and  $Cu_{1b}$ . MII and DII are present in the discal cell, MII being bordered proximally and the more costal half of DII on both sides by light structural blue scales. Hindwing with slightly orange borders to the submarginal lunules. EII between the lunules and the marginal orange bars black, surrounded by structural blue. Postdiscal lunules crimson in cells  $R_1$ ,  $M_3$ ,  $Cu_{1a}$  and  $Cu_{1b}$ , largely so in cell  $M_2$ , orange in cells  $R_5$  and  $M_1$  bordered proximally with light structural blue scales—also distally in the case of the lunules in cells  $R_5$ ,  $M_1$ ,  $M_2$  and  $M_3$ . MI and MII present as thin black lines. MI proximal to discal band, MII runs from the costal margin to the commencement of  $Cu_{1b}$  on the median vein. A white band runs proximally to this and on into cell  $Cu_{1b}$ . Veins 2A and 3A are overlaid with black and lightly surrounded by light blue.

SIZE. ♂; 1 specimen only, 39·3. ♀; 2 specimens only, 46·5, 45·2.

DISTRIBUTION. **Vanuatu** (New Hebrides): Tanna Island; Lornatum, north of Isangel (Smart, 1977: 58), Lenakel. Burgess in Smart (1977: 58) reports that '*P. sacco* is found in an area extending from five miles south to ten miles north of the district headquarters station of Isangel / Lenakel and for about a mile inland from the coast. As much of the south of Tanna is densely forested, however, and as collecting is confined to the few and primitive earth "roads", it is probable that the butterfly occurs over a much wider area. The fact that it has hitherto escaped detection in a fairly well collected locality suggests that it may eventually be found to occur on the neighbouring islands such as Erromango'. 1 ♂, 3 ♀, genitalia of holotype.

TYPE-MATERIAL. The male holotype and four male and five female paratypes are in the P. Smart collection, St Mary's, West Sussex. One male and one female paratype are deposited on permanent loan in the BMNH, and these bear the label; 'Paratype (yellow)'. In addition the male bears the following label; 'South New Hebrides Tanna Island, near Isangel 1-7 May 1976 (A. Sacco) SARUMAN MUSEUM Paratype 1. *Polyura sacco* ♂'. The female bears the additional labels; 'FEEDING ON SAP OF YOUNG EUCALYPTUS TREE IN GARDEN ALTITUDE ABOUT 150-200' / South New Hebrides Tanna Island. Isangel / Lenakel 7.x.1975 (A. Sacco) SARUMAN MUSEUM Paratype 2. *Polyura sacco* ♀'.

BIONOMICS. Specimens have been taken during January, August (Smart, 1977: 58), May and October at 45-60 m. It has been recorded as feeding on the sap—particularly fermenting—of various trees, especially Mandarin Orange, but also *Eucalyptus* and Bamboo. It has been described as, 'shy and retiring and having the typically powerful flight of the Charaxinae' (Burgess in Smart, 1977: 59).

EARLY STAGES. Little is known of the early stages of this butterfly, although it has been speculated that the foodplant is a species of *Poinciana* (Burgess in Smart, 1977: 59).

The fully grown caterpillar bears two tricoloured marks on the dorsal surface which are cranially dark greenish blue, then white, and posteriorly red, most probably on the third and fifth abdominal segments respectively. In common with other species of *Polyura*, the head is four horned.

The pupa is of similar shape to *P. sempronius* and is green, but with white on the wing cases only (A. Sacco, pers. comm.).

### *Polyura jupiter* (Butler)

(Figs 79-82, 84, 85, 88-90, Map 1)

*Charaxes jupiter* Butler, 1869: 14, pl. 5, figs 4, 7.

*Euelpis pyrrius jupiter* (Butler) Rothschild & Jordan, 1898: 573, fig. 22.

*Eriboea pyrrius jupiter* (Butler) Fruhstorfer, 1914: 728, pl. 135a.

*Eriboea jupiter* (Butler); Talbot, 1920: 406.

*Polyura pyrrius jupiter* (Butler) Stichel, 1939: 599.

*Polyura jupiter* (Butler); D'Abrera, 1971: 245, figs; 1977: 245, figs.

MALE, FEMALE. *Upperside*. Ground colour black, becoming brown towards wing bases. Forewing with a continuous row of cream-yellow submarginal spots, double in cell  $Cu_{1b}$ , postdiscal cream-yellow spots in cells  $R_5$  and  $M_1$ , a discal band of similar colour running from cell  $Cu_{1a}$  to the inner margin and surmounted by discal spots in cells  $M_2$  and  $M_3$ . Hindwing admarginals blue and restricted to the more posterior part of the outer margin and tails, with an orange spot at the tornus. A submarginal series of blue or white spots present. Cream-yellow discal band present which tapers from its commencement on the coastal margin to

cell  $Cu_{1b}$ , proximally bordered with blue. The discal bands of the upperside are well defined and do not extend into the wing bases. *Underside*. Ground colour rufous brown, becoming slightly olivaceous towards the outer margin. Forewing submarginal spots extended to form a narrow band. A similar band lies proximally to this and is a vestige of part of the ocelli. The pale bands correspond with those of the upperside, but are creamy white and proximally bordered by MI, DI, MII and DII present in discal cell, partly bordered with white as is a further portion of MII which appears in cells  $Cu_{1a}$  and  $Cu_{1b}$ . Hindwing tails blue-centred, margin black, admarginals ochraceous orange. A complete row of submarginal ocelli present, one in each cell, double in cell  $Cu_{1b}$ , and each bordered proximally with white. Postdiscal lunules crimson, proximally blue-bordered, and the whole enclosed with black in cells  $M_3$ ,  $Cu_{1a}$  and  $Cu_{1b}$ , similar, but becoming yellow posteriorly in cell  $R_1$ . Lunules in cells  $R_5$ ,  $M_1$  and  $M_2$  yellow or rufous yellow and bordered distally with light scaling in place of the black. The proximal black borders of the postdiscal lunules distally border the discal band, which is creamy white and closely approximates to the position of that of the upperside. Discal band bordered proximally with white. Veins 2a and 3a overlaid with black which ends just before the tornus on a curved, black line crossing 2A and 3A (part of MI).

Abdomen above brown, sometimes pale beneath.

**RANGE.** From Seram and Watubala through Kai Is., Aru, Waigeo, Biak, New Guinea, Fergusson I., Trobriand Is., The Bismark Archipelago and Tagula to the Solomon and Admiralty Is.

### *Polyura jupiter jupiter* (Butler)

(Figs 79, 80)

*Charaxes jupiter* Butler, 1869: 14, pl. 5, figs 4, 7; Salvin & Godman, 1877: 145. Holotype ♂, DORE (UM, Oxford) [examined].

*Nymphalis jupiter* (Butler) Kirby, 1871: 271.

*Charaxes pyrrhus kronos* Honrath, 1888: 250. LECTOTYPE ♂, NEW BRITAIN (BMNH), here designated [examined].

*Charaxes jupiter chronos* (sic) Honrath; Ribbe, 1898: 131.

*Eriboea pyrrhus chlorus* Fruhstorfer, 1914: 728. LECTOTYPE ♂, WAIGEO (BMNH), here designated [examined].

*Eriboea pyrrhus jupiter* (Butler) Fruhstorfer, 1914: 728, pl. 135a.

*Eriboea pyrrhus kronos* (Honrath) Fruhstorfer, 1914: 728.

*Eriboea jupiter jupiter* (Butler); Talbot, 1920: 406.

*Eriboea jupiter chlorus* Fruhstorfer; Talbot, 1920: 406.

*Polyura pyrrhus chlorus* (Fruhstorfer) Stichel, 1939: 599.

*Polyura pyrrhus jupiter* (Butler) Stichel, 1939: 599.

*Polyura pyrrhus kronos* (Honrath) Stichel, 1939: 600.

*Polyura jupiter jupiter* (Butler); D'Abrera, 1971: 245, fig.

*Polyura jupiter kronos* (sic) (Honrath); D'Abrera, 1971: 245; 1977: 245.

**MALE, and FEMALE.** *Upperside*. Forewing discal band cream or pale yellow; sometimes approaching, but never as dark as *keianus*, rarely with any associated glaucous scaling. Hindwing blue on distal margin of discal band joining with that on the outer margin at the tornus and normally vein  $Cu_{1b}$ .

Both *Charaxes pyrrhus kronos* Honrath and *Eriboea pyrrhus chlorus* Fruhstorfer fall within the range of variation exhibited by *P. j. jupiter* on mainland New Guinea.

**SIZE.** ♂:  $\bar{x}$  = 43.6,  $s$  = 1.8 (40 specimens). ♀:  $\bar{x}$  = 50.1,  $s$  = 2.8 (24 specimens).

**DISTRIBUTION.** **Waigeo.** Irian Jaya: [Kapaur]; Ati Ati Onin; [River Uty]; Arfak Mts, Anggi Lakes, [Mt Siwi]; Dore; Teluk Irian [Geelvinck Bay], [Rom]; Wanggar River, 24 km from Coast; [Nomnaghé], 40 km south of Wanggar; Weyland Mts, Menoo River, Waisai River; Snow Mts, Upper Setekwa River; Eilanden River; Humboldt Bay; Wandamen Mrs. **Papua New Guinea:** Madang (Fr. Wilh. Hafen); Astrolabe Bay; Erima; Melanua (Constantinhafen); west side of Herzog Mts, Watut River to [Buiang]; Finschafen; Simbana; Rawlinson Mts; Manam I. [Vulcan I.]; Rihona, Eastern Highlands; Port Moresby; Angabunga River, affl. of St Joseph River; Aroa River, [Owgarra]; Mambare River, Biagi; Hydrographer Mts; [Ekeikei]; [Babooni]; Milne Bay. **Fergusson I. Trobriand Is.:** Kiriwini. **New Britain** (Neu Pommern): [Kinigunang] (Ribbe, 1898: 131); [Herbertshöhe]; Ralum. **Duke of York I. New Ireland. New Hanover. Tagula I.** (Sudest Isl.): Mt Riu. 177 ♂, 30 ♀.

TYPE-MATERIAL. *Charaxes jupiter* Butler was described from a single male from 'Dory' collected by A. R. Wallace. This holotype is now in the UM, Oxford and bears the following labels; 'Holotype (red) / Dor. 71 / ♂. Dor. / C. jupiter Butler type / Coll. Wallace 1871. / Type. Butl. Lep. Ex. 1. p. 14. n. 4 t. 5 fig. 1. / Charaxes jupiter Butler HOLOTYPE det. R. L. Smiles 1978'.

*Charaxes pyrrhus kronos* Honrath is represented in the BMNH by a pair of syntypes which bear the following labels; 'Ralum, N. Pom. Parkinson 1886 / Specimen typicum / Adams Bequest. B.M. 1912-399.', in addition the male bears the following labels; 'Lectotype (purple) / B.M. TYPE No. Rh. 10600 / Charaxes pyrrhus kronos Honrath LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype. The female bears the following labels; 'Paralectotype (blue) / B.M. TYPE No. Rh. 10601 / Charaxes pyrrhus kronos Stichel PARALECTOTYPE det. R. L. Smiles 1978'.

*Eriboea pyrrhus chlorus* Fruhstorfer was described from two males and one female in the Fruhstorfer and two males in the Rothschild collection. These specimens are now in the BMNH. One male bears the following labels; 'Lectotype (purple) / Waigiu H. Fruhstorfer / Fruhstorfer Coll. B.M. 1937-285. / Eriboea pyrrhus chlorus Fruhstorfer LECTOTYPE det. R. L. Smiles 1978', and is designated lectotype. Of the remaining, one male and one female bear the following labels; 'Paralectotype (blue) / Waigiu H. Fruhstorfer / Type / Fruhstorfer Coll. B.M. 1937-285. / Eriboea pyrrhus chlorus Fruhstorfer PARALECTOTYPE det. R. L. Smiles 1978', and two males; 'Paralectotype (blue) / WAIGEU. Platen. / Rothschild Bequest B.M. 1931-1. / Eriboea pyrrhus chlorus Fruhstorfer PARALECTOTYPE det. R. L. Smiles 1978'.

BIONOMICS. Specimens have been recorded for all months of the year except August, at altitudes of 180-1800 m. A female in the UM, Oxford was taken whilst flying around a Lime tree and was probably attracted by exuding sap.

EARLY STAGES. This butterfly has been reared on *Albizia fulva* and has been observed feeding on *Albizia chinensis* (Szent-Ivany & Carver, 1967: 8) (Leguminosae).

### *Polyura jupiter* from Seram

(Fig. 81)

*Eriboea jupiter* ab. *rectifascia* Talbot, 1920: 405. Syntypes ♂, ♀, SERAM (BMNH) [examined].

MALE, FEMALE. *Upperside*. Hindwing with grey-blue associated with discal band more restricted than in the nominate subspecies, not reaching grey-blue on the outer margin. The name *rectifascia* was originally applied to a few specimens collected in central Seram with almost no grey-blue scaling on the distal margin of the discal band. Most specimens from Seram have more glaucous scaling than this but are not so extensively glaucous as in *P. j. jupiter*, although a few specimens of the nominate subspecies may approach them.

SIZE. ♂;  $\bar{x}$  = 44.2, s = 2.1 (30 specimens). ♀; 1 specimen only, 50.1.

DISTRIBUTION. **Seram**: Manuseia; Bonfia; Valley of R. Koea, Toloearang. 30♂, 1♀.

TYPE-MATERIAL. *Eriboea jupiter* ab. *rectifascia* Talbot was described from a series of three males and one female. These specimens are now in the BMNH and bear the following labels; 'Syntype (blue) / 2.20 / Joicey Bequest. Brit. Mus. 1934-120. / Eriboea jupiter rectifascia Talbot SYNTYPE det. R. L. Smiles 1978'. In addition two males bear the following label; 'Central Ceram. Mansuela, 6000 ft. Oct. & Nov.' 19 C. F. & J. Pratt.', and one male and one female the following; 'Central Ceram. Mansuela, 2500 ft. Oct. & Nov.' 19 C. F. & J. Pratt.'

BIONOMICS. This butterfly has been taken during August, October to November and December at altitudes between 30 and 1800 m.

### *Polyura jupiter glauca* (Joicey & Talbot)

(Fig. 82)

*Eriboea pyrha glauca* Joicey & Talbot, 1916: 73. LECTOTYPE ♂, BIAK (BMNH), here designated [examined].

*Eriboea jupiter glauca* Joicey & Talbot; Talbot, 1920: 406.

*Polyura pyrrhus glauca* (Joicey & Talbot) Stichel, 1939: 602.

MALE, FEMALE. *Upperside*. Forewing discal band with extended glaucous distal edge. Discal spot in cell  $M_3$  smaller than in *P. j. jupiter*.

The status of this taxon must remain in doubt until more specimens are seen.

SIZE. ♂; 2 specimens only, 40·7, 42·3. ♀; 1 specimen only, 51·5.

DISTRIBUTION. **Biak** (Schouten Is.): Biak. **Aru I.** 2♂, 1♀.

TYPE-MATERIAL. Described from two males and one female in the BMNH, and which bear the following labels; 'Biak, Schouten Is. North N. Guinea. June 1914. A. C. and F. Pratt. / Joicey Bequest. Brit. Mus. 1934–120.'. In addition the female bears the following labels; 'Lectotype (purple) / *Eriboea pyrrha glauca* Joicey & Talbot LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype. Two males also bear the following labels; 'Paralectotype (blue) / Co. Type. / *Eriboea pyrrha glauca* Joicey & Talbot PARALECTOTYPE det. R. L. Smiles 1978'.

BIONOMICS. The three specimens of this butterfly in the BMNH were collected during June.

### *Polyura jupiter watubela* (Rothschild)

(Fig. 85)

*Eulepis pyrrhus watubela* Rothschild, 1903: 311. Holotype ♂, WATUBELA IS. (BMNH) [examined].

*Eriboea pyrrhus watubela* (Rothschild) Fruhstorfer, 1914: 728.

*Eriboea jupiter watubela* (Rothschild); Talbot, 1920: 406.

*Polyura pyrrhus watubela* (Rothschild) Stichel, 1939: 601.

*Polyura jupiter watubela* (Rothschild); D'Abrera, 1971: 245.

MALE. *Upperside*. Discal bands pale yellow, lighter than *P. j. keiana*. Forewing spots in cells  $M_2$  and  $M_3$  separate from one another, and more separate from discal band than in that subspecies, but not so much as in *P. j. jupiter*.

SIZE. ♂; one specimen only, 46·8.

DISTRIBUTION. **Watubela Is.**: Kissui. 1♂.

TYPE-MATERIAL. Described from a holotype in the BMNH which bears the following labels; 'Holotype (red) / Kissoei, Watoebela (Kühn). / Rothschild Bequest B.M. 1939–1. / *Eulepis pyrrhus watubela* Roths. det. R. L. Smiles 1975'.

BIONOMICS. This butterfly has been recorded flying in March (Fruhstorfer, 1914: 728).

### *Polyura jupiter keiana* (Rothschild)

(Figs 84, 88)

*Charaxes pyrrhus keianus* Rothschild, 1897: 508. Holotype ♀, KAI IS. (BMNH) [examined].

*Charaxes keianus* Rothschild; de Nicéville & Kühn, 1898: 262, pl. 1, figs 4, 4a, 4b; de Nicéville, 1898: 140, pl. Z, figs 13, 14.

*Eulepis pyrrhus keianus* (Rothschild) Rothschild & Jordan, 1898: 578, pl. 6, fig. 2.

*Eriboea pyrrhus keianus* (Rothschild) Fruhstorfer, 1914: 729.

*Eulepis pyrrhus juta* Hulstaert, 1924: 80. 2 syntypes ♀, KAI BESAR (untraced) [not examined]. **Syn. n.**

*Polyura pyrrhus keianus* (Rothschild) Stichel, 1939: 601.

*Polyura pyrrhus juta* (Hulstaert) Stichel, 1939: 601.

*Polyura jupiter keianus* (Rothschild); D'Abrera, 1971: 245; 1977: 245.

MALE, FEMALE. *Upperside*. Discal bands yellow, tending to be wider than in the nominate subspecies. Forewing with discal spots in cells  $M_2$  and  $M_3$  very close or joined to discal band. *Underside*. Forewing with MI in cell  $M_2$  fused with DI at end of discal cell and forming straight line with MI in cell  $M_3$ .

Female much larger than the male.

*Eulepis pyrrhus juta* Hulstaert, according to the original description, falls within the variation exhibited by the BMNH series of this butterfly.



SIZE. ♂;  $\bar{x}$  = 45.4,  $s$  = 1.6 (21 specimens). ♀;  $\bar{x}$  = 53.6,  $s$  = 2.0 (19 specimens).

DISTRIBUTION. **Ewab Is.** (Key Is., Kei Is.): Kai Besar (Gr. Key), Har (Hulstaert, 1924: 80); Kai Doelah, Tual (Kei Toeal), [Robde]; Kai Ketjil (Little Key Island). 21 ♂, 19 ♀.

TYPE-MATERIAL. *Charaxes pyrrhus keianus* Rothschild was described from a female holotype, four male and two female paratypes. Of these, the holotype, three male and two female paratypes are in the BMNH. The holotype, two male and two female paratypes bear the following labels; 'Kei Toeal, I-III. 96 H. C. Webster / Rothschild Bequest B.M. 1939-1.'. One male paratype bears the following labels; 'Gr. Key. iv. 96 Webster / Rothschild Bequest B.M. 1939-1.'. In addition the holotype bears the following labels, 'Holotype (red) / Charaxes pyrrhus keianus Roths. HOLOTYPE det. R. L. Smiles 1975', and the paratypes; 'Paratype (yellow) / Charaxes pyrrhus keianus Roths. PARATYPE det. R. L. Smiles 1975'.

BIONOMICS. This butterfly has been taken during April, January to March and June to July.

EARLY STAGES. The pupa of this butterfly has been illustrated by de Nicéville & Kühn (1898: 261, pl. 1, figs 4, 4a, 4b) and is described as being 'pale green with snow white stripes and dashes'. Similar to *P. sempronius*. In the same paper the larva is noted as feeding on *Albizia* sp. (Leguminosae) and *Mesua ferrea* (Guttiferae).

### *Polyura jupiter admiralitatis* (Rothschild)

(Fig. 89)

*Eulepis pyrrhus admiralitatis* Rothschild, 1915b: 208. LECTOTYPE ♂, ADMIRALTY IS. (BMNH), here designated [examined].

*Eriboea jupiter admiralitatis* (Rothschild) Talbot, 1920: 406.

*Polyura pyrrhus admiralitatis* (Rothschild) Stichel, 1939: 601.

MALE, FEMALE. Larger than most specimens of the nominate subspecies, with proportionately narrower discal bands on upperside and underside than in other subspecies. *Underside*. Ground colour pale rufous. Forewing with M1 in cell  $M_2$  fused with DI at end of discal cell, but like *P. j. attila* in not forming straight line with M1 in cell  $M_3$ .

SIZE. ♂; one specimen only, 47.5. ♀; five specimens only, 52.3, 56.3, 54.1, 55.4, 55.6.

DISTRIBUTION. **Admiralty Is.**: Manus. 1 ♂, 5 ♀.

TYPE-MATERIAL. Described from one male and five females which are now in the BMNH and bear the following labels; 'Manus, Admiralty Isl. Sept. Oct. 1913 [Meek's Expedition] / Rothschild Bequest B.M. 1939-1.' In addition the male bears the following 'Lectotype (purple) / *Eulepis pyrrhus admiralitatis* Rothschild LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype. The five females also bear the following; 'Paralectotype (blue) / *Eulepis pyrrhus admiralitatis* Rothschild PARALECTOTYPE det. R. L. Smiles 1978'.

BIONOMICS. This butterfly is recorded as having been taken during September and October.

### *Polyura jupiter attila* (Grose-Smith)

(Fig. 90)

*Charaxes attila* Grose-Smith, 1889: 301; Grose-Smith & Kirby, [1887-1891]: 11. LECTOTYPE ♂, GUADALCANAL I. (BMNH), here designated [examined].

*Charaxes editha* Ribbe, 1898: 131; Rothschild & Jordan, 1898: 576. Holotype ♀, BOUGAINVILLE I. (BMNH) [examined].

*Eriboea pyrrhus attila* (Grose-Smith) Fruhstorfer, 1914: 728.

*Eriboea pyrrhus editha* (Ribbe) Fruhstorfer, 1914: 728.

*Eriboea jupiter attila* (Grose-Smith); Talbot, 1920: 406.

*Eriboea jupiter editha* (Ribbe); Talbot, 1920: 406.

*Polyura pyrrhus attila* (Grose-Smith) Stichel, 1939: 600.

*Polyura pyrrhus editha* (Ribbe) Stichel, 1939: 601.

*Polyura jupiter attila* (Grose-Smith); D'Abrera, 1971: 244, fig.

*Polyura jupiter editha* (Ribbe); D'Abrera, 1971: 245.

MALE. Similar in shape and size to *P. j. admiralitatis*. *Upperside*. Forewing with submarginal spots larger than in the above. *Underside*. Ground colour ochraceous yellow, sometimes becoming grey-green.

FEMALE. As male but larger and with straighter outer margins to forewings.

*Charaxes editha* Ribbe falls within the range of variation shown by the series of Solomon Is. *P. jupiter* in the BMNH, and although subtle differences *may* occur fairly constantly within the individual islands, no assessment can yet be made as to whether such is the case, as there is at present too little material available to make any adequate study of the nature of the variation within this group.

SIZE. ♂; 4 specimens only, 47.5, 52.6, 52.0, 45.0 mm. ♀;  $\bar{x}$  = 55.6,  $s$  = 2.8 (12 specimens).

DISTRIBUTION. **Solomon Is.**: Bougainville I.; Vella Lavella I.; Gizo I., Ranongga; Guadalcanal I., Aola. 4 ♂, 13 ♀.

TYPE-MATERIAL. *Charaxes attila* Grose-Smith was described from an unspecified number of specimens. In the BMNH are one male and one female belonging to the original type-series which bear the following labels; 'Guadalca: Solomon Is. / Type. / Joicey Bequest. Brit. Mus. 1934-120.' In addition the male bears the following labels; 'Lectotype (purple) / Charaxes attila Grose-Smith LECTOTYPE det. R. L. Smiles 1978', and is here designated lectotype. The female also bears the following labels; 'Paralectotype (blue) / Charaxes attila Grose-Smith PARALECTOTYPE det. R. L. Smiles 1978'.

*Charaxes editha* Ribbe, was described from a single specimen, the holotype, which is now in the BMNH and which bears the following labels; 'Holotype (red) / Salomo Archip. Bougainville C. Ribbe / Original / Rothschild Bequest B.M. 1939-1. / Charaxes editha Ribbe HOLOTYPE det. R. L. Smiles 1976'.

BIONOMICS. This butterfly has been taken during the months of March, April, May, July and November.

### *Polyura clitarchus* (Hewitson)

(Figs 13, 28, Map 1)

*Charaxes clitarchus* Hewitson, 1874: 37, pl. 19, figs 16, 17; Butler, 1876: 613. LECTOTYPE ♂, NEW

CALEDONIA (BMNH), here designated [examined].

*Eulepis clitarchus* (Hewitson) Rothschild & Jordan, 1898: 570, fig. 21.

*Eriboea clitarchus* (Hewitson) Fruhstorfer, 1914: 728.

*Polyura clitarchus* (Hewitson) Stichel, 1939: 602; D'Abrera, 1971: 245, figs; 1977: 245; Holloway & Peters, 1976: 302.

MALE, FEMALE. *Upperside*. Ground colour black. Forewing with complete row of submarginal spots, cream at apex and becoming progressively glaucous until completely so in the double spots of cell  $Cu_{1b}$ . Cream postdiscal dash stretching from radials to  $M_2$ . Discal patch cream-yellow, occupying distal half of discal cell and cells  $Cu_{1a}$ ,  $Cu_{1b}$  and 2a, ending on inner margin. This is well-defined distally, less so proximally, cream sometimes glaucous scales reaching to the base in some cases. Hindwing with admarginals for the most part glaucous, interrupted at veins, somewhat orange towards centres, that of cell  $Cu_{1b}$  being mainly distinctly orange. Submarginal spots and postdiscal lunules glaucous, disco-basal patch creamy yellow, reaching from anal margin to costal margin. Cells 2a and 3a somewhat buff coloured in male. *Underside*. Ground colour rufous-brown. Forewing submarginal spots forming an ill-defined band. Postdiscal streak in corresponding position to that of upperside as the discal band is for the most part, except that this is more clearly defined than that of the upperside and does not reach so far towards the base. MI present proximal to postdiscal streak and proximal to anteriorly pointing 'tooth' of discal band in cells  $M_2$  and  $M_3$ . MI often present in cell  $Cu_{1b}$  as a complete or partial circle, but is never found in cell  $Cu_{1a}$ . DI present at end of discal cell, and in the discal cell, MII proximal to this at the distal edge of the discal band, while DII forms a very heavy black bar on the proximal edge of the discal band. Hindwing outer margin black with a white fringe. Admarginals ochreous yellow, interrupted at the veins by blue scales which extend into the tails. Submarginal spots black, outlined proximally by blue then white scales. Postdiscal lunules complete, crimson in cells  $R_1$ ,  $M_3$ ,  $Cu_{1a}$  and  $Cu_{1b}$ , slightly lighter in cells  $R_5$ ,  $M_1$  and  $M_2$ , bordered distally with black,

proximally with pale structural blue scales. Discal band off-white, commencing on costal margin and narrowing to anal margin, bordered distally by MI which curves to the anal margin and interrupts the heavy, black line above 2A. 3A covered by a similar line, and both of these also outlined by thin, pale blue lines. MII runs from costal margin, where it is often found curving to join MI, to the commencement of  $Cu_{1b}$  on the cubitus. This is bordered proximally by a fairly diffuse bluish white line which extends beyond MII to end in cell  $Cu_{1b}$  just anterior to MI.

Abdomen brown to buff above, brown beneath.

SIZE. ♂;  $\bar{x}$  = 43.4,  $s$  = 1.2 (40 specimens). ♀; 2 specimens, 51.0, 51.8.

DISTRIBUTION. **Loyalty Is.:** Mare; Lifu. **New Caledonia:** 'Entres des Grottes'; Poya; Ouen Toro; Yahoué; Mt Koghi; Ile de Pins (Holloway & Peters, 1976: 302). 40 ♂, 2 ♀.

TYPE-MATERIAL. Described from an undisclosed number of specimens from New Caledonia. One male in the BMNH can be definitely ascribed to the above and bears the following labels; 'Lectotype (purple) / [New Caledonia] Hewitson Coll. 79-69 / B.M. TYPE No. Rh. 10427. / *Charaxes clitarchus* Hewitson LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype.

BIONOMICS. One male in the BMNH of this forest species (Holloway & Peters, 1976: 280) was taken during August.

### *Polyura andrewsi* (Butler) stat. rev.

(Figs 14, 29, Map 1)

*Charaxes andrewsi* Butler, 1900: 61, Pl. 9, fig. 8. LECTOTYPE ♂, CHRISTMAS I. (BMNH), here designated [examined].

*Eriboea pyrrhus andrewsi* (Butler) Talbot, 1920: 406.

*Polyura pyrrhus andrewsi* (Butler) Stichel, 1939: 602.

MALE, FEMALE. *Upperside.* Ground colour dark brown. Forewing with a complete row of submarginal spots, double in cell  $Cu_{1b}$ . Postdiscal spots of similar size in cells  $R_5$  and  $M_1$ . Discal spots present in cells  $M_2$  and  $M_3$  surmounting a very diffuse, often almost obliterated discal band from  $Cu_{1a}$  to inner margin. All these pale markings yellow. Area from wing base to discal band clothed with buff-coloured scales. Hindwing outer margin black, partly fringed with white between the veins. Admarginals yellow-orange-centred becoming glaucous towards the veins and this extending into the tails. Submarginal spots complete and white, double in cell  $Cu_{1b}$ . Discal band commencing on costal margin, better defined than that of forewing, but becoming diffuse posteriorly between cells  $M_1$  and  $M_2$ . Area from discal band to within approximately 5 mm of tornus in male and 8 mm in female, to wing base clothed with buff, hair-like scales. *Underside.* Ground colour ochreous grey. Forewing with complete row of submarginal spots, double in cell  $Cu_{1b}$ . A black line runs down the wing between the discal band and submarginal spots from  $R_4$  to 2a, bordered distally from  $R_4$  to  $Cu_{1a}$  by a silver-blue line. Pale markings off-white. Discal band well defined, running from  $M_2$  (incorporating what would be the discal spots on the upperside) to the inner margin and extending anteriorly into the discal cell. The band thus encloses an area of ground colour bordered by MI and DI, which are almost on top of one another at the end of the discal cell; MI being also present in cell  $M_3$ ; and MII. DII is present as a thick, waisted, black bar lying in the discal cell proximal to the discal band. Hindwing outer margin black, fringed only slightly with white. Admarginals yellow-orange which often extends into the tails. Sometimes, however, the tails are blue-centred. Submarginal spots complete, double in cell  $Cu_{1b}$ , black-centred, bordered by blue proximal to which lies a white spot. Postdiscal lunules brick-red, complete in cells,  $R_1$ ,  $M_2$ ,  $M_3$ ,  $Cu_{1a}$  and  $Cu_{1b}$  with silver-blue scaling proximal to them, and bordered both distally and proximally with black. In cells  $R_5$  and  $M_1$  the lunules are almost obliterated, but the proximal silver-blue and black lines are present, the former being much more evident. A white discal band commences on the costal margin, narrows to end in cell  $Cu_{1b}$  and is proximally bordered by MI. MII runs from the costal margin to end in discal cell distally bordering a white line which extends to end diffusely in cell  $Cu_{1b}$ . 2A and 3A overlaid with black.

Abdomen in male brown above, buff beneath; in female brown above, only slightly paler beneath.

SIZE. ♂;  $\bar{x}$  = 4.5,  $s$  = 1.2 (11 specimens). ♀;  $\bar{x}$  = 52.9,  $s$  = 1.5 (13 specimens).

DISTRIBUTION. **Christmas I.:** Flying Fish Cove; Rocky Pt. 11 ♂, 13 ♀.

**TYPE-MATERIAL.** Described from a series of males and females in which no holotype was indicated. Five males and eight females in the BMNH are members of the type-series. One male bears the following labels; 'Lectotype (purple) / May, 1898. Christmas Island Flying Fish Coast / Rothschild Bequest B.M. 1939-1. / *Charaxes andrewsi* Butler LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype. The remaining specimens bear the following labels; 'Paralectotype (blue) / *Charaxes andrewsi* Butler PARALECTOTYPE det. R. L. Smiles 1978'. In addition, they bear the following labels, one male; 'Flying Fish Cove, 11-4-98 / B.M. Type No. Rh. 10428 *Charaxes andrewsi* ♂ Butl.', one female; 'Christmas I. C. W. Andrews. / Rothschild Bequest B.M. 1939-1.', two females; 'Christmas I. C. W. Andrews. 98-20. / B.M. Type No. Rh. 10429 [10430] *Charaxes andrewsi*, ♀ Butl.', one male and one female; 'May, 1898. Christmas Island Flying Fish Coast / Rothschild Bequest B.M. 1939-1.', one female; 'Rocky Pt. Christmas I. C. W. Andrews. Nov. 97. / Rothschild Bequest B.M. 1939-1.', one male and three females; 'Christmas I. C. W. Andrews. 98-20. / Levick Bequest 1941-83'.

**BIONOMICS.** Has been taken during February, March, April, May, June and September.

*Polyura galaxia* (Butler) stat. rev.

(Figs 15, 30, 91-93, 99-104, Map 1)

*Charaxes galaxia* Butler, 1866: 633, pl. 37, fig. 2; 1867: 457; Grose-Smith & Kirby, 1891: *Charaxes* 12, pl. 5, figs 3, 4.

*Nymphalis pyrrius* var. *galaxia* (Butler) Kirby, 1871: 270.

**MALE, FEMALE.** *Upperside.* Ground colour black. Forewing submarginal spots pale and complete. Pale postdiscal spots in cells  $R_5$  and  $M_1$  almost always present, sometimes fused; in female often joined to disco-basal patch, which runs from the subcostal veins to the inner margin and into the wing base. Hindwing outer margin black, slightly fringed with white. Admarginals blue or glaucous, often more or less orange at the centres. Clearly defined orange patch taking up most of the admarginal band of cell  $Cu_{1b}$ . Submarginal spots white or glaucous, normally complete. Disco-basal patch off-white to cream-yellow, running from costal margin to anal margin and into the wing base; distal margin diffuse, often glaucous. *Underside.* Ground colour grey-brown to ochreous yellow. Forewing submarginal spots pale and complete. Proximal to this a black line runs proximal to a blue-silver line ending in the region of 2a. Postdiscal spots in cells  $R_5$  and  $M_1$  normally fused, bordered proximally by MI. Discal spots in cells  $M_2$  and  $M_3$ , often fused with one another and with the discal patch, bordered proximally by MI. Discal patch runs from  $Cu_{1a}$  to inner margin, but does not extend into base. MI and MII not normally present in cells  $Cu_{1a}$  or  $Cu_{1b}$ . DI present at end of discal cell. A pale bar at centre of discal cell is bordered distally by MII, proximally by DII, which forms a thick, black, waisted bar. Hindwing outer margin black, slightly fringed with white between the veins. Admarginals predominantly yellow-orange, often becoming blue or glaucous at the veins, this blue continuing into the tails. Submarginal spots complete, black distally, white proximally, the black often accompanied by blue or glaucous scaling. Postdiscal lunules in cells  $M_3$ ,  $Cu_{1a}$ ,  $Cu_{1b}$  and often  $R_1$  and  $M_2$  crimson to scarlet, bordered proximally by silver-blue, the whole ocellus being enclosed proximally and distally by black lines, the proximal ones being more complete. Those of cells  $R_5$ ,  $M_1$ , and sometimes  $M_2$  and  $R_1$ , with the red part diminished to a greater or lesser extent, but much paler than the others. Discal band white to cream, running from costal margin and tapering to end between  $M_2$  and  $Cu_{1b}$ , bordered proximally by MI which follows a somewhat erratic zigzag course to end on the anal margin. MII runs from costal margin to cubitus and borders a pale line which ends diffusely in cell  $Cu_{1b}$ . 2A and 3A heavily overlaid with black.

Abdomen white above, white or brown beneath.

**RANGE.** This species is found in the islands of the Flores Sea from Sumbawa and Sumba, and east to the Tanimbar Is.

*Polyura galaxia galaxia* (Butler)

(Figs 91, 92)

*Charaxes galaxia* Butler, 1866: 633, pl. 37, fig. 2. LECTOTYPE ♂, TIMOR (BMNH), here designated [examined].

*Eulepis pyrrius galaxia* (Butler) Rothschild & Jordan, 1898: 586, fig. 29.

*Eulepis pyrhhus pyrhhulus* Fruhstorfer, 1903: 94. LECTOTYPE ♂, WETAR (BMNH), here designated [examined]. **Syn. n.**

*Eriboea pyrhhus galaxia* (Butler) Fruhstorfer, 1914: 727.

*Eriboea pyrhhus pyrhhulus* (Fruhstorfer) Fruhstorfer, 1914: 727.

*Eriboea sempronius galaxia* (Butler); Talbot, 1920: 407.

*Eriboea sempronius pyrhhulus* (Fruhstorfer); Talbot, 1920: 407.

*Polyura pyrhhus galaxia* (Butler) Stichel, 1939: 595; D'Abbrera, 1971: 244, fig.; 1977: 244, fig.

*Polyura pyrhhus pyrhhulus* (Fruhstorfer) Stichel, 1939: 596; D'Abbrera, 1971: 244; 1977: 244.

**MALE, FEMALE.** *Upperside.* Forewing disco-basal patch reaches from just within discal cell to the outer margin less than two-thirds of the distance from the base to the tornus. Discal spots in cells  $M_2$  and  $M_3$  small, separate from the disco-basal patch and from each other. Postdiscal spots in cells  $R_5$  and  $M_1$ , and submarginal spots, smaller than in *P. galaxia jovis*, *scipio*, *kalaonica*, *alorana*, *lettiana*, *babberica* and *antigonus*. Hindwing with disco-basal patch less glaucous distally than *P. g. jovis*, *scipio*, *kalaonica* and *alorana*, the edge being much straighter. *Underside.* Ground colour grey-brown. Forewing with MI and MII absent from cells  $Cu_{1a}$  and  $Cu_{1b}$ . Hindwing postdiscal spots in cells  $R_1$ ,  $M_2$ ,  $M_3$ ,  $Cu_{1a}$  and  $Cu_{1b}$  crimson.

**SIZE.** ♂;  $\bar{x}$  = 49.8,  $s$  = 1.2 (38 specimens). ♀; 5 specimens only, 59.8, 58.9, 57.1, 56.7, 57.8.

**DISTRIBUTION.** **Wetar. Timor:** Dili; Suai; [Timor Central]. 38 ♂, 5 ♀.

**TYPE-MATERIAL.** *Charaxes galaxia* Butler was described from an undisclosed number of specimens, one of which is now in the BMNH and which bears the following labels; 'Lectotype (purple) / Timor / B.M. TYPE No. Rh. 10431. *Charaxes galaxia* ♂ Butl. / *Charaxes galaxia* Butler LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype.

*Eulepis pyrhhus pyrhhulus* Fruhstorfer. Three male syntypes are in the BMNH and bear the following labels; 'Wetter Fruhstorfer'. In addition one male bears the following labels; 'Lectotype (purple) / Type / Adams Bequest. B.M. 1912-399. / *Eulepis pyrhhus pyrhhulus* Fruhstorfer LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype. One male also bears the following labels; 'Paralectotype (blue) / Adams Bequest. B.M. 1912-399. / *Eulepis pyrhhus pyrhhulus* Fruhstorfer PARALECTOTYPE det. R. L. Smiles 1978', and the other male; 'Paralectotype (blue) / Type / *Eulepis pyrhhus pyrhhulus* Fruhstorfer PARALECTOTYPE det. R. L. Smiles 1978'.

**BIONOMICS.** There are records in the BMNH for January, February, May, October and November.

### *Polyura galaxia jovis* (Staudinger)

(Fig. 93)

*Charaxes jovis* Staudinger, 1895: 357. LECTOTYPE ♂, SUMBAWA (BMNH), here designated [examined].

*Charaxes (Murwareda) jovis* Staudinger; de Nicéville & Elwes, 1897: 692.

*Eulepis pyrhhus jovis* (Staudinger) Rothschild & Jordan, 1898: 589, fig. 32.

*Eriboea pyrhhus jovis* (Staudinger) Fruhstorfer, 1914: 726.

*Eriboea sempronius jovis* (Staudinger); Talbot, 1920: 407.

*Polyura pyrhhus jovis* (Staudinger) Stichel, 1939: 595.

**MALE, FEMALE.** *Upperside.* Submarginal spots much larger than in *P. g. galaxia*, glaucous distal margin of disco-basal patch often extending to within 5 mm of submarginal spots in cell  $Cu_{1b}$ . Discal spot in cell  $M_2$  much smaller than that in cell  $M_3$ , normally less than half the size. Hindwing submarginal spots large, often almost completely white. *Underside.* Ground colour ochreous yellow. Forewing submarginal spots larger than in *P. g. galaxia*. MI and MII often present in cells  $Cu_{1a}$  and  $Cu_{1b}$ , but are very variable. Hindwing postdiscal lunules in cells  $M_2$ ,  $Cu_{1a}$  and  $Cu_{1b}$  scarlet.

**SIZE.** ♂;  $\bar{x}$  = 49.8,  $s$  = 1.3 (12 specimens). ♀; 3 specimens only, 55.2, 55.8, 55.1.

**DISTRIBUTION.** **Sumbawa.** 12 ♂, 3 ♀.

**TYPE-MATERIAL.** Originally described from four males, one of which is now in the BMNH, and bears the following labels; 'Lectotype (purple) / Origin. / Samb. Grel. / Sumbawa I. Ex Staudinger. / Godman-Salvin Coll. 96.-18. / *Charaxes jovis* Staud. 446. / *Charaxes jovis* Staudinger LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype.

*Polyura galaxia scipio* (Rothschild)

(Fig. 99)

*Eulepis pyrrhus scipio* Rothschild, 1898: 592, fig. 34. Holotype ♀, SUMBA (BMNH) [examined].*Eriboea pyrrhus scipio* (Rothschild) Fruhstorfer, 1914: 727.*Charaxes scipio* (Rothschild) van den Bergh, 1917: 14.*Eriboea sempronius scipio* (Rothschild) Talbot, 1920: 407.*Polyura pyrrhus scipio* (Rothschild) Stichel, 1939: 595.

MALE, FEMALE. *Upperside*. Similar to *P. g. jovis*. Forewing disco-basal patch a little wider, glaucous scaling of distal edge often within 2 mm of double spot in cell  $Cu_{1b}$ . Discal spot in cell  $M_2$  about half the size of that in cell  $M_3$ .

SIZE. ♂:  $\bar{x}$  = 50.9,  $s$  = 2.9 (14 specimens). ♀:  $\bar{x}$  = 60.7,  $s$  = 3.1 (11 specimens).

DISTRIBUTION. **Sumba**: Waingapu. 14 ♂, 11 ♀.

TYPE-MATERIAL. A female holotype, five male and three female paratypes in the BMNH bear the following label; 'Rothschild Bequest B.M. 1939-1.'. In addition the holotype bears the following labels; 'Holotype (red) / Waingapu, Sumba / *Eulepis pyrrhus scipio* Roths., HOLOTYPE det. R. L. Smiles 1975'. Two male paratypes also bear the following labels; 'Paratype (yellow) / S. Sumba, (A. Everett). / *Eulepis pyrrhus scipio* Roths., PARATYPE det. R. L. Smiles 1975', one male and one female paratype; 'Paratype (yellow) / Waingapu, Sumba / *Eulepis pyrrhus scipio* Roths., PARATYPE det. R. L. Smiles 1975', one female paratype; 'Paratype (yellow) / Sumba, Native Coll. / *Eulepis pyrrhus scipio* Roths., PARATYPE det. R. L. Smiles 1975', and two male and one female paratypes; 'Paratype (yellow) / Sumba, Febr. 96. W. Doherty. / *Eulepis pyrrhus scipio* Roths., det. R. L. Smiles 1975'.

BIONOMICS. Recorded as flying from November until February (Fruhstorfer, 1914: 727). There are records in the BMNH for January, February, September and December.

'According to Doherty, *scipio* in contrast with *E. eudamippus* being fond of flying near the ground, always flies above high trees.' (Fruhstorfer, 1914: 727).

*Polyura galaxia kalaonica* (Rothschild)

(Fig. 100)

*Eulepis pyrrhus kalaonicus* Rothschild, 1898: 591. LECTOTYPE ♀, KALAO (BMNH), here designated [examined].*Eriboea pyrrhus kalaonicus* (Rothschild) Fruhstorfer, 1914: 728.*Eriboea sempronius kalaonicus* (Rothschild); Talbot, 1920: 407.*Polyura pyrrhus kalaonicus* (Rothschild) Stichel, 1939: 596.

MALE, FEMALE. *Upperside*. Similar to *P. g. scipio*. Hindwing glaucous scaling more extensive in cells  $R_5$  and  $M_1$ . Submarginal white spots somewhat larger than in *P. g. jovis* or *scipio*. *Underside*. As in *P. g. jovis*, there being less tendency for MI and MII to be found in cells  $Cu_{1a}$  and  $Cu_{1b}$  of the forewing.

Specimens from Flores may be subspecifically distinct, the one battered pair in the BMNH having very pale admarginals on the hindwing upperside.

SIZE (excluding specimens from Flores). ♀; 4 specimens only, 60.1, 48.3, 56.6, 54.3.

DISTRIBUTION. **Flores**: Ende. **Kalao**. 1 ♂, 1 ♀ from Flores; 4 ♀ from Kalao.

TYPE-MATERIAL. Described from four female specimens now in the BMNH which bear the following label; 'Kalao, Dec. 95 A. Everett.'. In addition one female bears the following labels; 'Lectotype (purple) / Rothschild Bequest B.M. 1939-1. / *Eulepis pyrrhus kalaonicus* Rothschild LECTOTYPE det. R. L. Smiles 1978', and is designated lectotype. One female also bears the following labels; 'Paralectotype (blue) / Joicey Bequest. Brit. Mus. 1934-120. / *Eulepis pyrrhus kalaonicus* Rothschild PARALECTOTYPE det. R. L. Smiles 1978', and two females; 'Paralectotype (blue) / Rothschild Bequest B.M. 1939-1. / *Eulepis pyrrhus kalaonicus* Rothschild PARALECTOTYPE det. R. L. Smiles 1978'.

BIONOMICS. There are records in the BMNH for capture during December.

*Polyura galaxia alorana* (Rothschild)

(Fig. 101)

*Eulepis pyrrhus aloranus* Rothschild, 1898: 588, fig. 31. Holotype ♀, ALOR (BMNH) [examined].*Eriboea pyrrhus aloranus* (Rothschild) Fruhstorfer, 1914: 727.*Eriboea sempronius aloranus* (Rothschild); Talbot, 1920: 407.*Polyura pyrrhus aloranus* (Rothschild) Stichel, 1939: 595.

MALE, FEMALE. *Upperside*. Similar to *P. g. jovis* but forewing with a much smaller disco-basal patch covering approximately two-thirds of the inner margin, and only slightly larger than that of *P. g. galaxia*. *Underside*. As in *P. g. kalaonica* but hindwing postdiscal lunules in cells  $M_3$ ,  $Cu_{1a}$  and  $Cu_{1b}$  crimson.

SIZE. ♀; 1 specimen only, 59·9.

DISTRIBUTION. Alor. 1 ♀.

TYPE-MATERIAL. Described from a female holotype now in the BMNH, and a male in Pagenstecher's collection. The holotype bears the following labels; 'Holotype (red) / Alor iv.97 Everett. / Rothschild Bequest B.M. 1939-1. / Ch. pyrrhus aloranus Type Rothschild. Nov. Zoo. 98. / Eulepis pyrrhus aloranus Rothschild HOLOTYPE det. R. L. Smiles 1975'.

BIONOMICS. The holotype was taken during April.

*Polyura galaxia lettiana* (Rothschild)

(Fig. 102)

*Eulepis pyrrhus lettianus* Rothschild, 1898: 587, fig. 30. Holotype ♀, LETI (BMNH) [examined].*Eulepis pyrrhus romanus* Fruhstorfer, 1904b: 172. LECTOTYPE ♀, ROMANG (BMNH), here designated [examined]. **Syn. n.***Eriboea pyrrhus lettianus* (Rothschild) Fruhstorfer, 1914: 727; Talbot, 1920: 406.*Eriboea pyrrhus romanus* (Fruhstorfer) Fruhstorfer, 1914: 727.*Eriboea sempronius romanus* (Fruhstorfer); Talbot, 1920: 407.*Polyura pyrrhus lettianus* (Rothschild) Stichel, 1939: 596; D'Abbrera, 1971: 244; 1977: 244.*Polyura pyrrhus romanus* (Fruhstorfer) Stichel, 1939: 596.

MALE, FEMALE. *Upperside*. Similar to *P. g. galaxia* but forewing with larger submarginal spots. Disco-basal patch slightly larger, often joined to discal spots which in turn are larger. *Underside*. As in *P. g. galaxia*.

*Eulepis pyrrhus romanus* Fruhstorfer falls within the range of variation exhibited by *P. g. lettiana*.SIZE. ♂; 5 specimens only, 45·1, 46·2, 51·0, 43·4, 48·0, ♀;  $\bar{x}$  = 56·1,  $s$  = 4·2 (9 specimens).

DISTRIBUTION. Kisar. Romang. Leti. Moa. 5 ♂, 10 ♀.

TYPE-MATERIAL. *Eulepis pyrrhus lettianus* Rothschild was described from a single female. This holotype is in the BMNH and bears the following labels; 'Holotype (red) / Letti, July 1892. W. Doherty / Joicey Bequest. Brit. Mus. 1934-120. / Eulepis pyrrhus lettianus Rothschild HOLOTYPE det. R. L. Smiles 1975'.

*Eulepis pyrrhus romanus* Fruhstorfer was described from an unspecified number of specimens from 'Roma'. One female in the BMNH can be positively identified as belonging to the type-series, bears the following labels; 'Lectotype (purple) / Roma Fruhstorfer. / Type / Fruhstorfer Coll. B.M. 1937-285. / Eulepis pyrrhus romanus Fruhstorfer det. R. L. Smiles 1978', and is hereby designated lectotype.

BIONOMICS. Has been recorded as flying in July (Fruhstorfer, 1914: 727), and according to records in the BMNH, has been taken during July and August.

*Polyura galaxia antigonus* (Fruhstorfer)

(Fig. 103)

*Eulepis pyrrhus antigonus* Fruhstorfer, 1904a: 140. LECTOTYPE ♂, DAMAR (BMNH), here designated [examined].

*Eriboea pyrrhus antigonus* (Fruhstorfer) Fruhstorfer, 1914: 727; Talbot, 1920: 406.  
*Polyura pyrrhus antigonus* (Fruhstorfer) Stichel, 1939: 596; D'Abrera, 1971: 244; 1977: 244.

MALE, FEMALE. *Upperside*. Similar to *P. g. galaxia*, but with pale markings yellower, submarginal spots larger. Hindwing admarginals often extended beyond cell  $M_1$ . *Underside*. As in *P. g. galaxia*, but forewing with larger submarginal spots. Hindwing with generally broader discal band.

SIZE. ♂;  $\bar{x}$  = 46.5,  $s$  = 1.3 (7 specimens). ♀;  $\bar{x}$  = 55.9,  $s$  = 1.8 (9 specimens).

DISTRIBUTION. **Sermata. Damar.** 7 ♂, 9 ♀.

TYPE-MATERIAL. Described from an unspecified number of specimens, two males and three females of which are now in the BMNH, and bear the following labels; 'Dammer Fruhstorfer / Fruhstorfer Coll. B.M. 1937-285'. In addition one male bears the following labels; 'Lectotype (purple) / *Eulepis pyrrhus antigonus* Fruhstorfer LECTOTYPE det. R. L. Smiles 1978', and is here designated lectotype. The remaining male and three females also bear the following labels; 'Paralectotype (blue) / *Eulepis pyrrhus antigonus* Fruhstorfer PARALECTOTYPE det. R. L. Smiles 1978'.

BIONOMICS. There are records in the BMNH for November and December.

### *Polyura galaxia babberica* (Fruhstorfer)

(Fig. 104)

*Eulepis pyrrhus babbericus* Fruhstorfer, 1903: 93. LECTOTYPE ♀, BABAR (BMNH), here designated [examined].

*Eriboea pyrrhus babbericus* (Fruhstorfer) Fruhstorfer, 1914: 727; Talbot, 1920: 406.

*Polyura pyrrhus babbericus* (Fruhstorfer) Stichel, 1939: 596; D'Abrera, 1971: 244; 1977: 244.

MALE, FEMALE. *Upperside*. Similar to *P. g. antigonus*, but hindwing with smaller submarginal spots, and admarginals not extending beyond cell  $M_1$ . *Underside*. As in *P. g. antigonus*.

SIZE. ♂; 1 specimen only, 49.2. ♀; 3 specimens only, 52.1, 59.9, 56.7.

DISTRIBUTION. **Babar.** 1 ♂, 3 ♀.

TYPE-MATERIAL. Described from two females in the Fruhstorfer collection. Both these specimens are now in the BMNH, and bear the following labels; 'Type / Babber Fruhstorfer.'. In addition one female bears the following labels; 'Lectotype (purple) / Adams Bequest. B.M. 1912-399 / *Eulepis pyrrhus babbericus* Fruhstorfer LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype. The remaining female also bears the following labels; 'Paralectotype (blue) / Fruhstorfer Coll. B.M. 1937-285. / *Eulepis pyrrhus babbericus* Fruhstorfer PARALECTOTYPE det. R. L. Smiles 1978'.

### *Polyura galaxia seitzi* (Rothschild)

(Figs 15, 30)

*Charaxes pyrrhus seitzi* Rothschild, 1897: 508. Holotype ♀, TANIMBAR IS. (BMNH) [examined].

*Eulepis pyrrhus seitzi* (Rothschild) Rothschild & Jordan 1898: 585, Pl. 5, fig. 1.

*Eriboea pyrrhus seitzi* (Rothschild) Fruhstorfer, 1914: 728.

*Eriboea sempronius seitzi* (Rothschild); Talbot, 1920: 406.

*Polyura pyrrhus seitzi* (Rothschild) Stichel, 1939: 601.

*Polyura jupiter seitzi* (Rothschild); D'Abrera, 1971: 245. 1977: 245.

MALE, FEMALE. *Upperside*. Forewing submarginals much smaller than those of any other subspecies, often not complete. Disco-basal patch very much smaller, taking up approximately half the inner margin. Pale areas of upperside similar in colouring to those of *P. g. galaxia*. *Underside*. Ground colour dark grey-brown, much darker than any other subspecies. Forewing with MI and MII absent from cells  $Cu_{1a}$  and  $Cu_{1b}$ . Hindwing postdiscal spots in cells  $R_5$  and  $M_1$  darker than those of other subspecies, but still differentiated from those in cells  $R_1$ ,  $M_2$ ,  $M_3$ ,  $Cu_{1a}$  and  $Cu_{1b}$ .

SIZE. ♂;  $\bar{x}$  = 45.6,  $s$  = 2.0 (12 specimens). ♀;  $\bar{x}$  = 54.8,  $s$  = 2.3 (12 specimens).



DISTRIBUTION. **Tanimbar Is.:** Larat; Sera (Rothschild, 1897: 508), [Sjerra] (Rothschild & Jordan, 1898: 585), [Mt Kuhlmann] (Rothschild, 1897: 508); South Jamdena, 32 km (20 miles) N. of Saumlaki; Selaru. 12 ♂, 12 ♀.

TYPE-MATERIAL. Described from a female holotype, two male and two female paratypes, all now in the BMNH, which bear the following label 'Rothschild Bequest B.M. 1939-1.'. The holotype also bears the following labels; 'Holotype (red) / Selaru, Tenimber Islands. / Ch. pyrrhus seitzi Rothschild. Type 1. N.Z. 97 / Charaxes pyrrhus seitzi Rothschild. HOLOTYPE det. R. L. Smiles 1975'. The remaining paratypes all bear the following labels; 'Paratype (yellow) / Charaxes pyrrhus seitzi Rothschild PARATYPE det. R. L. Smiles 1975'. In addition one male bears the following label; 'Selaru III 97 W. Doherty.', a further male, 'Selaru, Tenimber.', and two females 'Tenimber, June-July. 1892, W. Doherty.'

BIONOMICS. Recorded as flying from March to July (Fruhstorfer, 1914: 728). There are records in the BMNH for February, March, April to May, June to July and November to March.

*Polyura sempronius* (Fabricius) **stat. rev.**

(Figs 105, 106, Map 1)

*Papilio sempronius* Fabricius, 1793: 62.

*Eriboea pyrrhus sempronius* (Fabricius) Fruhstorfer, 1914: 728, pl. 134d.

*Eriboea sempronius* (Fabricius); Talbot, 1920: 406.

*Polyura pyrrhus sempronius* (Fabricius) Burns & Rotherham, 1969: 70, fig. 51.

MALE, FEMALE. *Upperside.* Ground colour black. Forewing with all markings cream. Submarginal spots complete, those of cells  $Cu_{1a}$  and  $Cu_{1b}$  very often continuous with disco-basal patch which extends to the wing base, fills the discal cell and also incorporates the discal spots in cells  $M_2$  and  $M_3$ . Postdiscal spots in cells  $R_5$  and  $M_1$  elongated and of similar size. Hindwing admarginals glaucous, often suppressed in cells  $R_1$  and  $R_5$ , that of cell  $Cu_{1b}$  mostly orange. Submarginal spots complete, white, often becoming glaucous towards tornus. Disco-basal patch cream, extending to base, well-defined distally at costal margin, otherwise becoming glaucous distally and less well-defined. *Underside.* Ground colour light brown becoming slightly greenish towards external margins. Forewing submarginal spots off-white and complete, normally running into one another. Proximal to these runs an erratic black line from the costal to the inner margins, outlining the distal edge of the off-white discal patch which extends into the discal cell between MII and DII and upwards beyond the end of the discal cell. Postdiscal off-white patch from vein  $M_2$  to costal margin proximally delineated by MI. MI in cell  $M_2$  running into MI in cell  $M_3$  and fused with DI at the end of the discal cell. MII present in discal cell and often in cell  $M_3$ , DII in discal cell forms a thick, waisted, black bar. MI and MII only rarely present in cell  $Cu_{1a}$ , never in cell  $Cu_{1b}$ . Hindwing admarginals orange, blue at veins, this colour also extending into tails. Submarginal spots complete; black surrounded by blue scales, joined proximally to a series of white spots. Postdiscal lunules brick-red in cells  $M_3$ ,  $Cu_{1a}$  and  $Cu_{1b}$ , partly so in cells  $R_1$  and  $M_2$ , delineated proximally by lilac scales, and the whole enclosed proximally and distally by black lines. Those of cells  $R_5$ ,  $M_1$  and partly  $R_1$  and  $M_2$  similar, but the brick-red suppressed and the distal black largely replaced with lilac. Discal band off-white, commencing on costal margin and tapering to end in cell  $Cu_{1a}$ , proximally delineated by MI which turns in a zigzag manner through ninety degrees to end on the inner margin. MII runs from the costal margin to end on the cubitus. A white line running proximally to MII extends beyond it to end in cell  $Cu_{1b}$ . Veins 2A and 3A strongly overlaid with black lines. Cells 2a and 3a sometimes off-white, but more often grey-brown.

Abdomen cream above, brown, sometimes off-white, beneath.

RANGE. Coastal Australia and up to 480 km inland from Northern Territory east and south to South Australia and Lord Howe Island.

*Polyura sempronius sempronius* (Fabricius)

(Figs 105, 106)

*Papilio sempronius* Fabricius, 1793: 62. Syntype(s) (sex?), [AUSTRALIA] (untraced) [not examined].

*Nymphalis sempronius* (Fabricius) Godart, 1824: 354; Westwood, [1850]: 309; Kirby, 1871: 271.

*Jasia australis* Swainson, [1833]: 114, pl. 114. Holotype (sex?), AUSTRALIA (untraced) [not examined].

*Charaxes sempronius* (Fabricius) Doubleday, 1844: 110; Butler, 1866: 633; Edwards, 1889: 13; Illidge, 1898: 95; Beutenmüller, 1901: 151; Rainbow, 1907: 85, figs 49–54, 88; Froggat, 1907: 217.

*Charaxès tyrtaeus* Felder & Felder, 1859: 399, pl. 9, fig. 3. LECTOTYPE ♀, [AUSTRALIA] ('India') (BMNH), here designated [examined].

*Eulepis pyrrhus sempronius* (Fabricius) Rothschild & Jordan, 1898: 593, figs 35, 35a, 35b, pl. 13, figs 3, 4, pl. 14a, figs 37, 38; Waterhouse & Lyell, 1914: 51, pl. 5, fig. 41.

*Eriboea pyrrhus* d.s.f. *australis* (Swainson) Fruhstorfer, 1914: 728.

*Eriboea pyrrhus tyrtaeus* (Felder & Felder) Fruhstorfer, 1914: 728.

*Polyura pyrrhus sempronius* (Fabricius) Stichel, 1939: 596; Harslett, 1965: 108; McCubbin, 1971: 42, figs; D'Abbrera, 1971: 244, figs; 1977: 244, figs; Common & Waterhouse, 1972: 277, pl. 29, fig. 1; Quick, 1974: 67, 69; Atkins, 1975: 132; Smart, 1976: 219, fig. 20; Hatch, 1977: 55, figs 1, 2; Brunet, 1977: 47; Daniels & Moulds, 1977: 50; Fisher, 1978: 162, figs 55, 56; De Baar, 1979: 88.

*Polyura pyrrhus sempronius* f. *australis* (Swainson) Stichel, 1939: 598.

*Polyura pyrrhus tyrtaeus* (Felder & Felder) Stichel, 1939: 598.

*Eriboea pyrrhus sempronius* (Fabricius); Manski, 1960: 70.

*Polyura pyrrhus* (Linnaeus); Slater & Slater, 1974: [12, 13], figs.

MALE, FEMALE. *Upperside*. Admarginal band at tornus contains a strongly orange patch. *Underside*. Forewing with DII in discal cell broad. Hindwing submarginal black spots and orange admarginals very strongly marked.

SIZE. ♂;  $\bar{x}$  = 45.1,  $s$  = 2.7 (40 specimens). ♀;  $\bar{x}$  = 53.9,  $s$  = 3.0 (40 specimens).

DISTRIBUTION. **Australia**. Western Australia: Roebourne; Yampi Sound (Common & Waterhouse, 1972: 277); Careening Bay; Pt Nelson (Swainson, [1833]: 114). Northern Territory: Darwin; Roper R. (Waterhouse & Lyell, 1914: 51); Groote Eylandt. Queensland: Thursday Is.; Ingham; Mackay (Waterhouse & Lyell, 1914: 51); Mitchellin (Common & Waterhouse, 1972: 277); Cedar Bay; Cooktown; Kuranda; Cairns; Rockingham Bay; Davenport; [Burdelain R.]; Dawson Distr.; Moreton Bay; Brisbane; Cape York. New South Wales: Richmond R.; Manning; Tuncurry (Waterhouse & Lyell, 1914: 51); Leeton (Common & Waterhouse, 1972: 277); Warrumbungle National Park (Daniels & Moulds, 1977: 50); Sydney; Narrabeen; Nowra; Killara. Victoria: Beaumaris; Benalla; Bogong; Dimboola; Glen Waverly; Heidelberg; Melbourne City; Stanhope; Viewbank; Wail; Warrandyte; Yan Yean (Quick, 1974: 69). South Australia: Adelaide (Quick, 1974: 67); Whyalla; Underdale; St Peters; Belvue (Hatch, 1977: 61). 42♂, 52♀.

This butterfly seems only recently to have reached Victoria and South Australia, no records having appeared before 1972.

TYPE-MATERIAL. *Charaxes tyrtaeus* Felder & Felder was described from an undisclosed number of specimens represented in the BMNH by two females which bear the following labels; 'India septentr. Type / Felder Colln. / FELDER'S TYPE / Rothschild Bequest B.M. 1939-1.'. In addition, one female bears the following labels; 'Lectotype (purple) / *Charaxes tyrtaeus* Felder & Felder LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype. The remaining female also bears the following labels; 'Paralectotype (blue) / *Charaxes tyrtaeus* Felder & Felder PARALECTOTYPE det. R. L. Smiles 1978'.

BIONOMICS. This species has been described as uncommon, becoming more so towards '... the southern limits of its range.' (Common & Waterhouse, 1972: 277). McCubbin (1971: 45) reports that it is quite common around Sydney, and Brunet (1977: 47) describes its status as common in Adelaide.

Edwards (1889: 13) notes 'the *Charaxes* [*sempronius*] as it alights upon a bunch of the beautiful and sweet-scented flowers of *Bursaria spinosa* closes its wings with a grating sound not unlike that of *Prepona*, and repeats the same as it is disturbed from its resting place'. The butterfly is attracted by the fermenting sap exuded by shrubs (Waterhouse & Lyell, 1914: 51). Indeed, Fruhstorfer (1914: 728) notes that it often flies in orange plantations, but gives the reason as being '... in order to fly across them and to escape into the woods.', whereas a more likely explanation is that the butterfly is lured by the exuding sap of the orange trees. The butterfly has been taken on the sap of *Polygala myrtifolia* (Brunet, 1977: 47).

The flight period is '... throughout the year in the north; October to May in the South'. (McCubbin, 1971: 42). In the BMNH there are records for January, February, March, November and December.

*P. sempronius sempronius* in Queensland has been observed hill-topping between 10.00 and 16.00 hrs, occupying the treetops higher than 3 m from the ground (Atkins, 1975: 132).

EARLY STAGES. Eggs are laid singly on the upper surface of a leaf of the foodplant. They are spherical, yellowish green, mottled red-brown towards the apex, and '... delicately reticulated with longitudinal ribs and fine striae' (Rainbow, 1907: 85), and are about 2 mm in diameter (McCubbin, 1971: 45).

The first instar larva has two pairs of black horns on the head and is yellowish green. The subsequent instars (2–5) have short projections, one pair between the most dorsal pair of horns, one each between the dorsal and dorso-lateral horns (Common & Waterhouse, 1971: 278), and one projection on each side of the head beneath the dorso-lateral horns. The mature larva is granulated with white, each granule being associated with a minute 'hair'. The colour is predominantly green or bluish green with a yellowish lateral line. The tail is bifid and pinkish or bluish. Normally the third and fifth segments of the abdomen each has a transverse yellow lunule edged anteriorly with purple or a black line containing tiny blue spots. In some cases similar markings are found on other segments. The head is rough, dull green, yellowish and bluish at the sides (Common & Waterhouse, 1971: 278; Rainbow, 1907: 85).

Pupa smooth, often shiny, green or bluish green with irregular white markings on wings and a pair of white lines on the dorsal part of the abdomen. The insect normally suspends itself from the foodplant (Common & Waterhouse, 1971: 278).

Illustrations of the head capsules of the five larval instars are provided by Common & Waterhouse (1972: pl. 27, figs 1–5); of the egg, first, second, third, mature larvae and the pupa can be seen in Fisher (1978: figs 55, 56); colour illustrations of the larva and pupa are to be found in McCubbin (1971: 42 & 43) and Slater & Slater (1974: [12]); and colour photographs of the emergence of the imago from the pupa in D'Abbrera (1971: 24, 25; 1977: 24, 25).

Recorded food plants are: *Acacia decurrens*, *A. maidenii*, *A. baileyana*, *A. dealbata*, *A. longifolia*, *A. podalyriifolia* (Common & Waterhouse, 1972: 278), *A. neriifolia* (Harslett, 1965: 108), *A. spectabilis*, *Caesalpinia ferrea* (De Baar, 1979: 88), *Robinia pseudacacia* (Rainbow, 1907: 89), *Delonix regia*, *Cassia surrattensis* (Manski, 1960: 70), *C. fistula* (Illidge, 1898: 95), *C. javanica* (McCubbin, 1971: 42), *C. alata*, *Albizia celtis* (Common & Waterhouse, 1972: 278), *A. lebbeck* (Manski, 1960: 70) (Leguminosae), *Brachychiton populneum* (Harslett, 1965: 108), *B. acerifolium* (Manski, 1960: 70) (Sterculiaceae), *Cinnamomum camphora* (Common & Waterhouse, 1972: 278) (Lauraceae), *Lagerstroemia indica* (Lythraceae), *Celtis panicula*, *C. philippinensis*, *C. sinensis* (Ulmaceae), and climbing roses (Rosaceae) (Manski, 1960: 70).

#### *Polyura sempronius tiberius* (Waterhouse)

*Eulepis pyrrhus tiberius* Waterhouse, 1920: 468. Holotype ♀, LORD HOWE I. (AM, Sydney) [colour transparencies of upper and undersides examined].

*Polyura pyrrhus tiberius* (Waterhouse) Stichel, 1939: 598; Peters, 1969: 64; Smithers, 1970: 378; Common & Waterhouse, 1972: 278.

MALE, FEMALE. *Upperside*. Darker yellow than *P. s. sempronius*, the orange tornal patch less prominent in the hindwing. *Underside*. Forewing paler than in *P. s. sempronius*, dark bar across the middle of the discal cell (DII) narrower. Hindwing discal band larger, brick-red postdiscal lunules smaller. Black submarginal spots faint and the orange-brown admarginals very pale.

DISTRIBUTION. **Lord Howe I.**: Transit Hill; Anderson Road (Smithers, 1970: 378). 1 ♂ (CSIRO, Canberra).

TYPE-MATERIAL. Described from a single female.

BIONOMICS. Has been recorded as flying during February, March, April and December (Peters, 1969: 64), and during November (Smithers, 1970: 378).

#### *Polyura dehanii* (Westwood)

(Figs 15, 31, 114, 115)

*Nymphalis dehanii* Westwood, [1850]: 308.

*Charaxes kadenii* Felder & Felder; Wood, 1877: 618, fig. 357.

- Eulepis kadeni* (sic) (Felder & Felder) Rothschild & Jordan, 1898: 598, figs 37, 38.  
*Eriboea dehaani* (sic) (Westwood) Fruhstorfer, 1914: 726, pl. 137a; Roepke, 1932: 96, fig. 169.  
*Charaxes dehaani* (sic) (Westwood) Roepke, 1938: 353, pl. 36, fig. 6.  
*Polyura kadenii* (Felder & Felder) Stichel, 1939: 592.

MALE, FEMALE. *Upperside*. Ground colour black with a diffuse cream-yellow discal patch, blue-grey at the peripheries, which reaches from  $M_2$  to the inner margin. A diffuse spot of like colour surmounts this in cell  $M_1$ . Hindwing with a similar cream-yellow patch which extends to the wing base. Admarginals metallic blue, extending into tails which are strongly curved and 'caliper-like', interrupted in cell  $Cu_{1b}$  by a deep yellow spot. A submarginal white transverse bar present in cells  $R_5$ ,  $M_1$ ,  $M_2$  and  $M_3$ ; vestiges of similar markings may be found in cells  $Cu_{1a}$  and  $Cu_{1b}$ . Underside ground colour white, ochreous green distally. Forewing with MI, MII, DI, DII and ocelli present. Hindwing with MI and MII present, joining at the junction of  $Cu_{1b}$  and the cubitus. This turns sharply in cell  $Cu_{1b}$  and terminates on the anal margin. Proximal to this band cells  $Cu_{1b}$  and 2A are densely speckled with black. Postdiscal spots are lunar, maroon, proximally bordered with structural blue and black scales in that order. The distal, maroon component is completely suppressed in cells  $R_1$ ,  $R_5$  and  $M_1$ . Outer margin similar to upperside but white transverse bars more complete and with a yellow spot interrupting the structural blue of EI in cells  $M_3$  and  $Cu_{1a}$  in addition to that in cell  $Cu_{1b}$ . EI suppressed in cells  $R_5$ ,  $M_1$  and  $M_2$ .

*Polyura dehanii dehanii* (Westwood)

(Figs 16, 31, 114)

*Nymphalis dehanii* Westwood, [1850]: 308. Syntype[s] (sex?), [JAVA] (probably in MNHN, Paris) [not examined].

*Charaxes kadenii* Felder & Felder, 1860: 232, pl. 3, fig. 2; Wallace, 1869: 178, fig.; Butler, 1895: 386.

LECTOTYPE ♂, [JAVA] (BMNH), here designated [examined].

*Nymphalis kadenii* (Felder & Felder) Kirby, 1871: 271.

*Eulepis kadenii* (Felder & Felder) Moore, [1896]: 263.

*Charaxes kadeni* (sic) Felder & Felder; Fruhstorfer, 1897: 236.

*Eulepis kadeni kadeni* (sic) (Felder & Felder); Rothschild & Jordan, 1898: 599, fig. 37.

*Eriboea dehaani dehaani* (sic) (Westwood) Fruhstorfer, 1914: 726, pl. 135a; Roepke, 1932: 96, fig. 169.

*Charaxes dehaani dehanii* (sic) (Westwood) Roepke, 1938: 353, pl. 36, fig. 6.

*Polyura kadenii* [*kadenii*] (Felder & Felder) Stichel, 1939: 592.

*Polyura dehaanii* (sic) (Westwood) Stichel, 1939: 593.

MALE, FEMALE. *Underside*. Forewing with postdiscal spots strongly marked in each cell from costal margin to cell  $Cu_{1b}$ .

SIZE. ♂:  $\bar{x} = 44.1$ ,  $s = 1.1$  (43 specimens). ♀: 3 specimens only, 50.8, 48.0, 49.1.

DISTRIBUTION. **Java**: Sukabumi; Mt Gede, Tjibadas. 43 ♂, 3 ♀.

TYPE-MATERIAL. *Nymphalis dehanii* Westwood was described from an unspecified number of specimens of unstated sex in the 'Jardin des Plantes'. The specimen or specimens are presumably now in the MNHN, Paris.

*Charaxes kadenii* Felder & Felder was described from an undisclosed number of specimens from Java. One male in the BMNH bears the following labels; 'Lectotype (purple) / Coll. Kaden. / Godman—Salvin Coll. 94—187. / B.M. TYPE No. Rh. 10433. *Charaxes kadenii* ♂ Feld. / *Charaxes kadenii* Felder & Felder LECTOTYPE det. R. L. Smiles 1978', and is here designated lectotype.

BIONOMICS. There are records for this butterfly in the BMNH during March–April, March–May, August and September, between 600 and 1300 m.

*Polyura dehanii sulthan* (Hagen)

(Fig. 115)

*Charaxes kadeni* (sic) Felder & Felder; Honrath, 1892: 4.

*Charaxes* (*Eulepis*) *kadenii* Felder & Felder; de Nicéville & Martin, 1896: 434.

*Charaxes kadenii* var. *sulthan* Hagen, 1896: 184. LECTOTYPE ♂, SUMATRA (BMNH), here designated [examined].

*Charaxes kadenii* var. *sumatrana* Hagen, 1896: 184. Syntypes (sex?), SUMATRA (probably in Landessammlungen für Naturkunde, Karlsruhe) [not examined]. [Synonymized with *Polyura kadenii sulthan* (Hagen) Stichel, 1939: 593.]

*Eulepis kadeni* (sic) *sulthan* (Hagen) Rothschild & Jordan, 1898: 600, fig. 38.

*Eriboea dehaani* (sic) *sulthan* (Hagen) Fruhstorfer, 1914: 726.

*Polyura kadenii sulthan* (Hagen) Stichel, 1939: 593.

MALE, FEMALE. *Underside*. Forewing with postdiscal spots strongly marked from cells  $R_4$  to  $M_3$ , those in cells  $Cu_{1a}$  and  $Cu_{1b}$  very faint.

SIZE. ♂;  $\bar{x} = 43.0$ ,  $s = 1.4$  (23 specimens). ♀; 1 specimen only, 45.8.

DISTRIBUTION. Sumatra: [Gaju Districts; Battak Plateau] (Fruhstorfer, 1914: 726); Sungaikumbang, Kerintji; [Bng. Proepoc, Pad. Bovenland]; Padangpandjang; Sinabung, 23 ♂, 1 ♀.

TYPE-MATERIAL. No holotype of *Charaxes kadenii* var. *sulthan* Hagen was selected from the original type-series. One male from this series is in the BMNH and bears the following labels; 'Lectotype (purple) / Type Charaxes Kadeni Feld. var Sulthan Hag. Iris Julilaft. 96. Hochebene von Tobah Dele. / Levick Bequest B.M. 1941-83 / Charaxes kadenii sulthan Hagen LECTOTYPE det. R. L. Smiles 1978', and is here designated lectotype.

BIONOMICS. There are records in the BMNH for this butterfly during April, June, September-October, and September-December at altitudes between 500 and 1600 m. It is also recorded as having been taken . . . 'on the faeces of Karbouw buffaloes, deposited on the sandy river beds where the buffaloes used to drink' (de Nicéville & Martin, 1896: 434).

### *Polyura cognata* (Snellen van Vollenhoven)

(Figs 43, 59)

*Charaxes cognatus* Snellen van Vollenhoven, 1861: 159, pl. 9, figs 1, 2; Staudinger, 1886: 173. Holotype ♂, MOLUCCAS (RNH, Leiden) [examined].

*Nymphalis cognatus* (Snellen van Vollenhoven) Kirby, 1871: 271.

*Eulepis cognatus* (Snellen van Vollenhoven) Rothschild & Jordan, 1898: 595, fig. 36; Cockayne, 1924: 11.

*Eriboea cognatus* (Snellen van Vollenhoven) Fruhstorfer, 1914: 725, pl. 135a.

*Charaxes* (*Eriboea*) *cognatus* Snellen van Vollenhoven; Fiedler, 1914: 255, fig.

*Charaxes* (*Eulepis*) *cognatus* Snellen van Vollenhoven; Martin, 1924: 103.

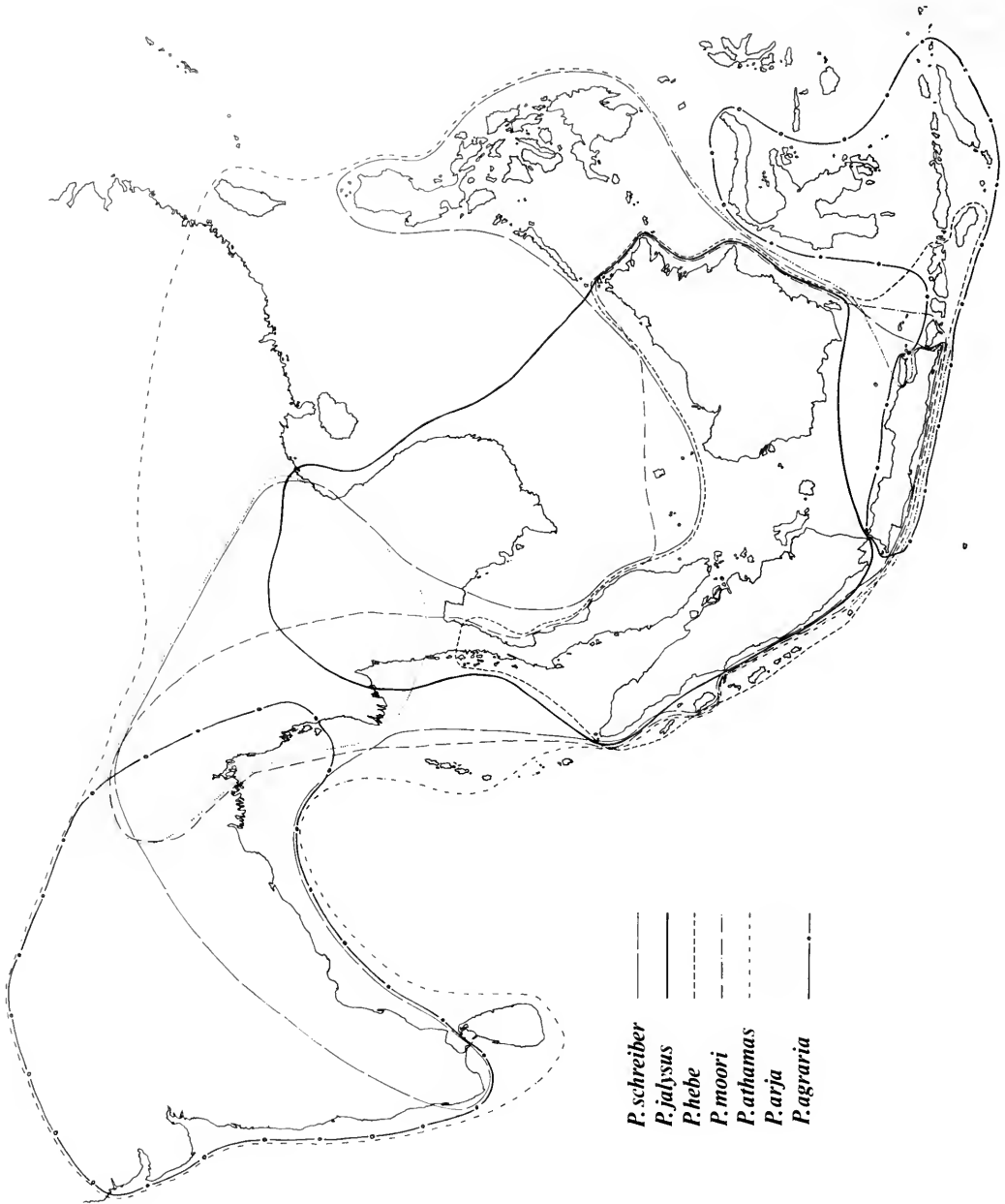
*Charaxes* (*Eulepis*) *cognatus* [geographic] f. *kailicus* Martin, 1924: 105. Syntype[s] (sex?), SULAWESI (described from living specimens not subsequently collected). **Syn. n.**

*Polyura cognatus* (Snellen van Vollenhoven) Stichel, 1939: 591.

*Polyura cognatus kailicus* (Martin) Stichel, 1939: 592.

MALE. *Upperside*. Ground colour black-brown. Forewing postdiscal spots in cells  $R_5$  to  $Cu_{1b}$  white or yellow. Discal spots in cells  $R_5$  to 2A generally white, those in cells  $R_5$  to  $M_2$  sometimes yellow, and the spot in cell  $M_2$  displaced from the others towards the discal cell. White areas in cells  $Cu_{1b}$  and 2A enlarged, united to form a short band, and surrounded by structural blue scales. Hindwing with blue admarginal streaks in cells  $M_1$  to  $Cu_{1b}$ , that in cell  $Cu_{1b}$  interrupted by a yellow spot. Submarginal white spots present in every cell, double in cell  $Cu_{1b}$ . A white discal band is present from the costal margin and tapers to a point at vein  $Cu_{1b}$ . This band is entirely surrounded from  $M_1$  to the tornus with structural blue scales. *Underside*. Ground colour olivaceous brown. Forewing ocelli largely obscured, MI complex proximally, enclosing white markings. Discal cell and wing bases predominantly white, the former being largely enclosed with black. Hindwing with EI and EII forming dark metallic lines enclosing yellow marginal streaks against a blue background in each cell. Postdiscal spots in cells  $R_1$ ,  $M_3$ ,  $Cu_{1a}$  and  $Cu_{1b}$  predominantly crimson, bordered proximally by blue structural or sometimes white scales, and the whole enclosed with a black line. The crimson part of the ocelli in cells  $R_5$ ,  $M_1$  and  $M_2$  is obliterated. A white discal band is present which corresponds to that of the upperside, and is bordered proximally by MI. The area from MII to the wing bases almost to the tornus white, lightly speckled with black. Hindwing tails slightly curved.

FEMALE. There are no females in the BMNH, but the illustration given by Fiedler (1914: 256) shows an insect with much the same markings as the male, but with the hindwing tails more curved. Only the upperside is shown.



Map 2 Distribution of the *Polyura athamas*-group in the Indo-Australian Region.

From the description, *Charaxes cognatus* f. *kailicus* Martin falls within the range of apparently continuous variation to be found in this species which, in those examples in the BMNH, does not appear to be geographically determined.

SIZE. ♂;  $\bar{x} = 46$ ,  $s = 1.6$  (14 specimens).

DISTRIBUTION. **Sulawesi** (Celebes): Kalawara; Pekawa; Kolawi; Pasankaju; Berg Gavalisi (Martin, 1924: 104); Manado; Buol [Bhool]; Tondano, Rambukers, Minahasa, Tanggari; Sawangan; Tolitoli; Palopo, Gulf of Boni; Maros and Tjamba ('région basse entre'); Makasar; Kintabaru, Palu. 15 ♂.

TYPE-MATERIAL. *Charaxes cognatus* Snellen van Vollenhoven was described from a single male. This holotype is in the RNH, Leiden and bears the following labels; 'Cat No. 1. / ♂ / Type / Reinw Moluque / *Eulepis cognatus* v. Voll type'.

*Charaxes (Eulepis) cognatus* f. *kailicus* Martin was described in the event of specimens from the north of Sulawesi proving different from those of the south, and was based on Martin's recollections of specimens he had seen flying when on that island.

BIONOMICS. There are records in the BMNH for capture during April, August to September, September, November and November to December. In addition, Martin (1924: 108) notes that it has been taken in March and July.

### *Polyura schreiber* (Godart)

(Figs 44, 45, 60, 61, 107–113, Map 2)

*Nymphalis schreiber* Godart, [1824]: 852.

*Paphia schreibers* (sic) (Godart) Horsfield, 1829: pl. 6, figs 3, 3a.

*Charaxes schreiberi* (Godart) Distant, 1883: 104, pl. 13, fig. 2; de Nicéville, 1886: 274; Schwanwitsch, 1926: 501, pl. 2, fig. 9.

*Eulepis schreiberi* (Godart) Moore, [1896]: 261, pl. 188, figs 1, 1a, 2, 2a, 2b; Antram, 1924: 128, fig. 261.

*Eulepis schreiber* (Godart); Rothschild & Jordan, 1898: pl. 12, figs 1, 2; 1899: 220.

*Eriboea schreiber* (Godart) Fruhstorfer, 1914: 724, pl. 135a.

*Eriboea schreiberi* (Godart); Evans, 1924: 895, pl. 17, fig. F, 2, 1; Wynter-Blyth, 1957: 147, pl. 2, fig. 4, pl. 20, fig. 4.

*Polyura schreiber* (Godart) Stichel, 1939: 588; Corbet & Pendlebury, 1978: 212.

*Polyura schreiberi* (Godart); Corbet & Pendlebury, 1956: 244; Boonsong, Askins, Nabhitabita & Samruadkit, 1977: 140, pl. 68, fig. 343.

MALE, FEMALE. *Upperside*. Ground colour black, brown thinly overlaid with structural blue scales towards bases. Forewing apical and postdiscal white spots may or may not be present. Discal band white, beginning narrowly in cell  $M_2$  and ending on the inner margin. The half of the band nearest to the inner margin is often bordered by a substantial area of structural blue scales distally, and a very small amount proximally. Hindwing admarginals blue towards veins and this extending into the tails, often with orange in the cells which is more apparent in the female than in the male. Submarginal spots small, white and normally complete. Discal band commencing on the costal margin and tapering to end in or near cell  $Cu_{1b}$ . This band bordered distally and slightly proximally with structural blue scales as in the forewing. *Underside*. Ground colour pale magenta. Forewing olive-green on outer margin. All postdiscal spots have become strongly delineated chevrons except the more posterior of the double spots in cell  $Cu_{1b}$  which has become a dense, black spot. A white discal band runs from cell  $R_5$  to the inner margin, its dentate distal edge outlined with black lines and its proximal edge by  $MI$ —also black.  $DI$  is present at the end of the discal cell.  $MII$  runs parallel with  $MI$ , beginning on the radial vein and ending in cell  $Cu_{1b}$ . Along the distal edge of  $MII$  and the proximal edge of  $MI$  run thin structural blue lines which encompass an olive-green band.  $DII$  is represented by two small black dots which lie half way between  $MII$  and the base. Hindwing outer margin black, admarginals predominantly yellow, but blue along the veins and running into the tails. The submarginal spots have become black streaks lying proximal to the admarginals, and these are bordered proximally by a thin white band. Postdiscal lunules lie on a diffuse olive-green band, which is interrupted at cell  $R_5$ . They are crimson, bordered proximally by a thin, pale blue line, and the whole encompassed by thin black lines.  $MI$  and  $MII$  are bordered by blue scales as in the forewing, and encompass an olive-green band. Both commence on the costal margin,  $MII$  ending at the commencement of  $Cu_{1b}$  from the cubitus and  $MI$  ending in cell  $Cu_{1b}$ , where it fades out, but recommences in the same cell after having turned through ninety degrees to end on the anal margin.

Abdomen black above, male off-white beneath, female black beneath.

*Polyura schreiber schreiber* (Godart)

(Figs 107, 108)

*Nymphalis schreiber* Godart, [1824]: 852. Holotype, JAVA (destroyed).*Charaxes schreiberi* (Godart) Doubleday, 1844: 110.*Nymphalis schreiberi* (Godart); Westwood, 1850: 309; Horsfield & Moore, 1857: 205, pl. 6, figs 3, 3a; Kirby, 1871: 271.*Eulepis schreiber schreiber* (Godart) Rothschild & Jordan, 1899, 221.*Eriboea schreiber schreiber* (Godart) Fruhstorfer, 1914: 725, pl. 135a; Roepke, 1932: 96, fig. 168.*Charaxes schreiber schreiber* (Godart); Roepke, 1938: 352, pl. 35, fig. 4.*Polyura schreiber* (Godart) Stichel, 1939: 588.

The smallest of the subspecies (see below).

MALE, FEMALE. *Upperside*. Forewing with a small, white, subapical spot in cell  $M_1$ . Discal band narrow, not normally extending beyond  $M_3$  in male,  $M_2$  in female. Hindwing admarginals normally partly orange in each cell from apex to tornus. White submarginal spots clearly defined.

SIZE. ♂;  $\bar{x}$  = 38.1,  $s$  = 1.5 (30 specimens). ♀;  $\bar{x}$  = 44.2,  $s$  = 1.7 (of 27 specimens).

DISTRIBUTION. **Java**: Malang distr.; Mt Gede; Bogor; Djampang Kulon; Djember, Res. Besuki; G. Tengger, Res. Pasuruan; Jakarta (Batavia); Sukabumi. 30 ♂, 27 ♀.

TYPE-MATERIAL. According to the original description the 'type' was collected by M. Marchand in Java. It was subsequently housed at Chartres where it was destroyed during the Second World War (P. Viette, pers. comm.).

BIONOMICS. Most common of all the subspecies (Fruhstorfer, 1914: 725). There are records in the BMNH for August and August to September at elevations between 400 and 1200 m. Fruhstorfer (1914: 725) states 'The butterfly occurs from the coast up to an elevation of about 1200 m. It flies swiftly and does not fear even the proximity of human beings, for I saw it flying in large gardens near Sukabumi. . . .'

EARLY STAGES. The larva when full grown is approximately 70 mm long, similar to that of *P. sempronius*. The horns are green, becoming brownish yellow at the tips. There is a white ring around the body at the junction of the head and the first thoracic segment. Fruhstorfer (1914: 724) states 'On the fifth segment, right across the back of the larva, there is a finely dotted, brownish-yellow crescent with rounded points concave towards the head; this crescent is bordered by a light greenish-yellow line and a black one following outwardly.'. However, Horsfield & Moore (1857: pl. 6, fig. 3) show two such crescents, one on the third abdominal, and one on the fifth abdominal segments. The larva, in common with most *Polyura* and *Charaxes*, spins a platform of silk on the foodplant, on which it rests, during which time the anal claspers are not used, and the posterior end of the larva is held away from the leaf (Fruhstorfer, 1914: 724).

The pupa is green with white, cloudy markings on the wings and white lines on the abdomen. The abdominal spiracles and the head are brown (Fruhstorfer, 1914: 724; Horsfield & Moore, 1857: pl. 6, fig. 3a). The pupal stage lasts approximately 13 days (Fruhstorfer, 1914: 724).

Larval food plants are: *Nephelium lappaceum* (Sapindaceae), *Rourea santaloides* (Connaraceae), *Wagatea spicata* and *Cynometra cauliflora* (Leguminosae) (Fruhstorfer, 1914: 724).

*Polyura schreiber wardii* (Moore)

(Fig. 109)

*Charaxes schreiberi* (Godart); Davidson, Bell & Aitken, 1896: 257.*Eulepis wardii* Moore, [1896]: 262, pl. 188, figs 2, 2a, 2b. LECTOTYPE ♂, INDIA (BMNH), here designated [examined].*Eulepis schreiber wardi* Moore; Rothschild & Jordan, 1898: pl. 12, fig. 2; 1899: 222.*Eulepis schreiberi* (Godart); Bell, 1909: 648, 663, pl. 1, figs 4, 4a [in part].*Eriboea schreiber wardi* (Moore) Fruhstorfer, 1914: 725.*Eriboea schreiberi wardi* (Moore); Evans, 1924: 895, pl. 17, fig. F2.1; 1927: 93, pl. 17, fig. F2.1.*Polyura schreiber waardi* (sic) (Moore) Stichel, 1939: 588.



MALE, FEMALE. *Upperside*. Forewing with subapical and postdiscal spots absent. Discal white spots present in cells  $R_5$  and  $M_1$  forming a stepped continuation of the discal band. Hindwing admarginals with orange coloration variable between being present in every cell from the apex to the tornus, to being absent from all but cell  $Cu_{1b}$ .

Underside with black lines heavily marked.

SIZE. ♂;  $\bar{x} = 42.1$ ,  $s = 2.8$  (24 specimens). ♀;  $\bar{x} = 47.0$ ,  $s = 2.6$  (17 specimens).

DISTRIBUTION. **India**. Kerala: Calicut; Tellicherry, Anjirucady. Kanara: Karwar; Nilkund; [Arbail]; [Gair-soppa]; [Hatockeri]. Coorge: [Urti]. 25 ♂, 18 ♀.

TYPE-MATERIAL. Described from an undisclosed number of specimens. Two males are now in the BMNH, one of which bears the following labels; 'Lectotype (purple) / Karwar. Aitken. Pur. from E. Swinhoe. 1900–250. 9.90 / B.M. TYPE No. Rh. 10434 *Eulepis wardii*, ♂ Moore. / *Eulepis wardii* Moore LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype. The remaining male bears the following labels; 'Paralectotype (blue) / Moore Coll. 98–128. Karwar, N. Canara, Bombay, J. R. Bell. / B.M. TYPE No. Rh. 10435 *Eulepis wardii*, ♂ Moore. / *Eulepis wardii* Moore PARALECTOTYPE det. R. L. Smiles 1978'.

BIONOMICS. A rare butterfly, the males of which are often found basking during the hottest part of the day on '... chosen trees about certain rocky peaks' (Rothschild & Jordan, 1899: 222). Fruhstorfer (1914: 725) reports that it is often found '... fluttering around isolated trees on rocky ledges of rocks during the hottest hours of the day.' There are records in the BMNH for January, February, March, April, September, October, November and December. Moore ([1896]: 262) records a capture at 3700 ft [1130 m].

EARLY STAGES. The adult larva, according to Moore ([1896]: 262, pl. 188, fig. 2b), is ostensibly the same as that of *P. schreiber schreiber*, the yellow crescent being found on the third abdominal segment. Rothschild & Jordan (1899: 223) observe: 'A larva, which emerged from the egg on October 25th, did not become a pupa until January 26th, and no part of this time was passed in hibernation.'

The pupa is green with lighter markings and a light line laterally connecting the abdominal spiracles, which are brown; as is the top of the head and the tail (Moore, [1896]: pl. 188, fig. 2b).

Larval food plants are: *Rourea santaloides* (Connaraceae) and *Wagatea spicata* (Leguminosae) (Davidson, Bell & Aitken, 1896: 257).

### *Polyura schreiber* (Godart) from Andaman Is.

(Fig. 110)

FEMALE. *Upperside*. The white discal spots in cells  $R_5$  and  $M_1$  are displaced distally, and a subapical white spot is present in cell  $R_5$ .

SIZE. 49.85.

DISTRIBUTION. **Andaman Is.**: Port Blair. 1 ♀ (BMNH).

### *Polyura schreiber assamensis* (Rothschild)

(Fig. 111)

*Eulepis schreiberi* (Godart) Moore, [1896]: 261, pl. 188, figs 1, 1a [in part].

*Eulepis schreiber assamensis* Rothschild, 1899: 223, fig. 39. Holotype ♂, INDIA: Khasi Hills (BMNH) [examined].

*Eriboea schreiber assamensis* (Rothschild) Fruhstorfer, 1914: 725.

*Eriboea schreiberi assamensis* (Rothschild); Evans, 1924: 895; 1927: 93.

*Polyura schreiberi assamensis* (Rothschild) Pinratana, 1979: 103, fig. N175a.

MALE, FEMALE. *Upperside*. Similar to *P. s. schreiber*, but discal band more dentate on its distal edge, and normally extending to  $M_2$ . *Underside*. Black markings heavy as in *P. s. wardii*.

SIZE. ♂;  $\bar{x} = 41.8$ ,  $s = 2.1$  (40 specimens). ♀;  $\bar{x} = 46.8$ ,  $s = 2.2$  (6 specimens).

DISTRIBUTION. **India**: Assam: Khasi Hills; Jaintia Hills; Shillong; Cachar; Cherrapunji; Margherita. Nagaland: Naga Hills. **Burma**: Arakan; Toungoo (Moore, [1896]: 261); Maymyo; Bilin Valley; Kawkareik, [Thingannyi]; Pyinmana Dist., edge of Karen Hills; Tavoy; Tenasserim, Victoria Point. **Thailand**: Phet Buri (Petchaburi), [Tung Luang]; Hin Lap. **Vietnam**: Chiem Hoa. 46 ♂, 6 ♀.

TYPE-MATERIAL. A male holotype, two male and one female paratypes are in the BMNH. The holotype and two male paratypes bear the following label; 'Rothschild Bequest B.M. 1939-1.' In addition, the holotype bears the labels; 'Holotype (red) / Khasias / *E. schreiberi assamensis* type! Rothschild. / *Eulepis schreiber assamensis* Rothschild HOLOTYPE det. R. L. Smiles 1975': one male paratype bears the labels; 'Paratype (yellow) / Khasia Hills Assam. / *Eulepis schreiber assamensis* Rothschild PARATYPE det. R. L. Smiles 1975': and one male paratype bears the labels; 'Paratype (yellow) / Jaintia Hills / *Eulepis schreiber assamensis* Rothschild PARATYPE det. R. L. Smiles 1975'. The female paratype bears the following labels; 'Paratype (yellow) / Shillong. Crowley Bequest. 1901-78. / *Eulepis schreiber assamensis* Rothschild PARATYPE det. R. L. Smiles 1975'.

BIONOMICS. A very rare butterfly (Fruhstorfer, 1914: 725). There are records in the BMNH for all months of the year except April and July at altitudes between 450 and 1900 m.

*Polyura schreiber tisamenus* (Fruhstorfer)

(Figs 44, 60)

*Charaxes schreiberi* (Godart); Butler, 1879: 539.

*Eulepis schreiber malayicus* Rothschild, 1899: 224 [in part].

*Eriboea schreiber tisamenus* Fruhstorfer, 1914: 725. LECTOTYPE ♂, SINGAPORE (BMNH), here designated [examined].

*Eriboea schreiber entheatus* Fruhstorfer, 1914: 725. Holotype ♂, SUMATRA (BMNH) [examined]. **Syn. n.**

*Eriboea schreiber valesius* Fruhstorfer, 1914: 725. LECTOTYPE ♂, SUMATRA (BMNH), here designated [examined]. **Syn. n.**

*Eriboea schreiberi tisamenus* Fruhstorfer; Evans, 1924: 895; 1927: 93; Corbet & Pendlebury, 1934: 178.

*Polyura schreiber tisamenus* (Fruhstorfer) Stichel, 1939: 590; Corbet & Pendlebury, 1978: 213.

*Polyura schreiber entheatus* (Fruhstorfer) Stichel, 1939: 590.

*Polyura schreiber valesius* (Fruhstorfer) Stichel, 1939: 590.

*Polyura schreiberi tisamenus* (Fruhstorfer); Corbet & Pendlebury, 1956: 246; D'Abrera, 1958: 80, figs. 1-3; Pinratana, 1979: 103, fig. N1756.

*Polyura schreiberi* (Godart); Lee, 1960: 226, figs. A-E.

MALE. *Upperside*. Forewing with discal band not extending beyond vein  $M_2$  and with subapical and postdiscal spots small or absent. This tendency is perhaps less marked in the few Sumatran specimens in the BMNH (*valesius* Fruhstorfer), but is subject to much variation. Hindwing admarginals similar to *P. s. wardii*.

FEMALE. More variable than male—similar to that of *P. s. assamensis*.

*Eriboea schreiber entheatus* Fruhstorfer and *Eriboea schreiber valesius* Fruhstorfer both fall within the range of variation exhibited by a more representative series of *P. s. tisamenus* than was available to Fruhstorfer.

SIZE. ♂;  $\bar{x}$  = 43.0,  $s$  = 1.3 (19 specimens). ♀;  $\bar{x}$  = 48.4,  $s$  = 1.1 (11 specimens).

DISTRIBUTION. **West Malaysia**: Langkawi Islands (Morishita, 1968: 62, fig. 9). Perak, Kinta; Malacca, Tanjong Malim; Penang. **Singapore**: Queen Astrid Park. **Sumatra**: [Padang Bovenland]; [Kandg. Ampat, Pad. Beneden]; Gajo Mts; Lebongtandai. **Bangka I. Belitung I.** 19 ♂, 11 ♀.

TYPE-MATERIAL. *Eriboea schreiber tisamenus* Fruhstorfer has the type-series in the BMNH represented by two males which bear the following labels; 'E. Museo Singapore H. Fruhstorfer / Fruhstorfer Coll. B.M. 1937-285'. In addition one male bears the following labels; 'Lectotype (purple) / Type / *Eriboea schreiber tisamenus* Fruhstorfer LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype. The remaining male bears the additional labels; 'Paralectotype (blue) / *Eriboea schreiber tisamenus* Fruhstorfer PARALECTOTYPE det. R. L. Smiles 1978'.

*Eriboea schreiber entheatus* Fruhstorfer was described from a single female. This holotype is now in the BMNH and bears the following labels; 'Holotype (red) / Billiton I. Walter / Godman-Salvin Coll. 94.-187. / Type / Eriboea schreiber entheatus Fruh. HOLOTYPE det. R. L. Smiles 1975'.

*Eriboea schreiber valesius* Fruhstorfer was described from an undisclosed number of specimens, one male of which is now in the BMNH, bears the following labels; 'Lectotype (purple) / W.-Sumatra H. Fruhstorfer / Type / Fruhstorfer Coll. B.M. 1937-285. / Eriboea schreiber valesius Fruhstorfer LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype.

*Eulepis schreiber malayicus* Rothschild was described from 15 specimens, some of which must be included within the present subspecies. These are seven male and four female paratypes all of which bear the following labels; 'Paratype (yellow) / Rothschild Bequest B.M. 1939-1. / Eulepis schreiber malayicus Roths., PARATYPE det. R. L. Smiles 1975'. In addition two females bear the additional label; 'Penang, 21.I.99. (Curtis)', one male; 'Penang, 10.I.98. (Curtis)', one male; 'Penang, 16.I.99. (Curtis)', one female the following labels; 'Malacca Interior Castelnau / Felder Colln.', one male and one female the label; 'Malay. Pen.', one male; 'Gayoe, Sumatra. Jan. 92 (Hagen)', one male; 'Banka (Hagen)', and one male; 'Banka., 91. (Dr. Hagen)'.

BIONOMICS. Corbet & Pendlebury (1934: 178) report that the butterfly is rarely seen and that sometimes the wings only are found: also that the frequency of occurrence is higher in Singapore than on the mainland. There are records in the BMNH for January, January-April, April, May and September-December.

EARLY STAGES. The ovum is approximately 2 mm in diameter, golden yellow with a concave base. After 24 hours a brown band forms on the vertical axis and the ground colour changes to greenish grey with pink and black mottling. The egg hatches in approximately five days (D'Abbrera, 1958: 80).

First instar larva yellowish green, head dark red, spotted with black. Black head processes as for *P. sempronius*, but rather more curved. Approximately 5 mm long. After about nine days, when larva has reached 11 mm in length, it develops a crimson mark on the dorsum of the prothorax and mesothorax. In the second instar the colour of the lateral head processes is brown rather than black, and the body of the larva a dark bluish green dorsally and lighter green ventrally. The forked, backward pointing processes of the last abdominal segment become less prominent, and the length increases to about 15-17 mm. In the third instar the larva develops a white spot on the posterior edge of the dorsum of the third abdominal segment, and grows to about 25 mm. The fourth instar larva develops an orange fading to yellow, crescent-shaped mark, bounded by a black line on the dorsum of the third abdominal segment. On the outer periphery of this mark, small purple protuberances give a silvery sheen in certain light conditions. A white line becomes apparent on the posterior edge of the dorsum of the prothorax. Minute yellow spots can be seen over the rest of the integument. The head is pale green and the head processes are reddish brown. The larva grows to approximately 42 mm, by which time it has developed a dorsal crimson mark on the pro- and mesothorax. At this time the larva has the same appearance as the fifth instar larva which reaches a maximum length of about 67 mm. It completes pupation about twenty-four hours after suspending itself (D'Abbrera, 1958: 80, figs 1, 2).

The pupa is green with faint white lines on the wing cases. The spiracles are reddish brown, the eye cases beige and the cremaster brown. It is 25 mm long and its maximum breadth is 13 mm. Pupation lasts between 12 and 14 days (D'Abbrera, 1958: 80, fig. 3; Lee, 1960: 226).

Photographs of the emergence of the imago from the pupa may be found in Lee (1960: figs. A-E).

Recorded food plants are: *Nephelium lappaceum* (Sapindaceae) (D'Abbrera, 1958: 81), and *Ade-nanthera pavonina* (Leguminosae) (Lee, 1960: 226).

### *Polyura schreiber niasica* (Butler)

(Figs 45, 61)

*Charaxes niasicus* Butler, 1883: 56. LECTOTYPE ♂, NIAS (BMNH), here designated [examined].

*Eulepis niasica* (Butler) Moore, [1896]: 263.

*Eulepis schreiber niasicus* (Butler); Rothschild & Jordan, 1899: 225.

*Eriboea schreiber niasicus* (Butler) Fruhstorfer, 1914: 725.

*Polyura schreiber niasicus* (Butler) Stichel, 1939: 591.

MALE, FEMALE. *Upperside*. Structural blue areas are slightly green compared with other subspecies, particularly towards the wing bases in the males. *Underside*. Ground colour off-white contrasting with pinkish beige of other subspecies. Discal band in fore- and hindwings, outer margin and submarginal area of forewing, and area just distal to the postdiscal spots of the hindwing very much more green than in other subspecies.

Size. ♂; 4 specimens only, 42·6, 38·8, 39·9, 42·3. ♀; 3 specimens only, 44·9, 42·9, 48·0.

DISTRIBUTION. **Nias**: Gunungsitoli; [Hili Madjedja]; [Kalim Bungo]; southern Nias. 4♂, 3♀.

TYPE-MATERIAL. Described from an unspecified number of males; one is now in the BMNH, bears the following labels; 'Lectotype (purple) / Isle of Nias 83·25 / B.M. TYPE No. Rh 10436. *Charaxes niasicus*, ♂ Butl. / *Charaxes niasicus* Butler LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype.

BIONOMICS. Described by Fruhstorfer (1914: 725) as very rare. In the BMNH there are only records for September.

### *Polyura schreiber malayica* (Rothschild)

(Fig. 112)

*Eulepis schreiberi schreiberi* (Godart); Rothschild & Jordan, 1898: pl. 12, fig. 1.

*Eulepis schreiber malayicus* Rothschild, 1899: 224. Holotype ♂, SARAWAK (BMNH) [examined].

*Eriboea schreiber malayicus* (Rothschild) Fruhstorfer, 1914: 725.

*Polyura schreiber malayicus* (Rothschild) Stichel, 1939: 591.

MALE. *Upperside*. Very similar to *P. s. schreiber*, but with hindwing admarginals as in *P. s. wardii*. Male and female; forewing discal band more pronounced at vein  $Cu_{1b}$ .

SIZE. ♂;  $\bar{x} = 42\cdot0$ ,  $s = 1\cdot1$  (11 specimens). ♀; 3 specimens only, 45·5, 47·5, 47·8.

DISTRIBUTION. **Kalimantan**: Pontianak. **Sarawak**: Baram River. **Sabah**: Mt Kinabalu; Labuan; Sandakan; Lawas. 12♂, 3♀.

TYPE-MATERIAL. Described from a male holotype, eight male and six female paratypes, of which seven male and four female paratypes have already been dealt with here as *P. s. tisamenus* (see p. 162). All the remaining types bear the following label; 'Rothschild Bequest B.M. 1939-1.'. In addition the holotype bears the labels; 'Holotype (red) / Baram R., Oct. 91 A. Everett. / *Eulepis schreiber malayicus* Roths., HOLOTYPE det. R. L. Smiles 1975'. All the remaining paratypes bear the labels; 'Paratype (yellow) / *Eulepis schreiber malayicus* Roths., PARATYPE det. R. L. Smiles 1975'. Additionally one male bears the label; 'Kina Balu. N. Borneo.', one female; 'Lawas N. Borneo A. Everett', and one female the labels; 'Dist. Coll. / Borneo (Cutta).'

BIONOMICS. In the BMNH there is only one date of capture recorded—October.

### *Polyura schreiber luzonica* (Rothschild)

*Charaxes schreiberi* (Godart); Semper, 1887: 78; Casto de Elera, 1895: 272.

*Eulepis schreiber luzonicus* Rothschild, 1899: 225. Holotype ♂, LUZON (probably in Senckenberg Museum, Frankfurt) [not examined].

*Eriboea schreiber luzonicus* (Rothschild) Fruhstorfer, 1914: 725.

*Polyura schreiber luzonicus* (Rothschild) Stichel, 1939: 591.

MALE. *Upperside*. Pale blue scaling on distal edge of discal band of the forewing more extensive than in other subspecies. Hindwing with discal band very narrow. Pale blue scaling heavy in discal cell and very extended, reaching to vein  $R_5$ . *Underside*. Greenish median bar wider than in other subspecies. Hindwing with white discal band narrow. Yellow admarginal spots much broader than in *P. s. malayica* or *P. s. schreiber*.

**DISTRIBUTION.** **Philippines:** Luzon, Mariveles; Bataan; Orion (Casto de Elera, 1895: 272). I have seen no specimens.

**TYPE-MATERIAL.** Described from one battered male from Mariveles, Luzon in Georg Semper's collection. This holotype is now probably with the rest of Semper's Philippine material in Frankfurt.

*Polyura schreiber bilarensis* Jumalon

(Fig. 113)

*Polyura schreiberi bilarensis* Jumalon, 1975: 59, figs 23, 24. Holotype ♀, BOHOL (University of San Carlos Collection, Cebu) [not examined].

**MALE, FEMALE.** *Upperside.* Structural blue associated with white discal band reduced. Forewing with outer margin of discal band rather more dentate than in *P. s. schreiber*, broader in the male than in *P. s. malayica*. *Underside.* Forewing with triangular dark area in cells  $M_2$  and  $M_3$  above discal band, green as in *P. s. niasica*, not brown, but much larger than in that subspecies. Hindwing postdiscal spot in cell  $M_2$  reduced to form a black-edged, blue spot.

**SIZE.** ♀; 1 specimen only, 43.4.

**DISTRIBUTION.** **Philippines:** Panaon I., San Francisco (Jumalon, 1975: 61); Bohol, Bilar. 1 ♀.

**BIONOMICS.** The type-series was collected during April and September. One female in the BMNH was collected during May.

*Polyura schreiber praedicta* Schröder & Treadaway

*Polyura schreiber praedictus* Schröder & Treadaway, 1980: 241, fig. 5. Holotype ♀, PALAWAN (Treadaway coll., Frankfurt-am-Main) [not examined].

**FEMALE.** Forewing upperside with white discal band reaching into cell  $M_2$ . White spot in cell  $R_5$  and that in cell  $M_1$  large and equal in size.

**SIZE.** ♀; 45–46 mm (Schröder & Treadaway, 1980: 241).

**DISTRIBUTION.** **Palawan:** Langan; Olanguan (Schröder & Treadaway, 1980: 241). I have seen no specimens.

**BIONOMICS.** The holotype and paratype were collected during October and January respectively.

*Polyura athamas* (Drury)

(Figs 17–19, 32–34, 87, 94–98, Map 2)

*Papilio athamas* Drury, 1770: 5, pl. 2, fig. 4.

*Nymphalis athamas* (Drury) Godart, [1824]: 935; Horsfield & Moore, 1858: 205, pl. 6, figs. 3, 3a; Kirby, 1871: 271.

*Charaxes athamas* (Drury) de Nicéville, 1886: 275; Schwanwitsch, 1926: 501, pl. 2, fig. 10.

*Eulepis athamas* (Drury) Rothschild & Jordan, 1898: pl. 10, figs 1–5, 7–11, pl. 11, figs 1–12, pl. 13, figs. 10, 11; 1899: 245; Bingham, 1905: 220, fig. 41; Antram, 1924: 127, fig. 260.

*Eriboea athamas* (Drury) Stichel, 1909: 109, pl. 61a; Fruhstorfer, 1914: 718; Evans, 1924: 895, pl. 17, fig. F.2, 2; Wynter-Blyth, 1957: 148, pl. 20, fig. 6.

*Polyura athamas* (Drury) Stichel, 1939: 552; Lewis, 1973: 271, pl. 150, fig. 1; Smart, 1975: 219, fig. 23.

**MALE, FEMALE.** *Upperside.* Ground colour black, becoming brown towards the bases of the wings. A pale green or yellowish green discal band runs down both wings commencing in the forewing on vein  $M_3$  and tapering to a point at or around vein 2A in the hindwing. This band is narrower and far more well defined than in *P. moori* or *hebe*. A similarly coloured pale spot lies postdiscally in cell  $M_1$  of the forewing, and distal to it, in cell  $R_5$ , there is often found another rather smaller spot. Hindwing with centres of tails blue; admarginals, where present, orange, but paler at the anal angle. A continuous row of white or pale yellow spots runs along the outer submargin. *Underside.* Ground colour pinkish brown, with olivaceous or darker

brown patches present along the outer margin of the forewing, and distal to the postdiscal lunules of the hindwing. Forewing with a continuous row of chevrons running from cells  $R_5$  to  $Cu_{1b}$ , surmounting a dark brown patch in cell  $Cu_{1b}$ . A pale green discal band, similar in shape to that of the upperside, is surrounded by a red-brown, arcuate band which is sometimes partly ochreous, and continues into the umbra. This band is delineated towards the base of the wing by MI and MII, and surrounds a spot of similar colour to the discal band in cell  $M_1$ , which has a black line (part of MI) along its proximal edge. DI is present as a faint spot at the end of the discal cell, and DII as one or two spots lying in the discal cell. Hindwing with tails blue-centred. Admarginals yellow-orange. A double row of black and white submarginal spots are present as in *P. moori*. Postdiscal lunules similar to *P. hebe* and *moori*, but that of cell  $M_1$  often very small indeed. Discal band shaped as that of the upperside, and of similar colour to that of the forewing. It tapers to a small, yellow-orange patch just beyond vein  $Cu_{1b}$ , as in *P. moori*, and like the forewing is bordered along its outer edge by the umbra, and along its inner edge by a red-brown, often olivaceous band delineated by MI and MII.

Abdomen brown above, buff or buff-brown beneath.

FEMALE. Differs from the male in size and in the often wider, paler discal bands on the upperside.

RANGE. From Sri Lanka, throughout India, Bangladesh, Burma, into southern China, Hainan and Taiwan, through Vietnam, Laos, probably Khmer Republic, Thailand, Western Malaysia, Singapore, Andaman Is., Sumatra, Nias, Natuna Is., Borneo, throughout the Philippines, through Java, Madura, Bali, and the Lesser Sunda Is. to Sawu, Timor, Wetar and Leti.

*Polyura athamas athamas* (Drury)

(Figs 17, 32, 87, 94)

*Papilio athamas* Drury, 1770: 5, pl. 2, fig. 4. Syntype(s) (sex ?), CHINA (untraced) [not examined].

*Charaxes bharata* Felder & Felder, 1867: 438. LECTOTYPE ♂, INDIA (BMNH), here designated [examined].

*Charaxes samatha* Moore, 1879: 831. Syntype(s), BURMA (probably in Zoological Survey of India, Calcutta) [not examined].

*Eulepis hamasta* Moore, 1882: 238; [1896]: 256, pl. 185, figs 1, 1a. LECTOTYPE ♂, INDIA (BMNH), here designated [examined].

*Eulepis athamas* (Drury) Moore, 1882: 238; [1896]: 252, pl. 184, figs 1, 1a, 1b, 1c; Rothschild & Jordan, 1898: pl. 10, figs 1, 3, 9; Bell, 1909: 660, pl. D, fig. 19.

*Charaxes athamas* var. *samatha* Moore; Distant, 1883: 106, pl. 13, fig. 8, text-fig. 37.

*Nymphalis athamas* (Drury) Lang, 1884: 181.

*Charaxes athamas* (Drury); Elwes, 1888: 367; Manders, 1890: 526; Longstaff, 1905: 98; Kershaw, 1907: 55, pl. 2a, fig. 15.

*Nymphalis athamas* var. *bharata* (Felder & Felder) Robbe, 1892: 129.

*Nymphalis athamas* var. *samatha* (Moore) Robbe, 1892: 129.

*Eulepis bharata* (Felder & Felder) Swinhoe, 1893: 289.

*Charaxes* (*Eulepis*) *athamas* (Drury); Mackinnon & de Nicéville, 1897: 377; de Nicéville, 1902: 9.

*Eulepis athamas* ab. *samatha* (Moore) Fruhstorfer, 1898: 60 [in part].

*Eulepis athamas hamasta* Moore; Fruhstorfer, 1898: 60.

*Eulepis athamas agrarius* f. (temp. ?) *madeus* Rothschild, 1899: 249. Holotype ♂, SRI LANKA (BMNH) [examined].

*Eulepis athamas athamas* (Drury); Rothschild & Jordan, 1899: 250.

*Eulepis athamas athamas* f. temp. *bharata* (Felder & Felder); Rothschild & Jordan, 1899: 252.

*Eulepis athamas athamas* f. temp. *hamasta* Moore; Rothschild & Jordan, 1899: 253.

*Eriboea athamas* (Drury) Stichel, 1909: 169, pl. 61a, Fruhstorfer, 1914: 718.

*Eriboea athamas* ab. *hamasta* (Moore) Stichel, 1909: 169, pl. 52c.

*Eriboea athamas* f. *bharata* (Felder & Felder) Stichel, 1909: 169; Fruhstorfer, 1914: 718, pl. 134a.

*Eriboea athamas* f. *hamasta* (Moore); Fruhstorfer, 1914: 718.

*Eriboea athamas madeus* (Rothschild) Fruhstorfer, 1914: 718; Evans, 1924: 895; 1927: 93; Woodhouse & Henry, 1942: 52, pl. 7, fig. 4, pl. 40, fig. 6.

*Eriboea athamas samatha* (Moore) Fruhstorfer, 1914: 719; Evans, 1927: 93; Corbet & Pendlebury, 1934: 177, pl. 12, fig. 154.

*Eriboea athamas dexippus* Fruhstorfer, 1914: 2; Fruhstorfer, 1915: 748. Holotype ♂, VIETNAM (MHN, Geneva) [not examined]. **Syn. n.**

- Eriboea athamas athamas* (Drury); Evans, 1924: 895, pl. 17, fig. F.2.2; Rhé-Philipe, 1931: 421.  
*Polyura athamas* [*athamas*] (Drury) Stichel, 1939: 552.  
*Polyura athamas* [*athamas*] f. *bharata* (Felder & Felder) Stichel, 1939: 555.  
*Polyura athamas* [*athamas*] f. *hamasta* (Moore) Stichel, 1939: 556.  
*Polyura athamas madeus* (Rothschild) Stichel, 1939: 558.  
*Polyura athamas samatha* (Moore) Stichel, 1939: 559; Corbet & Pendlebury, 1956: 245, pl. 44, fig. 137, pl. 8, fig. 101; 1978: 212, pl. 18, fig. 8, genitalia fig. 111; Pinratana, 1979: 98, fig. N166.  
*Polyura athamas athamas* (Drury); Hill, Johnston & Bascombe, 1978: 14.

An extremely variable subspecies.

MALE, FEMALE. *Upperside*. Subapical spot in cell  $R_5$  variable between being absent or strongly marked. Sometimes another subapical spot is present in cell  $R_4$ . A number of names have been given to forms having discal bands of different widths. In India, Bangladesh, Burma, Thailand etc. it may be possible to fit most individuals into one of three loosely defined groups; those with a narrow band approximately as wide as the black basal area of the wing (f. *athamas*), an intermediate group with the band half as wide again (f. *bharata*), and those with the discal band wider than this (f. *hamasta*). Several authors have considered these forms to be seasonal, and this is likely. However, when an attempt is made to place specimens from Western Malaysia or Singapore into these groups they prove rather less appropriate. Hindwing admarginals normally completely obscured, sometimes only partly so. *Underside*. Ground colour pinkish buff. Shape of discal band variable.

*Eulepis athamas agrarius* f. *madeus* Rothschild was described in an attempt to provide seasonal form names for south Indian and Sri Lankan *P. athamas* which Rothschild & Jordan considered to be a separate subspecies from typical *athamas*.

*Eriboea athamas dexippus* Fruhstorfer was the name given to a supposed Vietnamese subspecies. I can see no sufficient reason for separating this form from typical *athamas*.

*Charaxes samatha* Moore describes a narrow banded form from Burma which approximates to f. *athamas*.

SIZE. ♂;  $\bar{x}$  = 33.2, s = 2.1 (40 specimens). ♀;  $\bar{x}$  = 37.8, s = 2.9 (40 specimens).

DISTRIBUTION. **Sri Lanka** (Ceylon): Kandy; Elahera; Belihul Oya; Wellawaya; Tangalla; Deniyaya; Haragama; Ratnapura. **India**: Tiruchirappalli (Trichinopoly); Nilgiri, Coonoor; Nilgiri, [Kalar]; Nilgiri, [Droog]; N. Kanara, Karwar; Calicut; Coorg, Mercara; Mysore, [Cubbany R.]; Hyderabad, Balaghat; [Ramandravy]; Tarapur; [P'loza]; [Khandesh]; [Kakirawa]; Poona District; Matheran; Madura, [Shambaganur]; Chani, [Chan]; N.W. Himalayas, Kumaun; N.W. Himalayas, Tons Valley, Garhwal; Khaira; Ganjam; Ranikhet; Mussoorie; Mandi; Kulu, Sultanpur; Kulu, Dharmsala; Deesa; Orissa District, Sambalpur; Chamba Valley; Nepal, [Chilimi]; Sikkim, Gangtok; Sikkim, Lachen Lachung; Sikkim, [Padong]; Sikkim, Tumlong; Sikkim, [Phedong]; Singlah; Kurseong; [Senchal]; [Troomling]; Darjeeling, [Gopaldhara]; Darjeeling, [Turkvar]; [Kalapahai]; [Pashok]; Assam, Jaintia Hills; Assam, [Sadarghat]; N.E. Assam, Daffa Hills; Assam, North Lushai; Assam, Cherrapunji; Upp. Assam, Dibrugarh; Garo Hills; Khasi Hills, Shillong; Naga Hills, Kohima; Naga Hills, Nichuguard; Naga Hills, [Jakama]; Naga Hills, Ghaspahi; Naga Hills, [Kirbari]; Kamla River [Kamlang River]; Manipur, Imphal; Manipur, [Burma River]; [Buxa]; [Mylang River]. **Bangladesh**: Sylhet. **Burma**: Hukawng Valley, [Muenghi Hill Tracts]; [Hlmedet forests]; Katha; East Bhamo District; Maymyo; Northern Shan State, Gokteik; Northern Shan State, [Siam Road]; Southern Shan State, Loimwe; Nampanet, Thazi to Taung-gyi; Karen Hills, Pattechaung; Pegu; Bassein; Rangoon; Tavoy. **China**: Sichuan (Szechwan); N. of Tibet (Thibet); Yunnan, Mengtzu; T'eng ch'ung (Teng-yueh-Ting); Kowloon. **Hong Kong**. **Taiwan** (Formosa). **Hainan**: [Youboi]. **Vietnam**: Muong-Khuong; Tongking, Yen Bai; Central Tongking, Chiem Hoa; [Nam-Hou (Black River)]; Xom Giong; [Nacham]; [Bac-Kan]. **Laos**: [Muang Baw]; Cataracts of Xé Kong River (Sekong River). **Thailand** (Siam): Doi Inthanon (Doi Angka); [Klong Pong Kapo] 99.18E 16.15N; [Hue Tak So]; [Muok-Lek]; Phrae District, [Me Sai Song]; Khlong Khlung; [Khao Sabab Hill], nr Chanthaburi; Hin Lap; [Luhang Prahang]; Bangkok; Ranong; [Praachuap Prov., Pak Tawan]. **West Malaysia**: Langkawi Is.; N. Kedah, Canglun (Changloon), [Jalan Sintok]; Penang, [Waterfall Valley]; Penang Hill; Pinang, Lakat and [Pamboo]; North Perak, Sira Chior, Pelus River; North Perak, Terong; Perak, Kinta; Perak, Sungei, Pahang Road; Perak, Cameron Highlands, [19th mstone]; Perak, Ulu Gopeng; Perak, Taiping; S. Perak, Telom; Bukit Kutu; Mr Tahan; Pahang; Selangore; Ulu Kelang; [East Pegu]; [Hot Springs, 7th mile]. **Singapore**. 728 ♂, 119 ♀.

TYPE-MATERIAL. *Charaxes bharata* Felder & Felder was described from an undisclosed number of specimens. Two males in the BMNH bear the following labels; 'FELDER COLL.<sup>N</sup> / Roths-

child Bequest B.M. 1939-1.'. In addition, one male bears the following labels; 'Lectotype (purple) / Darjeeling Stoliczka type / Bharata Feld / TYPE of bharata Feld. / Charaxes bharata Felder & Felder LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype. The remaining male bears the additional labels; 'Paralectotype (blue) / India septent. Silhet type / Charaxes bharata Felder & Felder PARALECTOTYPE det. R. L. Smiles 1979'.

*Eulepis hamasta* Moore is represented in the BMNH by a male and two female syntypes. The male bears the following labels; 'Lectotype (purple) / Dharmasala 82, 23 ♂ / Eulepis hamasta Moore LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype. The remaining two females are included here under *P. agraria agraria*.

*Eulepis athamas agrarius* f. (temp.?) *madeus* Rothschild is represented in the BMNH by a male holotype bearing the following labels; 'Holotype (red) / Kandy / N.Z.98 t.10. f.7. / Type / Rothschild Bequest B.M. 1939-1. / Eulepis athamas agrarius f. madeus Roths. HOLOTYPE det. R. L. Smiles 1977'.

**BIONOMICS.** In the BMNH there are records for the capture of this butterfly over the whole year. However, in more northerly parts of its range the flight period may be restricted. According to Elwes (1888: 367) it is '... common in Sikkim at low elevations from April to December.' Records in the BMNH show elevations of up to 2600 m.

An extremely fast butterfly. Lang (1864: 181) observed, 'It pitches on rocks in mid stream and flashes off again if approached. It is not common, and very difficult to capture; yet one very hot day in June I saw seven individuals sitting with closed wings, motionless, on a foul spot (by the damp sandy margin of a stream), so close together, that I might have put my hat over all of them.' Longstaff (1905: 98) observed the butterfly '... feeding upon human ordure'. According to one author 'The most likely haunts are rocky nullah beds where it flashes from tree to rock, frequently settling on patches of damp sand. Sometimes it flits around some favoured tree; while exuding sap and ordure of any sort is always a strong attraction' (Rhé-Philipe, 1931: 421).

**EARLY STAGES.** The egg is sub-globular, smooth and yellow, and is attached to the underside of the leaf (Kershaw, 1907: 55). According to Bell (1909:662) it 'is laid in a sunny place on the upper side of a leaflet'.

The larva is similar to that of *P. hebe*, and has a predominantly green head striped longitudinally with pale green. Jaws reddish. The body is dark yellowish green, ventrally paler, legs yellow. It is covered thickly with minute white tubercles. The yellow lateral line is rather variable in depth of colour, but is normally stronger towards the posterior end of the animal. Larvae may have dorsal crescent- or irregular crescent-shaped markings on the third, fifth and seventh abdominal segments, on the third and fifth segments only, or on every segment of the body. These markings are normally yellow dorsally, becoming white laterally (Moore, [1896]: 253, pl. 184, figs 1, 1a; Kershaw, 1907: pl. 2a, fig. 15; Bell, 1909: 660; Fountaine, *in litt.*). According to Moore ([1896]: 255), the last pair of legs of the larva are not used for walking. It feeds at night and, as is typical in the group, spins a platform by binding the leaflets with silk, using this to rest upon when not feeding (Bell, 1909: 662).

The pupa is very similar to that of *P. hebe*, green with diffuse white streaks, and having the spiracles and the cremaster brown (Moore, [1896]: 254, pl. 184, fig. 1a; Bell, 1909: 660; Fountaine, *in litt.*).

Recorded food plants are; *Acacia moluccana* (Woodhouse & Henry, 1942: 52), *A. catechu* (Mackinnon & de Nicéville, 1897: 377), *A. pennata*, *A. caesia* (Bell, 1909: 662), *Albizia julibrissin* (Mackinnon & de Nicéville, 1897: 377), *A. stipulata*, *A. milletti* (Fruhstorfer, 1914: 718), *A. lebbek* (Bell, 1909: 662), *Caesalpinia mimosioides* (Davidson & Aitken, 1890: 278), *C. sappan*, *C. ruga*, *C. bonducella* (Bell, 1909: 662), *Poinciana regia* (Davidson & Aitken, 1890: 278), *Adenantha pavonica* (Wynter-Blyth, 1957: 494), *Leucaena leucocephala*, *Abarema clypearia* (Hill, Johnston & Bascombe, 1978: 14) (Leguminosae), and *Grewia* (Fruhstorfer, 1914: 718) (Tiliaceae).

### *Polyura athamas andamanica* (Fruhstorfer)

(Fig. 95)

*Eulepis athamas andamanicus* Fruhstorfer, 1906: 179. Holotype ♀, ANDAMAN IS. (BMNH) [examined].



*Eriboea athamas andamanicus* (Fruhstorfer) Fruhstorfer, 1914: 718; Evans, 1924: 895; 1927: 93.

*Polyura athamas andamanicus* (Fruhstorfer) Stichel, 1939: 556.

MALE, FEMALE. *Upperside*. Discal bands narrower than in any other subspecies. A small subapical spot is present in cell  $R_5$ . *Underside*. Ground colour pinkish brown. MI and MII of both wings heavier than in any other subspecies.

SIZE. ♂;  $\bar{x}$  = 33.7,  $s$  = 0.5 (7 specimens). ♀; 1 specimen only, 36.9.

DISTRIBUTION. **Andaman Is.**: Middle Andaman; South Andaman. 7 ♂, 1 ♀.

TYPE-MATERIAL. Described from a single female specimen from the Andaman Is. This holotype is now in the BMNH and bears the following labels; 'Holotype (red) / Andamanen Butler ex coll. H. Fruhstorfer / Type / Fruhstorfer Coll. B.M. 1937-285. / *Eulepis athamas andamanicus* Fruhstorfer HOLOTYPE det. R. L. Smiles 1977'.

BIONOMICS. In the BMNH there are capture records for June.

### *Polyura athamas kannegieteri* (Lathy)

(Figs 18, 33)

*Eulepis kannegieteri* Lathy, 1913: 136. LECTOTYPE ♂, Nias (BMNH), here designated [examined].

*Eriboea athamas kannegieteri* (Lathy) Fruhstorfer, 1914: 719.

*Polyura athamas kannegieteri* (Lathy) Stichel, 1939: 559.

MALE. *Upperside*. Discal band narrower than that of *P. a. uraeus*, but wider than in *P. a. andamanicus*. Forewing with subapical spot in cell  $R_5$  wholly suppressed. *Underside*. Ground colour less pink than in *P. a. athamas*. Hindwing postdiscal red lunule in cell  $R_1$  surrounded by a very dense, black area, and a similar area distal to the lunules in cells  $M_2$ ,  $M_3$  and  $Cu_{1a}$ , the red portions of which are restricted. White areas associated with postdiscal lunules very much larger.

SIZE. ♂;  $\bar{x}$  = 33.5,  $s$  = 1.1 (8 specimens).

DISTRIBUTION. **Nias**: [Kalim Bungo]. 8 ♂.

TYPE-MATERIAL. Described from eight males. These specimens are now in the BMNH and bear the following labels; 'Kalim Bungo M. Nias 1<sup>st</sup> sem' 96 R. Mitschke / Ex Coll. Van de Poll. / B.M. TYPE No. Rh. 10583[-90] *Eulepis kannegieteri*. ♂ Lathy'. In addition one male bears the following labels; 'Lectotype (purple) / Adams Bequest, B.M. 1912-399 / *Eulepis kannegieteri* Lathy LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype. Of the others, five bear the additional label; 'Adams Bequest. B.M. 1912-399, and two the label; 'Fruhstorfer Coll B.M. 1937-285.'. These seven specimens also bear the labels; 'Paralectotype (blue) / *Eulepis kannegieteri* Lathy PARALECTOTYPE det. R. L. Smiles 1979'.

BIONOMICS. Other than the type-data, and the statement 'Very scarce and local' (Fruhstorfer, 1914: 719), nothing is known.

### *Polyura athamas uraeus* (Rothschild)

(Fig. 96)

*Eulepis athamas* (Drury); Rothschild & Jordan, 1898: pl. 10, fig. 8.

*Eulepis athamas uraeus* Rothschild, 1899: 254. LECTOTYPE ♂, SUMATRA (BMNH), here designated [examined].

*Eriboea athamas uraeus* (Rothschild) Fruhstorfer, 1914: 719.

*Eriboea athamas faliscus* Fruhstorfer, 1914: 719. Syntypes ♂, SABAH (untraced) [not examined]. **Syn. n.**

*Polyura athamas uraeus* (Rothschild) Stichel, 1939: 558.

MALE. Wing shape as in *P. a. athamas*. Hindwing tails rather shorter than in that subspecies. *Upperside*. Discal band wider than in *P. a. kannegieteri* or *andamanica*. Forewing with subapical spot in cell  $R_5$  missing. Postdiscal spot in cell  $M_1$  about the same size as that of *P. a. adamanica*, *kannegieteri*, and *acuta*. *Underside*. Ground colour pinkish brown.

*Eriboea athamas faliscus* Fruhstorfer was described from the lowlands of north-eastern Borneo. Specimens in the BMNH from Sabah show no essential differences from Sumatran specimens.

SIZE. ♂;  $\bar{x}$  = 32.7,  $s$  = 1.5 (40 specimens).

DISTRIBUTION. **Sumatra**: [Selesseh]; [Setinjau]; Palembang Dist., Bukittinggi [Fort de Kock]; Batak Mts; [Bekantschan]; [Scolak Daras]; Lubuk Sikaping; Lebongtandai; Deli; Tebing Tinggi; Padang; Padangsidempuan; Solok; Dist. Lubuk Linggau; North Kerintji Valley. **Sabah**: Sandakan; Lawas; Mt Kinabalu; [Mt Marapok, Dent Province]; Baluk [Balç]; Malaman, [Province Clarke]; Silam, Darvel Bay; Labuan; Sungai Mengalong. **Sarawak**: Bidi; R. Koyan; Baram R.; Mt Mulu; Mt Dulit; Kuching; Penank Hill. **Kalimantan**: Pengaron; Selakau; Mahakam; Pontianak; River Sintang; [Tameang Lajang]. **Natuna Is.**: Bunguran. 136 ♂.

TYPE-MATERIAL. Described from 17 males from Sumatra, 13 males from Borneo and one male from Natuna Is. Of these, all but two of the specimens from Borneo are in the BMNH and bear the following label; 'Rothschild Bequest B.M. 1939-1.' One male bears the labels; 'Lectotype (purple) / Selesseh, N.E. Sum., 18.iii.94 / Eulepis athamas uraeus Rothschild LECTOTYPE det. R. L. Smiles 1979', and is designated lectotype. All the remaining specimens are labelled; 'Paralectotype (blue) / Eulepis athamas uraeus Rothschild PARALECTOTYPE det. R. L. Smiles 1979'. Of these, eight bear the following additional label; 'Selesseh, N.E. Sum., 21.ii.94 [18.iii.94, 18.iv.93, 17.viii.93, 21.v.93, 13.viii.93, 17.vii.93, 25.vii.93] Dr. Martin.', one the label; 'Sumatra Wallace, type / FELDER COLL<sup>N</sup> / COTYPE of attalus' (see also *P. a. attalus*), two the label; 'Setinjau, W. Sumatra febr. 97 [vi-98] (Ericsson)', one; 'Palembang distr, o.s. Lat. 107 Long. 96', one; 'Fort de Kock SUMATRA', one; 'Upp. Palembang distr. Voelcker.', one; 'Battak Mts, N.E. Sum., v.94, Dr Martin.', one; 'Bekantschan, N.E. Sum., III.94. Dr Martin.', one; 'Lawas N. Borneo A. Everett.', one; 'Lawas. April 92 (A. Everett)', one; 'Kina Balu', two; 'Baram R., N. Borneo Oct. 91 (Everett)', one; 'Mt Mulu 1-4000 ft. N. Borneo Aug. Dec. 94 Hose coll.', one; 'Mt Dulit II.III.94 (Hose)', two; 'Pengaron, S. O. Borneo', and one; 'Bunguran, Natuna Is., vii.x.94 (Hose)'.

BIONOMICS. There are records in the BMNH for the entire year at altitudes between 300 and 1500 m. One specimen was captured whilst drinking at wet rocks.

EARLY STAGES. Larva green, most dorsal pair of horns twice as long as the lateral pair. Mandibles yellow. Lateral line whitish. Spiracles white. Two streak-like, whitish, transverse bands above the 'middle segments': attains a length of about 5 cm (Fruhstorfer, 1914: 719).

Pupa smooth and rounded, green, slightly glossed and shaded with white, leaving a fine green dorsal line, and two broader green lateral stripes. The wing cases are more green costally, head rather more green, back and posterior end more white. Spiracles brownish yellow. Cremaster surrounded by six glossy rufous tubercles (Fruhstorfer, 1914: 719).

Fruhstorfer (1914: 719) also states: 'After 11 days the pupa appears in the morning discoloured, the white discal band of the forewings shining plainly through; but only between 1-2 o'clock in the afternoon the imago appears.'

Food plant: *Albizia stipulata* (Leguminosae) (Fruhstorfer, 1914: 719).

### *Polyura athamas palawanica* (Rothschild)

(Fig. 97)

*Charaxes athamas* (Drury); Staudinger, 1889: 81; Semper, 1892: 335.

*Eulepis athamas* (Drury); Rothschild & Jordan, 1898: pl. 11, figs 9, 10.

*Eulepis athamas palawanicus* Rothschild, 1899: 256. LECTOTYPE ♂, PALAWAN (BMNH), here designated [examined].

*Eriboea athamas palawanicus* (Rothschild) Fruhstorfer, 1914: 720.

*Polyura athamas palawanicus* (Rothschild) Stichel, 1939: 563.

MALE, FEMALE. Hindwing tails, whilst longer than those of *P. a. uraeus*, are shorter than those of *P. a. athamas* and are almost equal in length, unlike *P. a. uraeus* or *acuta*. *Upperside*. Discal band similar to *P. a. uraeus*. Forewing with subapical spot in cell  $R_5$  absent, and postdiscal spot of cell  $M_1$  slightly larger than in

*P. a. andamanica*, *kannegieteri*, *uraeus* or *acuta*. Hindwing with orange admarginals present. Submarginal white spots large. *Underside*. Ground colour pinkish brown. Outer margin of discal band of hindwing straight or only slightly concave between the costal margin and vein  $M_3$ .

FEMALE. Differs in the paler colour of the discal bands of the upperside.

SIZE. ♂;  $\bar{x}$  = 33.4,  $s$  = 1.3 (33 specimens). ♀; 1 specimen only, 36.0.

DISTRIBUTION. **Palawan**: Dumarán; Paragua Ridge (Semper, 1892: 335); S. Palawan. 33 ♂, 1 ♀.

TYPE-MATERIAL. Of the original five males and one female in the type-series, only one male and one female in the BMNH can be definitely ascribed to those described. Of these, the male bears the following labels; 'Lectotype (purple) / Süd Palawan / N.Z. 98. t.11, f.10 / E. ath. palawanicus Rothschild. Type! Nov. Zool. / Rothschild Bequest B.M. 1939-1. / Eulepis athamas palawanicus Rothschild LECTOTYPE det. R. L. Smiles 1979', and is here designated lectotype. The female bears the following labels; 'Paralectotype (blue) / Palawan / N.Z. 98. t.11. f.9. / Rothschild Bequest B.M. 1939-1. / Eulepis athamas palawanicus Rothschild PARALECTOTYPE det. R. L. Smiles 1979'.

BIONOMICS. Has been captured during January and August according to records in the BMNH, but most specimens are not dated. One specimen was captured on human faeces and bears the note, 'flies from July to October.'

### *Polyura athamas acuta* (Rothschild)

(Figs 19, 34)

*Charaxes athamas* (Drury): Semper, 1887: 79.

*Eulepis athamas* (Drury); Rothschild & Jordan, 1898: pl. 11, figs 7, 8.

*Eulepis athamas acutus* Rothschild, 1899: 256. Holotype ♂, MINDANAO (BMNH) [examined].

*Eriboea athamas acutus* (Rothschild) Fruhstorfer, 1914: 720.

*Polyura athamas acutus* (Rothschild) Stichel, 1939: 563.

MALE, FEMALE. Forewing shape as in *P. a. palawanica*, hindwing more elongate, with outer margin straighter. Posterior tail normally longer than anterior one in male. *Upperside*. Discal bands narrower than *P. a. palawanica*. In forewing, subapical spot of cell  $R_5$  normally present. Hindwing with orange admarginals as in *P. a. palawanica*, white submarginal spots smaller than in that subspecies. *Underside*. Ground colour slightly darker than in *P. a. palawanica*. Outer margin of hindwing discal band concave between costal margin and vein  $M_3$ .

SIZE. ♂;  $\bar{x}$  = 31.6,  $s$  = 1.3 (18 specimens). ♀; 2 specimens only, 36.7, 36.9.

DISTRIBUTION. **Mindanao**: Sarangani (Semper, 1887: 79, Rothschild, 1899: 256); Davao. **Bohol** (Semper, 1887: 79, Rothschild, 1899: 256). **Mindoro**. **Luzon**: Palali, Benguet. 18 ♂, 2 ♀.

TYPE-MATERIAL. Described from a male holotype and five male and one female paratypes, now in the BMNH. The holotype bears the following labels; 'Holotype (red) / Mindanao or. Platen / E. ath. acutus Type! Rothschild. Nov. Zool. 99. / Rothschild Bequest B.M. 1939-1. / Eulepis athamas acutus Rothschild HOLOTYPE det. R. L. Smiles 1977'. The paratypes all bear the following labels; 'Paratype (yellow) / Rothschild Bequest B.M. 1939-1. / Eulepis athamas acutus Rothschild PARATYPE det. R. L. Smiles 1977'. In addition two males bear the label; 'Mindanao or. Platen', one male; 'Mindanao Davao or. 1889 Platen.', one male the labels; 'Luzon, Lorquin type. / FELDER COLL<sup>N.</sup>;', one male the label; 'Mindoro', and one female; 'Mindoro. ix.94. Everett.'

BIONOMICS. According to records in the BMNH it has been taken during December and at an altitude of 600 m, but most specimens lack such data.

### *Polyura athamas attalus* (Felder & Felder)

(Fig. 98)

*Nymphalis athamas* (Drury); Horsfield & Moore, 1858: 205, pl. 6, figs 3, 3a.

*Charaxes attalus* Felder & Felder, [1867]: 438. LECTOTYPE ♂, JAVA (BMNH), here designated [examined].

*Nymphalis athamas* var. *attalus* (Felder & Felder) Robbe, 1892: 129.

*Charaxes phrixus* Röber, 1895: 64. Holotype ♀, JAVA (probably in MNHU, Berlin) [not examined].

*Eulepis attalus* (Felder & Felder) Moore, [1896]: 263.

*Eulepis athamas* (Drury); Rothschild & Jordan, 1898: pl. 11, figs 1, 3.

*Eulepis athamas attalus* (Felder & Felder); Rothschild & Jordan, 1899: 257.

*Eriboea athamas attalus* (Felder & Felder) Fruhstorfer, 1914: 719; Roepke, 1932: 95, fig. 166.

*Eriboea athamas attalus* f. *phrixus* (Röber) Fruhstorfer, 1914: 719.

*Eriboea athamas phrixus* (Röber); Roepke, 1932: 95.

*Charaxes athamas attalus* Felder & Felder; Roepke, 1938: 348, pl. 35, figs 8, 9.

*Polyura athamas attalus* (Felder & Felder) Stichel, 1939: 560.

*Polyura athamas attalus* ? f. *phrixus* (Röber) Stichel, 1939: 561.

MALE, FEMALE. Wingshape as in *P. a. uraeus*, *palawanica* etc. Hindwing tails as in *P. a. palawanica*. Upperside. Discal bands broader than in *P. a. palawanica*, or narrower as in *P. a. uraeus*; there are intermediates. Typical *attalus* was described from a particularly wide banded specimen, and most examples have narrower bands than this (f. *phrixus*). Forewing with subapical spot in cell  $R_5$  often present, and sometimes a further spot in cell  $R_4$ . Hindwing with orange admarginals normally present to some degree, rarely completely suppressed. Underside. Ground colour pinkish brown.

SIZE. ♂;  $\bar{x}$  = 31.6,  $s$  = 1.1 (40 specimens). ♀;  $\bar{x}$  = 34.6,  $s$  = 1.0 (12 specimens).

DISTRIBUTION. Java: Mt Gede; Sukabumi; [Preanger], Pelabuhan Ratu; Bandung; [Plaboan]; Teluk [Wijnkoopsbaai]; Bogor; Lawang. 75 ♂, 12 ♀.

TYPE-MATERIAL. *Charaxes attalus* Felder & Felder was described from an undisclosed number of specimens in the van der Capellen collection. One male in the BMNH can definitely be ascribed to the type-series, bears the following labels; 'Lectotype (purple) / Java CII van d. Capell type / TYPE of attalus Feld. / FELDER COLL<sup>N</sup>. / Rothschild Bequest B.M. 1939-1. / Charaxes attalus Felder & Felder LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype. One specimen which has already been included in the type-series of *Eulepis athamas uraeus* Rothschild is labelled as a 'cotype' of *attalus* Felder & Felder, but I doubt that this is a syntype of *attalus* as the Felders' description states the locality Java quite clearly, whereas the aforementioned specimen was collected by Wallace in Sumatra.

BIONOMICS. Specimens in the BMNH have been collected during May-June and August-September at altitudes of up to 1200 m.

EARLY STAGES. The larva figured by Horsfield & Moore (1858: pl. 6, fig. 3) is very similar to that of other *P. athamas* subspecies. The crescent-shaped dorsal marks are shown on abdominal segments 3 and 5. The illustration of the pupa (Horsfield & Moore, 1858: pl. 6, fig. 3a) similarly is very like those of other *P. athamas* subspecies. Fruhstorfer (1914: 719) describes the pupa as '... largely green, with white wingcases and delicate white subdorsal and lateral stripes.'

### *Polyura agraria* (Swinhoe)

(Figs 20, 35, 83, 86, Map 2)

*Charaxes agrarius* Swinhoe, 1887: 425, pl. 40, fig. 3.

Very similar to *P. athamas*, differing mainly in wingshape which is more elongate in both wings. If the length of a straight line between the forewing base and apex ( $x$ ) is divided by a straight line from the forewing base to the end of vein 2A ( $y$ ), then  $x/y$  = 1.46(♂),  $s$  = 0.03, 1.49(♀),  $s$  = 0.03, contrasted with  $x/y$  = 1.40(♂),  $s$  = 0.03, 1.42(♀),  $s$  = 0.03 for *P. athamas*. It is possible that *P. agraria* is a form of *P. athamas*, as its distribution is split between India and Burma, and the Lesser Sunda Is., in mostly rather dry areas. The one good diagnostic character is wingshape, and if *P. agraria* from India and Burma is distinct, then specimens from the Lesser Sunda Islands can also be grouped on the same character. Were it not for the fact that seasonal forms of *P. athamas* are already well documented, I would have no hesitation in accepting its status as infra-subspecific.

RANGE. In north and south India, Burma, again in Java, Bali, through the Lesser Sunda Is. to Leti, and Sulawesi.

*Polyura agraria agraria* (Swinhoe)

(Figs. 20, 35)

*Charaxes agrarius* Swinhoe, 1887: 425, pl. 40, fig. 3. LECTOTYPE ♂, INDIA (BMNH), here designated [examined].

*Eulepis agrarius* (Swinhoe) Moore, 1896: 257, pl. 185, figs 2, 2a.

*Eulepis athamas agrarius* (Swinhoe); Fruhstorfer, 1898: 60; Rothschild & Jordan, 1899: 248; Rhé-Philipe, 1911: 757; Ormiston, 1924: 19.

*Eriboea athamas agrarius* (Swinhoe) Fruhstorfer, 1914: 718; Evans, 1924: 895; 1927: 93.

*Polyura athamas agrarius* (Swinhoe) Stichel, 1939: 557.

*Polyura agrarius* (Swinhoe); Fujioka, 1970: 30, pl. 12, figs 1, 2, fig. 9.

MALE, FEMALE. *Upperside*. Postdiscal spot in cell  $M_1$ , not accompanied by another in cell  $R_5$ . Subapical pale spots present in cell  $R_5$ , and normally  $R_4$ .

SIZE. ♂;  $\bar{x}$  = 30.3,  $s$  = 1.5 (27 specimens). ♀;  $\bar{x}$  = 33.5,  $s$  = 1.9 (9 specimens).

DISTRIBUTION. **India:** Tiruchirappalli (Trichinopoly); Nilgiri, Coonoor; Nilgiri, [Kalar]; Mysore, Bangalor; Hyderabad (Haldárábád), Singareni; Mhow; N.W. Himalayas, Kumaun; Kulu, Dharmsala; Orissa District, Sambalpur. **Burma:** Handauk; Heiblentauing; Mt Victoria; Chin Hills; Tilin Yaw; Yedu. 27 ♂, 9 ♀.

TYPE-MATERIAL. *Charaxes agrarius* Swinhoe is represented in the BMNH by two male and one female types. One male and one female bear the following labels; '49 Mhow. 10.81. type / Joicey Bequest Brit. Mus. 1934-120.'. In addition the male bears the following labels; 'Lectotype (purple) / *Charaxes agrarius* Swinhoe LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype. The female bears the following additional labels; 'Paralectotype (blue) / *Charaxes agrarius* Swinhoe PARALECTOTYPE det. R. L. Smiles 1979'. The remaining male bears the following labels; 'Paralectotype (blue) / 49 Mhow. 10.81 / 82.25 / *Charaxes agrarius* Swinhoe PARALECTOTYPE det. R. L. Smiles 1979'.

*Eulepis hamasta* Moore has already been dealt with under *Charaxes athamas athamas* where the male from the type-series has been designated lectotype. The two females are included here and bear the following labels; 'Paralectotype (blue) / *Eulepis hamasta* Moore PARALECTOTYPE det. R. L. Smiles 1979'. In addition one female bears the following labels; 'Dharmasala 82.23 ♀ / B.M. TYPE No. Rh. 10438, *Eulepis hamasta* ♀ Moore. The remaining female bears the following additional labels; 'Kulu / Dharmasala 82.23 Kulu N.W. Himalayas / B.M. TYPE No. Rh. 10439 *Eulepis hamasta* Moore'.

BIONOMICS. Specimens in the BMNH have been captured flying during February, March, May, July, October, November to December, and December, at elevations up to 900 m.

*Polyura agraria fruhstorferi* (Röber)

(Fig. 83)

*Charaxes fruhstorferi* Röber, 1895: 63; Fruhstorfer, 1898: 57. Holotype ♀, JAVA (BMNH) [examined].

*Charaxes athamas batavianus* Fruhstorfer, 1898: 57. LECTOTYPE ♂, JAVA (BMNH), here designated [examined]. **Syn. n.**

*Charaxes (Eulepis) batavianus* Fruhstorfer; de Nicéville & Elwes, 1898: 691 [in part].

*Eulepis athamas attalus* f. *fruhstorferi* (Röber) Rothschild & Jordan, 1899: 259.

*Eriboea athamas attalus* f. *fruhstorferi* (Röber) Fruhstorfer, 1914: 719.

*Eriboea athamas fruhstorferi* (Röber); Roepke, 1932: 95.

*Polyura athamas attalus* f. *fruhstorferi* (Röber) Stichel, 1939: 561.

*Polyura athamas batavianus* (Fruhstorfer) Stichel, 1939: 561.

MALE, FEMALE. *Upperside*. Very similar to *P. a. agraria*, but normally with only one subapical spot, and this in cell  $M_1$ . Occasionally another may be present in cell  $M_2$ , but not in cell  $R_5$ . Hindwing with admarginals less suppressed than in the nominate subspecies, and clearly orange.

*Charaxes athamas batavianus* Fruhstorfer corresponds very closely to *Charaxes fruhstorferi* Röber, and is here treated as a synonym of it.

SIZE. ♂;  $\bar{x}$  = 30.5,  $s$  = 1.0 (10 specimens), ♀;  $\bar{x}$  = 33.6,  $s$  = 2.4 (11 specimens).

DISTRIBUTION. **Java**: Jakarta [Batavia]; Bogor. **Madura**. 10 ♂, 11 ♀.

TYPE-MATERIAL. *Charaxes fruhstorferi* Röber is represented in the BMNH by a female holotype bearing the labels; 'Holotype (red) / Java merid. 1500' 1891 H. Fruhstorfer. / Fruhstorfer Coll. B. M. 1937-285. / *Charaxes fruhstorferi* Röber HOLOTYPE det. R. L. Smiles 1977'.

*Charaxes athamas batavianus* Fruhstorfer was described from eleven males and seven females, seven males and four females of which are now in the BMNH and which bear the following label; 'Batavia Java 1897 ex. coll. Fruhstorfer'. In addition, one male bears the following labels; 'Lectotype (purple) / Rothschild Bequest B.M. 1939-1. / *Charaxes athamas batavianus* Fruhstorfer LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype. The remaining specimens all bear the additional labels; 'Paralectotype (blue) / *Charaxes athamas batavianus* Fruhstorfer PARALECTOTYPE det. R. L. Smiles 1979'; of these, one male and two females are labelled; 'Rothschild Bequest B.M. 1939-1.', and five males and two females; 'Fruhstorfer Coll. B.M. 1937-285.'

### *Polyura agraria piepersianus* (Martin) comb. n.

*Charaxes athamas* (Drury); Piepers & Snellen, 1877: 11.

*Charaxes (Eulepis) athamas piepersianus* Martin, 1924: 107. Holotype (sex?), SULAWESI (probably in RNH, Leiden) [not examined].

I have examined colour transparencies of a female from M. Jaques Plantrou's collection; this female seems to me to have closer affinities with specimens from the Lesser Sunda Is. (*P. agraria sumbaensis* and *alphius*) than with specimens of *P. athamas* from Borneo.

FEMALE. *Upperside*. Forewing with postdiscal spots limited to cell  $M_1$ , not present in cell  $R_5$ . Hindwing with admarginals orange and clearly marked. *Underside*. As in *P. agraria sumbaensis*, but with discal band of hindwing narrowing at cell  $Cu_{1b}$ , and then broadening out to end on the anal margin.

SIZE. ♀; 1 specimen only, approximately 37.5.

DISTRIBUTION. **Sulawesi** (Celebes): Bonthain; Allu (Piepers & Snellen, 1877: 11); Makasar (Plantrou Coll.). 1 ♀ (upper and underside photographs).

TYPE-MATERIAL. Martin's description is based on a pencil sketch which he received from R. van Eecke, of a specimen in the RNH, Leiden; one of two previously listed by Piepers & Snellen (1877: 11). According to Martin only one of those butterflies could be found, the Bonthain specimen; the other from Allu having been lost.

BIONOMICS. The female in M. Jaques Plantrou's collection was taken in May.

### *Polyura agraria sumbaensis* (Swinhoe) comb. n.

(Fig. 86)

*Eulepis sumbaensis* Swinhoe, 1897: 408. LECTOTYPE ♂, SUMBA (BMNH), here designated [examined].

*Eulepis athamas* (Drury); Rothschild & Jordan, 1898: pl. 11, figs 4, 5, 6.

*Eulepis athamas sumbaensis* Swinhoe; Rothschild & Jordan, 1899: 260.

*Eriboea athamas stratioticus* Fruhstorfer, 1914: 720. LECTOTYPE ♂, LOMBOK (BMNH), here designated [examined]. **Syn. n.**

*Eriboea athamas sumbaensis* (Swinhoe) Fruhstorfer, 1914: 720.

*Eriboea athamas menaius* Fruhstorfer, 1914: 720. LECTOTYPE ♀, SUMBAWA (BMNH), here designated [examined]. **Syn. n.**

*Polyura athamas stratioticus* (sic) (Fruhstorfer) Stichel, 1939: 561.

*Polyura athamas sumbaensis* (Swinhoe) Stichel, 1939: 562.

*Polyura athamas menaius* (Fruhstorfer) Stichel, 1939: 562.

MALE, FEMALE. *Upperside*. Discal bands narrow, slightly wider in females. Forewing with postdiscal spot of cell  $M_1$  often extended into cell  $R_5$ . A subapical spot is also present in cell  $R_5$ . Hindwing with orange admarginals present, extending into tails, which are not blue-centred. Proximal to this is a row of pale yellow spots which are larger than those of *P. a. alphius*. *UNDERSIDE*. Reddish bands which border the discal bands paler than in *P. a. athamas*. Ground colour pale pinkish brown. Hindwing with outer margin of discal band concave between the costal margin and vein  $M_3$ .

*Eriboea agraria stratiocus* Fruhstorfer and *Eriboea agraria menaius* Fruhstorfer may show slight differences from typical *sumbaensis* in about 50 per cent of specimens, but these are far from clear and are very inconsistent.

SIZE. ♂;  $\bar{x} = 32.0$ ,  $s = 1.3$  (37 specimens), ♀;  $\bar{x} = 35.6$ ,  $s = 1.8$  (22 specimens).

DISTRIBUTION. **Bali**: Buleleng district. **Lombok**: Pringgabaya; Sapit. **Sumbawa**: Tambora. **Sumba**: Waingapu. **Alor**. **Flores**: S. Flores. **Adonara**. **Pantar**. 37 ♂, 22 ♀.

TYPE-MATERIAL. *Eulepis sumbaensis* Swinhoe was described from an undisclosed number of males and two females. These are represented in the BMNH by two males and two females. One male bears the following labels; 'Lectotype (purple) / Waingapo, Pur. from E. Swinhoe. 1900-250. / 4 / Waingapo / B.M. TYPE No. Rh. 10440 Eulepis sumbaensis, ♂ Swinh. / Eulepis sumbaensis Swinhoe LECTOTYPE det. R. L. Smiles 1979', and is here designated lectotype. All the remaining specimens bear the following labels; 'Paralectotype (blue) / Eulepis sumbaensis Swinhoe PARALECTOTYPE det. R. L. Smiles 1979'. Of these one female bears the additional labels; 'Waingapo. Pur. from E. Swinhoe. 1900-250. / 4 / ♀ Waingapo / B.M. TYPE No. Rh. 10441 Eulepis sumbaensis. ♀ Swinh.'. The remaining pair bear the additional labels; '82.25 / Joicey Bequest Brit. Mus. 1934-120.'. Of these, the male also bears the label; '2422. ♂ Waingapo Sumba Isl', and the female; '41 ♀ Waingapo'.

*Eriboea athamas stratiocus* Fruhstorfer was described from an undisclosed number of specimens, twelve males and five females of which are now in the BMNH. Of these, one male bears the labels; 'Lectotype (purple) / Type / Lombok Pringabaya April 1896 H. Fruhstorfer / Fruhstorfer Coll. B.M. 1937-285. / Eriboea athamas stratiocus Fruhstorfer LECTOTYPE det. R. L. Smiles 1979', and is here designated lectotype. The remaining specimens all bear the labels; 'Paralectotype (blue) / Eriboea athamas stratiocus Fruhstorfer PARALECTOTYPE det. R. L. Smiles 1979'. Five males and one female bear the additional label; 'Lombok Pringabaya April 1896 H. Fruhstorfer'. Of these, one male and one female bear the label; 'Fruhstorfer Coll. B.M. 1937-285.', one male; 'ex coll. Ch. Oberthur', one male; 'Joicey Bequest. Brit. Mus. 1934-120.', and two males; 'Rothschild Bequest B.M. 1939-1.'. Four males and one female bear the additional label; 'Lombok Sapit 2000' Mai-Juni 1896 H. Fruhstorfer'. Of these, one male bears the label; 'ex coll. Ch. Oberthur.', two males; Fruhstorfer Coll. B.M. 1937-185.', and one male and one female; 'Rothschild Bequest B.M. 1939-1.'. Two males and three females bear the additional label; 'Lombok Sapit 2000' April 1896 H. Fruhstorfer'. Of these, one female bears the label; 'ex coll. Ch. Oberthur', and two males and two females; 'Fruhstorfer Coll. B.M. 1937-285.'.

*Eriboea athamas menaius* Fruhstorfer was described from an undisclosed number of specimens, one female of which is now in the BMNH, and which bears the following labels; 'Lectotype (purple) / Sumbawa Tambora 1897 ex coll. Fruhstorfer / Fruhstorfer Coll. B.M. 1937-285. / Eriboea athamas menaius Fruhstorfer LECTOTYPE det. R. L. Smiles 1979'. I designate this specimen the lectotype.

BIONOMICS. Specimens in the BMNH have been captured during February, April, May-June, September, October, November and December-March at altitudes up to 610 m. Fruhstorfer (1914: 720), referring to Lombok specimens, states that it is found '... from the shore to an elevation of 2,500 feet [760 metres]'.

### *Polyura agraria alphius* (Staudinger)

(Fig. 116)

*Charaxes alphius* Staudinger, 1886: 172. Syntype(s) (sex?), TIMOR (probably in MNHU, Berlin) [not examined].

*Eulepis athamas* (Drury); Rothschild & Jordan, 1898: pl. 11, figs 11, 12.

*Eulepis athamas alpius* (Staudinger) Rothschild & Jordan, 1899: 261.

*Eriboea athamas alpius* (Staudinger) Fruhstorfer, 1914: 720.

*Eriboea athamas oitylus* Fruhstorfer, 1914: 720. LECTOTYPE ♂, WETAR (BMNH), here designated [examined]. **Syn. n.**

*Polyura athamas alpius* (Staudinger) Stichel, 1939: 562.

*Polyura athamas oitylus* (Fruhstorfer) Stichel, 1939: 563.

MALE, FEMALE. As in *P. a. sumbaensis* except for subapical spot in cell  $R_5$ , which is larger, and postdiscal spot in cell  $R_5$ , which is similarly larger, being at least half the size of that in cell  $M_1$ .

*Eriboea athamas oitylus* Fruhstorfer appears to me to fall within the range of variation exhibited by *P. a. alpius*.

SIZE. ♂;  $\bar{x}$  = 32.0,  $s$  = 1.0 (40 specimens), ♀; 2 specimens only, 35.6, 36.3.

DISTRIBUTION. **Sawu. Timor:** Dili; Baucau; [Bere Daoe]; Suai; [Matai]. **Wetar. Leti.** 38 ♂, 2 ♀.

TYPE-MATERIAL. *Eriboea athamas oitylus* Fruhstorfer was described from an undisclosed number of specimens represented in the BMNH by six males all bearing the label; 'Wetter Fruhstorfer'. Of these, one male bears the additional labels; 'Lectotype (purple) / Type / Fruhstorfer Coll. B.M. 1937-285. / *Eriboea athamas oitylus* Fruhstorfer LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype. The remaining specimens bear the additional labels; 'Paralectotype (blue) / *Eriboea athamas oitylus* Fruhstorfer PARALECTOTYPE det. R. L. Smiles 1979'. Of these, three males bear the label; 'Fruhstorfer Coll. B.M. 1937-285.', and two males; 'Adams Bequest. B.M. 1912-399.'.

BIONOMICS. Specimens in the BMNH have been captured during January, February, March, May, August and December. One specimen was captured at 910 m.

### *Polyura arja* (Felder & Felder)

(Figs 21, 36, 117)

*Charaxes arja* Felder & Felder, [1867]: 438; de Nicéville, 1886: 278; Schwanwitsch, 1926: 501, pl. 2, fig. 11.

LECTOTYPE ♂, BANGLADESH (BMNH), here designated [examined].

*Nymphalis athamas* var. *arja* (Felder & Felder) Kirby, 1871: 271.

*Charaxes (Eulepis) arja* Felder & Felder; Wood-Mason & de Nicéville, 1887: 363.

*Eulepis arja* (Felder & Felder) Moore, [1896]: 258, pl. 186, figs 1, 1a, 1b, 1c; Rothschild & Jordan, 1899: 244.

*Charaxes arja roeberi* Fruhstorfer, 1898: 59. Syntypes (sex?), INDIA (probably in MNHU, Berlin) [not examined].

*Eulepis arja roeberi* (Fruhstorfer) Rothschild & Jordan, 1898: pl. 10, fig. 6.

*Eulepis arja* f. temp. *vernus* Rothschild, 1899: 244. Holotype ♂, INDIA: Sikkim (BMNH) [examined].

*Eulepis arja* f. temp. *arja* ab. *roeberi* (Fruhstorfer); Rothschild & Jordan, 1899: 245.

*Eriboea arja* (Felder & Felder) Fruhstorfer, 1914: 720; Evans, 1924: 895; 1927: 93; Wynter-Blyth, 1957: 149, pl. 20, fig. 5.

*Eriboea arja* d.s.f. *vernus* (Rothschild) Fruhstorfer, 1914: 720, pl. 134a.

*Eriboea arja* w.s.f. *roeberi* (Fruhstorfer) Fruhstorfer, 1914: 720, pl. 134a.

*Polyura arja* (Felder & Felder) Stichel, 1939: 564; Duckworth, Watson & Whalley, 1975: 267.

*Polyura arja* f. *roeberi* (Fruhstorfer) Stichel, 1939: 565.

*Polyura arja* f. *vernus* (Rothschild) Stichel, 1939: 565.

*Polyura arja arja* (Felder & Felder); Pinratana, 1979: 98, fig. N167.

MALE, FEMALE. Similar in most respects to *P. athamas*, but differs from that species in the following respects: on the upperside, the colour of the discal bands is white, sometimes anteriorly pale green; the colour of the postdiscal and, if present, of the subapical spots is also white or pale green; and the distal edge of the discal band of the hindwing is strongly bordered with structural blue.

As in *P. athamas athamas*, several forms have been described. The taxon *arja* was described from specimens with discal bands of medium width corresponding with a similar form in *P. a. athamas*; the majority of specimens fall into this category. A very narrow banded form (f. *roeberi*) is in the



BMNH from Sikkim, Assam, Nagaland, Bhutan, and also from Thailand and Vietnam and flies with other forms. A third form has very broad discal bands and a large postdiscal spot (f. *vernus*).

SIZE. ♂:  $\bar{x} = 35.3$ ,  $s = 1.5$  (40 specimens), ♀:  $\bar{x} = 39.1$ ,  $s = 2.8$  (40 specimens).

DISTRIBUTION. **India:** Sikkim; Singlah; Kurseong; [Troomling]; Landour; Bhutan, [Buxa]; Darjeeling, Tista Valley; Darjeeling, [Gopaldhara]; N. Assam, Dibrugarh; Assam, Digboi; Khasi Hills; Cherrapunji; Shillong; Cachar; Manipur; Naga Hills, Kohima; Naga Hills, Nichuguard; Naga Hills, Ghaspani. **Bangladesh:** Sylhet. **Burma:** Kawkaireik, [Thingannyi]; Thanbayagon [Kindah]; [Poungadaw], nr Thayetmyo; Kachin; [Kimpadia]; Tilin Yaw; Thandaung; Kalaw; East Bhamo District; Thaungyin Valley; Sadon; Northern Shan State, Wetwun; Northern Shan State, Maymyo; [Ruby Mines District]; Southern Shan State, Loimwe; Southern Shan State, [Siam Road]; Southern Shan State, Siam frontier; Karen Hills, [Chotaik]; Toungoo; Bassein; Papun, Methalauk Chaung; foot of Dawna Range; Rangoon, Kokine Lakes; Tavoy Valley; Pegu Hills; Ataran Valley, [Kyerkdon-Mitan], Tenasserim. **Thailand** (Siam): Pak Jong; Mae Wong, 99°07'E 15°55'N; Phrae District, [Me Tharn]; Mae Sariang; Hin Lap; [Muok-Lek]; [Pang Yao], 20 m. W. of Tak [Raheng]. **Vietnam:** Central Tongking, Chiem Hoa; [Nam-Hou (Black River)]; [Ko-Tich]; Van Bu; Cha Pa. 191 ♂, 63 ♀.

TYPE-MATERIAL. *Charaxes arja* Felder & Felder was described from an unspecified number of specimens from Assam. Two males in the BMNH represent the type-series and bear the following labels; 'FELDER COLL<sup>N</sup> / Rothschild Bequest B.N. 1939-1.'. In addition, one male bears the following labels; 'Lectotype (purple) / India sept. Silhet type / TYPE / Charaxes arja Felder & Felder LECTOTYPE det R. L. Smiles 1979', and is hereby designated lectotype. The remaining male bears the additional labels; 'Paralectotype (blue) / India septent Assam / Charaxes arja Felder & Felder PARALECTOTYPE det. R. L. Smiles 1979'.

*Eulepis arja* f. temp. *vernus* Rothschild is represented in the BMNH by one male holotype which bears the following labels; 'Holotype (red) / SIKKIM 23.3 1888 O. MØLLER / Rothschild Bequest B.M. 1939-1. / Eulepis arja f. temp. vernus Rothschild HOLOTYPE det. R. L. Smiles 1977'.

BIONOMICS. There are records in the BMNH for capture throughout the year at altitudes up to 1800 m. Duckworth, Watson & Whalley (1975: 267) observe 'This is a common butterfly over much of its range flying rapidly round in the thickest jungle, feeding on rotten fruit, plant sap, but not usually found at flowers.'

### *Polyura hebe* (Butler)

(Figs 37-39, 53-55, 118-126, Map 2)

*Charaxes hebe* Butler, 1866: 634, pl. 37, fig. 3.

*Nymphalis hebe* (Butler) Kirby, 1871: 271.

*Eulepis hebe* (Butler) Moore, [1896]: 263; Rothschild & Jordan, 1899: 299, p. 7, figs 1-3.

*Eriboea hebe* (Butler) Fruhstorfer, 1914: 721.

*Polyura hebe* (Butler) Stichel, 1939: 568; Boonsong, Askins, Nabhitabhata & Samruadkit, 1977: 140, pl. 68, fig. 342.

MALE, FEMALE. *Upperside*. Forewing apex, outer and costal margins black, with a pale, greenish yellow postdiscal spot in cell  $M_1$ . The rest of the wing covered by a discal patch, also pale greenish yellow, but greener than in *P. jalyus*. Hindwing in many cases almost completely pale greenish yellow except for a black outer margin and black submarginal, white pupilled ocelli, which may join to form a black submarginal band. The distal edge of the pale patch is often glaucous, and the admarginals are sometimes yellowish orange. Tails often blue-centred. *Underside*. Ground colour pale brown, sometimes a darker, pinkish brown. Forewing outer margin olive-brown. Submarginal spots are well delineated chevrons. A pale green discal band is surrounded by a red-brown, arcuate band which incorporates the umbra distally and, unlike *P. jalyus*, surrounds the pale green subapical spot. Towards the wing base this band is delineated by MI and MII, DI being present at the end of the discal cell, and DII as one or two minute black dots towards the base of the discal cell. Hindwing with margins olive-brown or black, admarginals suppressed or, if present, pale yellow-orange. A complete double row of black (distal) and white (proximal) submarginal spots is present; double spots in cell  $Cu_{1b}$ . Postdiscal lunules complete, displaced proximally from cells  $R_1$  to  $M_1$ , and smallest in cell  $M_1$ . In cell  $R_1$  and from cell  $M_2$  to the tornus, the lunules are outlined distally with

black, In cells  $M_3$ ,  $Cu_{1a}$  and exceptionally other cells, the lunules are bordered proximally with white. A thin black line divides them from a proximal red-brown band, which skirts the outer margin of a pale green discal band. This band begins on the costal margin and tapers to end in a point on vein  $Cu_{1b}$ , after running along it for about half its length. It is much narrower at the costal margin than the discal patch of the upperside, cf. *P. moori* which is only a little less wide. Like the forewing, the discal band is bordered proximally by a red-brown band, delineated by MI and MII.

Abdomen buff-brown, pleura often paler.

RANGE. From southern Burma through Western Malaysia, Singapore, the islands of Sumatra, Simeulue, Sipora, Nias, Borneo, Java, Bawean, Bali, Kangean and Lombok, to Sumba.

*Polyura hebe hebe* (Butler)

(Figs 37, 53, 118)

*Charaxes hebe* Butler, 1866: 634, pl. 37, fig. 3. LECTOTYPE ♀, SUMATRA (BMNH), here designated [examined].

*Charaxes albanus* Röber, 1895: 66. Holotype ♂, SUMATRA (BMNH) [examined].

*Eulepis hebe* (Butler) Rothschild & Jordan, 1898: pl. 12, fig. 10.

*Eulepis hebe hebe* (Butler); Rothschild & Jordan, 1899: 233.

*Eriboea hebe hebe* (Butler) Fruhstorfer, 1914: 721, pl. 134b.

*Polyura hebe* (Butler) Stichel, 1939: 568.

MALE, FEMALE. *Upperside*. Similar to *P. h. chersonesus* but with the pale areas, if anything, more extensive. The subapical spot of the forewing is normally larger. *Underside*. As in *P. h. chersonesus*.

The taxon *albanus* Röber is a very light form of this subspecies in which almost the entire upperside of the hindwing is covered by the disco-basal patch.

SIZE. ♂;  $\bar{x} = 35.8$ ,  $s = 1.5$  (40 specimens). ♀; 6 specimens only, 37.2, 37.8, 39.0, 39.6, 39.9, 40.0.

DISTRIBUTION. **Sumatra**: [Kröe, Res. Benkoelen]; Tebing Tinggi; South Kerintji Valley; [Kand<sup>g</sup> Ampat, Pad. Beneden]; Padang; Marang; Padangsidempuan; Palembang distr.; [Selesseh]; Gajo Mts [Gayoe Mts]; [Bekantschen]; [Setinjak]; Sibolga; Propoe nr Padang [Bng. proepoe, Pad. Bovenland]; Deli; Barisan Range, Lubuk Linggau nr Lahat; Lebongtandai. 71 ♂, 6 ♀.

TYPE-MATERIAL. *Charaxes hebe* Butler was described from an unspecified number of specimens from Sumatra. In the BMNH there is a female which bears the following labels; 'Lectotype (purple) / Sumatra. 64.64. / Charaxes hebe ♀ type Butler. / B.M. TYPE No. Rh. 10437. Charaxes hebe, ♀ Butl. / Charaxes hebe Butler LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype.

*Charaxes albanus* Röber was described from a single male specimen which is now in the BMNH, and which bears the following labels; 'Holotype (red) / Sumatra Deli ex coll. Fruhstorfer / Fruhstorfer coll. B.M. 1937-285 / Type / Albanus Rüb. spec. typ. / Charaxes albanus Röber HOLOTYPE det. R. L. Smiles 1976'.

BIONOMICS. There are records in the BMNH for all months of the year at altitudes between 490 and 1500 m.

*Polyura hebe chersonesus* (Fruhstorfer)

(Fig. 119)

*Charaxes hebe* Butler; Distant, 1883: 107, pl. 15, fig. 2 [in part].

*Charaxes attalus chersonesus* Fruhstorfer, 1898: 55. LECTOTYPE ♂, [WEST MALAYSIA] (BMNH), here designated [examined].

*Eulepis attalus chersonesus* (Fruhstorfer) Fruhstorfer, 1898: 56.

*Eulepis hebe chersonesus* (Fruhstorfer); Rothschild & Jordan, 1899: 231, pl. 7, fig. 1.

*Eriboea hebe chersonesus* (Fruhstorfer) Fruhstorfer, 1914: 721; Evans, 1924: 895; 1927: 93; Corbet & Pendlebury, 1934: 178, pl. 12, fig. 156.

*Polyura hebe chersonesus* (Fruhstorfer) Stichel, 1939: 569; Corbet & Pendlebury, 1956: 246; Fleming, 1975: 53, pl. 53, fig. N142A; Pinratana, 1979: 99, fig. N169.

MALE, FEMALE. *Upperside*. Disco-basal patches extended, that of the hindwing extending along the veins to the admarginals. Forewing band often extending diffusely into the discal cell. *Underside*. Ground colour light brown. Discal band of hindwing between costal margin and vein  $M_3$  concave.

SIZE. ♂;  $\bar{x} = 34.7$ ,  $s = 1.8$  (40 specimens). ♀; 6 specimens only, 35.2, 36.9, 37.1, 37.2, 38.1, 38.3.

DISTRIBUTION. **Burma**: Mergui, Lenya Valley; Victoria Point. **Thailand**: Ranong. **West Malaysia**. Perak: Kinta; Gopeng; Pahang Rd; Taiping; Kuala Kangsar; Batang Padang. [Gunong Ijau]; [Camp Joor, watershed betw. Perak and Pahang]. Selangore: Klang. Pahang: Mt Tahan. 42 ♂, 6 ♀.

TYPE-MATERIAL. Fruhstorfer listed two males from 'Singapore, Perak' as the types of this taxon, but then went on to describe the female. For this reason the type-series cannot be composed of two males only. As regards the type-locality, Rothschild & Jordan (1899: 231) state that Fruhstorfer obtained the specimens from the Museum at Singapore and labelled them 'ex Museo Singapore'. It is extremely unlikely that this locality is correct as *P. h. plautus* is found there. In the BMNH are a male and a female which I believe represent the type-series. They both bear the following labels; 'Fruhstorfer Coll. B.M. 1937-285 / Type'. In addition, the male bears the following labels; 'Lectotype (purple) / E. Museo Singapore H. Fruhstorfer. / Charaxes attalus chersonesus Fruhstorfer LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype. The female bears the additional labels; 'Paralectotype (blue) / Singapore Fruhstorfer / Charaxes attalus chersonesus Fruhstorfer PARALECTOTYPE det. R. L. Smiles 1978'.

BIONOMICS. In the BMNH there are records for January, March, May, June and November.

### *Polyura hebe plautus* (Fruhstorfer)

(Fig. 120)

*Charaxes [attalus] plautus* Fruhstorfer, 1898: 54. LECTOTYPE ♂, SINGAPORE (BMNH), here designated [examined].

*Eulepis attalus plautus* (Fruhstorfer) Fruhstorfer, 1898: 56.

*Eulepis hebe plautus* (Fruhstorfer); Rothschild & Jordan, 1898: pl. 12, fig. 9; 1899: 232.

*Eriboea [hebe] falculus* Fruhstorfer, 1914: pl. 137a. Holotype (? sex), no locality (untraced).

*Eriboea hebe plautus* (Fruhstorfer) Fruhstorfer, 1914: 721, pl. 134b.

*Eriboea hebe falculus* Fruhstorfer; Fruhstorfer, 1914: 721.

*Polyura hebe plautus* (Fruhstorfer) Stichel, 1939: 569; Corbet & Pendelbury, 1956: 246.

*Polyura hebe falculus* (Fruhstorfer) Stichel, 1939: 569.

MALE, FEMALE. *Upperside*. Forewing with discal band restricted, not normally entering discal cell and with a straighter, less diffuse outer margin than in any subspecies except *fallax*, *nikias*, *kangeana*, *lombokiana*, *baweanica* and *arnoldi*. Hindwing band also restricted, covering about two-thirds of the wing—less than in any other subspecies. Admarginals largely suppressed. *Underside*. Ground colour light brown. Discal band of hindwing between costal margin and vein  $M_3$  straight or only slightly concave.

The name *falculus* Fruhstorfer was mistakenly applied to a figure (Fruhstorfer, 1914: pl. 137a) and was later published in the text of the same work as a synonym of *plautus*.

SIZE. ♂;  $\bar{x} = 34.7$ ,  $s = 1.7$  (12 specimens). ♀; 5 specimens only, 35.7, 36.9, 38.6, 33.9, 38.4.

DISTRIBUTION. **Singapore**: Serangoon. 12 ♂, 5 ♀.

TYPE-MATERIAL. *Charaxes [attalus] plautus* Fruhstorfer was described from an unspecified number of specimens from Singapore. The type-series is represented by the BMNH by seven males and four females. One male bears the following labels; 'Lectotype (purple) / Singapore Fruhstorfer / Type / Fruhstorfer Coll. B.M. 1937-285. / Charaxes [attalus] plautus Fruh. LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype. The remaining paralectotypes all bear the labels; 'Paralectotype (blue) / Charaxes [attalus] plautus Fruh. PARALECTOTYPE det. R. L. Smiles 1978': in addition, one male and one female bear the labels; 'Singapore H. Fruhstorfer / Fruhstorfer Coll. B.M. 1937-285.', one male and two females; 'Singapore Fruhstorfer / Type / Fruhstorfer Coll. B.M. 1937-285.', four males; 'Singapore Fruhstorfer / Type / Rothschild Bequest B.M. 1939-1.', and one female; 'E. Museo Singapore H. Fruhstorfer / Type / Fruhstorfer Coll. B.M. 1937-285.'.

*Eriboea* [*hebe*] *falculus* Fruhstorfer was a name introduced in error as a figure legend. The holotype must therefore be the illustrated specimen. However, none of those specimens from the Fruhstorfer collection in the BMNH correspond sufficiently with the figure to be considered, and as yet the specimen remains untraced.

**BIONOMICS.** There are records in the BMNH for March, April and July.

**EARLY STAGES.** The full-grown larva is dark green with a pale yellow lateral line, particularly noticeable towards the tail. The head is green with two lighter green bands, each running from the dorso-lateral horns to the mouth. The four horns are curved and backward pointing. On each segment there is a mottled, pale green crescent, with the points forward pointing and yellow (Fountaine, *in litt.*).

The pupa is green with ragged-edged white bands on the wing-cases, and white bands running down the abdomen to the caudal extremity, which is brown (Fountaine, *in litt.*).

**Foodplant:** *Adenantha pavonina* (Leguminosae) (Fountaine, *in litt.*).

### *Polyura hebe clavata* (van Eecke)

*Eriboea hebe clavata* van Eecke, 1918: 92, pl. 8, fig. 14. LECTOTYPE ♂, LASIA (RNH, Leiden), here designated [examined].

*Polyura hebe clavata* (van Eecke) Stichel, 1939: 571.

**MALE.** *Upperside.* Similar to *P. h. plautus*, but pale areas not so extensive as in that subspecies. Hindwing with disco-basal patch having the outer edge less indented, more glaucous. Submarginal spots larger. *Underside.* Similar to *P. h. plautus*, discal band of hindwing between costal margin and vein  $M_3$  slightly concave.

**SIZE.** 2 specimens only, 35·1, 35·4.

**DISTRIBUTION.** **Lasia** [Pulu Lasiak] (nr Simeulue, Indonesia). 2 ♂.

**TYPE-MATERIAL.** Described from two males, now in the RNH, Leiden, which both bear the label; 'Eriboea hebe clavata v. E. type ♂'. One male also bears the following labels; 'Lectotype (purple) / E. Jacobson Pulu Lasiak Sum. Jan. 1916 / 3 60 / Eriboea hebe clavata van Eecke LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype. The other male bears the additional labels; 'Paralectotype (blue) / E. Jacobson Pulu. Lasiak leg. G. Uarmsen [?] Sun. Jan. 1916 / 3 61 / Eriboea hebe clavata van Eecke PARALECTOTYPE det. R. L. Smiles 1979'.

**BIONOMICS.** Has been taken during January according to the specimens from the RNH, Leiden, otherwise nothing else known.

### *Polyura hebe quaesita* Corbet

(Figs 39, 55)

*Polyura hebe quaesita* Corbet, 1942: 625. Holotype ♂, SIPORA (BMNH) [examined].

**MALE.** *Upperside.* Forewing similar to *P. h. plautus*, discal band slightly more restricted. Hindwing with disco-basal patch rather more extensive, distal edge more clearly dentate than even *P. h. clavata*, more glaucous than in *P. h. plautus*. *Underside.* Ground colour paler than that of *P. h. plautus*, area distal to the postdiscal spots of the hindwing olive-green. Discal band of the hindwing between costal margin and vein  $M_3$  slightly concave.

**SIZE.** 1 specimen only, 34·0.

**DISTRIBUTION.** **Sipora I.** (south-west of Sumatra). 1 ♂.

**TYPE-MATERIAL.** Described from a single male. This holotype is now in the BMNH and bears the following labels; 'Holotype (red) / Sipora I., W. of Sumatra, October 1924 (C. B. K. & N. S.) / B.M. TYPE No. Rh. 15038 Polyura hebe quaesita Cbt. ♂ Holotype. / Brit. Mus. 1942-21. / Polyura hebe quaesita Corbet HOLOTYPE det. R. L. Smiles 1975'.

**BIONOMICS.** Apart from the data on the type-specimen, I know of no other information regarding this subspecies.

*Polyura hebe fallacides* (Fruhstorfer)

(Fig. 121)

*Charaxes fallacides* Fruhstorfer, 1895a: 170. Holotype ♂, NIAS (BMNH) [examined].*Charaxes hebe fallacides* Fruhstorfer; Fruhstorfer, 1898: 55.*Eulepis attalus fallacides* (Fruhstorfer) Fruhstorfer, 1898: 56.*Eulepis hebe* (Butler); Rothschild & Jordan, 1898: pl. 12, fig. 8.*Eulepis hebe fallacides* (Fruhstorfer); Rothschild & Jordan, 1899: 234.*Eriboea hebe fallacides* (Fruhstorfer) Fruhstorfer, 1914: 721, pl. 134b.*Polyura hebe fallacides* (Fruhstorfer) Stichel, 1939: 570.

MALE, FEMALE. *Upperside*. Forewing as in *P. h. chersonesus* but with less pale scaling overlying the discal cell. Hindwing with the edge of the disco-basal patch in the male, distinctly blue, and this extending along the veins to the admarginals. *Underside*. Ground colour pale brown. Hindwing discal band with outer edge slightly concave between the costal margin and vein  $M_3$ .

FEMALE. *Upperside*. Subapical spot of forewing much larger than in male. Hindwing with distal edge of disco-basal patch less glaucous, less well-defined and more extensive than in male.

SIZE. ♂;  $\bar{x}$  = 34.0,  $s$  = 1.1 (29 specimens); ♀; 1 specimen only, 37.1.

DISTRIBUTION. **Nias**: Gunungsitoli; [Kalim Bungo]; Lahagu; [Dyama]; [Parea, S. Bona]. 29 ♂, 1 ♀.

TYPE-MATERIAL. Described from a single specimen. This male holotype is now in the BMNH and bears the following labels; 'Holotype (red) / Nias ex coll. Fruhstorfer / Type / Fruhstorfer Coll. B.M. 1937-285. / *Charaxes fallacides* Fruhstorfer, HOLOTYPE det. R. L. Smiles 1975'.

BIONOMICS. There are records in the BMNH for February-March, March, March-May, and September.

*Polyura hebe ganymedes* (Staudinger)

(Fig. 122)

*Charaxes ganymedes* Staudinger, 1886: 173; Fruhstorfer, 1898: 54. Syntype(s) (? sex), BORNEO (MNHU, Berlin) [not examined].*Eulepis ganymedes* (Staudinger) Moore, [1896]: 263.*Eulepis attalus ganymedes* (Staudinger); Fruhstorfer, 1898: 55.*Eulepis hebe ganymedes* (Staudinger); Rothschild & Jordan, 1899: 232, pl. 7, fig. 2.*Eriboea hebe ganymedes* (Staudinger) Fruhstorfer, 1914: 721.*Polyura hebe ganymedes* (Staudinger) Stichel, 1939: 569.

MALE. *Upperside*. Forewing discal band with outer margin more diffuse than in other subspecies, and produced along veins  $Cu_{1b}$  and 2A almost to the outer margin. Hindwing with outer margin of disco-basal patch highly dentate, glaucous, and often extending along the veins to the admarginals towards the anal angle. *Underside*. Ground colour brown. Outer margin of discal band from costal margin to vein  $M_3$  highly concave.

FEMALE. Differs in its larger size, in the proportionately larger subapical spot of the forewing, and in the straighter outer margin of the forewing.

SIZE. ♂;  $\bar{x}$  = 37.1,  $s$  = 1.7 (32 specimens). ♀; 4 specimens only, 42.7, 40.3, 41.4, 36.9.

DISTRIBUTION. **Sarawak**: Kuching; Bidi; Mt Mulu; Limbang R. **Sabah**: Mt Kinabalu; [Mt Marapok, Dent. Province]; Lawas; Sandakan. **Kalimantan**: Pontianak. 32 ♂, 4 ♀.

BIONOMICS. There are records in the BMNH for January, April, August, August-December, and December-February, at altitudes between 300 and 1200 m.

*Polyura hebe fallax* (Röber)

(Fig. 123)

*Charaxes fallax* Röber, 1894: 290, 291, 293. Syntype(s) (? sex), JAVA (MNHU, Berlin) [not examined].*Eulepis smerdis* Moore, [1896]: 263. [Nomen nudum.]

*Eulepis hebe* (Butler); Rothschild & Jordan, 1898: pl. 12, fig. 12.

*Eulepis hebe fallax* (Röber) Rothschild & Jordan, 1899: 235.

*Eriboea hebe fallax* (Röber) Fruhstorfer, 1914: 721; Roepke, 1932: 96, fig. 167.

*Charaxes hebe fallax* Röber Roepke, 1938: 350, fig. 52, pl. 35, fig. 10, pl. 36, fig. 7.

*Polyura hebe fallax* (Röber) Stichel, 1939: 570.

MALE, FEMALE. *Upperside*. Forewing discal band outer margin slightly curved, not produced along veins, not glaucous—similar to *P. h. nikias*, *kangeana*, *lombokiana*, *baweanica* and *arnoldi*. Hindwing disco-basal patch with outer margin only slightly diffuse, barely dentate. Dark submarginal band broad, admarginals largely suppressed, but blue centres to tails present. *Underside*. Ground colour light brown, forewing subapical spot large. Hindwing with outer margin of discal band from costal margin to vein  $M_3$  only slightly concave.

SIZE. ♂;  $\bar{x}$  = 34.8,  $s$  = 1.2 (40 specimens). ♀;  $\bar{x}$  = 38.0,  $s$  = 1.4 (8 specimens).

DISTRIBUTION. **Java**: Sukabumi; Pelabuhan Ratu; [Palabuan]; Mt Gede; Prov. Pasuruan, [Kallpari]; Bogor; Lawang. 84 ♂, 10 ♀.

BIONOMICS. There are records in the BMNH for February, February and March, and July–August at altitudes up to 1500 m. Fruhstorfer (1914: 721) notes ‘The butterflies are met in wet places near crossings of rivers’.

EARLY STAGES. Two foodplants have been noted: *Adenanthera pavonina* and *Albizia falcata* (Leguminosae) (Roepke, 1938: 350).

### *Polyura hebe nikias* (Fruhstorfer)

(Fig. 124)

*Charaxes (Eulepis) hebe* Butler; de Nicéville & Elwes, 1898: 692.

*Eulepis hebe* (Butler); Rothschild & Jordan, 1898: pl. 12, fig. 11; Fruhstorfer, 1906: 179.

*Eulepis hebe fallax* (Röber); Rothschild & Jordan, 1899: 235 [in part].

*Eriboea hebe nikias* Fruhstorfer, 1914: 721. Syntype(s) (? sex), BALI (probably in MNHU, Berlin (Staudinger coll.), or ZSBS, Munich (Martin coll.)) [not examined].

*Polyura hebe nikias* (Fruhstorfer) Stichel, 1939: 571.

MALE. *Upperside*. Similar to *P. h. fallax*, but discal bands more restricted. Hindwing admarginals suppressed, as are blue centres of tails (cf. *P. h. fallax*). *Underside*. Ground colour brown; hindwing discal band outer margin only slightly concave from costal margin to vein  $M_3$ .

SIZE. ♂;  $\bar{x}$  = 32.5,  $s$  = 0.7 (7 specimens).

DISTRIBUTION. **Bali**. 7 ♂.

BIONOMICS. In the BMNH there are records for capture during March and April, in low country and at altitudes between 600 and 1200 m. Fruhstorfer (1914: 721) describes it as very rare.

### *Polyura hebe kangeana* (Fruhstorfer)

(Fig. 125)

*Eulepis hebe kangeanus* Fruhstorfer, 1903: 94. LECTOTYPE ♂, KANGEAN IS. (BMNH), here designated [examined].

*Eriboea hebe kangeanus* (Fruhstorfer) Fruhstorfer, 1914: 721.

*Polyura hebe kangeanus* (Fruhstorfer) Stichel, 1939: 571.

MALE. *Upperside*. Forewing similar to *P. h. fallax*; subapical spot larger than in *P. h. nikias* or *lombokiana*. Hindwing with outer margin of disco-basal patch more extensive than in *P. h. fallax*, *nikias*, *lombokiana*, or *plautus*, extending along veins to form a dentate margin. Admarginals only partly suppressed, blue or orange. Blue centres present in tails. *Underside*. Ground colour light brown. Hindwing discal band outer margin slightly concave between costal margin and vein  $M_3$ .

SIZE. ♂;  $\bar{x}$  = 33.3,  $s$  = 0.6 (7 specimens).

DISTRIBUTION. **Kangean Is.** 7 ♂.

**TYPE-MATERIAL.** According to the original description, Fruhstorfer had four males; however, six males in the BMNH bear an identical, partly handwritten label; 'Kangean Fruhstorfer'. As Fruhstorfer collected in this area only between 1895 and 1896, and the description was not published until 1903, these six specimens must all be included in the type-series. In addition to the above label, one male bears the following; 'Lectotype (purple) / hebe kangeanus Fruhst. [Fruhstorfer's handwriting] / Fruhstorfer Coll. B.M. 1937-285. / Eulepis hebe kangeanus Fruhstorfer LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype. All the remaining specimens bear the labels; 'Paralectotype (blue) / Eulepis hebe kangeanus Fruhstorfer PARALECTOTYPE det. R. L. Smiles 1979'. In addition four males bear the following; 'Fruhstorfer Coll. B.M. 1937-285.', and one of these an extra label; 'Type'. The remaining male bears the additional label; 'Rothschild Bequest B.M. 1939-1'.

**BIONOMICS.** In the BMNH there is a record for August-September, otherwise nothing is known.

*Polyura hebe lombokiana* (Fruhstorfer)

(Figs 38, 54)

*Charaxes attalus lombokianus* Fruhstorfer, 1898: 56. LECTOTYPE ♂, LOMBOK (BMNH), here designated [examined].

*Eulepis attalus lombokianus* (Fruhstorfer) Fruhstorfer, 1898: 56.

*Eulepis hebe lombokianus* (Fruhstorfer); Rothschild & Jordan, 1899: 236, pl. 7, fig. 3.

*Eriboea hebe lombokianus* (Fruhstorfer) Fruhstorfer, 1914: 721.

*Polyura hebe lombokianus* (Fruhstorfer) Stichel, 1939: 571.

**MALE.** *Upperside.* Forewing similar to *P. h. nikias*. Hindwing with outer margin of disco-basal patch extending as far as in *P. h. fallax*, but glaucous. Admarginals a subdued orange; tails blue-centred. *Underside.* Ground colour brown, but with a rather more rufous cast than is the case in *P. h. nikias*, *kangeana* or *baweanica*. Outer margin of discal band between costal margin and vein  $M_3$  slightly concave.

**SIZE.** ♂;  $\bar{x}$  = 34.2,  $s$  = 0.8 (7 specimens).

**DISTRIBUTION.** **Lombok:** Sapit; Pringabaja; Sewela. 7 ♂.

**TYPE-MATERIAL.** Described from an unspecified number of specimens which are now represented in the BMNH by five males. Of these, one male bears the following labels; 'Lectotype (purple) / Lombok Sapit 2000' Mai-Juni 1896 H. Fruhstorfer. / Type / Fruhstorfer Coll. B.M. 1937-285. / Charaxes attalus lombokianus Fruh. LECTOTYPE det. R. L. Smiles 1979', and is here designated lectotype. The remaining four males all bear the following labels; 'Paralectotype (blue) / Charaxes attalus lombokianus Fruh. PARALECTOTYPE det. R. L. Smiles 1979'. In addition these butterflies bear the following labels: one male; 'Lombok Sapit 2000' Mai-Juni 1896 H. Fruhstorfer / Rothschild Bequest B.M. 1939-1', one male; 'Lombok Sapit 2000' April 1896 H. Fruhstorfer. / Type / Rothschild Bequest B.M. 1939-1', one male; 'Lombok Sapit 2000' Mai-Juni 1896 H. Fruhstorfer. / Type / Fruhstorfer Coll. B.M. 1937-285.', and one male; 'Lombok Pringabaja April 1896 H. Fruhstorfer. / Rothschild Bequest B.M. 1939-1'.

**BIONOMICS.** There are records in the BMNH for April, May-June, and June at 600 m. Fruhstorfer (1914: 721) states that the butterfly is found up to 800 m.

*Polyura hebe baweanica* (Fruhstorfer)

(Fig. 126)

*Eulepis hebe baweanicus* Fruhstorfer, 1906: 179. Holotype ♂, BAWEAN (BMNH) [examined].

*Eriboea hebe baweanicus* (Fruhstorfer) Fruhstorfer, 1914: 721.

*Polyura hebe baweanicus* (Fruhstorfer) Stichel, 1939: 571.

**MALE.** *Upperside.* As in *P. h. kangeana*, but subapical spot larger. In the specimen available for study, the outer margins of the hindwings are badly damaged, so differences here may occur. *Underside.* Ground colour pale brown, paler than in *P. h. kangeana*, black markings rather fine. Hindwing outer margin of discal band almost straight, only very slightly concave between the costal margin and vein  $M_3$ .

SIZE. ♂; 1 specimen only, 32.8.

DISTRIBUTION. **Bawean**. 1 ♂.

TYPE-MATERIAL. Described from a single specimen now in the BMNH. This male holotype bears the following labels; 'Holotype (red) / Bawean Juli–Sept. Fruhstorfer / Type / Fruhstorfer Coll. B.M. 1937–285. / *Eulepis hebe baweanicus* Fruh. HOLOTYPE det. R. L. Smiles 1975'.

BIONOMICS. I have no information other than that with the holotype.

*Polyura hebe arnoldi* (Rothschild)

*Eulepis hebe arnoldi* Rothschild, 1899: 236. Holotype ♂, SUMBA (probably in Landesmuseum für Naturkunde, Wiesbaden) [not examined].

*Eriboea hebe arnoldi* (Rothschild) Fruhstorfer, 1914: 721.

*Polyura hebe arnoldi* (Rothschild) Stichel, 1939: 571.

MALE. *Upperside*. According to Rothschild's description, the light areas of the forewing are as in *P. h. fallax*, but are more extensive in the hindwing than in that subspecies. *Underside*. As in *P. h. fallax*, except for the discal band of the hindwing which is broader. DII of the forewing forms two black spots instead of one.

DISTRIBUTION. **Sumba**.

TYPE-MATERIAL. Described from a single male specimen from Pagenstecher's collection, now presumably in the depository shown above.

*Polyura moori* (Distant)

(Figs 40, 41, 56, 57, 149–153, Map 2)

*Charaxes moori* Distant, 1883: 108, pl. 13, fig. 3.

*Eulepis moori* (Distant) Moore, [1896]: 260, pl. 187, figs 2, 2a; Rothschild & Jordan, 1898: pl. 12, figs. 3–7; 1899: 237; Bingham, 1905: 224.

*Eriboea moori* (Distant) Fruhstorfer, 1914: 720, pl. 134b.

*Polyura moori* (Distant) Stichel, 1939: 565; Lewis, 1974: 271, pl. 150, fig. 5; Smart, 1976: 219, fig. 24.

MALE, FEMALE. *Upperside*. Forewing apex, outer and costal margins black, with a pale, greenish yellow postdiscal spot in cell  $M_1$ . The rest of the wing covered with a discal patch or band of similar colour. Hindwing with admarginals normally suppressed in cells  $R_1$ ,  $M_3$  and  $Cu_{1a}$ . In the darkest individuals, a black submarginal strip separates the admarginals from the greenish yellow, disco-basal patch. Towards the outer edge of this strip lie a row of white spots—one in each cell. In the lightest examples, however, this black strip is restricted to form small, black, circular patches around each white spot except at the wing apex in cells  $R_1$  and  $R_5$ , where it forms a larger patch (*cf. P. hebe*). *Underside*. Ground colour pale brown with a pinkish cast. Outer margins of forewing a darker brown, sometimes olivaceous. Submarginal spots are well-delineated chevrons. As in *P. hebe*, a pale green discal band is surrounded by a red-brown, arcuate band which incorporates the umbra distally and surrounds, in a majority of cases, the subapical, green spot (*cf. P. jalysus*). This band is delineated towards the wing base by MI and MII; DI being present at the end of the discal cell. DII is apparent as a small dot lying close to, or incorporated with, MII in the discal cell. Hindwing admarginals yellow. A complete double row of black (distal) and white (proximal) submarginal spots present; double spots in cell  $Cu_{1b}$ . Postdiscal lunules as in *P. hebe*. Discal band pale green, running from costal margin and tapering to end in a small, yellow-orange patch just beyond vein  $Cu_{1b}$ . It is only slightly less wide at the costal margin than the discal patch of the upperside, unlike *P. hebe*. As in the forewing, the discal band is bordered proximally by a red-brown band, delineated by MI and MII.

Abdomen above buff or off-white, pleura off-white, buff or brown beneath.

RANGE. From Sikkim, Assam, Nagaland through Burma, Western Malaysia and Singapore, to Sumatra, Nias, Java, Bali, Borneo and Natuna Is.

*Polyura moori moori* (Distant)

(Figs 40, 56, 150)

*Charaxes moori* Distant, 1883: 108, pl. 13, fig. 3; de Nicéville & Martin, 1896: 436. Holotype (? sex), WEST MALAYSIA [untraced].



*Eulepis moori* (Distant) Rothschild & Jordan, 1898: pl. 12, figs 4, 6.

*Eulepis moori moori* (Distant); Rothschild & Jordan, 1899: 239 [in part].

*Eriboea moori moori* (Distant) Fruhstorfer, 1914: 720, pl. 134b; Corbet & Pendlebury, 1934: 178.

*Polyura moori moori* (Distant) Stichel, 1939: 565; Corbet & Pendlebury, 1956: 246; 1978: 213; Pinratana, 1979: 98, fig. N168.

**MALE.** *Upperside.* Forewing subapical spot smaller than in *P. m. sandakana*. Discal band extended slightly along veins  $Cu_{1b}$  and 2A, but less than in *P. m. kaba*. Hindwing black area at apex smaller than in *P. m. saida*. Glaucoan outer margin of disco-basal patch extends along veins  $M_1$ ,  $M_2$  and  $Cu_{1b}$  to join admarginals, often along  $M_3$ , and sometimes along  $Cu_{1a}$ . *Underside.* Ground colour pinkish brown.

**FEMALE.** *Upperside.* Pale areas extended. *Underside.* Ground colour paler than in male.

**SIZE.** ♂;  $\bar{x}$  = 35.6,  $s$  = 1.2 (40 specimens). ♀; 4 specimens only, 39.3, 39.8, 35.5, 40.4.

**DISTRIBUTION.** **Western Malaysia** (Malaka): Perak; [Camp Joor, watershed betw. Perak and Pahang]. **Singapore.** **Sumatra:** Solok; Batak Mts; Padangsidempuan; Gajo Mts; Padang; Deli; Lebongtandai; [Be-kantschan]; Upper Palembang District; [Setinjak]; Gunung Talang, nr Padang [Gng. Talang, Pad. Bovenland]; Propoe, nr Padang [Bng. Proepoe, Pad. Bovenland]; Marang. 62♂, 4♀.

**TYPE-MATERIAL.** The holotype from 'Malay Peninsula, Province Wellesley', should have gone to the Tring museum with the rest of Distant's collection, which would mean that it would now be expected to be in the BMNH. Unfortunately I have been unable to trace this specimen.

**BIONOMICS.** In the BMNH there are records for January, February, March, January–April, May, May–August, September, and September–December at 500 m. De Nicéville & Martin (1896: 436) state that this butterfly occurs at 'lower elevations'.

### *Polyura moori sandakana* (Fruhstorfer)

(Fig. 151)

*Charaxes sandakanus* Fruhstorfer, 1895b: 197. Holotype ♂, [INDIA: Assam] (BMNH) [examined].

*Eulepis attalus sandakanus* (Fruhstorfer) Fruhstorfer, 1898: 56.

*Eulepis moori* (Distant); Rothschild & Jordan, 1898: pl. 12, fig. 3.

*Eulepis moori sandakanus* (Fruhstorfer); Rothschild & Jordan, 1899: 242, pl. 7, figs 4, 5.

*Eulepis moori sandakanus* f. *marginalis* Rothschild, 1899: 242. Holotype ♂, INDIA: Naga Hills (BMNH) [examined].

*Eriboea moori sandakanus* (Fruhstorfer) Fruhstorfer, 1914: 720; Evans, 1924: 895; 1927: 93.

*Eriboea moori sandakanus* w.s.f. *marginalis* (Rothschild) Fruhstorfer, 1914: 720.

*Polyura moori sandakanus* (Fruhstorfer) Stichel, 1939: 566.

*Polyura moori sandakanus* f. *marginalis* (Rothschild) Stichel, 1939: 566.

**MALE.** *Upperside.* Forewing with subapical spot larger than in any other subspecies. Discal band as in *P. m. moori*. There are two forms: in one of these the hindwing is similar to *P. m. moori* but with pale areas slightly more extensive (f. *sandakana*). In the other there is a continuous black strip distal to the pale discal band and the submarginal white spots are very much smaller (f. *marginalis*). *Underside.* Ground colour light pinkish brown, often slightly lighter than in other subspecies.

**FEMALE.** Larger with pale areas more extensive than in both the male forms.

The females in the BMNH are the same in this respect and most closely resemble f. *sandakana*, although Rothschild (1899: 243) does mention a female f. *marginalis* in Staudinger's collection. Four males in the BMNH can be included in f. *sandakana* but the great majority are f. *marginalis*.

**SIZE.** ♂; 4 specimens only, 35.0, 36.0, 36.0, 36.7.

**DISTRIBUTION.** **North India:** Sikkim; Assam, Dafla Hills; Assam, Garo Hills; Assam, Khasi Hills; Nagaland, Naga Hills, Nichuguard. **Burma:** Ataran Valley; [Dansin Valley]; Moulmein; Victoria Point. 19♂, 3♀.

**TYPE-MATERIAL.** *Charaxes sandakanus* Fruhstorfer was described from 'Nord Borneo', but in fact Fruhstorfer subsequently corrected this (1914: 720), stating that specimens from Assam had been sold to him as coming from Borneo. The holotype is in the BMNH and bears the following

labels; 'Holotype (red) / Nordborneo Alverett ex coll. Fruhstorfer. / Type / Charaxes sandakanus Fruhstorfer HOLOTYPE det. R. L. Smiles 1975'.

*Eulepis moori sandakanus f. marginalis* Rothschild. The male holotype and two male paratypes are now in the BMNH and bear the following labels; 'Naga Hills Sherwill / Rothschild Bequest 1939-1.'. In addition the holotype bears the following labels; 'Holotype (red) / E. moori f. marginalis Type'. Rothschild, 1900. / *Eulepis moori sandakanus f. marginalis* Roths., HOLOTYPE det. R. L. Smiles 1975'. The two male paratypes bear the additional labels; 'Paratype (yellow) / *Eulepis moori sandakanus f. marginalis* Roths., PARATYPE det. R. L. Smiles 1975'.

BIONOMICS. There are records in the BMNH for capture during February, June, July, November and November to December. One specimen is labelled 50 feet [15 m].

### *Polyura moori kaba* (Kheil)

(Figs 41, 57)

*Charaxes kaba* Kheil, 1884: 27, pl. 3, fig. 19. Syntype(s) (? sex), NIAS (possibly in Národní Museum, Prague) [not examined].

*Eulepis attalus kaba* (Kheil) Fruhstorfer, 1898: 56.

*Eulepis moori kaba* (Kheil); Rothschild & Jordan, 1899: 241, pl. 7, fig. 6.

*Eriboea moori khaba* (sic) (Kheil) Fruhstorfer, 1914: 720.

*Polyura moori kaba* (Kheil) Stichel, 1939: 567.

MALE. *Upperside*. Forewing with outer edge of discal band more extensive than in other subspecies, and extending markedly into discal cell. Hindwing with outer edge of disco-basal patch extended to join admarginals only along veins  $M_1$  and  $M_2$ . *Underside*. Ground colour pinkish brown. Submarginal area of outer margin of forewing and area distal to postdiscal lunules in hindwing more distinctly olive-green than in any other subspecies.

FEMALE. Similar to male, but larger with pale markings more extensive.

SIZE. ♂;  $\bar{x}$  = 35.1,  $s$  = 0.7 (38 specimens). ♀; 1 specimen only, 40.0.

DISTRIBUTION. Nias: [Hili Madjedja]; [Dyma]; [Parea, S. Bonaa]; Lahagu; [Kalim Bungo]. 38 ♂, 1 ♀.

BIONOMICS. There are records in the BMNH for February to March, March to May, April and September. Described as very rare (Kheil, 1884: 27).

### *Polyura moori javana* (Röber)

(Fig. 152)

*Charaxes javanus* Röber, 1895: 66. Holotype ♂, JAVA (BMNH) [examined].

*Charaxes moori javanus* Röber; Fruhstorfer, 1898: 54 [in part]; Roepke, 1938: 350, pl. 35, fig. 11, text-fig. 53.

*Eulepis attalus javanus* (Röber) Fruhstorfer, 1898: 56 [in part].

*Eulepis moori* (Distant); Rothschild & Jordan, 1898: pl. 12, fig. 5.

*Eulepis moori moori* (Distant); Rothschild & Jordan, 1899: 239 [in part].

*Eriboea moori javanus* (Röber) Fruhstorfer, 1914: 720.

*Polyura moori javanus* (Röber) Stichel, 1939: 569.

MALE, FEMALE. *Upperside*. Very similar to *P. m. moori*, but with outer edge of forewing discal band less extended, and in male, with glaucous distal edge of disco-basal patch of hindwing often not joining admarginals, or only joining them at vein  $M_2$ . *Underside*. Ground colour pinkish brown.

SIZE. ♂;  $\bar{x}$  = 34.7,  $s$  = 1.5 (18 specimens). ♀; 1 specimen only, 40.4.

DISTRIBUTION. Java: Pelabuhan Ratu, Teluk [Wynkoopsbai], [Preanger]; [Palabuan]; Sukabumi, [Mt Sesoeroe]; Mt Gede. 18 ♂, 1 ♀.

TYPE-MATERIAL. Described from a single male. This holotype is now in the BMNH and bears the following labels; 'Holotype (red) / Java merid. Palabuan 1892 H. Fruhstorfer. / Fruhstorfer Coll. B.M. 1937-285. / Javanus Röb spec. typic. / Charaxes javanus Röber HOLOTYPE det R. L. Smiles 1975'.

**BIONOMICS.** In the BMNH there is one record for December. There is also one altitude record of 1200 m. Fruhstorfer (1914: 720) states that it flies between 610 and 760 m and that it is 'enormously scarce'.

*Polyura moori chalazias* (Fruhstorfer)

(Fig. 153)

*Charaxes (Eulepis) moori* Distant; de Nicéville & Elwes, 1898: 692.

*Eulepis moori moori* (Distant); Rothschild & Jordan, 1899: 239 [in part].

*Eriboea moori chalazias* Fruhstorfer, 1914: 720. Holotype ♂?, BALI (probably in ZSBS, Munich) [not examined].

*Polyura moori chalazias* (Fruhstorfer) Stichel, 1939: 568.

**MALE.** *Upperside.* Forewing as in *P. m. javana*. Hindwing with outer edge of discal band more blue than in other subspecies. According to the original description, it is smaller than other subspecies. *Underside.* Ground colour pinkish brown.

**SIZE.** 31·5.

**DISTRIBUTION.** Bali. 1 ♂.

**BIONOMICS.** The one specimen available for study was captured during September. According to Fruhstorfer (1914: 720) the butterfly is 'very rare'.

*Polyura moori saida* (Preyer & Cator) stat. n.

(Fig. 149)

*Charaxes moori* Distant; Staudinger, 1886: 173 [in part].

*Charaxes saida* Preyer & Cator, 1894 (1st October): 258; Corbet, 1947: 417. ? Syntype ♀, SABAH (BMNH) [examined].

*Charaxes heracles* Röber, 1894 (October): 291, 292, 294. Syntype[s] (sex?), BORNEO (possibly in MNHU, Berlin) [not examined]. **Syn. n.**

*Eulepis moori heracles* (Röber); Rothschild & Jordan, 1899: 239.

*Eriboea moori heracles* (Röber) Fruhstorfer, 1914: 721.

*Polyura moori heracles* (Röber) Stichel, 1939: 567.

**MALE.** *Upperside.* Forewing discal band similar to *P. m. javana*. Hindwing with rather more extensive black apex than in *P. m. moori*, *kaba*, *javana* or *chalazias*. *Underside.* Ground colour pinkish brown. Hindwing with distal edge of discal band proportionately further from the outer margin than in any other subspecies except, perhaps *P. m. kaba*, but lacking the olive-green patches of that butterfly.

**FEMALE.** Differs from the male in size, in the more extensive pale markings of the upperside, and in the lighter ground colour of the underside.

It is possible that specimens of this butterfly form a distinct subspecies in Natuna Is., but as yet too few are available for study.

**SIZE.** ♂;  $\bar{x}$  = 35·7,  $s$  = 1·0 (40 specimens). ♀; 3 specimens only, 40·7, 40·8, 41·4.

**DISTRIBUTION.** **Sabah:** [Byte] (Preyer & Cator, 1894: 258); [Province Clarke, Melamam]; Labuan I.; Mt Kinabalu; Sandakan; [Mt Marapok, Dent Province]; Lawas. **Sarawak:** S. Melinau; Baram River; Bidi. **Kalimantan:** River Sintang; Pontianak; Pengaron; [Tameang Lajang]; [Marabuk R.]; [Bantermasin]. **Natuna Islands:** Bunguran. 51 ♂, 3 ♀.

**TYPE-MATERIAL.** *Charaxes saida* Preyer & Cator was described from an undisclosed number of specimens from 'Byte', Borneo. In the BMNH there is a female which largely fits the somewhat brief description, but which is not labelled with the above locality. It is possible that this specimen is a syntype, and it bears the following labels; '? Syntype (blue) / *Charaxes saida* Pr. & Cat / type! / Sandakan. (Preyer & Cator). / Rothschild Bequest B.M. 1939-1. / *Charaxes saida* Preyer & Cator possible SYNTYPE det. R. L. Smiles 1975'.

**BIONOMICS.** In the BMNH there are records for January, February, March, April, August,

October and December to February at altitudes between 90 and 1500 m. One specimen was captured at urine on sand.

*Polyura jalysus* (Felder & Felder)

(Figs 138–141, Map 2)

*Charaxes jalysus* Felder & Felder, 1867: 438, pl. 59, fig. 5; Distant, 1833: 108, pl. 13, fig. 4.

*Eulepis jalysus* (Felder & Felder) Moore, [1896]: 259, pl. 187, figs. 1, 1a; Rothschild & Jordan, 1899: 261, pl. 7, fig. 7.

*Charaxes* (*Eulepis*) *jalysus* Felder & Felder; de Nicéville & Martin, 1896: 435.

*Eriboea jalysus* (Felder & Felder) Fruhstorfer, 1914: 722, pl. 137a.

*Charaxes hebe* var. *jalysus* Felder & Felder; Schwanwitsch, 1926: 502, pl. 2, fig. 12.

*Polyura jalysus* (Felder & Felder) Stichel, 1939: 572; Lewis, 1974: 271, pl. 150, fig. 4.

**MALE, FEMALE.** *Upperside.* Ground colour (discal area) pale greenish yellow. Forewing with apex, costal and outer margins black. Subapical pale greenish yellow spot present in cell  $M_1$ . Hindwing outer margin black, tails blue-centred; admarginals orange, proximal  $t_1$  which run a row of white spots on a black ground. *Underside.* Forewing outer margin brown, submarginal ocelli present as well-delineated chevrons overlying a pale magenta or beige ground which includes the costal margin also. Subapical off-white spot in cell  $M_1$  proximally bordered by  $M_1$ . A dark, rufous-brown, arcuate band, bordered towards the wing base by  $M_1$  and  $M_{II}$  and interrupted at the end of the discal cell by  $DI$ , encloses a pale, greenish, discal patch which extends from vein  $M_3$  to the inner margin. Hindwing outer margin black, tails beige or pale blue-centred. Admarginals orange or ochreous yellow, and distal to a double row of spots—a black distal and a white proximal series on a beige ground. Postdiscal spots of other species are here represented as a complete, non-differentiated series of submarginal, brick-red or crimson lunules proximally outlined with pale bluish scales and the whole delineated by black. Proximal to this lies the orange umbra (Schwanwitsch, 1926: pl. 2, fig. 12) which, together with a rufous brown bar delineated by  $M_1$  and  $M_{II}$ , for the most part encloses the pale greenish discal patch. Wing base and anal margin beige.

Abdomen buff, darker above than beneath.

**RANGE.** Burma to Thailand, Vietnam, West Malaysia, Sumatra and Borneo. It is to be expected that this species will also be found in Laos and Cambodia.

*Polyura jalysus jalysus* (Felder & Felder)

(Figs 138, 139)

*Charaxes jalysus* Felder & Felder, 1867: 438, pl. 59, fig. 5. LECTOTYPE ♂, WEST MALAYSIA (BMNH), here designated [examined].

*Eriboea jalysus jalysus* (Felder & Felder) Fruhstorfer, 1914: 722, pl. 137a; Corbet & Pendlebury, 1934: 178, pl. 12, fig. 155.

*Polyura jalysus jalysus* (Felder & Felder) Stichel, 1939: 572; Corbet & Pendlebury, 1956: 246; Fleming, 1975: 54, pl. 56, fig. N143; Pinratana, 1979: 99, fig. 170b.

**MALE, FEMALE.** *Upperside.* Forewing with discal cell normally black or brown. Hindwing with disco-basal pale area not extending along the veins to connect with the admarginals, but leaving a well-defined black band between itself and the submarginal white spots.

**SIZE.** ♂;  $\bar{x}$  = 35.9,  $s$  = 1.1 (40 specimens). ♀; 1 specimen only, 39.2.

**DISTRIBUTION.** **Vietnam:** Bao Ha; Chiem Hoa; Tong. **West Malaysia.** Penang. Perak: Pondok Tanjong; [Lakatt & Pambo]; Taiping; [Jor. Camp]; Batang Padang. Pahang: Mt Tahan; Bedong, Gunong. Selangore: Kuala Lumpur, Ampang. Malacca. **Sumatra:** Gajo Mts; Batak Mts; [Selesseh]; Lebongtandai; [Setinjak]; Deli; Bila; Sibolga; Padangsidempuan, [Kand<sup>8</sup>. Ampat, Pad. Beneden]. 66 ♂, 1 ♀.

**TYPE-MATERIAL.** The type-series is represented in the BMNH by two males and one female which bear the labels; 'Malacca interior Castelnau / FELDER COLL<sup>N</sup> / Rothschild Bequest B.M. 1939-1'. In addition one male bears the labels; 'Lectotype (purple) / TYPE / Charaxes jalysus C. & R. Felder LECTOTYPE det. R. L. Smiles 1978', and is here designated lectotype. The remaining pair bear the additional labels; 'Paralectotype (blue) / Charaxes jalysus C. & R. Felder PARALECTOTYPE det. R. L. Smiles 1978'.

**BIONOMICS.** There are records in the BMNH for all months of the year except November, at altitudes up to 1000 m.

*Polyura jalysus ephebus* (Fruhstorfer)

(Fig. 140)

*Eriboea jalysus ephebus* Fruhstorfer, 1914: 722; Evans, 1927: 93. Holotype ♂, BURMA (BMNH) [examined]. *Eriboea jalysus* (Felder & Felder); Godfrey, 1930: 301.

*Polyura jalysus ephebus* (Fruhstorfer) Stichel, 1939: 572; Pinratana, 1979: 99, fig. N170a.

**MALE, FEMALE.** *Upperside.* Pale greenish yellow areas more extensive than in other subspecies. Forewing with pale area normally extending into discal cell. Hindwing with pale area extending along the veins to the admarginals, the black submarginal band being thereby reduced.

**SIZE.** ♂:  $\bar{x}$  = 36.3,  $s$  = 0.8 (40 specimens). ♀: 1 specimen only, 37.1.

**DISTRIBUTION.** **Burma:** Shan State, [Muong Gnow]; Karen Hills, Pattechaung, [Chataip]; Toungoo; Kaw-kareik, [Thingannyi], Sukli; Tenasserim, Dawna Range; Thaungyin Valley; East Pegu; Tavoy, [Meke]. **Thailand** (Siam): Nakhon Phanom, Tha Uthen; [Muok-Lek]; Mae Wong. 48 ♂, 1 ♀.

**TYPE-MATERIAL.** Represented in the BMNH by a male holotype which bears the following labels; 'Holotype (red) / Burma. / Moore Coll. 98-128. / B.M. TYPE No. Rh. 10795 E. jalysus ephebus ♂ Fruh. / *Eriboea jalysus ephebus* Fruh. HOLOTYPE det. R. L. Smiles 1977'.

**BIONOMICS.** There are records in the BMNH for January, February, March, April, May, July, July–November, September, October, November and December at altitudes between 150 and 1500 m.

*Polyura jalysus triphonus* (Fruhstorfer)

(Fig. 141)

*Eriboea jalysus triphonus* Fruhstorfer, 1914: 722, pl. 134b. LECTOTYPE ♂, SABAH (BMNH), here designated [examined].

*Polyura jalysus triphonus* (Fruhstorfer) Stichel, 1939: 573.

**MALE.** *Upperside.* Similar to *P. j. jalysus*, but with slightly more extensive pale greenish yellow areas which extend into the discal cell of the forewing, and along the veins towards the admarginals of the hindwings, although in neither case is this so great as in *P. j. ephebus*. The submarginal white spots of the hindwing are larger than in *P. j. jalysus*.

**SIZE.** ♂:  $\bar{x}$  = 36.3,  $s$  = 1.4 (24 specimens).

**DISTRIBUTION.** **Sabah:** Lawas; Kinabalu (Kina Balu). **Sarawak:** Bidi; Gunong Mulu National Park, W. Melinau Gorge. **Kalimantan:** Riv. Sintang; Pontianak; Pengaron. 25 ♂.

**TYPE-MATERIAL.** Described from an undisclosed number of specimens from 'North Borneo'. The type-series in the BMNH consists of four males, one of which bears the following labels; 'Lectotype (purple) / Nord-Borneo Lawas Februar A. Everett ex coll. H. Fruhstorfer / Type / Fruhstorfer Coll. B.M. 1937-285. / *Eriboea jalysus triphonius* Fruhstorfer LECTOTYPE det. R. L. Smiles 1978', and is designated lectotype. The remaining three males all bear the following labels; 'Paralectotype (blue) / Nord-Borneo ex coll. Fruhstorfer / *Eriboea jalysus triphonius* Fruhstorfer PARALECTOTYPE det. R. L. Smiles 1978'. In addition two of these bear the additional label; 'Fruhstorfer Coll. B.M. 1937-285.', and one the label; 'Rothschild Bequest B.M. 1939-1.'.

**BIONOMICS.** A rare butterfly (Fruhstorfer, 1914: 722). It has been taken during March and December–February between 100 and 1200 m, and has been observed at urine on sand according to records in the BMNH.

*Polyura delphis* (Doubleday)

(Figs 49, 65, 127–131)

*Charaxes delphis* Doubleday, 1843: 217, pl. 7.

*Murwareda delphis* (Doubleday) Moore, [1896]: 266, pl. 190, figs 1, 1a.

*Eulepis delphis* (Doubleday) Rothschild & Jordan, 1899: 281, figs 40, 41, 42.

*Eriboea delphis* (Doubleday) Fruhstorfer, 1914: 723.

*Polyura delphis* (Doubleday) Stichel, 1939: 585; Lewis, 1974: 217, 150, fig. 2; Duckworth, Watson & Whalley, 1975: 267.

MALE, FEMALE. *Upperside*. Ground colour predominantly pale cream-yellow. Forewing apex black with a cream-yellow subapical spot often in cell  $R_5$ . Hindwing outer margin highly dentate, submarginal lunules black towards apex, becoming progressively grey-blue towards anal angle, this extending along the veins towards the outer margin and into the tails. *Underside*. Ground colour silver-white. Forewing with a row of submarginal yellow spots from cells  $R_5$  to  $Cu_{1b}$ , that of cell  $Cu_{1b}$  being doubled, proximal to which is a row of grey-blue lunules. MI is present postdiscally in cells  $R_5$  and  $M_1$  just beyond the end of the discal cell in cell  $M_2$ , and fused with MII to form a grey-blue-centred, black circle in cell  $Cu_{1a}$ . DI is present only at the end of the discal cell, and MII is present just proximal to this in the discal cell which together with DI forms a grey-blue-centred semi-lunar marking. DII has been reduced to form two or three black spots in the discal cell. Hindwing admarginals yellow. A dentate blue line runs proximal to them and extends into the tails. A yellow band runs distally to the submarginal spots which, in cells  $R_1$  to  $M_2$ , are yellow, and in cells  $M_3$  to  $Cu_{1b}$  are red. The proximal circuli of the ocelli are grey-blue. MI and MII are fused to form a circle on the costal margin and often in cell  $R_1$ —these may or may not be grey-blue-centred. MI and MII are also joined to form a partial boundary around DI at the end of the discal cell. MI is also often present as a very thin black line in cells  $Cu_{1a}$ ,  $Cu_{1b}$  and 2A.

Abdomen above cream-yellow, white beneath.

RANGE. From north-eastern India and Bangladesh through Burma, Thailand, West Malaysia and Singapore to the islands of Sumatra, Nias, Java, Borneo and Palawan.

Several subspecies have been described, some of which show only slight differences. However, as these differences seem fairly constant they are outlined below.

### *Polyura delphis delphis* (Doubleday)

(Figs 127, 128)

*Charaxes delphis* Doubleday, 1843: 217, pl. 7. LECTOTYPE ♂, BANGLADESH (BMNH), here designated [examined].

*Nymphalis delphis* (Doubleday) Westwood, 1850: 309.

*Eulepis delphis delphis* (Doubleday) Rothschild & Jordan, 1899: 283, fig. 40.

*Eriboea delphis delphis* (Doubleday) Fruhstorfer, 1914: 723.

*Polyura delphis delphis* (Doubleday) Stichel, 1939: 585; Pinratana, 1979: 102, fig. N174a.

MALE, FEMALE. *Upperside*. Forewing with apical black area more restricted than in other races (except *P. d. nivea*), particularly in cells  $R_5$ ,  $M_1$  and  $M_2$ . In cell  $M_1$  a residual black spot is often seen, sometimes completely separate from the black apex. Postdiscal spots of hindwing often larger.

SIZE. ♂;  $\bar{x}$  = 45.8,  $s$  = 2.1 (40 specimens). ♀; 2 specimens only, 55.9, and 48.3.

DISTRIBUTION. **India**. Sikkim. Assam: Khasi Hills; Cherrapunji; [Daleswari R.], North Lushai. Nagaland: Nichuguard, Naga Hills. Manipur: Cachar R.; Irang R.; [Lengba R.]. **Bangladesh**: Sylhet. **Burma**: Huckawng Valley; Sadon; Me Song; Karen Hills, Pattechaung; Toungoo; Tenasserim, [Tandong]; [Dahgwii]; Thandaung; [Ponsckai]; [Thoungoen]; Moulmein; Kawkareik; East Pegu; Kadan Kyun [King Island], Mergui; Tavoy; Foot of Downa Range; Ataran Valley, [Taungwaing]; Salween. **Thailand** (Siam): Phrae District, [Me Sai Song]; [Muok-Lek]; [Khao Sabab Hill], nr Chanthaburi; [Hot Spring, W. Siam]; Hin Lap. 103 ♂, 2 ♀.

TYPE-MATERIAL. *Charaxes delphis* Doubleday was described from an undisclosed number of specimens. One specimen in the BMNH bears the following labels; 'Silhet 45-33. / B.M. TYPE No. Rh. 10452. / Lectotype (purple) / *Charaxes delphis* Doubleday LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype.

BIONOMICS. There are records in the BMNH for all months of the year, at altitudes between 350 and 3200 m.

*Polyura delphis concha* (Snellen van Vollenhoven)

(Figs 49, 65)

*Charaxes concha* Snellen van Vollenhoven, 1861: 162, pl. 10, figs 1, 3; Butler, 1866: 635; de Nicéville & Martin, 1896: 433. LECTOTYPE ♂, SUMATRA (RNH, Leiden), here designated [examined].

*Eulepis delphis concha* (Snellen van Vollenhoven) Rothschild & Jordan, 1899: 284, fig. 41.

*Eulepis delphis delphinion* Fruhstorfer, 1904d: 75. Holotype ♂, BORNEO (BMNH), [examined]. Syn. n.

*Eriboea delphis concha* (Snellen van Vollenhoven) Fruhstorfer, 1914: 723, pl. 134c.

*Eriboea delphis delphinion* (Fruhstorfer) Fruhstorfer, 1914: 724.

*Eulepis deephis (sic) concha* (Snellen van Vollenhoven); Ellis, 1917: 107.

*Polyura delphis concha* (Snellen van Vollenhoven) Stichel, 1939: 586; Pinratana, 1979: 102, fig. N174b.

MALE, FEMALE. *Upperside*. Forewing with black subapical area more extensive than in the nominate subspecies, the subapical white spot reduced or obliterated. Hindwing submarginal lunules normally white-centred, clearly defined and black, or partly black in cells  $R_1$ ,  $R_5$  and  $M_1$ . *Underside*. Often with a blue-centred, black-ringed spot in cell  $R_1$  extra to that on the costal margin.

The differences suggested by Fruhstorfer for *Eulepis delphis delphinion* are far from constant when applied to a more extensive sample than the type-series.

SIZE. ♂;  $\bar{x}$  = 46.8,  $s$  = 1.3 (40 specimens). ♀; 2 specimens only, 53.3 and 54.6.

DISTRIBUTION. **West Malaysia**. Kedah: Changlun, [Jalan Sintok]. Perak: [Ulu Ijok]; Sungei, Kelan [Klah]; Pelus R., K. Temoh, Sira Chior; Bukit Kutu; Ipoh. Negri Sembilan: Tampin. Pahang: [Gunong Tahan]. **Singapore**: [Straits Settlements]. **Sumatra**: Lebongtandai; [Begoemit]; Sibolga; [Quala Lemoerak]; [Kand<sup>8</sup> Ampat, Pad. Beneden]; Bila; [Selesseh]; Gajo Mts; Marang; Deli; Solok. **Kalimantan**: source of the Mahakam River; Pengaron, Martapura; Pontianak. **Sarawak**: Mt Dulit; Kuching; R. Kapah, trib. of R. Tinjar. **Sabah**: Silam, Darvel Bay; Labuan I.; Mt Kinabalu; Ibul [Bole, Brit. N. Borneo, Province Clarke]; Tenom; [Mt Marapok, Dent Province]. Untraced locality: [Marabuck R.]. 118 ♂, 3 ♀.

TYPE-MATERIAL. *Charaxes concha* Snellen van Vollenhoven was described from a series of three specimens, two from Java and the third from Sumatra. These three specimens are now in the RNH, Leiden. The male from Sumatra most closely resembles the figure in the original description, bears the following labels; 'Lectotype (purple) / Cat. N° 1. / ♂ / Ludeking Sumatra / Charaxes concha v. Voll type / Charaxes concha Snellen van Vollenhoven LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype. The remaining two males bear the following labels; 'Paralectotype (blue) / Cat. N° 1 [2] / Type / ♂ / Blume Java / Charaxes concha v. Voll type / Charaxes concha Snellen van Vollenhoven PARALECTOTYPE det. R. L. Smiles 1978'.

*Eulepis delphis delphinion* Fruhstorfer, was described from a 'type' from south Borneo and an undisclosed number of specimens from north and central Borneo. The holotype and two male paratypes are in the BMNH and bear the label; 'Fruhstorfer Coll. B.M. 1937-285.' In addition the holotype bears the following labels; 'Holotype (red) / Type / S. Borneo H. Fruhstorfer. / Eulepis delphis delphinion Fruhstorfer HOLOTYPE det. R. L. Smiles 1977. The paratypes bear the following labels; 'Paratype (yellow) / Eulepis delphis delphinion Fruhstorfer PARATYPE det. R. L. Smiles 1977. In addition one paratype bears the label; 'N. Borneo 1898, Wat.' and the other; 'Quellgebiet des Mahakam Flusses'.

BIONOMICS. In the BMNH there are records for January, February, March, May, June, July, August, November and December at altitudes between 130 and 1300 m.

EARLY STAGES. A poor black and white illustration of the larva appears in Morishita (1972: 6).

*Polyura delphis othonis* (Fruhstorfer)

(Fig. 129)

*Eulepis delphis othonis* Fruhstorfer, 1904d: 75. LECTOTYPE ♂, NIAS (BMNH), here designated [examined].

*Eriboea delphis othonis* (Fruhstorfer) Fruhstorfer, 1914: 724.

*Polyura delphis othonis* (Fruhstorfer) Stichel, 1939: 587.

MALE, FEMALE. *Upperside*. Hindwing with submarginal blue-grey lunules lacking the white pupil to be found in the nominate subspecies, normally not present in cell  $R_1$  and almost obliterated in cell  $R_5$ . The lunule in cell  $M_1$  is blue-grey, not black. *Underside*. Hindwing with ochreous submarginal band much broader than that of the nominate subspecies.

SIZE. ♂;  $\bar{x} = 47.1$ ,  $s = 1.0$  (14 specimens). ♀; one specimen only, 54.0.

DISTRIBUTION. **Nias**: Gunungsitoli; Orahili; [Dyma]; [Lalfago]; [Kalim Bungo]. 14 ♂, 1 ♀.

TYPE-MATERIAL. Described from one male and one female in the collection of Prof. Thieme, and one male in the Fruhstorfer collection. The last is now in the BMNH, bears the following labels; 'Lectotype (purple) / Type / Nias insula. / Fruhstorfer Coll. B.M. 1937-285. / *Eulepis delphis othonis* Fruhstorfer LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype.

BIONOMICS. In the BMNH there are records for January, February, March, May and September.

### *Polyura delphis cygnus* (Rothschild)

(Fig. 130)

*Charaxes concha* Snellen van Vollenhoven, 1861: 162 [in part].

*Eulepis delphis cygnus* Rothschild, 1899: 285. LECTOTYPE ♂, JAVA (BMNH), here designated [examined].

*Eriboea delphis cygnus* (Rothschild) Fruhstorfer, 1914: 724.

*Polyura delphis cygnus* (Rothschild) Stichel, 1939: 587.

Both sexes with underside markings less prominent than in other subspecies.

SIZE. ♂;  $\bar{x} = 45.0$ ,  $s = 1.0$  (23 specimens). ♀; 5 specimens only, 49.8, 46.5, 49.6, 52.9 and 50.6.

DISTRIBUTION. **Java**: [Plaboan]; [Palabuan]; Pelabuhan Ratu; Mt Halimun; Mt Djampang; Sukabumi; Mt Gede; South Java; East Java. 23 ♂, 5 ♀.

TYPE-MATERIAL. Described from two males now in the BMNH. One specimen bears the following labels; 'Lectotype (purple) / Java occident Mons Gede 4000' 1896 H. Fruhstorfer. / *E. delphis cygnus* Roths. Type 1899. / Rothschild Bequest B.M. 1939-1. / *Eulepis delphis cygnus* Rothschild LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype. The remaining male bears the following labels; 'Paralectotype (blue) / Java occident Mons Gede 4000' 1896 H. Fruhstorfer. / Rothschild Bequest B.M. 1939-1. / *Eulepis delphis cygnus* Rothschild PARALECTOTYPE det. R. L. Smiles 1978'.

BIONOMICS. In the BMNH there are records for January, March, May, June and December at altitudes between 350 and 1600 m.

### *Polyura delphis nivea* (Rothschild)

(Fig. 131)

*Eulepis delphis niveus* Rothschild, 1899: 286, fig. 42. LECTOTYPE ♂, PALAWAN (BMNH), here designated [examined].

*Eriboea delphis niveus* (Rothschild) Fruhstorfer, 1914: 724.

*Polyura delphis niveus* (Rothschild) Stichel, 1939: 587.

MALE, FEMALE. *Upperside*. Forewing with black apex more restricted than in any other subspecies. Hindwing underside lacking the spot in cell  $R_1$  often found in *P. d. concha*.

SIZE. ♂;  $\bar{x} = 43.7$ ,  $s = 2.0$  (7 specimens). ♀; 1 specimen only, 46.8.

DISTRIBUTION. **Palawan**: Mt Langan. 7 ♂, 1 ♀.

TYPE-MATERIAL. Described from two males, one of which is in the BMNH and bears the following labels; 'Lectotype (purple) / Süd Palawan / Rothschild Bequest B.M. 1939-1. / *Eulepis delphis niveus* Rothschild LECTOTYPE det. R. L. Smiles 1978', and is hereby designated lectotype.

BIONOMICS. This is a rare butterfly, and in the BMNH there are only records for May and October.



*Polyura posidonius* (Leech)

(Figs 42, 58)

*Charaxes posidonius* Leech, 1891: 30; Leech, 1892: 127, pl. 14, fig. 4. LECTOTYPE ♂, CHINA (BMNH), here designated [examined].

*Charaxes clitiphon* Oberthür, 1891: 12, pl. 2, fig. 11. LECTOTYPE ♂, CHINA (BMNH), here designated [examined].

*Murwareda posidonius* (Leech) Moore, 1895: 267.

*Eulepis posidonius* (Leech) Rothschild & Jordan, 1899: 275, pl. 7, fig. 8.

*Eriboea posidonius* (Leech) Stichel, 1909: 170, pl. 52d; Fruhstorfer, 1914: 722.

*Polyura posidonius* (Leech) Stichel, 1939: 577; Lewis, 1974: 288, pl. 197, fig. 11.

*Polyura posidonius clitiphon* (Oberthür) Stichel, 1939: 577.

**MALE.** *Upperside.* Forewing elongate, costal margin almost straight. Ground colour brown or black. A submarginal series of yellow spots is associated with the outer margin and is probably derived from the proximal part of the circuli of the ocelli. This derivation can more clearly be seen in *P. eudamippus*, *nepenthes*, and *narcaea* where the row is almost postdiscal. The discal band is pale yellowish green as is a double postdiscal patch in cells  $R_5$  and  $M_1$ , and a spot in cell  $M_2$  which lies just beyond the end of the discal cell. Hindwing shape rather square with margins smooth rather than dentate. Outer margin black, admarginals large and yellow, centres of tails and lines beyond the disco-basal patch in cell  $Cu_{1b}$  blue. Disco-basal patch pale yellowish green, containing a brown band running from the wing base to end diffusely in cell  $Cu_{1b}$ . *Underside.* Ground colour pale magenta. Forewing outer marginal band well-defined, brown as is an arcuate band which encompasses the pale green discal band on its proximal and anterior sides, the umbra, which likewise forms a well-defined band, and a triangular patch lying proximal to a light green patch in cells  $R_5$  and  $M_1$ . This triangular patch and the arcuate band are distally bordered by a black line (MI). The arcuate band is projected upwards along the end of the discal cell, forming a Y-shape, which is distally bordered by DI. MII and DII do not delineate the proximal border of this band as is the case in *P. dolon*, *narcaea*, *eudamippus* or *nepenthes*, but are fragmented to form a scattering of small black spots in the discal cell. Hindwing with outer margin brown as in forewing, and a similarly coloured band running from the costal margin near the wing base to the postdiscal lunules in cell  $Cu_{1b}$ . This is delineated distally by MI, and proximally by MII. The admarginals are pale yellow, orange distally; tails blue centred. The postdiscal lunules are crimson, complete, proximally lilac or blue, and border onto a black line which also delineates the pale green discal patch, and above, a red-brown costal streak found only in this species. The anal pouch is largely pale green, peppered with minute black spots. A part of MI crosses vein 2A transversely here, almost reaching the anal margin.

Thorax black above, yellow streaked with black beneath. Abdomen black above and beneath. Genitalia valves often pale yellow.

**SIZE.** ♂;  $\bar{x} = 39.5$ ,  $s = 1.4$  (28 specimens).

**DISTRIBUTION.** **China:** Tibet, [Fou-Lin]; Tibet, [Moenia]; Tibet, Ta Ho; Tibet, [Oua-Se, Yu-tong, Kitchang-Kou]; E. Tibet, [Posho]; Tsekou; Ta-Lou, [Yuin-Kin]; Ni-tou; Siao-Lou; K'ang-Ting [Tatsien-Lou]; Pa-Wo-Lung [Baurong]; Ta-Tu Ho Valley [Valée du Tong-Ho]; Wa-ssu-Kou; [Tchang-Kou]. 28 ♂.

**TYPE-MATERIAL.** *Charaxes posidonius* Leech was described from three males which are now in the BMNH. Of these, two males bear the following labels; 'Wa-ssu-Kow, 5000 ft. Native coll. June 1890. / Leech Coll. 1901-173 / B.M. TYPE No. Rh. 10447[8]'. In addition, one male bears the labels; 'Lectotype (purple) / Type ♂ Leech / *Charaxes posidonius* Leech LECTOTYPE det. R. L. Smiles 1979', and is designated lectotype. The second of these two bears the additional label; 'Cotype ♂ Leech', and like the third specimen bears the labels; 'Paralectotype (blue) / *Charaxes posidonius* Leech PARALECTOTYPE det. R. L. Smiles 1979'. The third male bears the additional labels; 'Ni-tou, 5000 ft. Native coll. 1890. / Rothschild Bequest B.M. 1939-1.'.

*Charaxes clitiphon* Oberthür was described from an undisclosed number of specimens collected by R. P. Dubernard in Tsekou. One male now in the BMNH bears the labels; 'Lectotype (purple) / Thibet Tsekou R. P. Dubernard / Levick Bequest B.M. 1941-83. / *Charaxes clitiphon* Oberthür LECTOTYPE det. R. L. Smiles 1979', and is here designated lectotype.

**BIONOMICS.** Specimens in the BMNH have been collected during April, May, June and July, at altitudes from 1500 to 2900 m.

*Polyura narcaea* (Hewitson)

(Figs 50, 66, 132–137)

- Nymphalis narcaeus* Hewitson, [1854]: [87], pl. [44], figs 1, 4.  
*Eulepis narcaeus* (Hewitson) Rothschild & Jordan, 1899: 277, pl. 7, figs. 9, 10.  
*Eriboea narcaea* (Hewitson); Stichel, 1909: 170, pl. 52d; 1914: 722.  
*Polyura narcaea* (Hewitson) Stichel, 1939: 573.  
*Polyura narcaea* (Hewitson); Lewis, 1974: 288, pl. 197, fig. 10.

MALE, FEMALE. *Upperside*. Ground colour brown or black, reduced by the enlargement of the pale yellowish green areas of the wings—submarginal spots, disco-basal patches etc.—to form a series of narrow bands, the most distinctive of which form a Y-shape at the end of the discal cell of the forewing. Forewing with submarginal spots enlarged, often separate, but sometimes merging to form a band. Discal cell pale yellowish green and forming a part of the disco-basal patch. Hindwing with outer margin black. A vestige of the admarginals showing yellowish orange is often seen; the tails are blue-centred. The remainder of the wing is pale yellowish green except for two black bands, the first well defined and running from the costal margin close to the apex, to the tornus where it contains some structural blue. The second band runs from the wing base, down cell  $Cu_{1b}$  parallel with the vein, to end at the tornus, and is much more faintly marked, sometimes absent. *Underside*. With pale green areas corresponding to the pale yellowish green areas of the upperside. Ground colour silvery white. Forewing with a well-defined brown band running along the outer margin, a similar band running along the costal margin, and a Y-shaped system of brown bands corresponding to those of the upperside. This system of bands is outlined distally by MI and DI, and proximally by MII as is the case in *P. eudamippus*. A further brown band runs from the costal band, past the end of the 'Y' and ends on the inner margin, being distally delineated with black. DII is either absent or reduced to form normally only one or exceptionally two or three small spots in the discal cell. Hindwing with outer margin brown; admarginals ochreous yellow but restricted. Submarginally there is a continuous series of black spots, one in each cell, two in cell  $Cu_{1b}$ . Postdiscal spots deep red, united to form a continuous band the inner edge of which is pinkish lilac and is bordered proximally by a black line. A brown band runs from the costal margin near the wing base and curves to end near the tornus. The anterior portion is delineated by MI and MII.

Abdomen black above, underside normally black but sometimes buff beneath.

RANGE. From Assam to China and in Taiwan, Vietnam, Burma and Thailand.

*Polyura narcaea narcaea* (Hewitson)

(Figs 50, 66, 132)

- Nymphalis narcaeus* Hewitson, [1854]: [87], pl. [44], figs 1, 4; Kirby, 1871: 271. LECTOTYPE ♂, CHINA: Shanghai (BMNH), here designated [examined].  
*Charaxes mandarinus* Felder & Felder, [1867]: 437. LECTOTYPE ♂, CHINA: Shanghai (BMNH), here designated [examined].  
*Charaxes narcaeus* (Hewitson) Lewis, 1879: 257; Leech, 1892: 126.  
*Charaxes narcaeus* var. *thibetanus* Oberthür, 1891: 11, pl. 2, fig. 10; Leech, 1892: 127. LECTOTYPE ♂, CHINA: Ch'ang-yang (BMNH), here designated [examined].  
*Charaxes satyrina* Oberthür, 1891: 13. LECTOTYPE ♂, CHINA: [Snowy Valley], nr Ning-po (BMNH), here designated [examined]. [Synonymized by Stichel, 1939: 574.]  
*Charaxes narcaeus* var. *mandarinus* Felder & Felder; Leech, 1892: 127.  
*Murwareda narcaeus* (Hewitson) Moore, [1896]: 267.  
*Murwareda mandarinus* (Felder & Felder) Moore, [1896]: 267.  
*Murwareda tibetanus* (sic) (Oberthür) Moore, [1896]: 267.  
*Eulepis narcaeus* f. temp. *mandarinus* (Felder & Felder) Rothschild & Jordan, 1899: 280, pl. 7, fig. 10.  
*Eriboea narcaea* f. *aemiliani* Fernández, 1912: 304, fig. 2. Syntype(s) (sex?), CHINA (no locality designated) (untraced), [not examined].  
*Eriboea narcaea* w.s.f. *mandarinus* (Felder & Felder) Stichel, 1909: 170, pl. 52d; Fruhstorfer, 1914: 722.  
*Eriboea narcaea* ab. *thibetana* (Oberthür) Stichel, 1909: 170, pl. 52d.  
*Eriboea narcaea* f. *thibetana* (Oberthür); Fruhstorfer, 1914: 722.  
*Eriboea narcaeus richthofeni* Fruhstorfer, 1915: 38. LECTOTYPE ♂, CHINA: Tsingtao (BMNH), here designated [examined].

- Eriboea narcaeus richthofeni* f. *arna* Fruhstorfer, 1915: 38. LECTOTYPE ♂, CHINA: Tsingtao (BMNH), here designated [examined].
- Eriboea narcaea abrupta* Röber, 1925: 168. Syntype(s) (sex?), [CHINA] ('Mongolei') (probably in MNHU, Berlin) [not examined]. **Syn. n.**
- Eriboea narcaea acuminata* Lathy, 1926: 96, pl. 3, fig. 1; Bollow, 1930: 195. Holotype ♂, CHINA: Yunnan (MNHN, Paris) [colour transparencies of upper and undersides examined]. **Syn. n.**
- Eriboea narcaea* ab. *marginepunctatus* Lathy, 1926: 96, pl. 3, fig. 3. Holotype ♂, CHINA: Chiang-nan (MNHN, Paris) [colour transparencies of upper and undersides examined].
- Eriboea narcaea* ab. *intermedia* Lathy, 1926: 96, pl. 3, fig. 2; Bollow, 1930: 195. Holotype ♂, CHINA: Tung-men (MNHN, Paris) [colour transparencies of upper and undersides examined].
- Eriboea narcaea* (Oberthür); Bollow, 1930: 195.
- Eriboea narcaea* ab. *aemiliani* Fernández; Bollow, 1930: 195.
- Eriboea narvaea* ab. *marginepunctata* Lathy; Bollow, 1930: 195.
- Eriboea narcaea* w.s.f. *richthofeni* Fruhstorfer, Bollow, 1930: 195.
- Eriboea narcaea* d.s.f. *arna* Fruhstorfer; Bollow, 1930: 195.
- Polyura narcaeus* (Hewitson) Stichel, 1939: 573.
- Polyura narcaeus* f. *temp. mandarinus* (Felder & Felder) Stichel, 1939: 574.
- Polyura narcaeus* f. *temp. aemiliani* (Fernández) Stichel, 1939: 575.
- Polyura narcaeus* f. *marginepunctatus* (Lathy) Stichel, 1939: 575.
- Polyura narcaeus thibetanus* (Oberthür) Stichel, 1939: 575.
- Polyura narcaeus thibetanus* f. *intermedia* (Lathy) Stichel, 1939: 575.
- Polyura narcaeus acuminata* (Lathy) Stichel, 1939: 576.
- Polyura narcaeus abrupta* (Röber) Stichel, 1939: 576.
- Polyura narcaeus richthofeni* (Fruhstorfer) Stichel, 1939: 576.
- Polyura narcaeus richthofeni* f. *arna* (Fruhstorfer) Stichel, 1939: 576.

MALE, FEMALE. *Upperside*. Forewing with submarginal spots extending into cell  $R_4$  and situated closer to the apex than in other subspecies. Hindwing with tornus having the two white spots proximal to the yellow admarginal bar suppressed, particularly in the male. *Underside*. Brown bands of both wings often paler than in *P. n. meghaduta*.

There are two, probably seasonal, forms. A dark form (f. *mandarinus*) has the discal cell of the forewing upperside brown, and this extending to the inner margin: the brown band running from the base of the hindwing upperside to the tornus is well marked. A pale form (f. *narcaea*) does not have the discal cell of the forewing upperside filled with brown, and the band of the hindwing upperside is less well marked or absent.

*Eriboea narcaea abrupta* Röber was described from a pale specimen supposedly captured in Mongolia, but more probably from northern China. From a study of the description it would seem that it falls within the range of variation exhibited by this subspecies.

*Eriboea narcaea acuminata* Lathy was likewise described from a pale form falling within the range of variation exhibited by this subspecies.

SIZE. ♂:  $\bar{x}$  = 40.1,  $s$  = 2.2 (40 specimens). ♀:  $\bar{x}$  = 44.9,  $s$  = 2.6 (32 specimens).

DISTRIBUTION. **China**: Chiang-nan; Tung-men (Lathy, 1926: 96); Shandong, Ch'ing-tao [Tsingtao]; Shandong, [Jant'ai-Kiautschou]; Wa-ssu-Kou; [Tchang-Kou]; Shanghai; Ning-po; nr Ning-po, [Snowy Valley]; K'un-shan; S. Chekiang, Pi-hu-chen [Pihu], W. of Wen-chou; Zhejiang province, Ta-k'eng-ts'un [Takeng Tou]; N.W. Fujian; Chiu-chiang; Western Hu-pin; Ch'ang-yang; Ichang [Wychang]; Nanch'uan, southern Ssu-ch'uan shang [Szuch'uan]; Lo-shan [Kia-Ting-Fu]; Ssu-ch'uan shang [Suchwan], Kuan-hsien district; Pao-hsing [Mou-Pin]; K'ang-Ting [Ta-t sien-lou]; [Chia-Kou-Ho]; [Pa Tse Fang]; [Ta Tong Kiao]; Siao Lou; S. of Siao-Lou, [Se Pin—Lou Chan, Ya Tcheou]; S.W. of Siao Lou, [Kiong Tch'ou]; W. of Yaan, [Tien-Tsuen, Yui-Kin]; [Tay-Tou-Ho]; [Chow-pin-sa]; N. of Chungtien, [Siao-Ouisi]; nr Paoshan, [Wuin-Kin]; [Fou-Lin]; Tibet, Ta-Ho; [Moenia]. 351 ♂, 32 ♀.

TYPE-MATERIAL. *Nymphalis narcaeus* Hewitson is represented in the BMNH by a single male specimen which bears the following labels; 'Lectotype (purple) / Shanghai 54.8. / B.M. TYPE No. Rh. 10451 *Nymphalis narcaeus* ♂ Hew. / *Nymphalis narcaeus* Hewitson LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype.

*Charaxes mandarinus* Felder & Felder is represented in the BMNH by a male specimen which bears the following labels; 'Lectotype (purple) / Shanghai Muirhead type / FELDER COLL<sup>N</sup> / TYPE of mandarinus / Rothschild Bequest B.M. 1939-1. / *Charaxes mandarinus* Felder & Felder LECTOTYPE det. R. L. Smiles 1979', and is designated lectotype.

*Charaxes narcaeus* var. *thibetanus* Oberthür is represented in the BMNH by a male specimen which bears the following labels; 'Lectotype (purple) / Chang-yang. Pratt. / *Charaxes narcaeus thibetanus* figuré dans la XV<sup>e</sup>-liv<sup>re</sup> Etud. d'Entomolog. des Juni 1891. / Levick Bequest B.M. 1941-83, / *Charaxes narcaeus* var. *thibetanus* Oberthür LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype.

*Charaxes satyrina* Oberthür is represented in the BMNH by a single male specimen which bears the following labels; 'Lectotype (purple) / Chine / *Satyrina* Butler sp. nov. W. B. P. Snowy Valley / Levick Bequest 1941-83 / *Charaxes satyrina* Oberthür LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype.

*Eriboea narcaeus richthofeni* Fruhstorfer is represented in the BMNH by two males and one female, all of which bear the following label; 'Fruhstorfer Coll. B.M. 1937-285.' In addition one male bears the following labels; 'Lectotype (purple) / Tsingtau Fruhstorfer / Type / *Eriboea narcaeus richthofeni* Fruhstorfer LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype. The remaining pair bear the additional labels; 'Paralectotype (blue) / *Eriboea narcaeus richthofeni* Fruhstorfer PARALECTOTYPE det. R. L. Smiles 1979'. Of these the male bears the label; 'Tsingtau Dtsch.-China', whilst the female bears the labels; 'Tsingtau Fruhstorfer / Type'.

*Eriboea narcaeus richthofeni* f. *arna* Fruhstorfer is represented in the BMNH by a male and a female which bear the following labels; 'Type / Tsingtau Fruhstorfer / Fruhstorfer Coll. B.M. 1937-285.'. In addition the male bears the following labels; 'Lectotype (purple) / *Eriboea narcaeus richthofeni* f. *arna* Fruh. LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype. The female bears the additional labels; 'Paralectotype (blue) / *Eriboea narcaeus richthofeni* f. *arna* Fruh. PARALECTOTYPE det. R. L. Smiles 1979'.

BIONOMICS. There are records in the BMNH for January, April, May, June, July and August at altitudes from 300 to 1800 m. Stichel (1909: 170) gives, 'April to August, in 2 broods'.

*Polyura narcaea menedemus* (Oberthür) stat. n.

(Fig. 133)

*Charaxes satyrina menedemus* Oberthür, 1891: 13, pl. 2, fig. 9. LECTOTYPE ♂, CHINA: Tsekou (BMNH), here designated [examined].

*Charaxes narcaeus* var. *menedemus* Oberthür; Leech, 1892: 126.

*Murwareda menedemus* (Oberthür) Moore, [1896]: 267.

*Eriboea narcaea* ab. *menedemus* (Oberthür) Stichel, 1909: 170.

*Eriboea narcaea* d.s.f. *menedemus* (Oberthür); Fruhstorfer, 1914: 722.

*Eriboea narcaeus thibetanus* f. *menedemus* (Oberthür); Fruhstorfer, 1915: 39.

*Polyura narcaeus thibetanus* f. temp. *menedemus* (Oberthür) Stichel, 1939: 575.

MALE. *Upperside*. Similar to the pale form of *P. n. narcaea* with the submarginal spots of the forewing extending into cell  $R_4$ , but with these displaced away from the wing apex. Hindwing with tails much shorter than in that subspecies; white spots present at tornus.

There is some doubt as to whether this is a distinct subspecies due to an apparent overlap in distribution with the previous subspecies; however, of the four localities which are duplicated, 'Ta-t sien-lou', Siao-Lou and 'Siao-Ouisi' are, I believe, doubtful, and the fourth, 'Moenia', I have as yet not traced.

SIZE. ♂;  $\bar{x}$  = 35.4,  $s$  = 2.6 (40 specimens).

DISTRIBUTION. **China**: K'ang-Ting [Ta-t sien-lou]; N. of Chungtien [Siao-Ouisi]; [Moenia] (see above); [Lou-tse-Kiang]; Tsekou; Yunnan, Wei-hsi N. Yunnan, [Wei-Si-Bahand]; Yunnan, [Tsetchong]; Yunnan, Tali. 419 ♂.

TYPE-MATERIAL. Described from Tsekou and collected by R. P. Dubernard, but the types otherwise undistinguished. Two males in the BMNH bear the label; 'Levick Bequest 1941-83'. Of these, one bears the additional labels: 'Lectotype (purple) / Thibet Tsekou R. P. Dubernard / *Charaxes* var. *menedemus* Obthr. l'un des 2 exemplaires qui outreroi de modèle à la planche des

liv<sup>res</sup> XV. des Etud. d'Entom Juin 1891. / *Charaxes satyrina menedemus* Oberthür LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype. The remaining male bears the additional labels; 'Paralectotype (blue) / *Charaxes Menedemus* Obthr (le 2<sup>n</sup> specimen typicum). / *Charaxes satyrina menedemus* Oberthür PARALECTOTYPE det. R. L. Smiles 1979'.

**BIONOMICS.** Only a few specimens in the BMNH bear information other than the locality and the collector; however, those that do give months of capture of January, May to June and June.

*Polyura narcaea meghaduta* (Fruhstorfer)

(Fig. 134)

*Eriboea narcaeus meghaduta* Fruhstorfer, 1908: 127. LECTOTYPE ♂, TAIWAN (BMNH), here designated [examined].

*Eriboea narcaea* var. *formosana* Moltrecht, 1909: 132. Syntypes (sex?), TAIWAN (untraced) [not examined]. [Synonymized by Stichel, 1939: 577.]

*Eriboea narcaea meghaduta* Fruhstorfer; Fruhstorfer, 1914: 722, pl. 135a.

*Eriboea narcaea meghaduta* ab. *pallida* Lathy, 1926: 96, pl. 3, fig. 5. LECTOTYPE ♂, TAIWAN (MNHN, Paris), here designated [colour transparencies of upper and underside examined].

*Polyura narcaeus meghaduta* (Fruhstorfer) Stichel, 1939: 576; Okano & Ohkura, 1959: 45, pl. 44, fig. 136.

*Polyura narcaeus meghaduta* f. *pallida* (Lathy) Stichel, 1939: 577.

*Polyura narcaea meghaduta* (Fruhstorfer); Shirôzu, 1960: 253, pl. 59, figs 534–536, text-figs 282, 283.

**MALE.** As large as *P. n. narcaea*. *Upperside*. Submarginal spots in forewing not extending beyond cell  $R_5$  and displaced anteriorly from the wing apex. Hindwing with tails as in *P. n. narcaea*; white spots present at tornus. *Underside*. With brown bands often darker than in nominate subspecies. Pale green bands and spots almost white. Forewing discal cell with black spots (DII) large, often forming an irregular bar.

**SIZE.** ♂;  $\bar{x}$  = 39.2,  $s$  = 1.2 (31 specimens).

**DISTRIBUTION.** Taiwan (Formosa): [Chip Chip]; Chi-chi [Kasumigaseki, Shūshū]; [Shuisha]; [Kiayih]; Pu-li [Horisha]. 31 ♂.

**TYPE-MATERIAL.** *Eriboea narcaeus meghaduta* Fruhstorfer was described from three males which are now in the BMNH. All bear the following label; 'Fruhstorfer Coll. B.M. 1937–285.'. In addition, one male bears the labels; 'Lectotype (purple) / Type / CHIP CHIP VI 08 / *Eriboea narcaeus meghaduta* Fruhstorfer LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype. The two remaining specimens each bear the additional labels; 'Paralectotype (blue) / *Eriboea narcaeus meghaduta* Fruhstorfer PARALECTOTYPE det. R. L. Smiles 1979'. In addition, one male bears the labels; 'Formosa, Regenzeit Fruhstorfer / CHIP CHIP 16–31 VII 08', whilst the other bears the labels; 'Formosa Regenzeit Fruhstorfer / CHIP CHIP VI 08'.

*Eriboea narcaea meghaduta* ab. *pallida* Lathy was described from two males. I have seen photographs of one of these, now in the MNHN, Paris, which bears the following labels; 'ILE DE FORMOSA / *Eriboea narcaea* ♂ meghaduta ab. *pallida*, Lathy, Spec. typicum', and it is hereby designated lectotype.

**BIONOMICS.** Specimens in the BMNH were collected during May, June and July. One specimen was captured at 600 m. Fruhstorfer (1914: 722) states, 'Time of flight June at an elevation of about 1000 m.'.

*Polyura narcaea aborica* (Evans)

(Fig. 135)

*Eriboea narcaea* (sic) *aborica* Evans, 1924: 896, pl. 17, fig. F2.8. LECTOTYPE ♂, INDIA: N.E. Assam (BMNH), here designated [examined].

*Eriboea narcaea aborica* Evans; Evans, 1927: 94, pl. 17, fig. F2.8.

*Polyura narcaeus aborica* (Evans) Stichel, 1939: 576.

**MALE.** *Upperside*. Forewing with submarginal spots as in *P. n. meghaduta*. Hindwing with postdiscal black band blue-centred up to cell  $M_2$ , and narrower than in *P. n. thawgawa*.

SIZE. ♂; 2 specimens only, 34·1, 35·4.

DISTRIBUTION. **India:** Arunachal Pradesh? ('S.E. Thibet, Shemo R. '); Assam, Abor. 3 ♂.

TYPE-MATERIAL. Represented in the BMNH by three males, one of which bears the following labels; 'Lectotype (purple) / ASSAM: Abor. 5,500 ft. 4.vi.1913. W. H. Evans. / Brit. Mus. 1935-7. / *Eriboea narcaea aborica* Evans LECTOTYPE det. R. L. Smiles 1979', and is designated lectotype. The remaining two males bear the following labels; 'Paralectotype (blue) / *Eriboea narcaea aborica* Evans PARALECTOTYPE det. R. L. Smiles 1979'. In addition, one male bears the following labels; 'E. narcaea Shimo R. E. Tibet 2600' Bailey Exped'n 8.6.13 / ex coll. Hannington. / Rothschild Bequest 1939-1.', whilst the other male bears the additional labels; 'S.E. Thibet Shemo R. 2600 8.6.13 / Maj. F. M. Bailey Br. Mus. 1923-375 / B.M. TYPE No. Rh. 10450 *E. narcaeus aborica* ♂, Evans.'

BIONOMICS. No information other than that with the types.

*Polyura narcaea thawgawa* (Tytler) comb. n.

(Fig. 136)

*Eriboea narcaea thawgawa* Tytler, 1940: 109. LECTOTYPE ♂, BURMA (BMNH), here designated [examined].

MALE. Larger than *P. n. lissainei* with specimens from Vietnam the largest of all. *Upperside*. Forewing submarginal spots similar to but normally larger than those of *P. n. aborica*, *lissainei* or *meghaduta*. Hindwing with black postdiscal band darker and thicker than in *P. n. aborica* or *lissainei*, and mostly lacking a blue centre. Tails normally long; white spots present at tornus, but less well marked than in either *P. n. aborica* or *lissainei*.

SIZE. ♂;  $\bar{x}$  = 34·4,  $s$  = 2·0 (22 specimens).

DISTRIBUTION. **Burma:** Adung Valley; Haungtharaw Valley; Htawgaw. **Vietnam:** Tongking, [Ngai-Tio]. 23 ♂.

TYPE-MATERIAL. Described from a large series of males from Htawgaw. Of ten males in the BMNH, one bears the following labels; 'Lectotype (purple) / Htawgaw 5-8000' 1-7- $\frac{6}{27}$  / BURMA: Htawjaw. 5-8000ft. 1-7-vi-1927. H. C. Tytler. B.M. 1938-678 / *Eriboea narcaea thawgawa* Tytler LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype. The remaining nine males all bear the following labels; 'Paralectotype (blue) / *Eriboea narcaea thawgawa* Tytler PARALECTOTYPE det. R. L. Smiles 1979'. Eight of these bear the label; 'Htawgaw 5-8000' 1-7- $\frac{6}{27}$ '. Of these, seven bear the additional label; 'H. C. Tytler Coll. Brit. Mus. 1941-92', one the label; 'Brit. Mus. 1925-77', and one the labels; 'Hthawgaw N.E. Burma 9.6.27 / H. C. Tytler Coll. Brit. Mus. 1941-92'.

BIONOMICS. Specimens in the BMNH were captured during April, May and June, at altitudes between 1500 and 2450 m.

*Polyura narcaea lissainei* (Tytler)

(Fig. 137)

*Eulepis lissainei* Tytler, 1914: pl. 1, fig. 4; Tytler, 1915: 502. LECTOTYPE ♂, INDIA: Naga Hills (BMNH), here designated [examined].

*Eriboea narcaeus lissainei* (Tytler) Evans, 1924: 896, pl. 17, fig. F2.8; 1927: 94, pl. 17, fig. F2.8.

*Eriboea narcaea licsonei* (sic) (Tytler); Röber, 1925: 169.

*Polyura narcaeus lissainei* (Tytler) Stichel, 1939: 576.

The smallest of the subspecies.

MALE. *Upperside*. Forewing submarginal spots similar to those of *P. n. meghaduta* and *aborica*. Hindwing with black postdiscal band narrower and less well defined than in other subspecies, blue-centred only up to vein  $Cu_{1a}$  at the most. Tails long; pale spots very large at tornus.

SIZE. ♂;  $\bar{x}$  = 31·6,  $s$  = 0·9 (40 specimens).

DISTRIBUTION. **Thailand** (Siam): Bangkok. **India**: Naga Hills, Kohima; Naga Hills, [Kirbari]; Naga Hills, [Jakama]; Naga Hills, [Phesima]; [Di Chu]. 55 ♂.

TYPE-MATERIAL. Described from 16 males which are now in the BMNH. One male bears the following labels; 'Lectotype (purple) / Phesima, Naga Hills, May 1914 (Col. Tytler) / Rothschild Bequest B.M. 1939-1. / Eulepis lissainei Tytler LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype. All the remaining specimens bear the following labels; 'Paralectotype (blue) / Eulepis lissainei Tytler PARALECTOTYPE det. R. L. Smiles 1979'. In addition, two bear the labels; 'Phesima Naga Hills 5-7000' 4.13 / H. C. Tytler Coll. Brit. Mus. 1941-92', two the labels; 'Phesima Naga Hills. 5-7000' 5.13 / H. C. Tytler Coll. B.M. 1941-92.', one the labels; 'Phesima, Naga Hills, May 1914 (Col. Tytler) / Rothschild Bequest B.M. 1939-1.', one the labels; 'Phesima Naga Hills 5-7000' 4.13 / Rothschild Bequest B.M. 1939-1.', two the label; 'Phesima, Naga Hills. Assam. 5.1914 Col. H. C. Tytler. 1918-61', two the labels; 'Phesima, Naga Hills. H. T. Tytler / Phesima 5.14.', one the labels; 'Phesima 5.14 Manipur H. C. Tytler / Archibald Coll. B.M. 1926-391.', and four the labels; 'E. lissainei ♂ Phesima 5-14 / H. C. Tytler Coll. Brit. Mus. 1941-92'.

BIONOMICS. Specimens in the BMNH have been captured during April, May, June, July and August, at altitudes between 1400 and 2100 m.

*Polyura eudamippus* (Doubleday)

(Figs 6, 46-48, 62-64, 154-159)

*Charaxes eudamippus* Doubleday, 1843: 218, pl. 8; de Nicéville, 1886: 273.

*Eulepis eudamippus* (Doubleday) Rothschild & Jordan, 1898: pl. 8, figs 1-6, pl. 13, figs 15, 16; 1899: 263.

*Eriboea eudamippus* (Doubleday) Fruhstorfer, 1914: 722, pl. 134d.

*Polyura eudamippus* (Doubleday) Stichel, 1939: 577; Lewis, 1974: 271, pl. 150, fig. 3; Duckworth, Watson & Whalley, 1975: 267, figs 236d, e; Morishita, 1977: 3, figs 1, 3, 4, 6, 8-14.

MALE, FEMALE. *Upperside*. Ground colour black. Forewing with pale markings light yellow. A submarginal series of pale spots and a postdiscal series of larger pale spots are present. A discal spot lies at the end of the discal cell in cell  $M_2$ , and beyond this, in cells  $M_1$  and  $R_5$ , lie two similar, but smaller spots. The discal band, or disco-basal patch runs from vein  $M_3$  to the inner margin. Hindwing outer margin dentate, black; tails long and blue-centred. Admarginals yellow, blue, or mixed. Submarginal spots white, the largest in cell  $R_1$ , and becoming smaller towards cell  $Cu_{1b}$ . Disco-basal patch pale yellow, covering most of the wing, and lying adjacent to a series of blue-glaucous chevrons (derived from the externae of the ocelli). A brown, loosely defined band often runs from the base of the wing to the tornus, as in *P. narcaea*, and *posidonius*. *Underside*. Ground colour silvery white. White patches and spots correspond to the pale yellow ones of the upperside. Forewing with a well-defined green-yellow band running along the outer margin, and a Y-shaped system of similarly coloured bands lying at the end of, and outlining part of the discal cell, as in *P. posidonius* and *narcaea*. As is the case in the latter, this system of bands is outlined distally by MI and DI, and proximally by DII. Like *P. dolon* or *narcaea*, there is a costal band. A further greenish yellow band runs from the costal margin, past the end of the 'Y' and ends on the inner margin, distally bordering a complete series of black chevrons. DII is reduced to form two black spots in the discal cell. Hindwing admarginals greenish yellow, yellow at tornus. Submarginal spots black, white proximally. Postdiscal spots, unlike those of *P. posidonius* or *narcaea*, are chevron-shaped, black-outlined, and lie on the distal edge of a greenish/yellow band which runs from the costal margin to the anal margin just above the tornus, and it is this colour which shows through to the centre of the spots. A yellow band runs from the costal margin near the wing base and curves to end near the tornus. The anterior portion is delineated by MI and MII.

Male with abdomen white or brown above, white or partly white beneath. Female with abdomen white or brown above and brown beneath.

RANGE. From northern and eastern India and Bangladesh, south through Burma, Thailand, Laos, Cambodia, Vietnam to West Malaysia, and east to China, Hainan, Taiwan and Okinawa.

*Polyura eudamippus eudamippus* (Doubleday)

(Figs 46, 62, 154)

*Charaxes eudamippus* Doubleday, 1843: 218, pl. 8; Gillmer, 1906: 23. LECTOTYPE ♂, BANGLADESH (BMNH), here designated [examined].

*Nymphalis eudamippus* (Doubleday) Westwood, 1850: 309; Kirby, 1871: 271; Staudinger, 1886: 173, pl. 59.  
*Eulepis eudamippus* (Doubleday) Swinhoe, 1893: 289.  
*Eulepis eudamippus eudamippus* (Doubleday); Rothschild & Jordan, 1898: pl. 8, fig. 1; 1899: 265.  
*Eriboea eudamippus eudamippus* (Doubleday) Fruhstorfer, 1914: 722, pl. 134d; Evans, 1924: 896; 1927: 94.  
*Eulepis eudamippus* (sic) (Doubleday); Antram, 1924: 130, fig. 264.  
*Polyura eudamippus* [*eudamippus*] (Doubleday) Stichel, 1939: 577.  
*Polyura eudamippus eudamippus* (Doubleday); Morishita, 1977: 3, fig. 1.

MALE, FEMALE. *Upperside*. Forewing with discal cell yellow, wing base only slightly brown. Hindwing with submarginal black band narrow, more like a series of conjoined ocelli, containing large submarginal white spots. No brown band present running from the wing base to the tornus.

Underside with yellow bands paler than in *P. e. peninsularis*, *formosana*, *whiteheadi*, or *rothschildi*. Hindwing postdiscal chevrons rather more blue-centred than in some subspecies.

SIZE. ♂:  $\bar{x}$  = 49.3,  $s$  = 1.9 (40 specimens). ♀:  $\bar{x}$  = 58.4,  $s$  = 2.4 (21 specimens).

DISTRIBUTION. **India**: Nepal; Darjeeling; Gangtok; Kurseong; Lachen Lachung; Tumlong; Sikkim, [Phe-dong]; Sikkim, [Troomling]; Bhutan; [Rani st]; upper Assam, Margherita; Khasi Hills, Cherrapunji; Garo Hills; Assam, Shillong; Jaintia Hills; Abor Hills; Manipur, Imphal; Naga Hills, [Jakama]; Naga Hills, Nichuguard; Naga Hills, Tamu. **Bangladesh**: Sylhet. 202, ♂, 22 ♀.

TYPE-MATERIAL. Described from an unspecified number of syntypes from Sylhet. These are represented in the BMNH by three males and two females. One male bears the following labels; 'Lectotype (purple) / Silhet / B.M. TYPE No. Rh. 10442. / *Charaxes eudamippus* Doubleday LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype. The remaining specimens all bear the following labels; 'Paralectotype (blue) / *Charaxes eudamippus* Doubleday PARALECTOTYPE det. R. L. Smiles 1979'. Of these, one male bears the additional label; 'Silhet', one female the labels; 'Silhet / Silhet. Bought from Sowerby 45.33.', and one male the labels; 'Silhet. donée par M. Doubleday. / Ex Musaeo Arch. Guenée'.

BIONOMICS. Specimens in the BMNH have been captured during March to April, April, May, June, July, August, September and October at altitudes up to 1800 m. Several specimens from Lachen Lachung were supposedly collected between 2450 and 4900 m. Rothschild & Jordan (1899: 265) record that this subspecies is found commonly in the beds of streams, while Fruhstorfer (1914: 722) records that it is 'Common in the hot valleys of Sikkim'.

EARLY STAGES. Egg; spherical with longitudinal ribs and weak transverse ribbing, approximately 1.6 mm diameter (Gillmer, 1906: 23).

### *Polyura eudamippus nigrobasalis* (Lathy)

(Fig. 155)

*Charaxes nigrobasalis* Lathy, 1898: 192. LECTOTYPE ♂, THAILAND (BMNH), here designated [examined].  
*Eulepis eudamippus* (Doubleday); Rothschild & Jordan, 1898: pl. 8, figs 2, 3.  
*Eulepis eudamippus nigrobasalis* (Lathy) Rothschild & Jordan, 1899: 266.  
*Eriboea eudamippus jamblichus* Fruhstorfer, 1914: 722; Evans, 1924: 896; 1927: 94. LECTOTYPE ♂, BURMA (BMNH), here designated [examined]. **Syn. n.**  
*Eriboea eudamippus nigrobasalis* (Lathy) Fruhstorfer, 1914: 722; Evans, 1924: 896, pl. 17, fig. F2. 10; 1927: 94, pl. 17, fig. F2. 10.  
*Eriboea eudamippus celetis* Fruhstorfer, 1914: 722. Holotype ♂, VIETNAM (BMNH) [examined].  
*Eriboea eudamippus nigra* Lathy, 1926: 97. Holotype ♂, LAOS (MNHN, Paris) [colour transparencies of upper and underside examined].  
*Eriboea eudamippus major* Lathy, 1926: 97. LECTOTYPE ♂, VIETNAM (MNHN, Paris), here designated [colour transparencies of upper and underside examined]. **Syn. n.**  
*Polyura eudamippus jamblichus* (Fruhstorfer) Stichel, 1939: 579; Morishita, 1977: 12, fig. 13.  
*Polyura eudamippus nigrobasalis* (Lathy) Stichel, 1939: 579; Morishita, 1977: 12, fig. 11; Pinratana, 1979: 100, fig. N171b.  
*Polyura eudamippus nigra* (Lathy) Stichel, 1939: 580.  
*Eriboea eudamippus splendens* Tytler, 1940: 110. LECTOTYPE ♂, BURMA (BMNH) here designated [examined]. **Syn. n.**



*Eriboea eudamippus chota* Tytler, 1940: 110. Holotype ♂, BURMA (BMNH) [examined]. **Syn. n.**  
*Polyura eudamippus major* (Lathy) Stichel, 1939: 580; Morishita, 1977: 12.

**MALE.** *Upperside.* Forewing with discal cell black or pale yellow with all degrees of intermediate. Hindwing with submarginal black band broader than in *P. e. eudamippus*, and markedly broader at the wing apex than at the tornus, with submarginal white spots generally smaller than those of *P. e. eudamippus*, but larger than those of *P. e. cupidinius*, *peninsularis*, *whiteheadi*, *formosana* or *rothschildi*. Admarginals normally yellow, sometimes glaucous towards the distal edge. Only the smallest hint of a brown band running from the wing base to the tornus in even the darkest specimens. *Underside.* Postdiscal chevrons sometimes completely blue-centred.

Possible subspeciation in Burmese (*chota*, *spendens*, *jamblichus*), Vietnamese (*celetis*, *major*), and Laotian (*nigra*) populations appears tenuous, named subspecies being based on a few individuals showing such differences in character as colour of abdomen, width of hindwing band etc. It can be seen from a sufficiently long series that butterflies from the same locality exhibit a high degree of variation of these characters. In view of this the above taxa are treated here as synonyms.

**SIZE.** ♂;  $\bar{x}$  = 47.0, *s* = 4.1 (40 specimens).

**DISTRIBUTION.** **Vietnam:** Tongking, [Ngai-Tio]; [Riviere Noire]; Xom Giong. **Laos:** [Pak Munung]; Cataracts of Xé Kong [Sekong] R.; [Muang Baw]. **Cambodia:** Phnom Penh. **Thailand (Siam):** Khlung Khlung; [Pak-a-jong]; [Prachuap Prov., Pak Tawan]; Pak Chong; Hin Lap; [Hue Tak So]; [Muok Lek]; [Mae Melong Forest]; [Melanoung, Hot Springs]. **Burma:** Salween District, Papun to [Mai-hong-song]; Tavoy; Dawna Range. Tenasserim; Ataran Valley, [Kwi kalon], Haungtharaw Valley, Tenasserim; East Pegu; Bassein; Pattechaung, Karen Hills; Gokteik; Upper Mekong, Shan States; [Muong Gnow], Shan States; Loimwe, Shan States; Maymyo, N. Shan States; [Meetan]; Me Song; N. Chin Hills; East Bhamo District; Katha; Sadon; Hukawng Valley, [Muenghi Hill Tracts]; Nampandet; [Gole Tutap]; Htawgaw. 117♂.

**TYPE-MATERIAL.** *Charaxes nigrobasalis* Lathy was described from two males which are now in the BMNH, and which bear the following labels; 'Pak-a-jong. Siam / B.M. TYPE No. Rh. 10591[2]'. In addition, one male bears the labels; 'Lectotype (purple) / Adams Bequest B.M. 1912-399. / Charaxes nigrobasalis Lathy LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype. The remaining male bears the additional labels; 'Paralectotype (blue) / Charaxes nigrobasalis Lathy PARALECTOTYPE det. R. L. Smiles 1979'.

*Eriboea eudamippus jamblichus* Fruhstorfer was described from an unspecified number of males from Tenasserim. One specimen in the BMNH bears the following labels; 'Lectotype (purple) / Type / Lower Burma Fruhstorfer. / Fruhstorfer Coll. B.M. 1937-285. / Eriboea eudamippus jamblichus Fruhstorfer LECTOTYPE det. R. L. Smiles 1979', and is designated lectotype.

*Eriboea eudamippus celetis* Fruhstorfer was described from an unspecified number of specimens of which one was indicated as the 'type'. There are two males in the BMNH which bear the following labels; 'Süd-Annam Xom-Gom Februar H. Fruhstorfer / Rothschild Bequest B.M. 1939-1.'. One of these bears the additional labels; 'Holotype (red) / Type (red) / Eriboea eudamippus celetis Fruhstorfer HOLOTYPE det. R. L. Smiles 1977'. The other male bears the additional labels; 'Paratype (yellow) / Eriboea eudamippus celetis Fruhstorfer PARATYPE det. R. L. Smiles 1977'.

*Eriboea eudamippus nigra* Lathy was described from one male. This holotype is now in the MNHN, Paris, and bears the following labels; 'Cataracts of Sekong R., Laos, end II. beg. III.04. (W. Micholitz) / TYPE / Type / Eulepis ♂ eudamippus nigra Lathy Spec. typicum'.

*Eriboea eudamippus major* Lathy was described from five males from Tongking. I have received photographs of one of these specimens from the MNHN, Paris, which bears the following labels; 'Tonkin / Eulepis eudamippus major, Lathy Spec. typicum', and is hereby designated lectotype.

*Eriboea eudamippus splendens* Tytler was described from an unspecified number of specimens from Htawgaw. Two males in the BMNH bear the label; '♂ Htawgaw N. Burma 7.6.27'. In addition, one male bears the labels; 'Selected as type (G. T.) / E. eudamippus splendens Tytler 1940. / Eriboea eudamippus splendens Tytler LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype. The remaining male bears the additional labels; 'Paralectotype (blue) / H. C. Tytler Coll. Brit. Mus. 1941-92 / Eriboea eudamippus splendens Tytler PARALECTOTYPE det. R. L. Smiles 1979'.

*Eriboea eudamippus chota* Tytler was described from a series from Maymyo in which a male 'type' was indicated. In the BMNH are a male holotype and three male paratypes. The holotype bears the following labels; 'Holotype (red) / Maymyo E 3800 14.9.26 / Type selected by G. T. / *E. eudamippus chota* s-sp. nov. Tyt. / *Eriboea eudamippus chota* Tytler HOLOTYPE det R. L. Smiles 1977'. The three paratypes bear the following labels; 'Paratype (yellow) / H. C. Tytler Coll. Brit. Mus. 1941-92 / *Eriboea eudamippus chota* Tytler PARATYPE det. R. L. Smiles 1977'. In addition, one bears the label; 'Maymyo N. Shan States.', one the label; 'Loimwe S. Shan States 3.28', and one the label; 'Loimwe S. Shan States 4.28'.

BIONOMICS. There are records in the BMNH for all months of the year except December, at altitudes up to 1500 m.

*Polyura eudamippus cupidinius* (Fruhstorfer)

(Fig. 156)

*Eriboea eudamippus cupidinius* Fruhstorfer, 1914: 722. Holotype (sex?), CHINA: Yunnan (possibly in the Royal Scottish Museum, Edinburgh) [not examined].

*Eriboea eudamippus le moulti* Joicey & Talbot, 1916: 65, pl. 5, fig 1. LECTOTYPE ♂, CHINA: Tibet (BMNH), here designated [examined]. **Syn. n.**

*Polyura eudamippus cupidinius* (Fruhstorfer) Stichel, 1939: 581; Morishita, 1977: 12.

*Polyura eudamippus lemoulti* (Joicey & Talbot) Stichel, 1939: 580; Morishita, 1977: 12.

MALE, FEMALE. *Upperside*. Forewing with discal cell and base of wing brown or black, sometimes with a little diffuse pale scaling in the cell. Hindwing with submarginal black band very broad and evenly defined; less tapering than in other subspecies. Admarginals yellow, glaucous towards distal edge and very large at tornus. Base slightly brown, but no brown band between base and tornus. *Underside*. Hindwing with postdiscal chevrons normally only slightly blue-edged. Yellow admarginal at tornus large and completely interrupting silvery white submarginal ground colour to join with postdiscal yellow band.

The types of *Eriboea eudamippus lemoulti* Joicey & Talbot agree to a great extent with specimens from Yunnan, and any slight differences are likely to be due to variation.

SIZE. ♂;  $\bar{x} = 48.1$ ,  $s = 2.0$  (11 specimens). ♀; 1 specimen only, 50.8.

DISTRIBUTION. **China**: Tibet, [Vrianosong]; S.E. Tibet, Pemako, K'a-p'u; N. of Chungtien [Siao-Ouisi] Yunnan, [Pe Yen Tsin]; Yunnan, [Bahand]. 12♂, 1♀.

TYPE-MATERIAL. *Eriboea eudamippus cupidinius* Fruhstorfer, according to the original description was represented by a 'type in the Coll. Adams of the British Museum'. Much of this collection, and possibly this holotype, is now in the Royal Scottish Museum, Edinburgh, although it has yet to be found.

*Eriboea eudamippus lemoulti* Joicey & Talbot was described from six males from 'Vrianosong', Tibet. These specimens are now in the BMNH, and all bear the following label; 'Vrianosong Tibet'. In addition, one bears the labels; 'Lectotype (purple) / Joicey Bequest. Brit. Mus. 1934-120. / *Eriboea eudamippus le Moulty* Joicey & Talbot ♂ TYPE. / *Eriboea eudamippus lemoulti* Joicey & Talbot LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype. The remaining five males bear the additional labels; 'Paralectotype (blue) / *Eriboea eudamippus lemoulti* Joicey & Talbot PARALECTOTYPE det. R. L. Smiles 1979'. In addition four of these bear the label; 'Joicey Bequest. Brit. Mus. 1934-120.', and one the label; 'Levick Bequest 1941-83'.

BIONOMICS. Specimens in the BMNH were captured during January and June. One specimen was taken at 900 m.

*Polyura eudamippus rothschildi* (Leech)

(Figs 47, 63)

*Charaxes ganymedes* Leech, 1891: 30. LECTOTYPE ♂, CHINA: Sichuan (BMNH), here designated [examined]. [Junior primary homonym of *Charaxes ganymedes* Staudinger, 1886.]

*Charaxes rothschildi* Leech, 1892: 128, pl. 14, fig. 3; Oberthür, 1912: 316, pl. 105, fig. 971. [Replacement name for *Charaxes ganymedes* Leech.]

*Murwareda rothschildi* (Leech) Moore, [1896]: 267.

*Eulepis eudamippus* (Doubleday); Rothschild & Jordan, 1898: pl. 8, figs 5, 6.

*Eulepis eudamippus rothschildi* (Leech) Rothschild & Jordan, 1899: 267.

*Eriboea rothschildi* (Leech) Stichel, 1909: 169, pl. 52c.

*Eriboea eudamippus rothschildi* (Leech); Fruhstorfer, 1914: 722.

*Polyura eudamippus rothschildi* (Leech) Stichel, 1939: 580; Morishita, 1977: 11, fig. 10.

**MALE, FEMALE.** Wing shape more elongate than in other subspecies. *Upperside.* Forewing with discal cell and base of wing down to the inner margin dark brown or black, and the pale yellow discal band proportionately narrower than in any other subspecies except *weismanni*. Outer margin of this band much straighter than in *P. e. formosana*. Pale yellow submarginal and postdiscal spots as large as in any subspecies and normally rounded, unlike those of *P. e. cupidinius*, *nigrobasalis*, or *eudamippus* which are somewhat chevron-shaped. Hindwing with admarginals yellow, glaucous towards distal edge, or sometimes mostly glaucous. Submarginal black band broad, tapering strongly towards tornus. Distal edge of disco-basal patch straight between costal margin and vein  $Cu_{1a}$  in male, less so in female. Both sexes possess a brown band which runs from the wing base to the tornus although this is less strongly marked in the female than in the male. *Underside.* Postdiscal chevrons showing only very slight blue scaling and this on the proximal black border of each chevron.

**SIZE.** ♂;  $\bar{x} = 44.9$ ,  $s = 1.5$  (40 specimens), ♀;  $\bar{x} = 53.8$ ,  $s = 2.3$  (12 specimens).

**DISTRIBUTION.** **China:** Sichuan; [Tchang-Kou]; Ichang; [Chow-pin-sa]; N. Fujian; O-mei Shan; S. of Siao Lou [Ya-Tcheou]; Pao-hsing [Moupin]; Siao Lou; K'ang-Ting [Ta-t sien-Lou]; S.W. of Siao Lou [Kiong-Tchéou]; W. of Yaan [Ta-Lou, Yui-Kin]; [Frontiere Oriental du Thibet]. 179♂, 12♀.

**TYPE-MATERIAL.** Represented in the BMNH by a type-series of six males and one female all of which bear the label; 'Leech Coll. 1901-173.'. In addition, one male bears the labels; 'Lectotype (purple) / Omei-Shan, 3620 ft. Native coll. July & Aug. 1890. / B.M. TYPE No. Rh. 10444. / Charaxes rothschildi Leech LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype. The remaining specimens all bear the labels; 'Paralectotype (blue) / Charaxes rothschildi Leech PARALECTOTYPE det. R. L. Smiles 1979'. In addition, one male bears the label; 'Omei-Shan, 3620 ft. Native coll. May & June 1890.', one female the labels; 'Omei-Shan, 3620 ft. Native coll. May & June 1890. / B.M. TYPE No. Rh. 10445.', one male the label; 'Chow-pin-sa May & June', and three males the label; 'Moupin. Kricheldorf coll. June 1890.'.

**BIONOMICS.** Specimens in the BMNH were taken during May and June, June, and July and August; several at an altitude of approximately 1100 m.

#### *Polyura eudamippus kuangtungensis* (Mell)

*Eriboea eudamippus kuangtungensis* Mell, 1923: 158. Syntypes ♂, CHINA (probably in MNHU, Berlin) [not examined].

*Polyura eudamippus kuangtungensis* (Mell) Stichel, 1939: 580; Morishita, 1977: 11.

**MALE.** *Upperside.* According to the original description, has the discal bands of both wings paler than in *P. e. rothschildi*, which it most clearly resembles, and the black stripe which runs from the base to the tornus in the hindwing is broader. The underside with the black bars on the distal edge of the postdiscal brown bands of both wings enlarged. Beyond the bar at the end of the forewing cell there are two large black spots, and distal to these are two further smaller elongate spots.

**DISTRIBUTION.** **China:** mountain forests to the north of Guangdong Province (Mell, 1923: 158). I have not seen any specimens.

**TYPE-MATERIAL.** Described from 14 males, none of which was cited as a holotype. These syntypes are probably in the MNHU, Berlin.

#### *Polyura eudamippus whiteheadi* (Crowley)

(Fig. 157)

*Eulepis eudamippus whiteheadi* Crowley, 1900: 506, pl. 35, fig. 1. LECTOTYPE ♂, HAINAN (BMNH), here designated [examined].

*Eriboea eudamippus whiteheadi* (Crowley) Fruhstorfer, 1914: 723.

*Polyura eudamippus whiteheadi* (Crowley) Stichel, 1939: 580; Morishita, 1977: 11.

**MALE.** *Upperside.* Forewing with discal cell and base of wing down to the inner margin black or dark brown. Pale discal band proportionately wider than in *P. e. weismanni*, *formosana* or *rothschildi*. Outer margin of this band straighter than in *P. e. formosana*. Hindwing admarginals slightly glaucous, becoming blue. Submarginal black band very narrow, forming a series of conjoined ocelli which are proximally strongly blue. Outer edge of disco-basal patch runs right up to these ocelli and is regularly curved. Brown band runs from base and peters out half way to the tornus. *Underside.* Yellow bands narrower than in any other subspecies. Forewing with outer marginal band grey-brown and very narrow. A black bar runs across cells  $R_5$  and  $M_1$  beyond the end of the discal cell as in *P. e. formosana*, and *weismanni*.

**SIZE.** ♂; 3 specimens only, 41.9, 42.2, 43.9.

**DISTRIBUTION.** Hainan. 3 ♂.

**TYPE-MATERIAL.** The type-series is represented in the BMNH by two males which bear the following labels; 'Hainan Whitehead / Hainan. Crowley Bequest 1901-78.'. In addition one male bears the following labels; 'Lectotype (purple) / Type / B.M. TYPE No. Rh. 10443 / Eulepis eudamippus whiteheadi Crowley LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype. The remaining male bears the additional labels; 'Paralectotype (blue) / Eulepis eudamippus whiteheadi Crowley PARALECTOTYPE det. R. L. Smiles 1979'.

**BIONOMICS.** None of the specimens that I have seen give any information as to date of capture or altitude. Very rare (Fruhstorfer, 1914: 723).

### *Polyura eudamippus formosana* (Rothschild)

(Figs 48, 64)

*Eulepis eudamippus* (Doubleday); Rothschild & Jordan, 1898: pl. 8, fig. 4.

*Eulepis eudamippus formosanus* Rothschild, 1899: 268. Holotype ♂, TAIWAN (BMNH) [examined].

*Eriboea eudamippus formosanus* (Rothschild) Fruhstorfer, 1908: 127; 1914: 722, pl. 134c.

*Polyura eudamippus formosanus* (Rothschild) Stichel, 1939: 581; Shirôzu, 1960: 251, pl. 59, figs 531-533, text-fig. 280; Morishita, 1977: 11, fig. 9.

**MALE, FEMALE.** *Upperside.* Very similar to *P. e. whiteheadi*, except submarginal spots of forewing outer margin smaller, postdiscal bands of both wings narrower, and their edges more irregular, being extended along the veins. The submarginal black band of the hindwing is wider and tapers sharply to the tornus. The admarginals are, for the most part, blue, yellow at the tornus. *Underside.* Yellow bands broader than in any other subspecies except *P. e. weismanni*. As in *P. e. whiteheadi* and *weismanni*, a black bar runs across cells  $R_5$  and  $M_1$  beyond the end of the discal cell of the forewing. Postdiscal chevrons of the hindwing are sometimes without any blue, but normally show a little proximally.

The female is much larger than the male, and the bands of the upperside are slightly more yellow.

**SIZE.** ♂;  $\bar{x}$  = 41.2,  $s$  = 2.1 (40 specimens),  $\bar{x}$  = 51.4,  $s$  = 1.7 (6 specimens).

**DISTRIBUTION.** Taiwan (Formosa): [Le-hi-ku]; [Polisha]; [Konosu, Saitana]; [Chip Chip]; Chi-chi [Kasumigaseki, Shūshū]; T'a-k'ai shan; Chia-i district [Kagi Distr.]; Kuan-tsu-ling [Kanshirei]; Pu-li [Horisha]; Chi-lung [Keelung]; [Patchima]. 44 ♂, 7 ♀.

**TYPE-MATERIAL.** Described from a male holotype, one male and three female paratypes all of which are now in the BMNH, and which bear the following label; 'Rothschild Bequest B.M. 1939-1.'. In addition, the holotype bears the following labels; 'Holotype (red) / Keelung, 25.vii.96 (Jonas) / Eulepis eudamippus formosanus Roths. HOLOTYPE det. R. L. Smiles 1977'. The paratypes all bear the labels; 'Paratype (yellow) / Eulepis eudamippus formosanus Roths. PARATYPE det. R. L. Smiles 1977'. In addition, one male bears the label; 'Patchima, N. Formosa vii.96, Jonas', two females the label; 'Keelung viii.97. (Jonas)', and one female the label; 'Formosa'.

**BIONOMICS.** Specimens in the BMNH were collected during May, June, July and August, at altitudes up to 600 m.

*Polyura eudamippus weismanni* (Fritze)

(Figs 6, 158)

*Charaxes weismanni* Fritze, 1894: 898, fig. 12. 3 Syntypes (sex ?), OKINAWA (untraced) [not examined].*Eulepis eudamippus weismanni* (Fritze) Rothschild & Jordan, 1899: 269.*Eriboea eudamippus weismanni* (Fritze) Fruhstorfer, 1914: 723.*Polyura eudamippus weismanni* (Fritze) Stichel, 1939: 581; Shirôzu & Hara, 1962: 25, 38, pl. 80, fig. 11, pl. 93, figs 142.1-7; Kubo, 1963: 17, figs 5-18; Takahashi, Tanaka & Wakahashi, 1973: 88; Morishita, 1977: 10.

**MALE.** *Upperside.* Forewing mostly black except for a very narrow discal band, the submarginal and postdiscal spots, a spot at the end of the discal cell, and two discal spots in cells  $R_5$  and  $M_1$ . Hindwing with admarginals pale yellow; tails short, slightly blue-centred. Submarginal black band fairly wide and tapering strongly to the tornus. Submarginal spots large. Outer margin of disco-basal patch straight; basal band ends diffusely in cell  $Cu_{1b}$ . *Underside.* All yellow bands very broad, proportionately broader than in any other subspecies: that which runs along vein  $M_3$  of the forewing joining the postdiscal yellow band. As in *P. e. formosana* and *whiteheadi*, a black bar runs across cells  $R_5$  and  $M_1$  in the forewing, beyond the end of the discal cell. Hindwing postdiscal chevrons lacking any blue.

**SIZE.** ♂; 1 specimen only, 40.5.**DISTRIBUTION.** N. Okinawa: Motubu Peninsula; Nago; Haneji; Ôgimi; Kunigami; Yabu (Kubo, 1963: 15). 1 ♂.

**BIONOMICS.** The specimen in the BMNH was collected during August. According to Kubo (1963: 15) the adult butterflies have been taken chiefly in May, and from July to August, one specimen as early as April. The butterfly seems to be double brooded, but a small third brood may occur between September and October. They have the typical patrolling nature of the group, and both sexes are attracted to overripe and rotten fruit, especially pineapples, and tree sap (Kubo, 1963: 16).

The wasp *Telenomus kubo* has been found parasitizing the egg (Kubo, 1963: 21).

**EARLY STAGES.** Eggs are usually laid singly, normally on the upper surface, but occasionally on the underside of a leaf of the foodplant. They are spherical, approximately 1.8 mm diameter, with a flat top of about 1.3 mm diameter. The height is approximately 1.6 mm. It is minutely reticulated except for the upper part which has a ribbed area of thirty-two or thirty-three ridges starting on the flat-topped surface about two-thirds of the distance from the centre, and extends a similar distance below the margin of the flat top. It is pale yellow with a transparent and very thin shell (Kubo, 1963: 18, figs 5, 6; Shirôzu & Hara, 1962: 38, pl. 93, fig 142.1).

The egg hatches in three to five days, the larva on emergence eating part of the shell. The first instar larva is 6-7 mm long and possesses four straight horns, the inner two being about 2 mm long. They together with the caudal prominences, are black, the rest of the head mask being mostly pale brown; the body after feeding is pale green. The first moult occurs after about one week, the second instar larva having yellow horns, the colour extending to form a yellow rim to the mask. There is a yellow lateral line extending into the caudal projections which are likewise yellow. The dorsal surface becomes conspicuously granular. During the second instar the larva grows from approximately 8 mm to 14 mm long. After a further week it moults again, becoming about 19 mm long, growing in approximately four days to about 24 mm long when it undergoes a third moult. The fourth instar larva grows from 26 mm to 34 mm long in about nine days. The fifth instar larva (Fig. 6) measures 38 mm in length after the fourth moult, and in the observed cases, being both autumn larvae which went on to hibernate, the duration of this stage was about one month. It seems likely that in earlier broods this stage would be much shorter. The horns are exceptionally long, and the mask is much longer than broad. The outer horns are outwardly convex and are about 8 mm long, while the inner pair are fairly straight, curving only slightly inwards. They are serrated or spined, perhaps slightly less than in the fourth instar larva. The head is pale green with darker green bands running from the mouth to the horns which are yellowish green, as is the periphery of the mask. The serrations on the horns are black-tipped. The body is green, paler ventrally, and the surface finely granulated with yellow points. There is a yellow lateral line formed by the high density of these points, and the caudal projections are

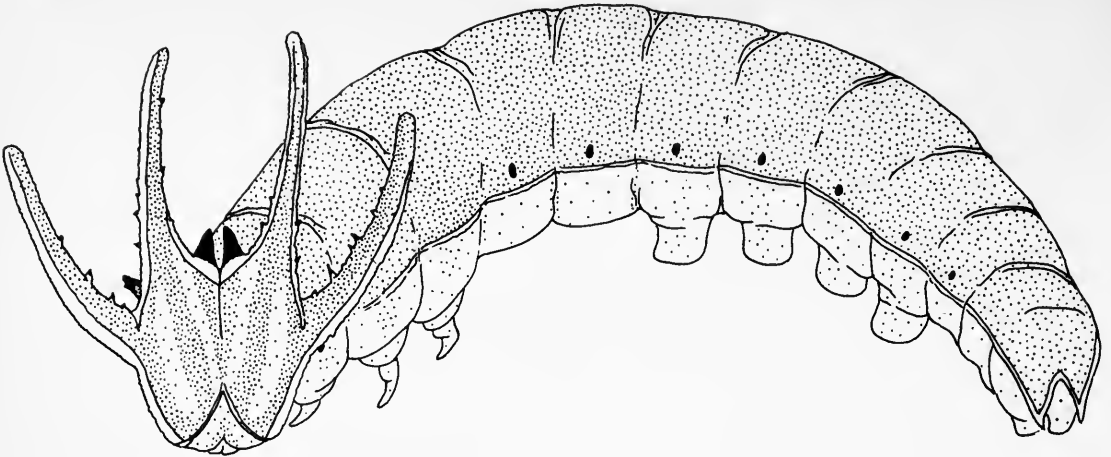


Fig. 6 Fifth instar larva of *Polyura eudamippus weismanni* (Fritze).

likewise yellow (Kubo, 1963: 18, figs 7–14; Shirôzu & Hara, 1962: 38, pl. 93, figs 142.2–5; Takahashi, Tanaka & Wakahashi, 1973: 86, 88, figs).

The larva usually pupates on a twig, never on the underside of a leaf. They may leave the foodplant to do so, especially if they are diapausing. The prepupal stage in autumn lasts about five days. The pupa is round, smooth, translucent emerald-green, sometimes with thin yellow lines, and very similar to other *Polyura* species (Kubo, 1963: 20, figs 15–18; Shirôzu & Hara, 1962: pl. 93, figs 142.6, 7).

According to Kubo (1963: 21) the butterfly overwinters as a pupa, but the possibility cannot be discounted that the larva may, in some cases overwinter, as Okinawa is free from frost.

Recorded foodplants are: *Rhamnella franguloides* (Rhamnaceae), *Celtis boninensis* (Ulmaceae) (Kubo, 1963: 17, figs 3, 4).

### *Polyura eudamippus peninsularis* (Pendlebury)

(Fig. 159)

*Eriboea eudamippus peninsularis* Pendlebury, 1933: 398; Corbet & Pendlebury, 1934: 178, pl. 12, fig. 157.

Holotype ♂, WEST MALAYSIA: Pahang (BMNH) [examined].

*Polyura eudamippus peninsularis* (Pendlebury) Stichel, 1939: 580; Corbet & Pendlebury, 1956: 245; Fleming, 1975: 54; Morishita, 1977: 13; Corbet & Pendlebury, 1978: 213.

**MALE.** *Upperside.* Forewing very similar to *P. e. eudamippus*, but with all or most of the discal cell and the wing base black or dark brown. Submarginal and postdiscal spots smaller than in that subspecies. Hindwing with admarginals completely yellow. Submarginal black band as in *P. e. eudamippus*. Base of wing slightly brown. *Underside.* Similar to *P. e. eudamippus*, but with yellow bands slightly narrower and browner. Forewing with DII much smaller, sometimes reduced to only one small black spot. Postdiscal chevrons of hindwing with a little peripheral blue.

**SIZE.** ♂; 5 specimens only, 44.9, 43.4, 42.6, 44.2, 44.6.

**DISTRIBUTION.** **West Malaysia:** Pahang, Cameron Highlands; Pahang, Lubok Temang; South Perak, Gunong Jasar; Perak, Batang Padang, [Jor Camp]. 5 ♂.

**TYPE-MATERIAL.** Described from a male holotype and five male paratypes. The holotype and one paratype are in the BMNH, the former bearing the labels; 'Holotype (red) / PAHANG. F. M. S. Lubok Tamang 3500 ft. March 7th 1924 H. M. Pendlebury. / Brit. Mus. 1934–80. / *Eriboea eudamippus peninsularis* Pendlebury HOLOTYPE det. R. L. Smiles 1977'. The paratype bears the labels; 'Paratype (yellow) / Perak. F. M. S. Batang Padang Jor Camp. Feb. 25<sup>th</sup> 1915 / Ex F. M. S. Museum B.M. 1955–354. / *Eriboea eudamippus peninsularis* Pendlebury PARATYPE det. R. L. Smiles 1977'.

BIONOMICS. Specimens in the BMNH were collected during February, March, September and December. Two specimens with altitude data were caught at 1100 and 1700 m respectively.

*Polyura nepenthes* (Grose-Smith)

(Figs 51, 67, 142, 143)

*Charaxes nepenthes* Grose-Smith, 1883: 58.

*Eriboea nepenthes* (Grose-Smith) Fruhstorfer, 1914: 723.

*Polyura nepenthes* (Grose-Smith) Stichel, 1939: 582; Boonsong, Askins, Nabhitabhata & Samruadkit, 1977: 138, fig. 339.

MALE, FEMALE. *Upperside*. Predominantly pale yellow. Apex of forewing black. As in *P. eudamippus*, a submarginal series of spots, and a postdiscal series of somewhat chevron-shaped spots present. Two discal spots present in cells  $M_1$  and  $R_5$  respectively. Hindwing with admarginals pale yellow, only slightly darker than the disco-basal patch which covers most of the rest of the wing, and is produced along the veins to join the admarginals. The tails are blue-centred. A series of black submarginal ocelli are present, encompassing very large pale yellow pupils. *Underside*. Ground colour silvery white. Forewing with a greenish yellow band running along the outer margin, but not so strongly marked as in *P. posidonius*, *narcaea*, *eudamippus* or *dolon*. A yellow or blue band runs from the end of the discal cell towards the inner margin, ending at vein  $Cu_{1b}$  or in cell  $Cu_{1b}$ . This is bordered by MI, MII and DI, but these are much thicker and more interrupted than in *P. dolon*, and unlike *P. posidonius*, *narcaea* or *eudamippus*, there is no similar band running along vein  $M_3$ . There is no costal band. A further yellow band runs from the costal margin to end around vein 2A, but is interrupted at the veins. The distal edge of this band is outlined by a complete series of black chevrons, and distal to these are more black chevrons extending upwards from cell  $Cu_{1b}$ , but not beyond cell  $R_5$ . MI is present in cells  $R_5$  and  $M_1$  as two black spots, and DII is likewise present as two black spots in the discal cell. Hindwing outer margin black, dentate; admarginals yellow, tails blue-centred. There is a complete series of black submarginal spots which are somewhat suppressed at the tornus. As is the case in *P. eudamippus* and *dolon*, the postdiscal chevrons are black-outlined, and lie on the distal edge of a yellow postdiscal band. In most specimens these chevrons are blue proximally, otherwise the colour of the accompanying band shows through. A yellow band runs from the costal margin near the wing base and curves to end near the tornus. The anterior portion is somewhat sporadically delineated by MI and MII, which may show blue scaling on the edge nearest to this band.

Abdomen in male off-white, sometimes brown above and beneath, female grey-brown above, brown or black beneath.

RANGE. In Thailand, Burma, Laos, Vietnam, western and south-western China, Hainan, and eastern China.

*Polyura nepenthes nepenthes* (Grose-Smith)

(Figs 51, 67, 143)

*Charaxes nepenthes* Grose-Smith, 1883: 58; Grose-Smith & Kirby, 1887: [4], pl. 2, figs 3, 4. LECTOTYPE

♂, THAILAND (BMNH), here designated [examined].

*Murwareda nepenthes* (Grose-Smith) Moore, [1896]: 267.

*Eulepis nepenthes* (Grose-Smith) Rothschild & Jordan, 1898: pl. 9, fig. 3; 1899: 269; Joicey & Talbot, 1928: 17.

*Eriboea nepenthes nepenthes* (Grose-Smith) Fruhstorfer, 1914: 723.

*Eriboea nepenthes fugator* Fruhstorfer, 1914: 723. LECTOTYPE ♂, VIETNAM (BMNH), here designated [examined]. **Syn. n.**

*Eriboea nepenthes* (Grose-Smith); Evans, 1924: 896; 1927: 94.

*Polyura nepenthes* [*nepenthes*] (Grose-Smith) Stichel, 1939: 582.

*Polyura nepenthes fugator* (Fruhstorfer) Stichel, 1939: 582.

*Polyura nepenthes* (Grose-Smith); Morishita, 1977: 5, fig. 2.

*Polyura nepenthes nepenthes* (Grose-Smith); Pinratana, 1979: 101, fig. N172.

MALE, FEMALE. *Upperside*. Forewing with pale spots fairly large, normally larger than in *P. n. kiangsiensis*. Pale markings beyond disco-basal patch in cell  $Cu_{1b}$  joined to the pale chevron in cell  $Cu_{1a}$  and partially to the disco-basal patch. *Underside*. Hindwing with postdiscal chevrons normally deeper than in *P. n. kiangsiensis*.

*Eriboea nepenthes fugator* Fruhstorfer falls within the range of variation exhibited by a long series of the nominate subspecies, and is treated here as a synonym.

SIZE. ♂;  $\bar{x}$  = 45.0,  $s$  = 1.7 (31 specimens). ♀; 2 specimens only, 53.7, 53.7.

DISTRIBUTION. **Laos**: Vang Vieng (Morishita, 1977: 5). **Thailand** [Siam]. **Burma**: Salween District, Papun to [Mai-hong-song]; Shan State, Salween River; N. Shan State, Kunglom [Kunlon]. **Vietnam**: Tong; [Ko-Tich]; Cha Pa; [Riviere Noire]; [Mont Bavi]; Chiem Hoa; Van Bu. **China**: Sichuan; Canton; Fujian Province; S. China, Fu-ning [Fu-chow]. **Hainan**: Tan-hsien [Nodoa]. 31 ♂, 3 ♀.

TYPE-MATERIAL. *Charaxes nepenthes* Grose-Smith is represented in the BMNH by three males, all of which bear the labels; 'Siam / Ex. Grose-Smith, 1910.'. One male bears the additional labels; 'Lectotype (purple) / Type / Joicey Bequest. Brit. Mus. 1934-120. / Charaxes nepenthes Grose-Smith LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype. The remaining two males bear the additional labels; 'Paralectotype (blue) / Co. Type. / Levick Bequest 1941-83. / Charaxes nepenthes Grose-Smith PARALECTOTYPE det. R. L. Smiles 1979'.

*Eriboea nepenthes fugator* Fruhstorfer was described from an unspecified number of specimens, and is represented in the BMNH by a single male which bears the labels; 'Lectotype (purple) / Type / Indochina H. Fruhstorfer / Fruhstorfer Coll. B.M. 1937-285. / Eriboea nepenthes fugator Fruhstorfer LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype.

BIONOMICS. Specimens in the BMNH have been collected during March, June, July, August, September and October. One specimen was collected at an altitude of approximately 600 m.

### *Polyura nepenthes kiangsiensis* (Rousseau-Decelle)

(Fig. 142)

*Eriboea nepenthes kiangsiensis* Rousseau-Decelle, 1938: 166, pl. 1, figs 1, 2. Holotype ♂, CHINA: Kiangsi (untraced) [not examined].

MALE, FEMALE. *Upperside*. Forewing with pale spots normally smaller than in the nominate subspecies. Submarginal spots and proximal chevrons in cell  $Cu_{1b}$ , not joined to chevron in cell  $Cu_{1a}$ , and only joined to the disco-basal patch along vein 2A. *Underside*. Hindwing postdiscal chevrons normally narrower than in *P. n. nepenthes*.

SIZE. ♂; 2 specimens only, 41.5, 46.0.

DISTRIBUTION. **E. China**: Kiangsi, [Long-Tchéou] (Rousseau-Decelle, 1938: 167); S. Zhejiang, Pihu; S. Zhejiang Province, Ta-k'eng-tsun [Takeng Tou]. 2 ♂.

TYPE-MATERIAL. Described from a male holotype from Kiangsi, and a female paratype from 'Long-Tchéou' which were part of Rousseau-Decelle's personal collection. Unfortunately, this collection was auctioned (C. Lemaire, pers. comm.) and I have been unable to trace the whereabouts of the types.

BIONOMICS. The specimens in the BMNH were collected during April and May, one at an altitude of approximately 350 m.

### *Polyura dolon* (Westwood)

(Figs 52, 68, 144-148)

*Charaxes dolon* Westwood, 1848: 55, pl. 27, figs 2, 3; de Nicéville, 1886: 272.

*Nymphalis dolon* (Westwood) Westwood, [1850]: 309.

*Murwarda* (sic) *dolon* (Westwood) Moore, [1896]: 263, pl. 187, figs 1, 1a.

*Eulepis dolon* (Westwood) Rothschild & Jordan, 1899: 271; Bingham, 1905: 226; Antram, 1924: 129, fig. 263.

*Eriboea dolon* (Westwood) Stichel, 1909: 170, pl. 61a; Fruhstorfer, 1914: 723; Wynter-Blyth, 1957: 149, pl. 21, fig. 1.

*Polyura dolon* (Westwood) Stichel, 1939: 582; Lewis, 1974: 288, pl. 197, fig. 9; Duckworth, Watson & Whalley, 1975: 267, fig. 236h; Boonsong, Askins, Nabhitabhata & Samruadkit, 1977: 140, pl. 68, fig. 340.

Similar to *P. nepenthes*.



**MALE, FEMALE.** *Upperside.* Disco-basal patches of both wings and postdiscal spots of forewing pale greenish yellow. Forewing with black apex containing a single row of postdiscal spots running from cell  $R_5$  to cell  $Cu_{1b}$ , the last often suppressed. Costal edge brown, a black bar running from this across the end of the discal cell. Hindwing with admarginals yellow, often blue or glaucous distally; tails blue-centred. A black submarginal band often appearing as a row of conjoined ocelli containing a series of purple submarginal spots, and proximal to these a series of yellow semicircles which sometimes join up with the admarginals. The remainder of the hindwing is covered by the disco-basal patch. *Underside.* Apex of forewing and submarginal band of hindwing corresponding to black areas of upperside, silvery white, disco-basal patches pale green. As in *P. posidonius*, *narcaea*, *eudamippus* and *nepenthes*, forewing with a band which runs along the outer margin, and a postdiscal band which runs from the costal margin to the inner margin near the tornus; these are yellowish brown, the latter being delineated distally by arcuate black lines in each cell. As in *P. nepenthes* a yellowish brown band runs from the end of the discal cell towards the inner margin, ending at vein  $Cu_{1b}$  or in cell  $Cu_{1b}$ . This is similarly bordered by MI, MII and DI, but these black lines are narrower and less interrupted than in *P. nepenthes*. As in *P. narcaea* and *eudamippus* there is a brown costal band. DII is represented by a single black spot which lies alongside the costal band in the discal cell. Hindwing admarginals brown or yellow, tails blue-centred. Proximally there lies a complete row of submarginal black spots somewhat suppressed at the tornus, which are surmounted in each cell by a postdiscal chevron. The postdiscal chevrons are black-outlined, as they are in *P. eudamippus* and *nepenthes*, and lie on the distal edge of a yellow postdiscal band. They are often slightly blue proximally. A further yellow band runs from the costal margin near the wing base and curves to end near the tornus. The outer edge is delineated by MI, and the inner edge down to just beyond the discal cell by MII. These lines are much narrower and less disrupted than in *P. nepenthes*.

Abdomen of both sexes brown or black above and beneath.

**RANGE.** In the Himalayas in northern India, Sikkim, West Bengal, Assam, Nagaland and Manipur, through Burma and Thailand to western China.

### *Polyura dolon dolon* (Westwood)

(Figs 52, 68, 144)

*Charaxes dolon* Westwood, 1848: 55, pl. 27, figs 2, 3. Syntype? ♂, INDIA: Almora (described from Malwa) (BMNH) [examined].

*Eulepis dolon dolon* (Westwood) Rothschild & Jordan, 1899: 273.

*Eriboea dolon dolon* (Westwood); Fruhstorfer, 1914: 723.

*Eriboea dolon* (Westwood): Wynter-Blyth, 1957: 149 [in part].

*Polyura dolon* [*dolon*] (Westwood) Stichel, 1939: 582.

**MALE, FEMALE.** *Upperside.* Forewing with postdiscal spots normally slightly larger than in *P. d. centralis*. Hindwing with submarginal blue or purple spots rather smaller than in any other subspecies. Individual specimens of *P. d. carolus* from China may have these spots as small or smaller as this character is very variable in that subspecies. Admarginals mostly yellow as in *P. d. centralis*, other subspecies all having more distal blue or glaucous coloration. *Underside.* Hindwing tails with only a trace of blue, less blue-centred than in any other subspecies.

**SIZE.** ♂;  $\bar{x}$  = 42.7,  $s$  = 1.3 (40 specimens). ♀; 1 specimen only, 52.8.

**DISTRIBUTION.** N. India: Kashmir; Sultanpur, Kulu; Tehri Garwhal, near Mussoorie; Mussoorie, [Aglar Valley]; Naini Tal; Kumaun, Almora; [Sundaryal]. Nepal: [Nepal Valley]; [Godaveri]; Katmandu. 42 ♂, 1 ♀.

**TYPE-MATERIAL.** *Charaxes dolon* Westwood was described from an unspecified number of specimens from 'Malwah' in the collection of Captain Boys. One male specimen in the BMNH may perhaps be a syntype, and has been labelled as a 'type' at sometime in the past. However, it is also labelled as coming from Almora and appears to have been repinned and perhaps reset, which would explain the discrepancy between the size of this specimen and the reported wingspan of the original description (3.5 ins). It was purchased by the BMNH in 1848 as part of the Boys collection. Apart from this specimen, I have not been able to trace any other possible members of the type-series.

*Eulepis dolon centralis* Rothschild. Of the 12 male paratypes traced in the BMNH, four males must be included in the present subspecies. All these bear the labels; 'Paratype (yellow) / Eulepis

*dolon centralis* Roths. PARATYPE det. R. L. Smiles 1977'. In addition, two bear the label; '69.41 Nepal.', and two the labels; 'Nepal. / Moore Coll. 98-128.'

**BIONOMICS.** Specimens in the BMNH have been taken during May at altitudes up to 4900 m. Very rare (Rothschild & Jordan, 1899: 271). According to Wynter-Blyth (1957: 150) 'All along the Himalayas there is a brood that appears early in May, but east of Simla there is an autumn brood as well.'

*Polyura dolon centralis* (Rothschild)

(Fig. 145)

*Nymphalis dolon* (Westwood); Horsfield & Moore, 1858: 206.

*Charaxes dolon* Westwood; Elwes, 1888: 367.

*Eulepis dolon* (Westwood) Rothschild & Jordan, 1898: pl. 9, fig. 1.

*Eulepis dolon centralis* Rothschild, 1899: 274. Holotype ♂, INDIA: Sikkim (BMNH) [examined].

*Eriboea dolon centralis* (Rothschild) Stichel, 1909: 170; Fruhstorfer, 1914: 723.

*Polyura dolon centralis* (Rothschild) Stichel, 1939: 583.

*Eriboea dolon* (Westwood); Wynter-Blyth, 1957: 150 [in part].

**MALE.** *Upperside.* Forewing with postdiscal spots normally smaller than in *P. d. dolon*. Hindwing with submarginal purple spots larger than in that subspecies. Admarginals as in *P. d. dolon*. *Underside.* Hindwing with tails more blue-centred, and tail associated with vein  $M_3$  often longer than in the nominate subspecies.

This may form one end of a cline running along the Himalayas, there being a gap in the distribution of the specimens which I have studied. It seems to me that specimens from Nepal, here included under *P. d. dolon*, approach specimens of *P. d. centralis*.

**SIZE.** ♂;  $\bar{x}$  = 43.4,  $s$  = 1.4 (40 specimens).

**DISTRIBUTION.** **NE. India:** Sikkim, Chunthang (Wynter-Blyth, 1957: 150); Sikkim, Lachen Lachung; Sikkim, [nr Trivi]; Darjeeling, [Gopaldhara]; [Runjit Valley]. 81 ♂.

**TYPE-MATERIAL.** Described from 27 males and one female, of which the male holotype and twelve male paratypes have been found in the BMNH. Of these, four paratypes have already been dealt with here as *P. d. dolon* (see above), and one paratype as *P. d. magniplaga* (see below). All the remaining types bear the following label; 'Rothschild Bequest B.M. 1939-1.'. In addition, the holotype bears the following labels: 'Holotype (red) / SIKKIM 26.4.1888 O. MØLLER / Eulepis dolon centralis Roths. HOLOTYPE det. R. L. Smiles 1977'. The seven paratypes bear the labels; 'Paratype (yellow) / Eulepis dolon centralis Roths. PARATYPE det. R. L. Smiles 1977'. In addition four paratypes bear the label; 'SIKKIM 20.4.1888 O. MØLLER', two the label; 'SIKKIM 2.5.1886 O. MØLLER', and one the label; 'SIKKIM 1.5.1886 O. MØLLER'.

**BIONOMICS.** Specimens in the BMNH were captured during March, April, May and June, at altitudes between 1000 and 4800 m. According to Fruhstorfer (1914: 273) 'It flies in April and May in the hot valleys occurring in but one generation.'

*Polyura dolon magniplaga* (Fruhstorfer)

(Fig. 146)

*Eulepis dolon magniplagus* Fruhstorfer, 1904 c: 381. LECTOTYPE ♂, INDIA: Assam (BMNH), here designated [examined].

*Eriboea dolon magniplagus* (Fruhstorfer) Fruhstorfer, 1914: 723, pl. 134c.

*Polyura dolon magniplagus* (Fruhstorfer) Stichel, 1939: 584.

**MALE, FEMALE.** *Upperside.* Forewing postdiscal spots larger than in *P. d. centralis*, often suppressed in cells  $Cu_{1b}$ . Hindwing with submarginal purple spots similar to *P. d. centralis*. Admarginals more blue distally and at the veins than in *P. d. dolon* or *centralis*, similar to *P. d. grandis*, and less blue than *P. d. carolus*. Tails mostly blue. *Underside.* Hindwing with tails much more blue-centred than in *P. d. dolon* or *centralis*.

**SIZE.** ♂;  $\bar{x}$  = 45.8,  $s$  = 1.8 (40 specimens), ♀; 5 specimens only, 52.2, 53.0, 54.7, 56.0, 58.5.

**DISTRIBUTION.** **NE. India:** Khasi Hills, Cherrapunji; Assam, Jaintia Hills; Shillong; Garo Hills; Naga Hills, [Kirbari]; Naga Hills, [Phesima]; W. Manipur Valley; Manipur, [Kahu]; Manipur, [Kanjuhul]; Manipur, Saitu. 46 ♂, 5 ♀.

**TYPE-MATERIAL.** *Eriboea dolon magniplagus* Fruhstorfer is represented in the BMNH by four males and one female bearing the label; 'Assam Khasia Hills ex coll. H. Fruhstorfer'. In addition, one male bears the following labels; 'Lectotype (purple) / Fruhstorfer coll. B.M. 1937-285. / Type / *Eulepis dolon magniplagus* Fruhstorfer LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype. The remaining specimens all bear the following labels; 'Paralectotype (blue) / *Eulepis dolon magniplagus* Fruhstorfer PARALECTOTYPE det. R. L. Smiles 1979'. In addition, three males bear the label; 'Fruhstorfer Coll. B.M. 1937-285.', and one of these the label; 'Type'. The remaining female bears the additional label; 'Rothschild Bequest B.M. 1939-1.'

*Eulepis dolon centralis* Rothschild. Of the twelve male paratypes traced in the BMNH, one male must be included in the present subspecies. This bears the labels: 'Paratype (yellow) / KHASI HILLS May 1889 W. A. HAMILTON / Rothschild Bequest B.M. 1939-1. / *Eulepis dolon centralis* Roths. PARATYPE det. R. L. Smiles 1979'.

**BIONOMICS.** Specimens in the BMNH have been captured during March, April, May, June, August and September at altitudes between 1600 and 2500 m.

### *Polyura dolon grandis* (Rothschild)

(Fig. 147)

*Eulepis dolon* (Westwood) Rothschild & Jordan, 1898: pl. 9, fig. 2.

*Eulepis dolon grandis* Rothschild, 1899: 275. LECTOTYPE ♂, BURMA: Shan State (BMNH), here designated [examined].

*Eriboea dolon grandis* (Rothschild) Fruhstorfer, 1914: 723.

*Polyura dolon grandis* (Rothschild) Stichel, 1939: 584; Pinratana, 1979: 101, fig. N172.

**MALE, Upperside.** Forewing postdiscal spots variable in size, but generally small, those of cell  $Cu_{1b}$  suppressed. Hindwing submarginal purple spots larger than in any other subspecies, occasionally centred with white. Admarginals very much like those of *P. d. magniplaga*, tails completely blue. **Underside.** Hindwing tails more blue than in any other subspecies.

**SIZE.** ♂;  $\bar{x} = 53.1$ ,  $s = 1.3$  (31 specimens).

**DISTRIBUTION.** **Burma:** Kalaw; S. Shan State, Mōng La; S. Shan State, Loimwe; Thandaung; Karen Hills; Tenasserim. **Thailand** (Siam): Upper Mae Nam River (Up. Menam R.); Bangkok. **Laos:** nr Luang-Prabang (Fruhstorfer, 1914: 723). 32 ♂.

**TYPE-MATERIAL.** Described from four males in the Tring Museum, none of which was selected as a holotype. These specimens are now in the BMNH and bear the following labels; 'Shan States / Rothschild Bequest B.M. 1939-1.'. In addition, one male bears the following labels; 'Lectotype (purple) / N. Z. 98 T.ix. f. 2 / *Eulepis dolon grandis* Rothschild LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype. The remaining three males bear the additional labels; 'Paralectotype (blue) / *Eulepis dolon grandis* Rothschild PARALECTOTYPE det. R. L. Smiles 1979'.

**BIONOMICS.** Specimens in the BMNH were collected during April and May at altitudes between 900 and 1400 m.

### *Polyura dolon carolus* (Fruhstorfer)

(Fig. 148)

*Eulepis dolon carolus* Fruhstorfer, 1904c: 381. LECTOTYPE ♂, CHINA (BMNH), here designated [examined].

*Charaxes dolon sinica* Oberthür, 1912: 315, pl. 105, fig. 970. LECTOTYPE ♀, CHINA ('Frontière orientale du Thibet') (BMNH), here designated [examined]. [Synonymized by Stichel, 1939: 585.]

*Eriboea dolon carolus* (Fruhstorfer) Fruhstorfer, 1914: 723; Bollow, 1930: 195.

*Eriboea dolon carolus* ab. *niger* Lathy, 1926: 97, pl. 3, fig. 4; Bollow, 1930: 195. Holotype ♂, CHINA (MNHN, Paris) [colour transparencies of upper and underside examined].

*Polyura dolon carolus* (Fruhstorfer) Stichel, 1939: 585.

*Polyura dolon carolus* f. *niger* (Lathy) Stichel, 1939: 585.

MALE, FEMALE. *Upperside*. Pale areas less yellow than in other subspecies. Forewing postdiscal spots large, generally obliterated or suppressed in cell  $Cu_{1b}$ . Hindwing submarginal purple spots smaller than in *P. d. grandis*, occasionally very small. Admarginals yellow overlaid with blue everywhere except at the tornus, sometimes almost completely blue. Tails largely blue, but with a broader black margin than *P. d. grandis*. Occasionally the base of the forewing is brown encompassing all of the discal cell and an area from the end of the discal cell to the inner margin. There may also be a brown basal band on the hindwing, running from the wing base and becoming more diffuse as it extends to the tornus (*nigra* Lathy). *Underside*. Hindwing tails blue-centred, but less so than in *P. d. grandis*.

SIZE. ♂;  $\bar{x}$  = 46.9,  $s$  = 3.4 (40 specimens), ♀; 1 specimen only, 56.3.

DISTRIBUTION. NE. India: Lohit Valley; Abor, [Shemo R.]. NE. Burma: Htawgaw; Sadon. China: ['Frontière orientale du Thibet']; Tibet, [Fou-Lin]; Tibet, Ta-Ho; [Tay-Tou-Ho]; S.E. Tibet, La-lung, [Pachakshiri]; S.E. Tibet, Ch'a-yü ho [Zayul], A-te-ko shan-k'ou [Atakang]; Yunnan, [Bahand]; Yunnan, [Pe Yen Tsing]; Yunnan, Tali; Yunnan, [Tsetchong]; Yunnan, K'un-ming [Yunnanfou]; N. of Chungtien [Siao Ouisi]; [Lou-tse-Kiang]; Tsekou; W. of Yaan [Tien Tsuen]; Siao-Lou, [Tchang-Chau-Pin]; K'ang-Ting [Ta-t sien-lou]; Pao-hsing [Mou-Pin]. 298 ♂, 1 ♀.

TYPE-MATERIAL. *Eulepis dolon carolus* Fruhstorfer is represented in the BMNH by one male which bears the following labels; 'Lectotype (purple) / Siao-Lou Chasseurs indigènes du P. Déjean 1901 / Type / Fruhstorfer Coll. B.M. 1937-285. / *Eulepis dolon carolus* Fruhstorfer LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype.

*Charaxes dolon sinica* Oberthür was described from an unspecified number of female specimens, although probably there was only one. One female in the BMNH bears the following labels; 'Lectotype (purple) / Frontière orientale du Thibet Chasseurs indigènes du P. Déjean 1905 / Levick Bequest 1941-83 / *Charaxes dolon sinica* Oberthür LECTOTYPE det. R. L. Smiles 1979', and is hereby designated lectotype.

*Eriboea dolon carolus* ab. *niger* Lathy was described from a single male in the MNHN, Paris. This holotype bears the following labels; 'TYPE / Ta Tsien Lou Thibet 1903 T. Térissé MUSEUM DE PARIS / *Eulepis dolon carolus* ab. *niger* Lathy Spec. typicum. / *Eriboea dolon carolus* ab. *niger* Lathy Lepidoptera. 1, 1926, p. 97, pl. 3'.

BIONOMICS. Specimens in the BMNH were collected during May, June and August at altitudes between 1300 and 2500 m.

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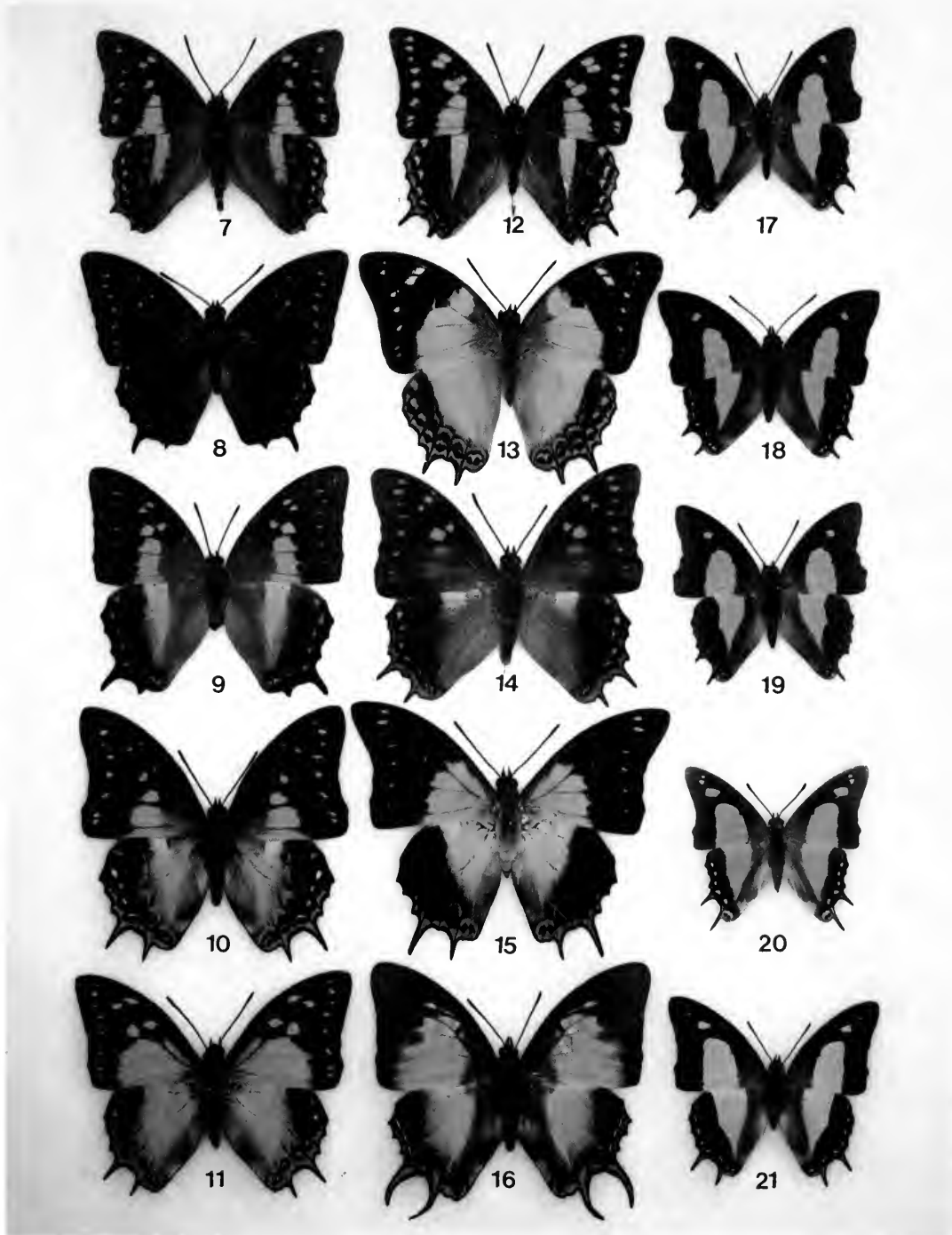
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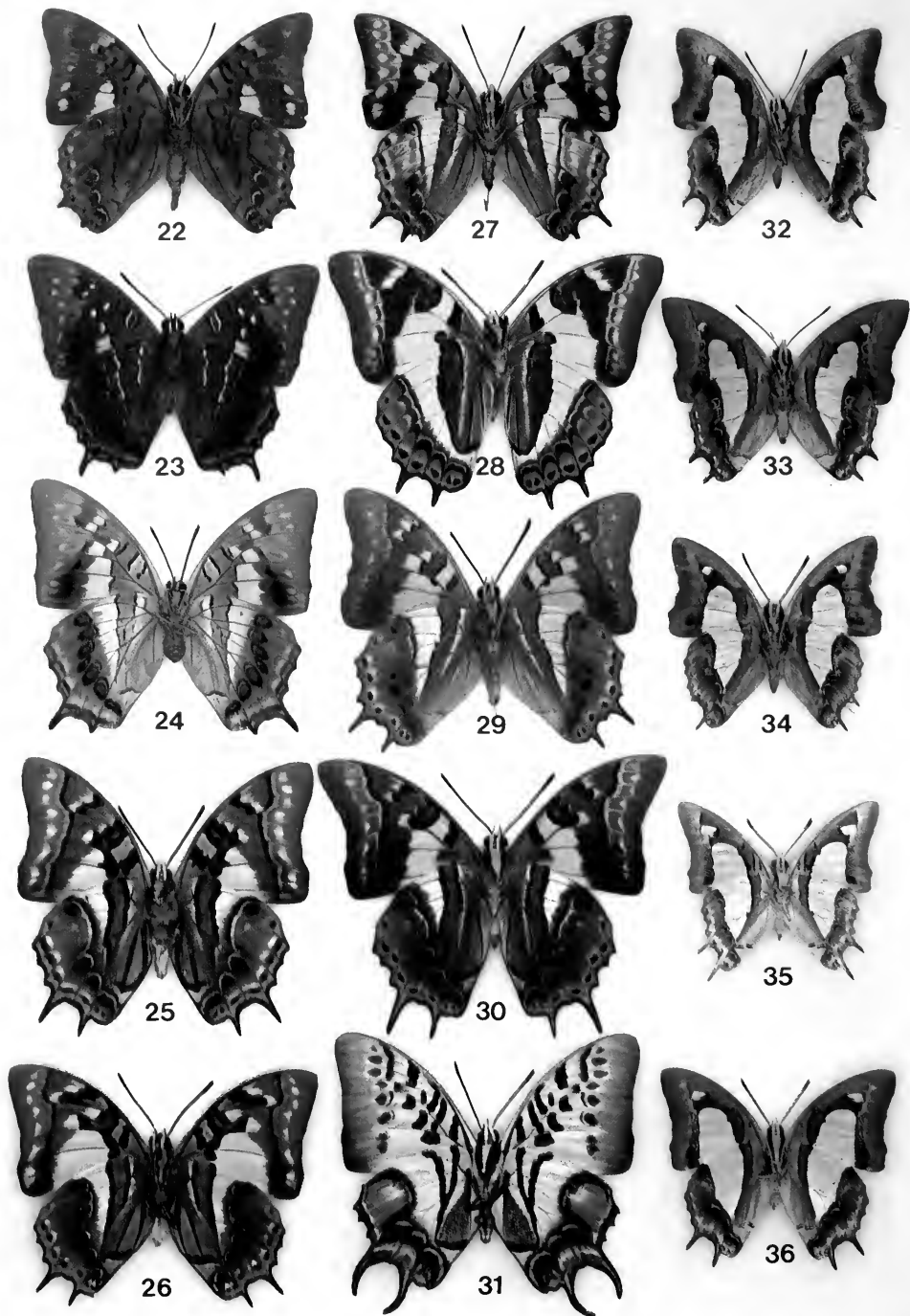


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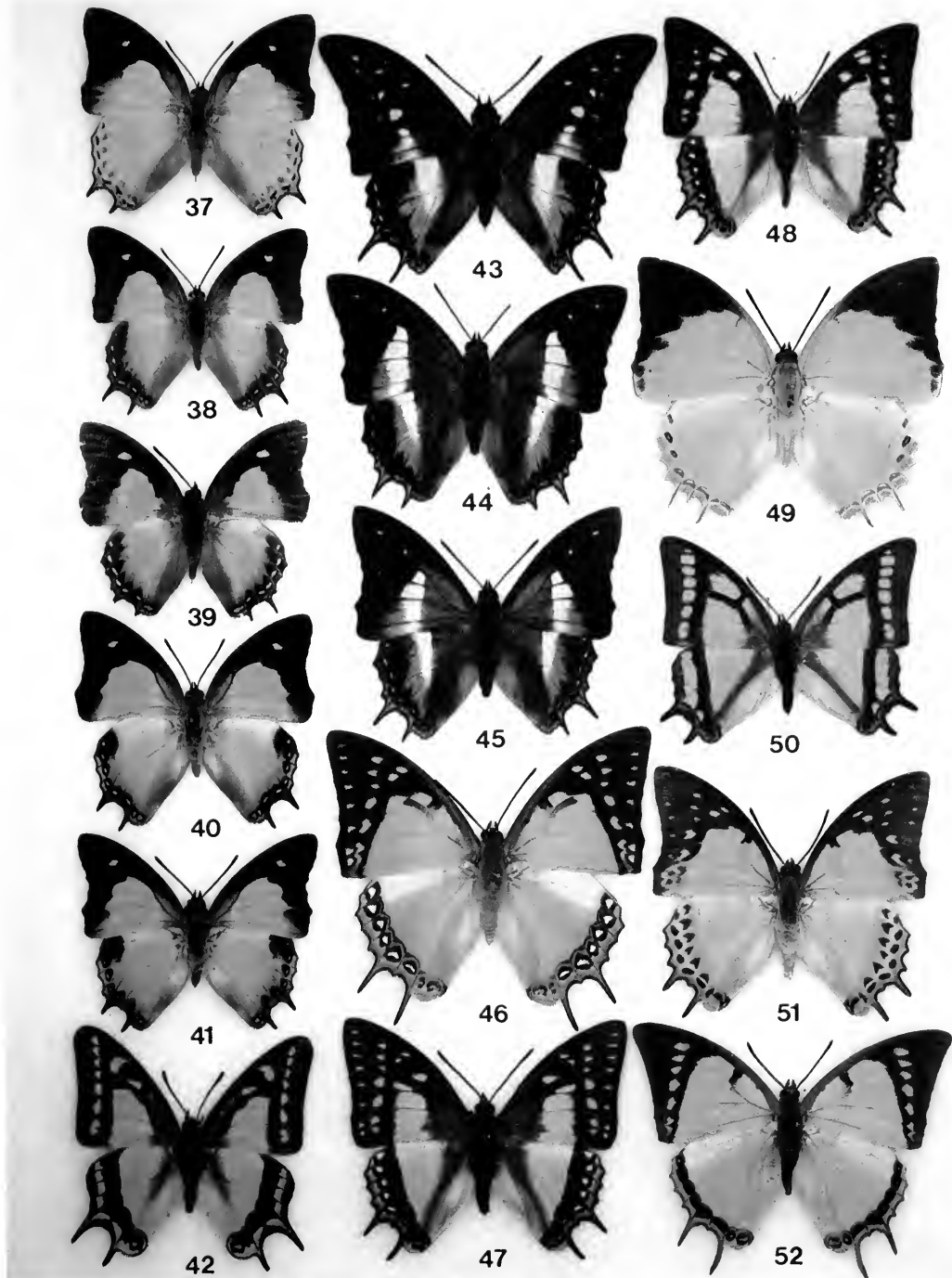
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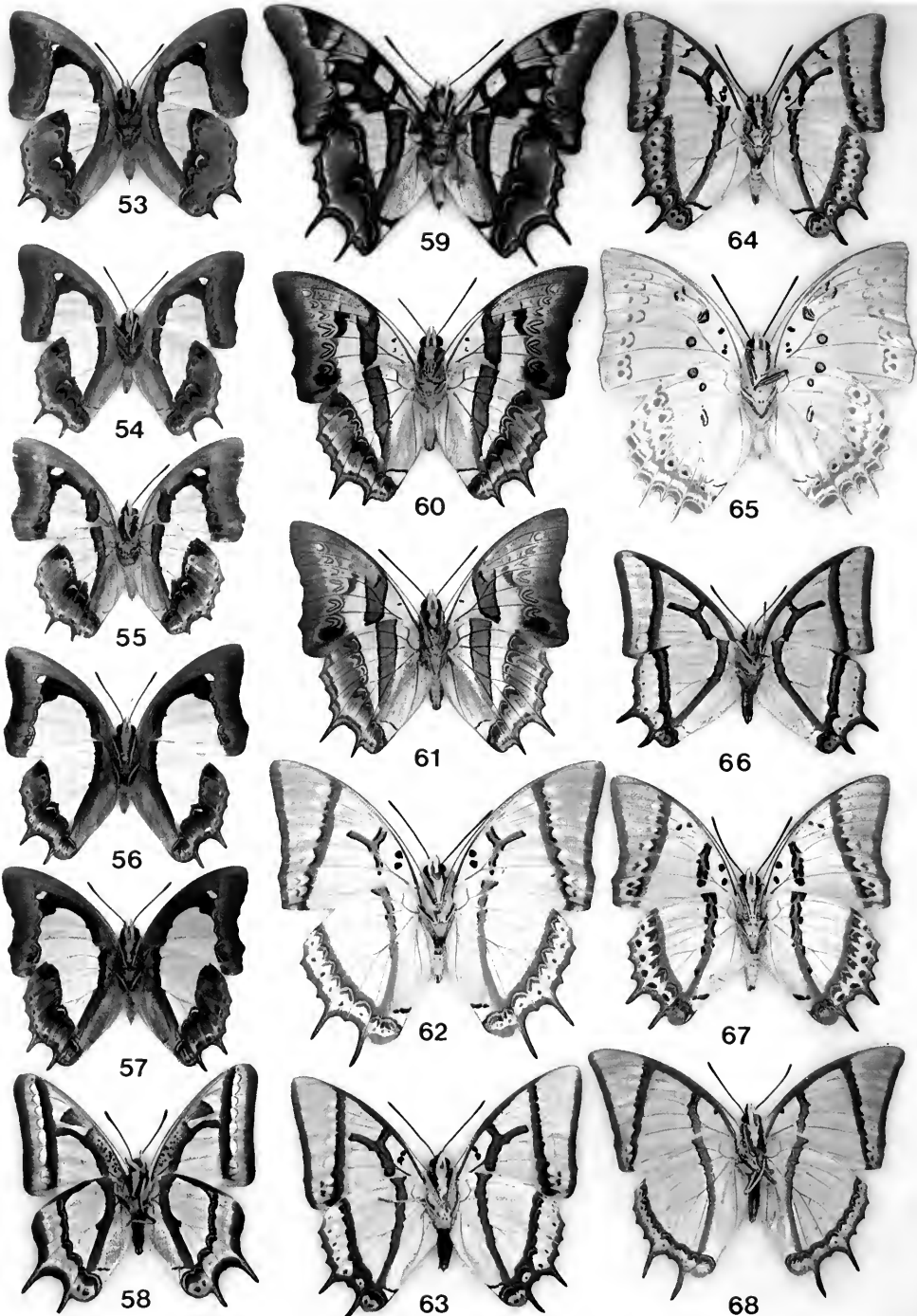
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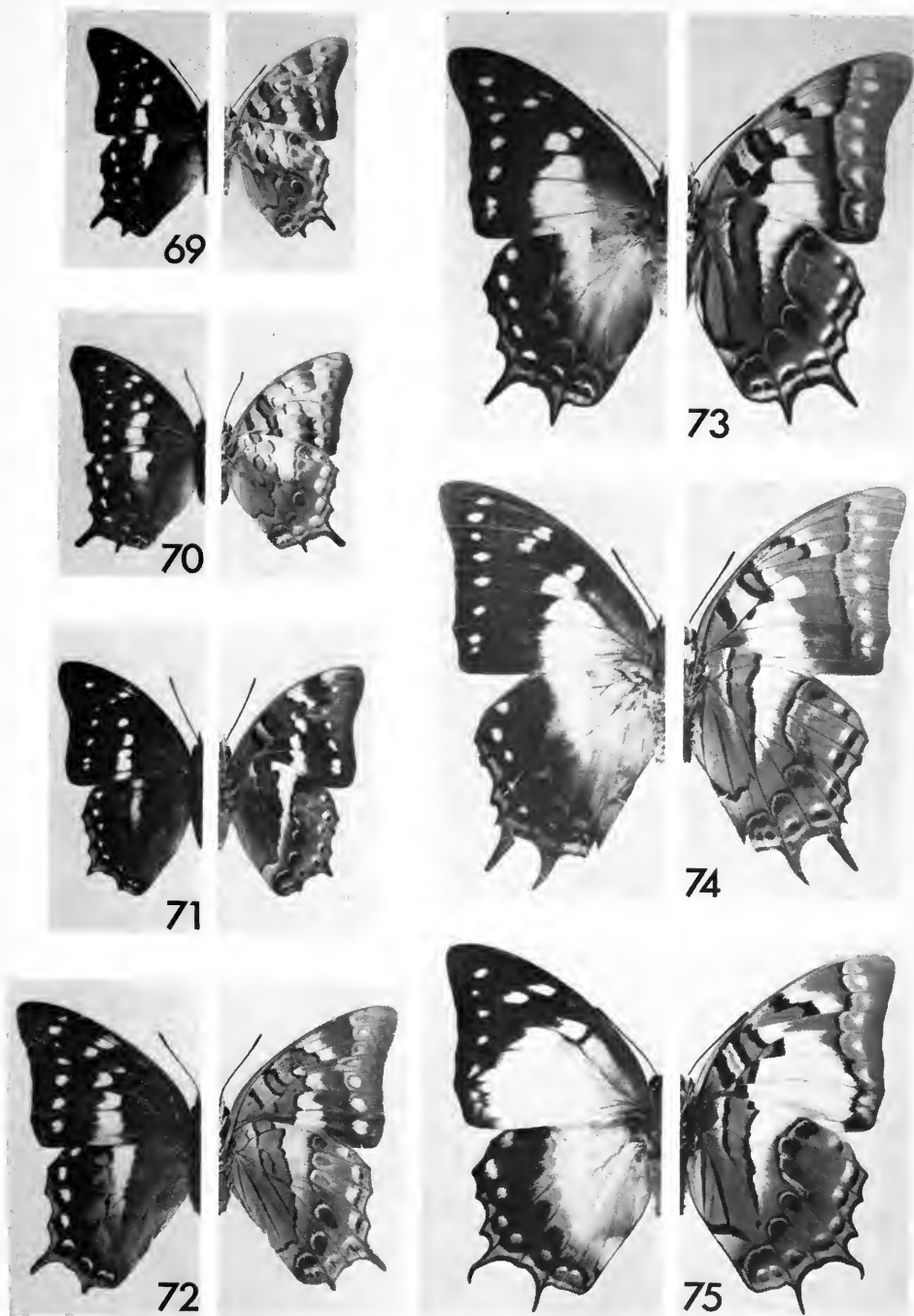
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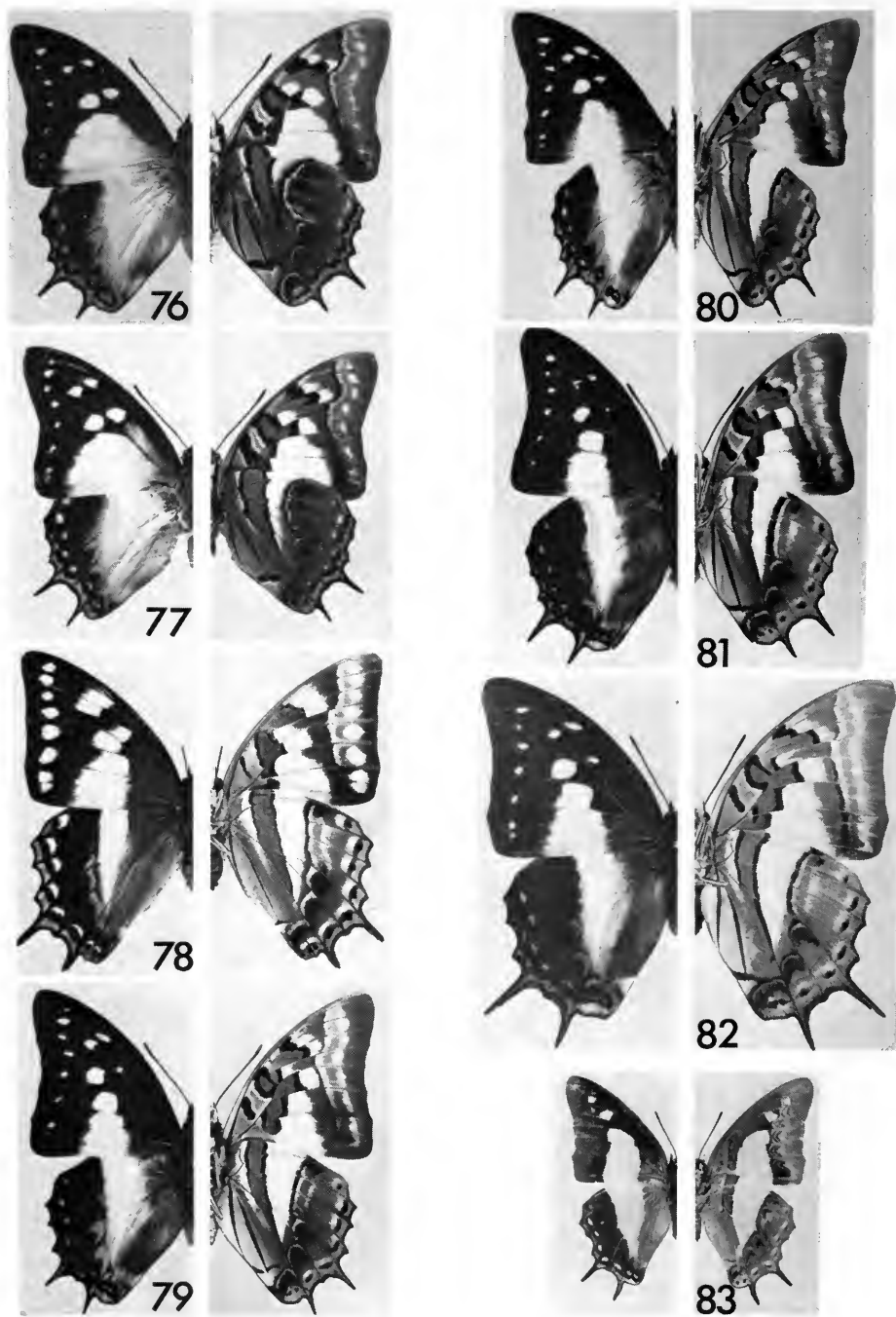


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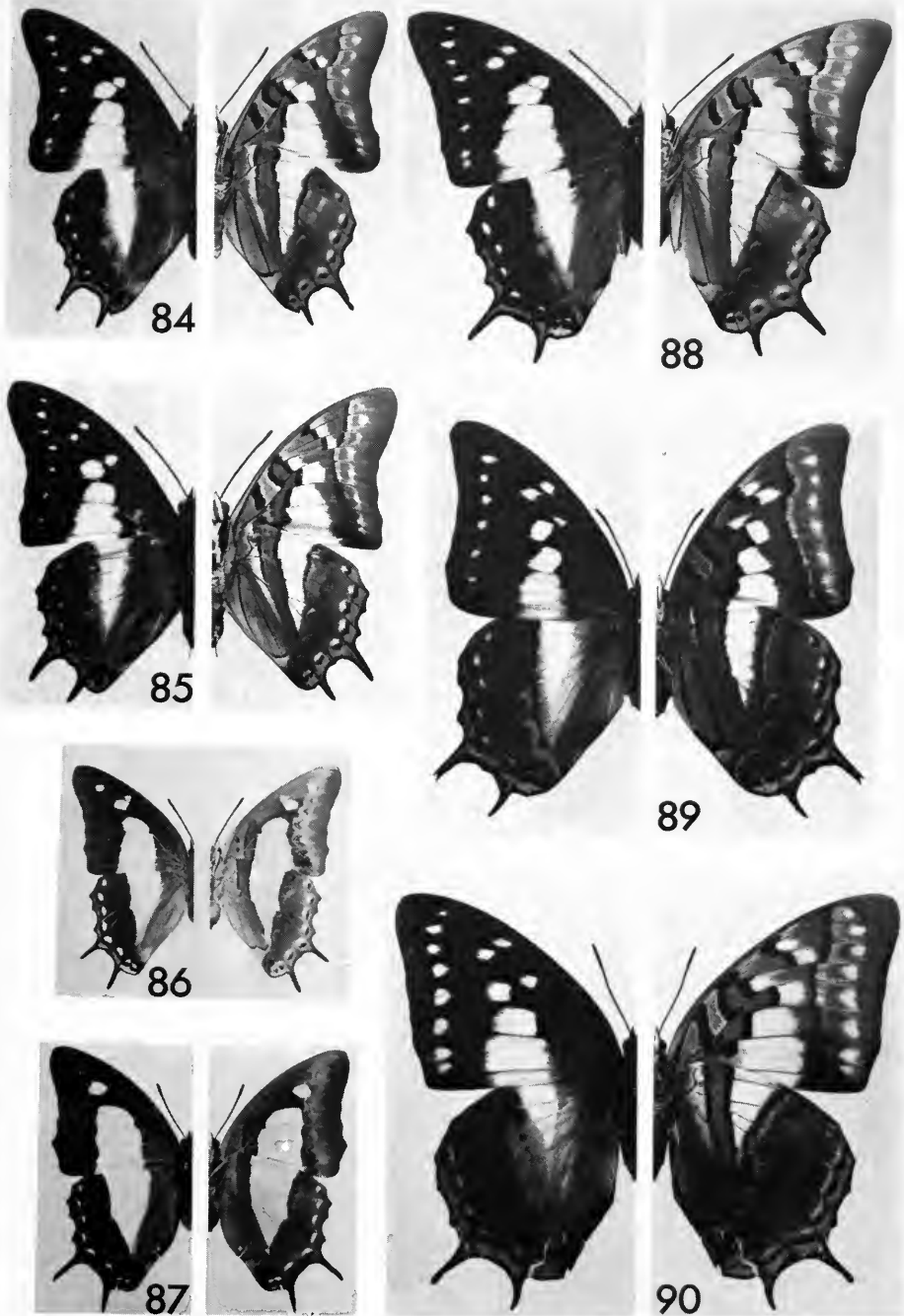
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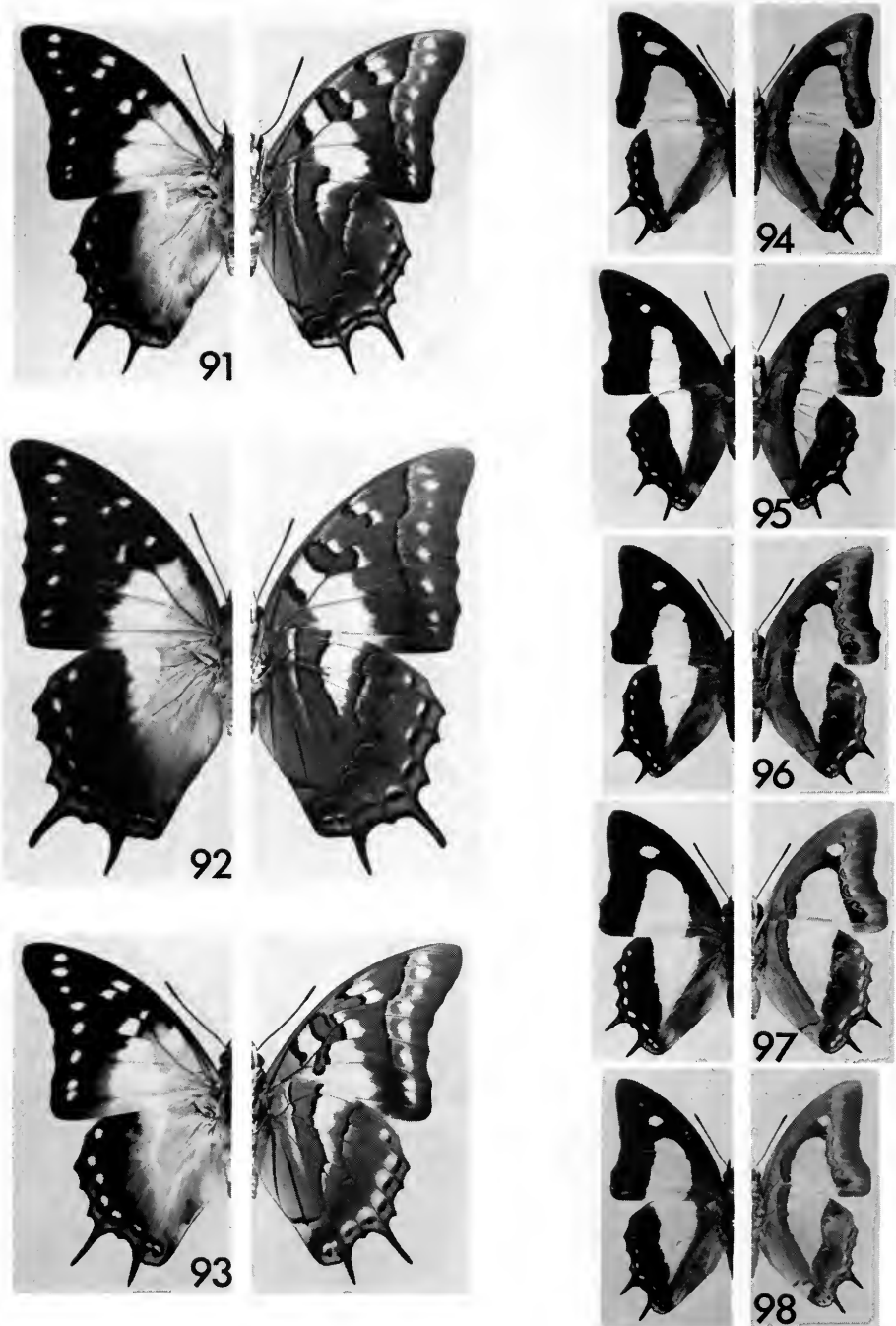


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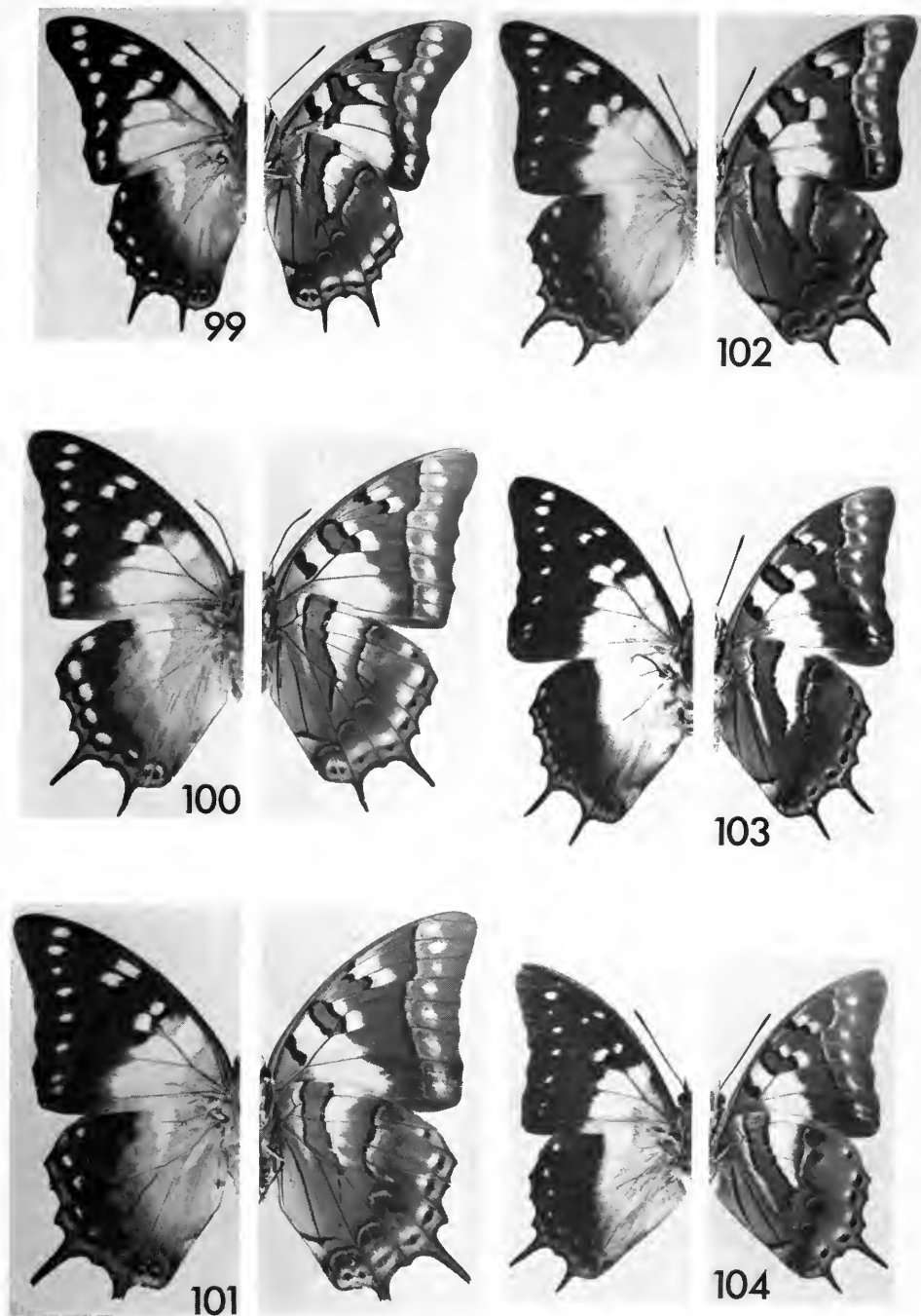




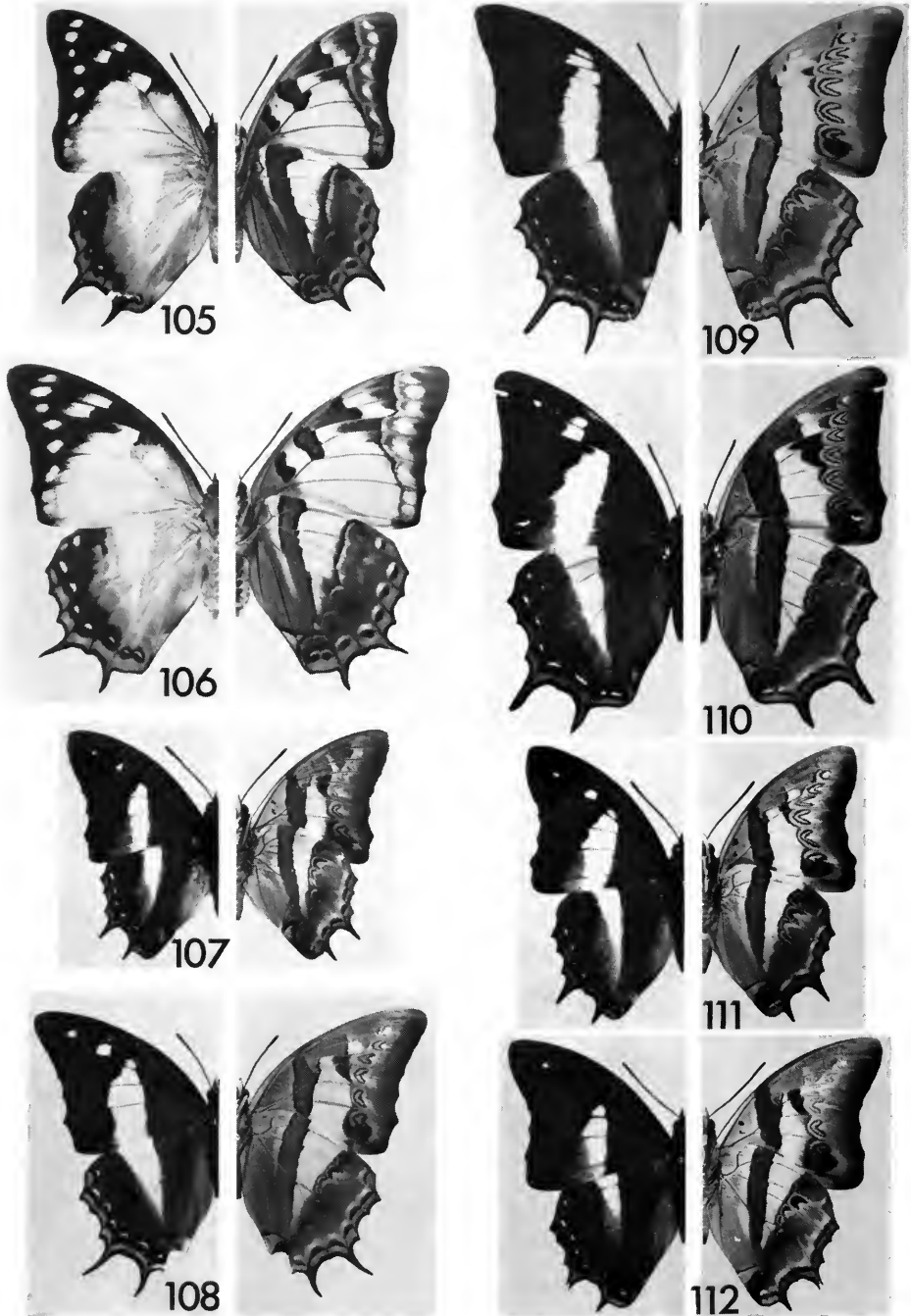
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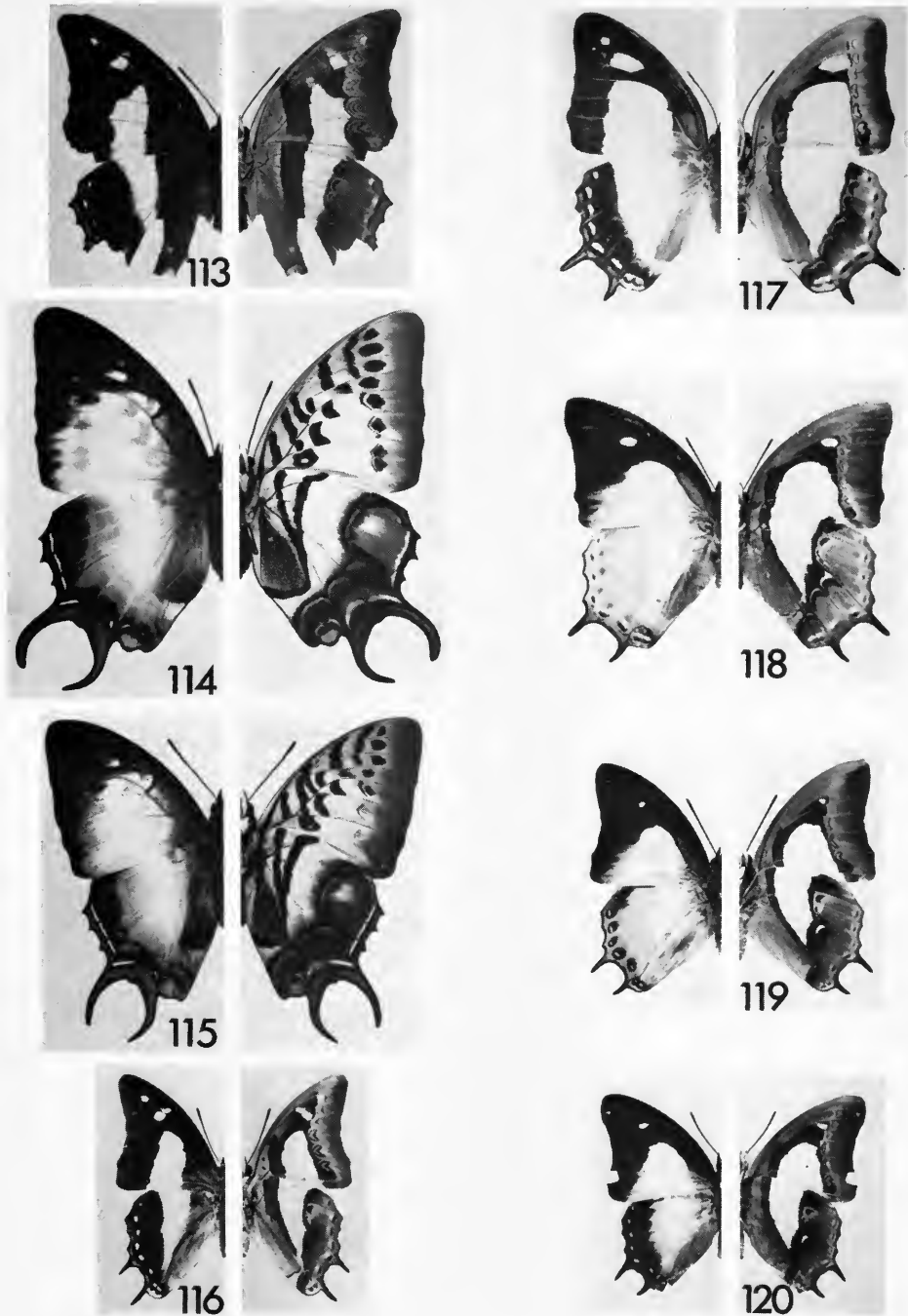
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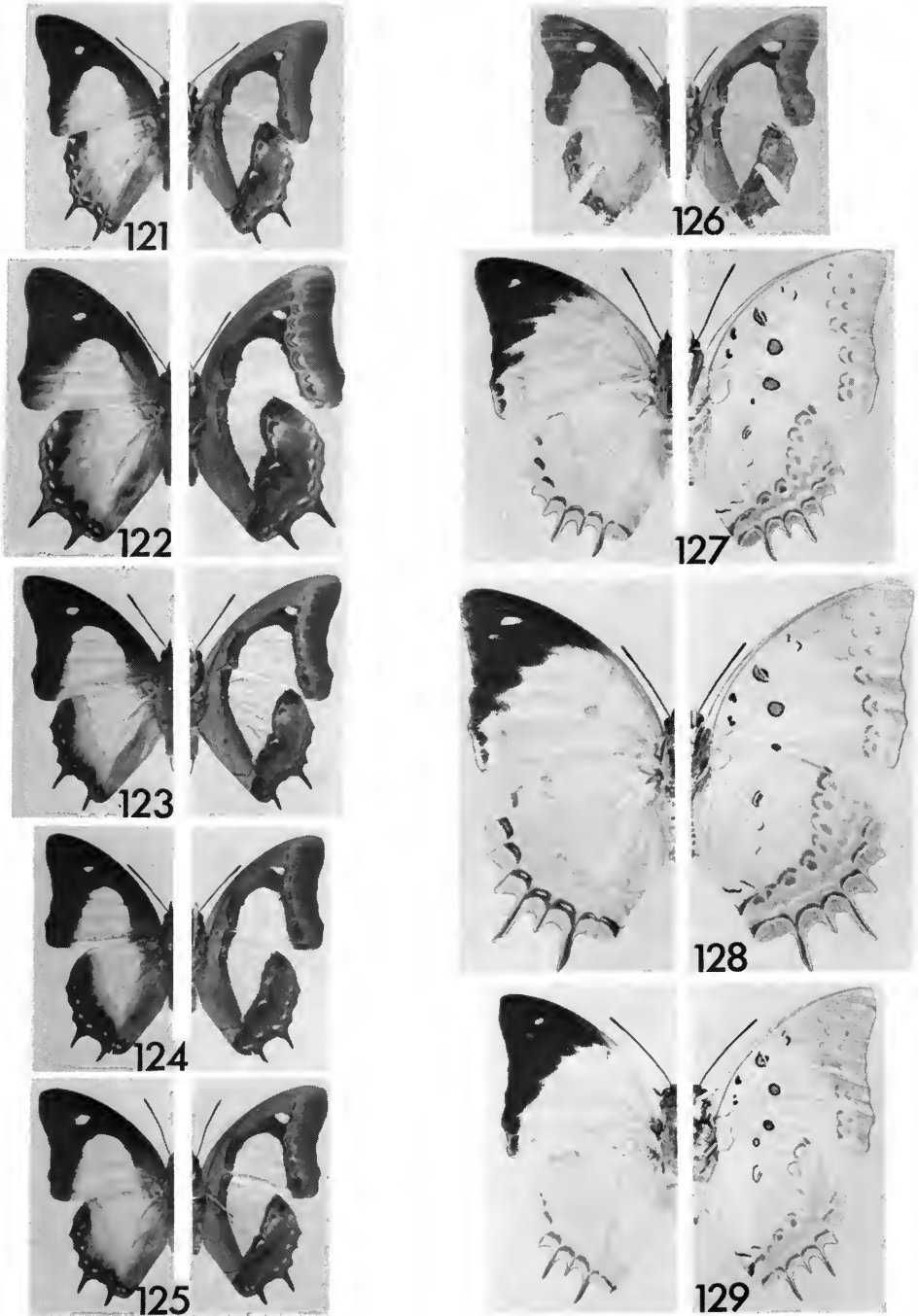
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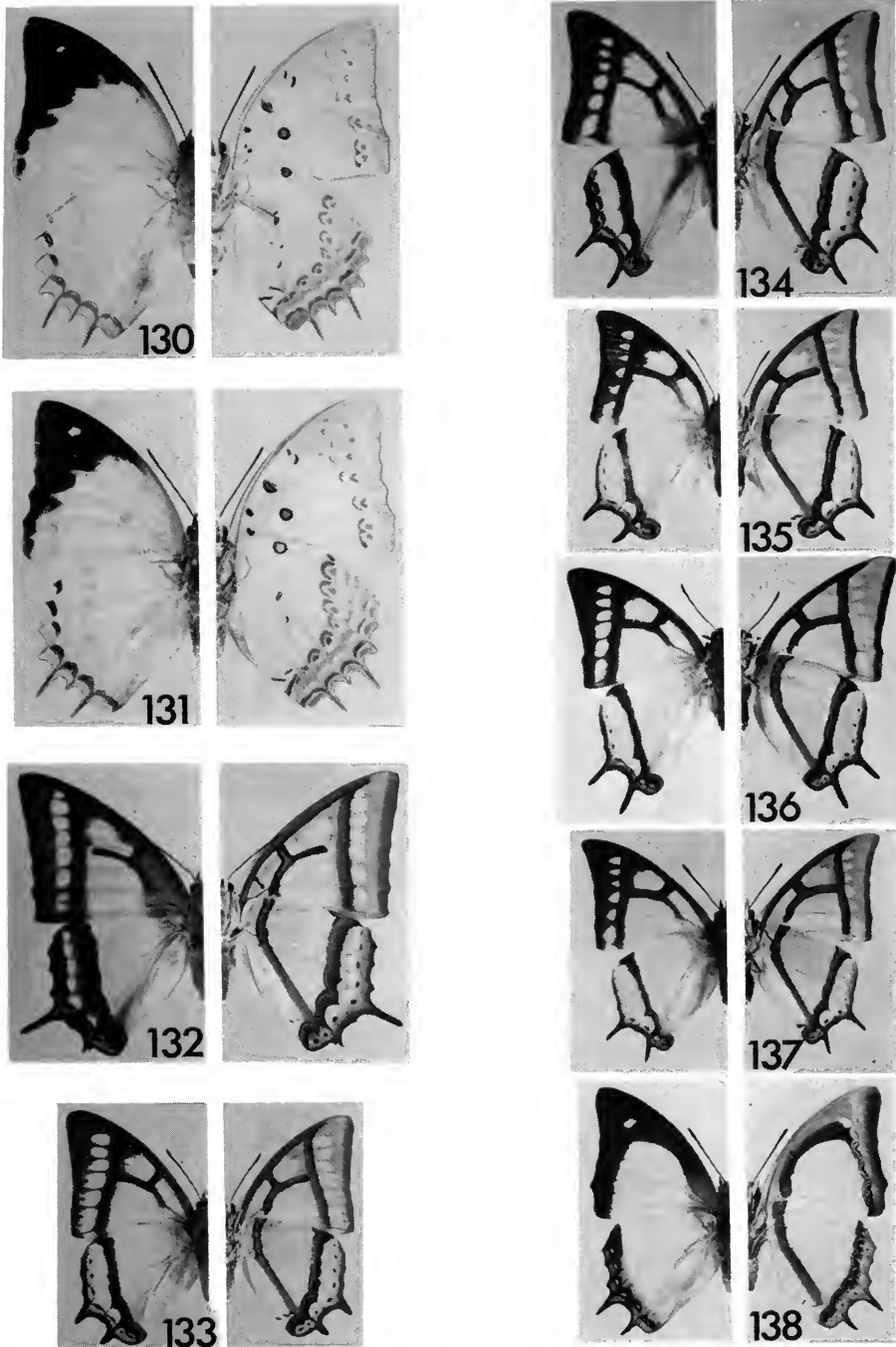
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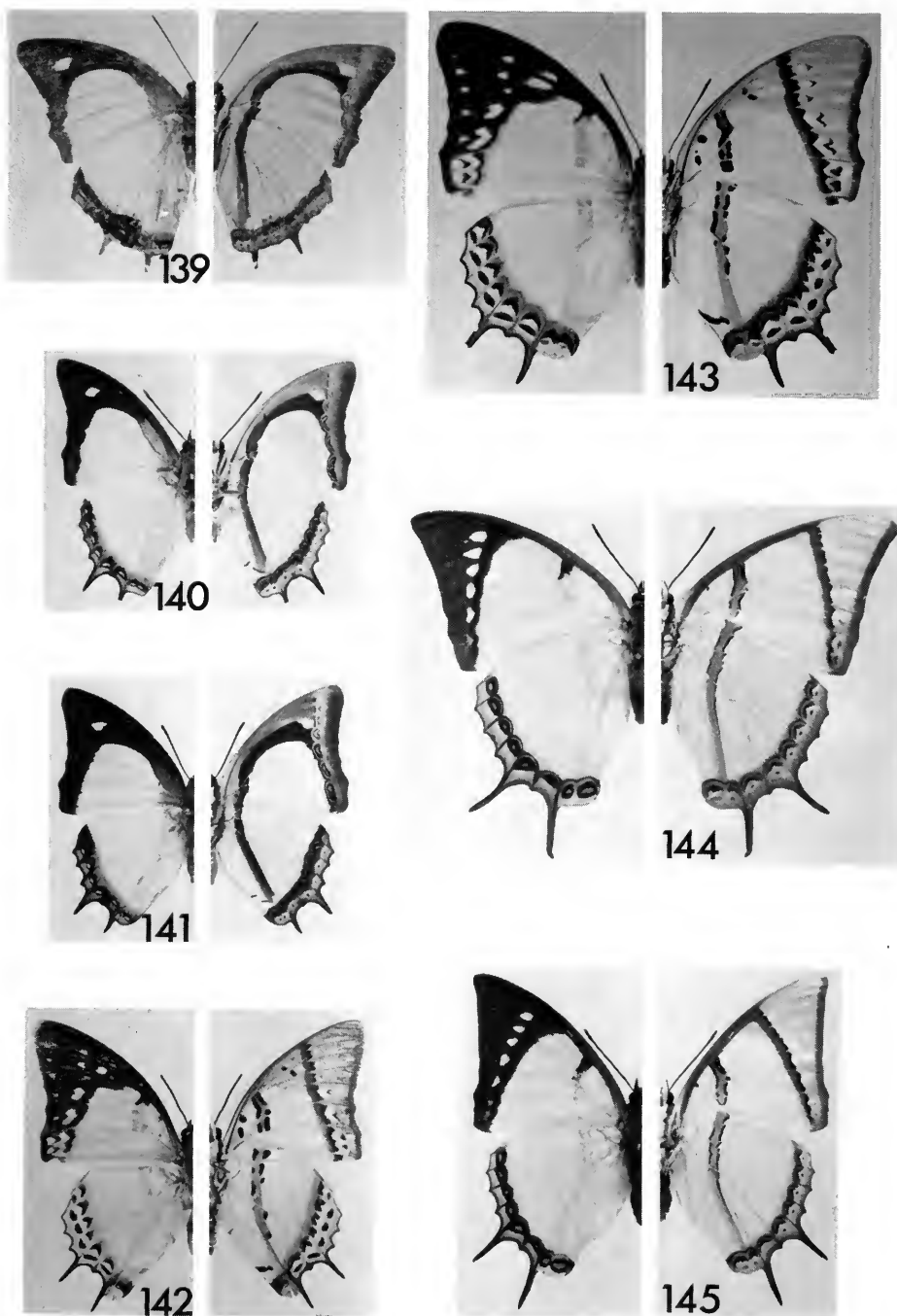


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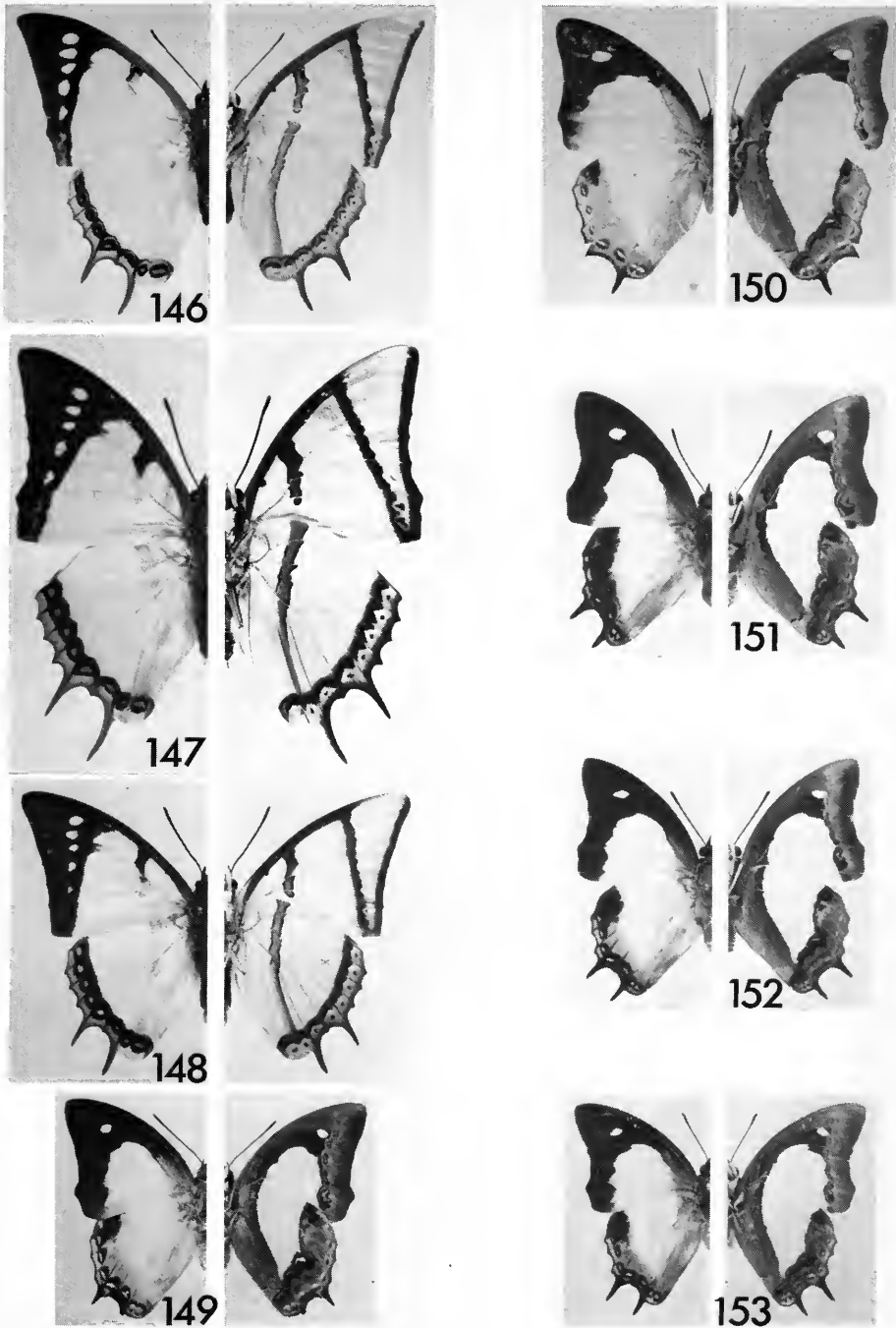
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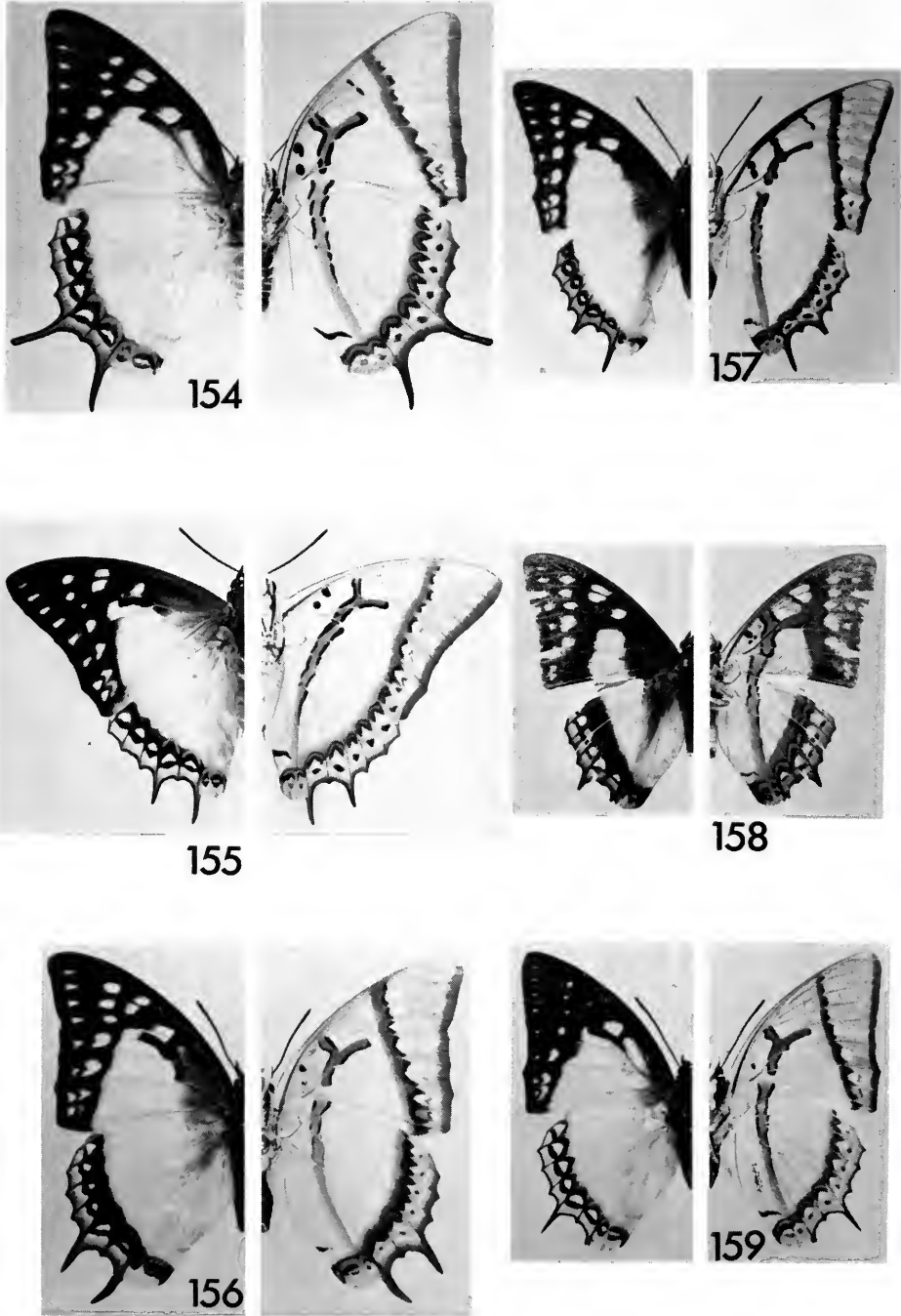


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# Bulletin of the British Museum (Natural History)



A taxonomic revision of the  
genus *Gastrimargus* Saussure  
(Orthoptera: Acrididae)

J. Mark Ritchie

Entomology series  
Vol 44 No 4

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# A taxonomic revision of the genus *Gastrimargus* Saussure (Orthoptera: Acrididae)

J. Mark Ritchie

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## Synopsis

The economically important grasshopper genus *Gastrimargus* is revised. Twenty-three species and eight subspecies are described, keyed and illustrated. Five species and two subspecies are new to science, and the male of *G. hyla* is described for the first time. Sixteen species and five subspecies are synonymised and four species are reduced to subspecies. Two species and two subspecies are reinstated from synonymy. Sixty-four primary types have been examined including one newly designated neotype and eight lectotypes. Available data on the biology and economic importance of the species are reviewed and their distributions are mapped. The biogeography of the genus is discussed in the light of past and present geological, vegetational and climatic factors, and contrasted with that of the related genus *Oedaleus*, recently revised.

## Introduction

### History of the genus

Saussure (1884) originally described *Gastrimargus* as a subgenus of *Oedaleus* Fieber, characterized by its stouter general shape, longer pronotum, and certain supposed differences in the reticulation of the tegmina. The first species he described in his new subgenus was *G. verticalis*, but he did not formally designate it as the type-species. Kirby (1910) synonymised *G. verticalis* with *G. virescens* and designated *virescens* as the type-species of *Gastrimargus*. This designation is unaffected by the fact that *G. virescens* had already been recognised as a junior synonym of *G. marmoratus* (Stål, 1873), whereas *G. verticalis* was and is a valid species. Despite later attempts to substitute *G. verticalis* (Sjöstedt, 1928; Johnston, 1956), *G. virescens* remains the type-species of *Gastrimargus*.

Kirby (1910) also raised *Gastrimargus* to full generic status without, however, giving any reason for doing so. From the beginning there was confusion over the identity of some species, and their correct generic assignment was sometimes in doubt, *Oedaleus virgula* being placed in *Gastrimargus* (as *G. madecassus* Saussure, 1884) in error. The first revision of the genus, by Sjöstedt (1928), tended to confuse rather than to clarify the position. He described numerous species, varieties (understood here and by previous authors in the sense of subspecies) and forms. An indication of the scale of the problem is given by the synonymy of *G. determinatus procerus* (p. 282), which Sjöstedt described no less than six times under various names in the course of his revision.

Over the last half century a few new taxa have been described, and some new synonymy has been reported (Dirsh, 1961; 1966; 1970), but no general study of the genus has been undertaken. Descamps (1972) included *Gastrimargus* among the small group of old world oedipodine grasshopper genera most in need of revision. At the commencement of this study 32 species and five subspecies were recognised. In this work 16 species and five subspecies are synonymised, four species are reduced to subspecies, two species and two subspecies are recalled from synonymy, and five new species and two new subspecies are described. A total of 23 species and eight subspecies are now recognised for which keys and diagnoses are provided below. Because of the small number of available specimens of some species and the extensive geographical variation within some species-groups, some of the taxonomic conclusions reached here may have to be modified in the light of future collecting.

### Economic importance

Members of the genus *Gastrimargus* are a conspicuous component of the tropical grassland ecosystems of Africa, Asia, and Australasia where, because of their numbers, they are sometimes considered injurious to pasture. Although there have as yet been no quantitative studies of their effects, the possible rôle of these and other grasshoppers as competitors of grazing stock is likely to assume increasing importance in tropical rangeland management.

Three species of *Gastrimargus*, *G. africanus* in Africa, *G. marmoratus* in South East Asia, and *G. musicus* in Australia are minor pests of agriculture. Of these, only *G. musicus* forms swarms and shows behavioural and morphological phase transformation (Common, 1948). The species is said to be favoured by overgrazing and deforestation, which provide bare ground for laying, and short and long grasses for feeding and roosting (Uvarov, 1977). In Malaysia *G. marmoratus* is often found in association with Lalang (*Imperata arundinacea*), an aggressive colonist in forest areas cleared for crops. In such areas *G. marmoratus* is able to move from the wild vegetation into the rice, maize, or other crop which is being grown.

With the continuing destruction of rain forest, and its replacement by vegetation types suitable for *Gastrimargus* species, it is likely that their importance as pests will grow. There is therefore a need for accurate identification of the species and a reliable knowledge of their ranges. References to economic importance are included in the text where appropriate, under species headings.

### Methods and terminology

In this preliminary study characters for identification and separation of species were derived from the external morphology and colour patterns of both sexes, especially the hind wing, and the internal genitalia of the males. The terminology employed is that previously used for *Oedaleus* (Ritchie, 1981). Sjöstedt (1928) used the term 'cotypus' in the sense of the modern paratype, while others used it in the sense of syntype. Sjöstedt's cotypes are therefore referred to as paratypes whenever they are mentioned. In the genitalia figures (Figs 1–110), the phallic complex is consistently shown in both dorsal and lateral views with the epiphallic membrane and epiphallus removed. For brevity this information is not repeated in the figure legends. The scale line in each of the figures represents 1 mm. For each species the right half of the epiphallus is figured first in dorsal view and then in postero-ventral view to exhibit the degree of development of the lophi which is unclear in dorsal view.

For commoner species the recording of label data of material examined has been confined to listing localities of capture or, in extreme cases, countries only. Full lists are deposited in the

libraries of the Centre for Overseas Pest Research and the British Museum (Natural History). Except where otherwise stated, material examined is from the collections of the British Museum (Natural History), London. All distances and altitudes are given in SI units and all measurements of insects are in millimetres. Where possible place names in mainland China are given according to the Pinyin system. Doubtful names are quoted verbatim from the original label and are indicated by enclosure within single quotation marks.

### Depositories

ORSTOM, Abidjan	Office de la Recherche Scientifique et Technique Outre-mer, Centre d'Adiopodoumè, Abidjan.
DA, Bangkok	Department of Agriculture, Bangkok.
MNHU, Berlin	Museum für Naturkunde der Humboldt-Universität zu Berlin.
IRSNB, Brussels	Institut Royal des Sciences Naturelles de Belgique, Brussels.
ANIC, Canberra	Australian National Insect Collection, Canberra.
IP, Eberswalde	Institut für Pflanzenschutzforschung, Eberswalde.
MZDS, Florence	Museo Zoologico della Specola, Florence.
MHN, Geneva	Muséum d'Histoire Naturelle, Geneva.
MCSN, Genoa	Muséo Civico di Storia Naturale, Genoa.
ZM, Hamburg	Zoologisches Institut und Zoologisches Museum, Universität Hamburg, Hamburg.
AFD, Hongkong	Agriculture & Fisheries Department, Hongkong.
BIBM, Honolulu	Bernice P. Bishop Museum, Honolulu.
RNH, Leiden	Rijksmuseum Van Natuurlijke Historie, Leiden.
ZI, Leningrad	Zoological Institute, Academy of Sciences of the U.S.S.R., Leningrad.
BMNH	British Museum (Natural History), London.
COPR, London	Centre for Overseas Pest Research, London.
NHM, Maastricht	Natuurhistorisch Museum, Maastricht.
UM, Oxford	University Museum, Hope Department of Entomology, Oxford.
MNH, Paris	Muséum National d'Histoire Naturelle, Paris.
ANS, Philadelphia	Academy of Natural Sciences, Philadelphia.
DATS, Pretoria	Department of Agricultural Technical Services, Pretoria.
TM, Pretoria	Transvaal Museum, Pretoria.
NR, Stockholm	Naturhistoriska Rijksmuseum, Stockholm.
MRAC, Tervuren	Musée Royal de l'Afrique Centrale, Tervuren.
ZIUC, Uppsala	Zoologiska Institutionen, Uppsala Universitet, Uppsala.
NM, Vienna	Naturhistorisches Museum, Vienna.
USNM, Washington	United States National Museum, Washington.

### *GASTRIMARGUS* Saussure

*Gastrimargus* Saussure 1884: 109, 110 [as subgenus of *Oedaleus* Fieber]. Type-species: *Gryllus virescens* Thunberg, 1815, by subsequent designation (Kirby, 1910: 226) [= *Gastrimargus marmoratus* (Thunberg, 1815) (Stål, 1873)].

*Gastrimargus* Saussure; Kirby, 1910: 226.

Medium size (total length 20–45 mm male, 24–64 mm female). Integument finely or moderately rugose and pitted. Antennae filiform, 0.80–1.25 times combined length of head and pronotum; flagellum with 22–27 segments. Fastigium of vertex concave, flat, or convex; raised marginal carinae distinct or indistinct, medial carina present or absent; fastigium narrowing to about half maximum width anteriorly, foveolae obsolete, or if present, triangular; frons in profile oblique or vertical, convex; frontal ridge with or without variable longitudinal sulcus, smooth, sometimes widening at median ocellus, widening evenly and obsolescent towards clypeus. Eyes oval, 1.2–1.5 times as deep as wide. Pronotum low to high tectiform with median carina from weakly raised to high blade-like (in *G. mirabilis*), intersected or not intersected by posterior sulcus; dorsum of pronotum sometimes with scattering of raised round warts; hind margin from rounded obtus-angular (gregarious phase of *G. musicus*) to sharply acutangular (*G. mirabilis*); mesosternal interspace trapezoidal or rectangular, wider than long, narrower or wider anteriorly than metasternal; metasternal interspace usually forming a closed elongate lozenge-shaped area (but with narrow anterior opening to metasternum in *G. willemsei*). Tegmen and wings fully developed or slightly abbreviated, in male exceeding

hind knees by variable amount, in female sometimes not reaching hind knees but never by more than one-third of hind femur length; intercalary vein of medial area of tegmen usually well-developed and serrate, at least in males (unserrated in *G. acutangulus*); hind wing unspecialised. Hind femur normal, of variable thickness, lacking specialised features; hind tibia as long as femur, with 11–14 inner and outer spines, inner apical spurs about 1.5 times length of outer spurs; tarsi unspecialised, arolium 0.3–0.6 times claw length. Male supraanal plate shield-shaped, rounded triangular; male cercus subconical to finger-shaped, 2.00–2.75 times its basal width; subgenital plate subconical with rounded apex. Genitalia typically oedipodine, similar to *Oedaleus*. Aedeagus (paired apical penis valves) short, variably projecting from short enclosing cingular rami, and bearing a subapical ventral process of variable size; epiphallus bridge-shaped with bilobate lophi, outer lobes often acutely projecting. Ovipositor of variable length, not markedly elongated; ventral valves variable in shape and degree of sclerotisation, usually with simple acute apex (bifurcated in *G. willemsei*); basivalvular sclerites rugose or smooth.

General coloration: brown with green/brown polymorphism variably expressed as lighter brown or green markings on frons, vertex, genae, pronotum, hind femora, and anal area of tegmen (dorsal surface when folded); pale oblique band on genae continued onto pronotal shoulders, sometimes partly or completely obscuring ×-marking, and occasionally forming a light border to dorsum of pronotum; ×-marking when visible cream, light brown, or light green, with anterior and posterior arms joined separately on each side of median carina; anterior or posterior arms or both may be obsolete. Tegmen usually opaque brown in basal half or two-thirds, green in anal area of green morphs, with two or three transverse pale bands extending variable distance from costal margin, situated one-eighth, one-quarter, and one-half along from base, sometimes somewhat more distally placed; bands sometimes reduced or, occasionally obsolete; remainder of tegmen clearing towards apex with dark speckling. Hind wing with or without fascia; basal area pale blue, pale greenish yellow, pale yellow, or bright sulphur yellow. Hind femur usually with two or three oblique transverse bands externally, coinciding with darker areas between pale bands of folded tegmen, producing camouflage effect; bands may be reduced or obsolete, with or without residual spotting on upper and lower carinulae; internal surface with or without transverse band sometimes coalescing to form solid brown or black zone in basal half of medial area; internal ventral surface red, black, blue, or straw-coloured; hind knees brown to black, hind tibiae yellow, orange, red, brown, purple, or straw-coloured.

### Taxonomic affinities and diagnostic characters

The genus *Gastrimargus* is classed among the Oedipodinae by virtue of its serrated medial intercalary vein and banded hind wings (the latter absent in extreme forms of *G. rothschildi* and *G. determinatus*). It is allied to *Locusta* L., *Oedaleus* (Ritchie, 1981), *Humbe* Bolivar, and *Oreacris* Bolivar, but may be differentiated from these and other genera of Oedipodinae by the following combination of characters.

1. Pronotum with median carina raised, arcuate, not deeply excised by posterior sulcus (as in *Pyncocrania* Uvarov, *Oreacris*).
2. Pronotal pattern, when visible, consisting of light ×-marking with anterior and posterior arms joined (separate in *Oedaleus*).
3. Tegmina with serrated intercalary vein, but without specialised stridulatory cross-veins (as in *Heteropternis* Stål or *Homoeopternis* Uvarov).
4. Hind femur lacking expanded upper or lower marginal area (as in *Oedipoda* Latreille or *Pyncodictya* Stål).
5. Genitalia with aedeagus short, never elongated (as in *Locusta*).

The species of the genus form a close-knit group, more closely allied even than those of *Oedaleus*. The recognition of distinct 'species-groups' based on common characters is therefore problematic, but loose assemblages can be made. In this study therefore the species are arranged in groups on the basis of apparent relationships as follows: *G. africanus*, *G. nubilus*, *G. lombokensis*, *G. subfasciatus*, *G. musicus*, *G. marmoratus*, *G. immaculatus*; *G. hyla*, *G. rothschildi*, *G. verticalis*; *G. miombo*, *G. determinatus*; *G. crassicollis*, *G. drakensbergensis*; *G. obscurus*, *G. wahlbergii*, *G. angolensis*. The remaining species are ungrouped. Interspecific affinities are discussed in detail under the species concerned.

### Keys to the species of *Gastrimargus*

A key to the species of *Gastrimargus* was given by Sjöstedt (1928), but the large number of synonyms which were accorded separate species status and the unreliable characters used to distinguish them rendered the result valueless as a tool for identification.

The two keys provided here cover Africa and the remainder of the old world separately. The occasional cases of sexual dimorphism are dealt with by keying out sexes separately where necessary (e.g. *G. verticalis mpwapwae*). A more serious difficulty is posed by the large amount of geographical variation among the members of the *G. africanus-musicus*-group. The loss of wing and hind femur colour characters in specimens of *G. africanus parvulus* from Indo-China and Java, and *G. musicus* from the Solomon Is. leads to a situation where, without label data, positive identification would in a small percentage of cases be impossible. Males can be separated with difficulty (key to non-African species, couplet 11, p. 246), but no reliable characters have been found to separate females. However, in view of the observed clinal variation within the two species determination can be made on the basis of their discontinuous ranges.

Two *Gastrimargus* specimens from Nigeria, of uncertain identity, possibly *G. verticalis*, have been omitted from the keys. They are discussed under *G. verticalis* (p. 275) and the male is shown in Fig. 135.

Characters from the male genitalia, particularly the length and shape of the aedeagus and the shape of the epiphallic lophi, have been used in the keys and diagnoses, but caution is necessary in interpreting small changes in shape of these and other parts of the phallic complex. As in some other genera, there is general uniformity of shape over the genus as a whole but considerable variation within one species or even within one population. There are two major problems of interpretation of the genitalia. Firstly, new material is added to the endocuticle of internal skeletal structures daily throughout all or most of the adult life of grasshoppers (Neville, 1963). Thus, for example, the cingular apodemes (including the zygotoma), and the aedeagal apodemes ('basal penis valves' of Dirsh) are continually extending and thickening at their anterior extremities. Up to ten or twelve growth layers can often be seen even by reflected light at fifty times magnification. Older animals therefore tend to have some features much more pronounced than younger ones, while in teneral insects the genitalia may be transparent and delicate, difficult to examine and easily deformed by handling. Secondly, the correct understanding of the epiphallus is complicated by its tendency to be curved or folded to a variable degree. If the epiphallus is considered in the position in which it is usually figured, lying on its ventral surface in the plane of the paper, there are three ways in which its apparent shape may vary. Firstly the anterior margin bearing the ancorae may be in the plane of the paper or curve upwards or downwards. Secondly the lateral plates with their anterior and posterior projections may also either lie flat or curve upwards or downwards, affecting the angle and shape of the lophi. Thirdly the bridge may be curved in the plane of the paper to a variable extent, altering the outline of the epiphallus and bringing the lophi closer together or pushing them apart. In view of these points specimens being compared must be examined in identical positions and from several angles. Genitalia drawings can only be used as a guide and should never be regarded as definitive.

### African species

- |       |  |                                       |   |
|-------|--|---------------------------------------|---|
| 1     | Hind wing bright blue basally (eastern and southern Africa) . . . . .  | <i>G. acutangulus</i> (Stål) (p. 298) |   |
| -     | Hind wing basally colourless, pale yellow, or bright yellow, rarely pale greenish blue, never bright blue . . . . .  |                                       | 2 |
| 2 (1) | Tegmen length less than 20 mm ♂, 22 mm ♀, not or barely reaching hind knees in female . . . . .  |                                       | 3 |
| -     | Tegmen length more than 20.5 mm ♂, 25 mm ♀, always exceeding hind knees in female . . . . .  |                                       | 5 |
| 3 (2) | Pronotal ×-marking with anterior arms distinctly curved, posterior arms not, or rarely faintly, visible (Fig. 150); posterior margin of pronotum rectangular to obtusangular; epiphallic lophi with relatively large, protrusive, and divergent outer lobes; posterior projection elongated and acute (Figs 100, 101); aedeagal valves strongly projecting, with large bulbous subapical ventral processes (Figs 98, 99); ventral ovipositor valves short, 1.2 times perpendicular basal width (Ivory Coast, Ghana, Zaire) . . . . . | <i>G. ochraceus</i> Sjöstedt (p. 301) |   |
| -     | Pronotal ×-marking with anterior arms straight, no more pronounced than posterior arms (Figs 129-132); hind margin of pronotum acutangular; epiphallic lophi with outer lobes small, not protrusive or divergent (Figs 39, 40, 43, 44); aedeagal valves weakly projecting, with small subapical ventral processes (Figs 37, 38, 41, 42); ventral ovipositor valves longer, 1.45 times perpendicular basal width . . . . .  |                                       | 4 |

- 4 (3) Pronotal ×-marking, when present, with straight posterior arms; hind margin of pronotum rounded acutangular (Figs 129, 130); lateral and ventral surfaces of thorax hairy; external upper and lower carinulae and medial area of hind femur with row of irregular brown speckles; tegmen length/pronotum length ratio 3·3 ♂, 2·4–2·7 ♀ (Ethiopia) *G. hyla* Sjöstedt (p. 268)
- Pronotal ×-marking with recurved posterior arms; pronotal hind margin sharply acutangular, at least in males (Figs 131, 132); thorax not hairy; external surface of hind femur unspckled, with longitudinal dark stripe of variable thickness in upper half of medial area; tegmen length/pronotum length ratio 2·4–3·2 ♂, 1·4–1·9 ♀ (Ethiopia) *G. rothschildi* Bolivar (p. 270)
- 5 (2) Dorsum of pronotum extremely elongated, more than 2·5 times length of lateral lobe; hind margin narrowly acutangular, forming an angle of less than 45° (Fig. 147); median carina high arcuate, blade-like, never intersected by posterior sulcus; hind femur narrow, elongated, length/depth ratio 5·1–5·7 ♂, 4·9–5·7 ♀; hind wing with complete fascia (Angola, Zaire, Zambia, Uganda) *G. mirabilis* Uvarov (p. 295)
- Dorsum of pronotum shorter, less than twice length of lateral lobe; hind margin forming an angle of more than 45°; median carina never blade-like, sometimes intersected by posterior sulcus; hind femur thicker, length/depth ratio usually less than 5 ♂♀, if more, then hind wing fascia very incomplete or absent 6
- 6 (5) Hind wing with well-defined continuous dark band and bright yellow basal area 7
- Hind wing with fascia continuous, interrupted, or absent, but basal area never bright yellow 8
- 7 (6) Tegmen length/pronotum length ratio 3·2–3·7 ♂, 2·9–3·6 ♀; inner and outer surfaces of hind femur with rows of irregular black specks on upper and lower carinulae; pronotal ×-marking variable, but usually distinct (Fig. 141); aedeagal valves strongly projecting, with large, bulbous subapical ventral processes (Figs 64, 65) (Zimbabwe, South Africa) *G. crassicollis* (Saussure) (p. 285)
- Tegmen length/pronotum length ratio 3·9–4·6 ♂, 3·8–4·6 ♀; hind femur without dark specks on carinulae; pronotal ×-marking, especially posterior arms, usually indistinct (Figs 121, 122); aedeagal valves weakly projecting, with weak subapical ventral process (Figs 1, 2) (Subsaharan Africa) *G. africanus africanus* (Saussure) (p. 248)
- 8 (6) Ventral surface and interior ventral carina of hind femur red; ventral ovipositor valves short, less than 1·25 times their perpendicular basal width (Angola) *G. insolens* sp. n. (p. 297)
- Ventral surface and interior ventral carina of hind femur black, blue-black, blue-grey, or straw-coloured, never red; ventral ovipositor valves longer, more than 1·25 times their perpendicular basal width 9
- 9 (8) Ventral surface of hind femur blue-grey to blue-black 10
- Ventral surface of hind femur straw-coloured 13
- 10 (9) Pronotum dorsally smooth, without warts (Fig. 142); median carina low arcuate (South Africa) *G. drakensbergensis* sp. n. ♂ only (p. 288)
- (♀ have hind femur ventral surface straw-coloured, not blue-black) 11
- 11(10) Female pronotum length less than 11·6 mm, tegmen length less than 28 mm; male with strong complete wing fascia and apical half of wing strongly infumate (Fig. 143); outer lobes of epiphallal lophi forming a small circular bump (Figs 74, 75) (Zaire, Angola) *G. obscurus* sp. n. (p. 290)
- Female pronotum length more than 12 mm, tegmen length more than 34 mm; male either with weak complete wing fascia and apical half of wing weakly infumate, or with strong fascia and apical half of wing clear (Figs 145, 146); outer lobes of epiphallal lophi laterally elongated, forming a lozenge-shaped bump (Figs 78, 79, 82, 83) 12
- 12(11) Hind wing fascia distinct, apical half of wing clear (Fig. 145); main wing veins usually tinted with pale blue basally; subapical ventral process of aedeagus bulbous, more strongly projecting (Figs 76, 77); outer edge of ventral ovipositor valves distinctly excavated (Fig. 80) (Eastern South Africa) *G. wahlbergii* (Stål) (p. 291)
- Hind wing fascia indistinct, apical half of wing indistinctly infumate (Fig. 146); wing veins never tinted with pale blue; subapical ventral process of aedeagus less strongly projecting (Figs 81, 82); outer edge of ventral ovipositor valves smoothly curved, almost straight (Fig. 84) (Angola, Zambia) *G. angolensis* (Sjöstedt) (p. 293)
- 13 (9) Hind wing without fascia (Fig. 138) (East and South Africa) *G. determinatus vitripennis* (Saussure) (p. 283)
- Hind wing with partial or complete fascia 14



- 14(13) Hind wing fascia complete, apical half of wing infumate (Fig. 134) (Tanzania)  
     *G. verticalis mpwapwae* sp. n. ♂ only (p. 277)  
 – Hind wing fascia complete or incomplete, apical half of wing never infumate . . . . . 15
- 15(14) Hind wing fascia not extending further anteriorly than 1A . . . . . 16  
 – Hind wing fascia extending to anterior margin of wing, narrowly interrupted between Cu2 and 1A (Figs 136, 142) . . . . . 17
- 16(15) Hind wing fascia not reaching hind margin of wing in females; tegmen short, 21–25 mm ♂, 32–40 mm ♀; tegminal pattern distinct, with pale transverse bands strongly marked (Eastern and southern Africa) . . . . . *G. verticalis* (Saussure) ♀ & some ♂ (p. 273)  
 – Hind wing fascia reaching hind margin of wing posteriorly in both sexes (Fig. 137); tegmen longer, 25–34 mm ♂, 42–48 mm ♀; tegminal pattern pale and indistinct, light transverse bands weakly marked (Fig. 137) (West and Central Africa to Uganda)  
     *G. determinatus procerus* (Gerstäcker) (p. 282)
- 17(15) Anterior arms of pronotal ×-marking meeting posterior arms at an angle of 90–120°; metazona with indistinct pale striae extending obliquely outwards and backwards on each side of median carina to hind margin (Fig. 136); ventral ovipositor valves with outer edge excavated (Fig. 56) (Central Africa) . . . . . *G. miombo* sp. n. (p. 278)  
 – Anterior arms of pronotal ×-marking meeting posterior arms at an angle of more than 125°; metazona without pale striae; ventral ovipositor valves with outer edge almost straight . . . . . 18
- 18(17) Males . . . . . 19  
 – Females . . . . . 20
- 19(18) Size smaller: tegmen usually less than 25 mm; pronotal ×-marking with very thin arms; hind wing band strongly incurved towards anal margin of wing, distinct as far as 6A (Fig. 133); aedeagus only moderately protruding from cingular rami (Figs 45, 47) (Eastern and southern Africa) . . . . . *G. verticalis verticalis* (Saussure) (p. 275)  
 – Size larger: tegmen more than 25 mm; pronotal ×-marking with thicker arms; hind wing band weakly incurved towards anal margin of wing, fading beyond 5A (Fig. 139); aedeagus strongly projecting from cingular rami (Figs 57, 58) (Cape Province)  
     *G. determinatus determinatus* (Walker) (p. 282)
- 20(18) Smaller insects: tegmen length less than 31 mm; hind wing with distinct broad fascia reaching anal margin of wing and incurving towards inner edge (Fig. 142) (South Africa)  
     *G. drakensbergensis* sp. n. (p. 288)  
 – Larger insects: tegmen length more than 36 mm; hind wing with fascia not reaching anal margin of wing, and only weakly incurved towards inner edge, fading beyond 5A (Fig. 140) (Cape Province) . . . . . *G. determinatus determinatus* (Walker) (p. 282)

**Non-African species**

- 1 Hind wing with basal area pale blue (Timor) . . . . . *G. subfasciatus* (de Haan) (p. 256)  
 – Hind wing basal area never blue (bases of major wing veins occasionally tinged with pale blue; see couplet 10) . . . . . 2
- 2 (1) Hind wing without fascia (Arabia) . . . . . *G. determinatus arabicus* Uvarov (p. 285)  
 – Hind wing with partial or complete fascia . . . . . 3
- 3 (2) Apical half of wing beyond fascia infumate, becoming as dark as fascia at tip of wing (Fig. 152) . . . . . 4  
 – Apical half of wing clear, wing tip sometimes infumate . . . . . 6
- 4 (3) Head small, femur length/head width ratio more than 3.6 ♂, 3.4 ♀ (Fig. 152); hind wing basal area bright sulphur yellow (New Caledonia) . . . . . *G. sarasini* (Saussure) (p. 305)  
 – Head larger, femur length/head width ratio less than 3.6 ♂, 3.3 ♀; hind wing basal area pale yellow, pale greenish yellow, or colourless . . . . . 5
- 5 (4) Hind wing with some darkened cross-veins in basal area (Fig. 151); metasternal interspace with narrow anterior medial opening, continuous with metasternum; epiphallus with lophi protruding backwards beyond posterior projections, outer lobes of lophi elongated, incurved (Figs 104, 105); ventral ovipositor valves long and apically bifurcated (Fig. 106); New Guinea) . . . . . *G. willemsei* sp. n. (p. 303)  
 – Hind wing without darkened cross-veins in basal area (Fig. 123); metasternal interspace closed; epiphallus with lophi not protruding backwards beyond posterior projections; outer lobe subtriangular, not incurved (Figs 10, 11) (Himalayas) . . . . . *G. nubilus* Uvarov (p. 252)
- 6 (3) Internal ventral surface of hind femur red (except *G. musicus* in Solomon Is.) . . . . . 7  
 – Internal ventral surface of hind femur straw to blue-black, never red . . . . . 8

- 7 (6) Small species, tegmen length less than 25 mm ♂, 32 mm ♀; hind wing basally pale yellow; fascia narrowly interrupted between Cu2 and 1A, with posterior portion thinning at its anterior end and curving inwards towards wing base along 2A (Fig. 124) (Lesser Sunda Is.)  
*G. lombokensis* Sjöstedt (p. 254)
- Larger species, tegmen length usually more than 25 mm ♂, 32 mm ♀ (females sometimes smaller in Solomon Is.); hind wing basally bright sulphur yellow (except in E. New Guinea and Solomon Is. where paler); fascia broad throughout, not incurved towards wing base along 2A (Fig. 126) (Australia, Tasmania, New Guinea, Solomon Is.)  
*G. musicus* (Fabricius) (p. 258)
- 8 (6) Internal ventral surfaces of hind femur blue-grey to blue-black (Arabia, Madagascar, India)  
*G. africanus* (Saussure) (p. 246)
- Internal ventral surface of hind femur straw-coloured . . . . . 9
- 9 (8) Hind wing fascia thin and indistinct, variably interrupted between *M* and 2A, sometimes between costal margin and 3A (Fig. 128) (Reunion) . . . . . *G. immaculatus* (Chopard) (p. 266)
- Hind wing fascia distinct, complete . . . . . 10
- 10 (9) Hind wing fascia, especially in female, with dark pigment diffusing outwards along 3A and subsequent veins towards wing tip (Fig. 127); main wing veins usually faintly tinged with pale blue basally; hind femur with external upper marginal and sometimes medial areas immaculate, unicolourous light brown or green; internal surface straw-coloured, with small brown patch in basal half of medial area only (South East Asia: Assam to W. New Guinea) . . . . . *G. marmoratus* (Thunberg) (p. 262)
- Hind wing fascia not diffusing outwards along wing veins; bases of wing veins not blue-tinged; hind femora usually with oblique transverse dark bands on external medial and upper marginal areas; internal medial area entirely black in basal two-thirds, separated from apical transverse black band by subapical pale zone . . . . . 11
- 11(10) Male cercus blunt, finger-like, with convexly rounded lower edge; aedeagus strongly projecting (Figs 20–23) (Solomon Is.) . . . . . *G. musicus* (Fabricius) (pale race) (p. 258)
- Male cercus acute, triangular, with concave lower edge; aedeagus weakly projecting (Figs 1–3) (Indo-China, Java, Kangean Is.) . . . . . *G. africanus parvulus* Sjöstedt (p. 251)

## Descriptions of the species

### *Gastrimargus africanus* (Saussure, 1888)

(Figs 1–7, 116, 117, 121, 122)

*Oedaleus* (*Gastrimargus*) *marmoratus* var. *africana* Saussure, 1888: 39.

This species is here divided into four subspecies under which the specific synonymy is separately listed.

**DIAGNOSIS.** Fastigium of vertex concave. Pronotum with median carina moderately arcuate, shallowly intersected by posterior sulcus; hind margin sharply or bluntly acutangular; dorsum smooth. Tegmen surpassing hind knees by one-quarter to one-half of hind femur length, according to subspecies. Genitalia (Figs 1–7): aedeagus very short, usually with small variable subapical ventral process (more pronounced in *G. a. sulphureus*, Fig. 3); epiphallus rather variable in outline, with protruding conical outer lobe of lophi slightly divergent to slightly convergent.

**COLORATION.** Dorsum of pronotum with pale × -marking often partly or completely obscured. Tegmen with basal pale transverse band sometimes reduced or absent. Hind wing with complete fascia (Figs 121, 122); basal area usually bright yellow (paler and sometimes greenish in subspecies *parvulus* and *sulphureus*); apex of wing variably infumate. Hind femur usually with three dark oblique transverse bands externally, sometimes obsolete in green morphs; internal surface with two basal bands forming black zone in medial area, apical band separate; interno-ventral carinula and ventral surface of hind femur blue-grey or blue-black (Africa, Madagascar, Arabia, India) to straw-coloured (China, Indo-China, Java). Hind tibiae basally brownish or reddish, subbasally straw, otherwise raspberry-red to dull pale reddish (in *G. parvulus*).

**AFFINITIES.** *G. africanus* is allied to the African *G. crassicollis* (p. 285) on the basis of the shared complete fascia and bright yellow basal area of the hind wing and the blue shading of the underside of the hind femur. In Asia *G. africanus* has close affinities with the montane species, *G. nubilus* (p. 252), and in Indo-China there is sometimes a close approach in size and general

appearance to the larger *G. marmoratus* (p. 262). The nearly related Australian species *G. musicus* (p. 258) is easily differentiated by the red undersides of the hind femora, but is otherwise very close to *G. africanus*. *G. crassicollis*, *G. marmoratus*, and *G. musicus* all have a distinctly longer aedeagus than *G. africanus*.

**DISTRIBUTION** (Figs 116, 117, and Biogeography section, p. 313). *G. africanus africanus* ranges across most of Africa south of the Sahara, S.W. Arabia and India. *G. africanus madagascariensis* is restricted to Madagascar. *G. africanus sulphureus* occurs in the mountains of Pakistan, Kashmir and Nepal, overlapping with the nominate race in the Simla hills of N.W. India. *G. africanus parvulus* is found in Indo-China and Java. Additional data for the distribution map were provided by Dr P. Basilewsky (MRAC, Tervuren) and Dr G. Demoulin (IRSNB, Brussels). Localities for the following countries were supplemented from the literature: Chad (Descamps, 1968), Cameroun (Descamps, 1953), Comoro Is. (Descamps & Wintrebert, 1969), Senegal (Roy, 1970), Ivory Coast (Gillon, 1974).

**BIOLOGY.** *G. africanus* frequents bare patches in tall grassland, open woodland and forest clearings (Jago, 1968; Joyce, 1952; Phipps, 1970). The species is often caught at light, and in Mali is believed to migrate between the Niger flood plain and the drier Sahel savannah (Descamps, 1965). There are normally two generations in drier areas (Descamps, 1953; Robertson & Chapman, 1962), but there may be three in Madagascar (Descamps & Wintrebert, 1966) and continuous breeding in Ghana (Chapman, 1962). The dry season is survived by both egg and adult (Gillon, 1974; Joyce, 1952; Robertson & Chapman, 1962). The egg stage may last 22–24 days during the rains (Golding, 1948; Davey *et al.*, 1959; Descamps, 1965). There are five or six nymphal instars (Davey *et al.*, 1959; Descamps, 1965) lasting 30–89 days in all (Davey *et al.*, 1959; Jerath, 1968). Details of the eggs and egg pod were given by Chapman (1961), Descamps & Wintrebert (1966), Katiyar (1960) (as *G. transversus*) and Phipps (1971). Birds, spiders, and *Scelio* spp. have been reported as natural enemies (Descamps & Wintrebert, 1966; Golding, 1948). There are published reports of damage by this species to maize and millet (Descamps, 1954), sorghum (Joyce, 1952), tobacco (Zacher, 1921) and some other plants.

**DISCUSSION.** *G. africanus orientalis* was based on material from India and Sri Lanka which does not differ morphologically from African specimens and the name is therefore synonymised. Sjöstedt (1928: 50) clearly designated one female from Sri Lanka, deposited in the MHN, Geneva, as the holotype. The female from Darjeeling in the NR, Stockholm labelled 'Typus' cannot therefore be the holotype.

Specimens from Simla, India wrongly determined by Sjöstedt (1928: 26) as *Gastrimargus minor* belong to *G. a. sulphureus*. *G. marmoratus* var. *minor* (Saussure, 1888: 39), described from Mongolia, is a *nomen incertae sedis* since no species of *Gastrimargus* is otherwise known from there and the original material of *minor* is lost. Saussure was familiar with *Oedaleus infernalis* from Mongolia and it is possible that it was this species that he was considering under the name *G. marmoratus* var. *minor*.

*G. parvulus* Sjöstedt is the most easterly race of *G. africanus* and is here retained as a subspecies. Sjöstedt described the green morph as *G. parvulus* and the brown morph as *G. pusillus*, a separate species. With the prerogative of first reviser *parvulus* is regarded as the senior synonym despite the line priority of *pusillus* (Sjöstedt: 1928: 38), since only *G. parvulus* has a precise type-locality.

The measurements of *G. africanus sulphureus* and *G. africanus parvulus* are generally much smaller than those of *G. africanus africanus*. Specimens of *G. africanus* from central Thailand are intermediate both in size and coloration between *G. a. parvulus* and the nominate subspecies. They may or may not show some degree of blue pigmentation on the underside of the hind femur and reduction in the intensity of the yellow colour of the hind wing basal area. The shorter wings and darker colour of *G. a. sulphureus* are presumably a response to high altitude. Genitalia differences within this highly variable species will not become clear until more material from a greater range of localities is available for study.

Key to subspecies of *G. africanus*

- 1 Hind femur with interior ventral surface suffused with blue-grey to blue-black in basal half . . . . . 2  
 – Hind femur ventrally straw-coloured, without blue pigment (E. China, Hong Kong, Vietnam, Burma, Thailand, Java, Kangean Is.) . . . . . *G. africanus parvulus* Sjöstedt (p. 251)
- 2 Tegmen surpassing hind knees by one-quarter to one-third of hind femur length. General coloration sombre; basal pale transverse band of tegmen partially or completely obsolete; hind wing basal area pale yellow or greenish yellow, not bright yellow. Subapical ventral process of aedeagus pronounced in lateral view (Fig. 3) (Pakistan, India (Uttar Pradesh, Punjab), Nepal) . . . . . *G. africanus sulphureus* Bei-Bienko (p. 250)
- Tegmen surpassing hind knees by one-third to one-half of hind femur length. General coloration more vivid; pale bands of tegmina distinct; hind wing basal area bright yellow. Subapical ventral process of aedeagus weak in lateral view (Fig. 2) . . . . . 3
- 3 Tegmen short, usually less than 27.5 mm ♂, 36.0 mm ♀; TL/PL ratio less than 3.9 ♂, 4.2 ♀. Metazona of pronotum with posterior arms of ×-marking usually visible and with several indistinct pale striae extending obliquely outwards and backwards on each side of median carina (Madagascar) . . . . . *G. africanus madagascariensis* Sjöstedt (p. 250)
- Tegmen longer, usually more than 25 mm ♂, 37 mm ♀; TL/PL ratio more than 3.9 ♂, 3.8 ♀. Metazona of pronotum with ×-marking usually effaced and without pale striae. (Africa, Arabia, India) . . . . . *G. africanus africanus* (Saussure) (p. 248)

*Gastrimargus africanus africanus* (Saussure, 1888)

*Oedaleus* (*Gastrimargus*) *marmoratus* var. *africana* Saussure, 1888: 39. LECTOTYPE ♂, SOUTH AFRICA (MHN, Geneva), here designated [examined].

*Gastrimargus africanus* (Saussure) Kirby, 1910: 227.

*Gastrimargus africanus* var. *zebrata* Sjöstedt, 1928: 41. Holotype ♀, TANZANIA (NR, Stockholm) [examined]. [Synonymised by Dirsh, 1966: 426.]

*Gastrimargus africanus* var. *orientalis* Sjöstedt, 1928: 41. Holotype ♀, SRI LANKA (MHN, Geneva) [examined]. **Syn. n.**

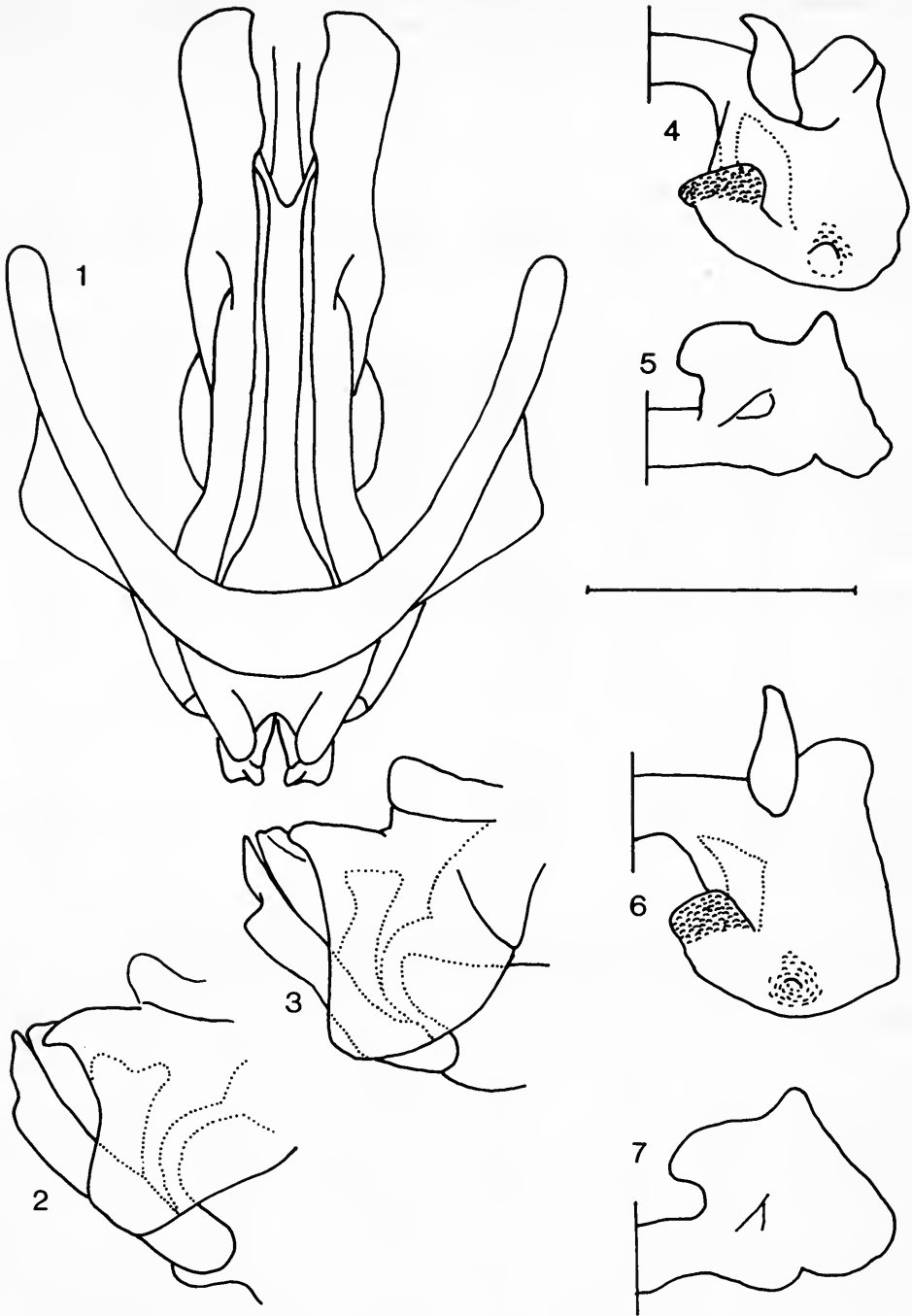
## MEASUREMENTS

Sample from Tanzania.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	38.23	5.01	7.08	29.18	16.93	3.88	4.37	4.12
Range	33.1–43.3	4.5–5.7	6.2–8.1	25.1–32.5	14.2–19.4	3.3–4.3	4.0–4.9	3.9–4.5
S.D.	2.076	0.270	0.412	1.543	1.104	0.204	0.170	0.150
n	30	30	26	30	30	30	30	26
Females								
Mean	53.36	7.12	9.82	40.56	23.59	5.48	4.31	4.14
Range	48.7–58.5	6.6–7.7	9.0–10.9	37.2–44.7	20.6–25.9	4.9–5.9	4.0–4.7	3.8–4.6
S.D.	2.284	0.270	0.447	1.952	1.291	0.225	0.155	0.195
n	30	30	28	30	30	30	30	28

## MATERIAL EXAMINED

*Gastrimargus marmoratus* var. *africana* Saussure, lectotype ♂, South Africa: Cape of Good Hope (MHN, Geneva). *Gastrimargus africanus* var. *zebrata* Sjöstedt, holotype ♀, Tanzania: Mt Kilimanjaro (NR, Stockholm). *Gastrimargus africanus* var. *orientalis* Sjöstedt, holotype ♀, Sri Lanka, no further data (MHN, Geneva).



Figs 1-7 *Gastrimargus africanus*, genitalia. 1, *G. a. africanus*, phallic complex, dorsal view; 2, same, posterior portion, lateral view; 3, same, *G. sulphureus*; 4, *G. a. africanus*, epiphallus, right half, dorsal view; 5, same, posterior view; 6, *G. a. sulphureus*, epiphallus, right half, dorsal view; 7, same, posterior view.

In addition to the type-material listed above, 1126 specimens of this subspecies were examined from the following countries: **Sierra Leone, Mali, Niger, Ghana, Nigeria, Togo, Pigalu (Annobón), Principé I., São Tomé I., Cameroun, Central African Republic, Libya, Sudan, Ethiopia, Congo, Zaire, Uganda, Rwanda, Burundi, Kenya, Angola, Zambia, Malawi, Tanzania, Zimbabwe, Mozambique, South Africa, Swaziland, Comoro Is., Seychelles, Saudi Arabia, Yemen, Pakistan, India** (including 1 ♀, Sikkim, E. Himalayas, Kurseong, 1900 m, 14. viii. 1909 (*Jenkins*); 1 ♂, Balugaon, Puri distr., Orissa, 21–23.vii.1913 (*Annandale*); 1 ♀, Darjeeling, 29.xi.1904 (*Gulmann*) (NR, Stockholm) [all three specimens paratypes of *Gastrimargus africanus* var. *orientalis* Sjöstedt, the Darjeeling specimen incorrectly labelled 'Typus']), **Sri Lanka** (including 1 ♀, no locality data (*Green*) [figured in error as '*G. transversus*' by Kirby, 1914: 145]; 1 ♂, no data (*Humbolt*) (MHN, Geneva) [allotype of *Gastrimargus africanus orientalis* Sjöstedt]), **Nepal, Tibet, Burma, Thailand.**

*Gastrimargus africanus madagascariensis* Sjöstedt, 1928 subsp. rev.

*Gastrimargus africanus* var. *madagascariensis* Sjöstedt, 1928: 41. Holotype ♀, MADAGASCAR (NR, Stockholm) [examined]. [Incorrectly synonymised by Dirsh, 1963: 273.]

MEASUREMENTS

Sample from Madagascar.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	32.28	4.56	6.76	24.37	16.42	3.66	4.49	3.63
Range	29.1–36.0	4.1–5.0	6.1–7.4	21.8–27.4	15.2–17.9	3.3–4.0	4.2–4.9	3.3–3.9
S.D.	1.477	0.207	0.312	1.178	0.661	0.170	0.168	0.164
n	29	29	25	29	25	25	25	25
Females								
Mean	43.60	6.33	9.04	32.50	21.58	4.96	4.35	3.59
Range	39.5–47.6	5.8–6.9	8.0–10.0	29.3–35.6	18.7–23.4	4.2–5.6	3.9–4.6	3.3–4.2
S.D.	2.320	0.263	0.542	1.864	1.118	0.269	0.176	0.175
n	33	39	38	36	38	38	38	35

MATERIAL EXAMINED

*Gastrimargus africanus* var. *madagascariensis* Sjöstedt, holotype ♀, **Madagascar**: Tananarive (NR, Stockholm).

**Madagascar**: 18 ♂, 14 ♀, Tananarive, Namsana, 25.vii.–26.ix.1928 (*Zolotarevsky*); 7 ♀, Vohimarina, Tongobory, Tulear, 2.i.1928 (*Zolotarevsky*); 1 ♀, Andranoabo, Betioky, Tulear, 8.ii.1928 (*Zolotarevsky*); 1 ♀, Andranolava, Tongobory, Tulear, 27.xii.1927 (*Zolotarevsky*); 1 ♂, 2 ♀, Ejeda, Betioky, Tulear, 16.ii.1928 (*Zolotarevsky*); 1 ♀, Maroroky, Ankajoah, 17.xii.1927 (*Zolotarevsky*); 2 ♀, Manera, Tulear, 15.xii.1927 (*Zolotarevsky*); 4 ♀, no data; 2 ♂, Sakamena, Betioky, 15.v.1928 (*Zolotarevsky*); 3 ♀, Santa, Betroka, 14.v.1928 (*Zolotarevsky*); 1 ♂, Ambohimitombo forest, 24.i.1895 (*Forsyth Major*); 1 ♀, Tananarive, 8.x.1970 (*Hammond*); 1 ♂, no data (*Zolotarevsky*); 2 ♀, Tserazafy, Valala-Advisa-Syakita, 12.viii.1913 (*Beck*); 2 ♂, Arivonimamo, 3.viii.1913 (*Beck*); 1 ♂, Tsiafakombo, 'Aketa', 4.viii.1913 (*Beck*); 1 ♀, Tsiafakombo, 'Advisa', 4.viii.1913 (*Beck*); 1 ♂, Soafoy, 1400 m, 15.viii.1913 (*Beck*); 1 ♂, Amboniriana, Fsikovodrinrina, 26.viii.1913 (*Beck*); 1 ♂, Antanety, Aketa, 17.ix.1913 (*Beck*); 1 ♀, Ambohibelo, 1280 m, 3.viii.1913 (*Beck*); 4 ♀, Sikora, (MHN, Geneva); 6 ♀, Tananarivo (MHN, Geneva); 1 ♂, no data (MHN, Geneva).

*Gastrimargus africanus sulphureus* Bei-Bienko, 1951 stat. n.

*Gastrimargus sulphureus* Bei-Bienko, 1951: 580. Holotype ♂, PAKISTAN (ZI, Leningrad) [examined]. [*Gastrimargus minor* (Saussure); Sjöstedt, 1928: 26. Misidentification, referred to *G. sulphureus* by Bei-Bienko, 1951: 580.]

## MEASUREMENTS

Sample from India, Pakistan and Nepal.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	30.62	4.59	6.03	22.46	15.29	3.79	4.04	3.72
Range	26.8–33.3	4.1–4.9	5.5–6.5	19.1–24.6	13.3–16.5	3.2–4.1	3.8–4.2	3.4–4.1
S.D.	1.478	0.184	0.329	1.212	0.773	0.216	0.134	0.191
n	17	18	16	18	15	15	15	16
Females								
Mean	42.36	6.73	8.59	30.89	21.78	5.46	4.00	3.55
Range	37.2–47.5	6.0–7.9	7.3–9.7	26.7–35.5	19.3–25.1	4.6–6.9	3.4–4.2	3.3–4.2
S.D.	3.012	0.521	0.711	2.529	1.800	0.578	0.177	0.225
n	12	15	15	13	15	15	15	13

## MATERIAL EXAMINED

*Gastrimargus sulphureus* Bei-Bienko, holotype ♂, **Pakistan**: Baluchistan, Ziarat, 2400 m, 6.viii.1929 (Evans) (ZI, Leningrad).

**Pakistan**: 1 ♀, Baluchistan, Ziarat, 2400 m, 1–15.viii.1930, 1 ♀, same data, 20.ix.1930; 1 ♂, Baluchistan, Urak valley, 26 km from Quetta, 2100 m, 8.vi.1930; (Evans); 1 ♂, 4 ♀, Baltistan; 1 ♂, Hunza, 2250 m, 27.viii.1913 (Hingston); 3 ♂, Achhebal, 21–24.ix.1923 (Dutt); 1 ♂, 2 ♀, Perimahal, nr Srinagar, 10.x.1923 (Fletcher). **India**: 3 ♂, 1 ♀, NW. India; 1 ♀, Uttar Pradesh, Garhwal (Longstaff); 2 ♂, Punjab, Simla, 2500 m, vii. (MNHU, Berlin); 1 ♂, 1 ♀, Punjab, Simla, 2500 m, vii. (NR, Stockholm); 1 ♂, 3 ♀, same but undated (NR, Stockholm); 1 ♀, Kandaghat, Simla hills, 1050–1380 m, viii.1925 (Chopra); 1 ♂, Aeni [?], Simla hills, 1050–1200 m, in jungle, viii–ix.1925 (Chopra); 2 ♂, Simla, 1950–2100 m, 2.ix.25 (Whistler). **Nepal**: 1 ♂, Nagarkot, 2100 m, 6.vi.1937 (Bailey).

*Gastrimargus africanus parvulus* Sjöstedt, 1928 stat. n.

*Gastrimargus parvulus* Sjöstedt, 1928: 38. Holotype ♀, JAVA (NM, Maastricht) [examined].

*Gastrimargus pusillus* Sjöstedt, 1928: 38. Holotype ♀, 'Nederl. Indien' (NM, Maastricht) [examined]. **Syn. n.**

## MEASUREMENTS

Sample from Thailand.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	36.83	5.09	6.94	27.83	17.55	4.09	4.19	4.01
Range	32.9–40.0	4.7–5.5	6.2–7.6	24.4–30.0	15.3–18.6	3.6–4.5	3.9–4.6	3.5–4.3
S.D.	1.710	0.208	0.405	1.333	0.821	0.210	0.162	0.193
n	33	35	33	33	33	33	33	31
Females								
Mean	51.52	7.35	9.48	38.79	23.92	5.83	4.11	4.09
Range	47.0–54.7	6.8–7.9	8.9–10.6	35.0–41.8	22.1–26.5	5.4–6.3	3.9–4.4	3.7–4.4
S.D.	1.825	0.252	0.384	1.697	1.304	0.261	0.147	0.192
n	20	20	19	20	19	19	19	19

Sample from Java.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	28.30	4.05	5.47	21.07	13.80	3.25	4.20	3.85
Range	28.1–28.4	3.9–4.2	5.4–5.6	20.8–21.4	13.8–13.8	3.2–3.3	4.1–4.3	3.8–3.9
S.D.	—	—	—	—	—	—	—	—
n	2	2	2	2	2	2	2	2
Females								
Mean	42.98	5.93	7.71	31.95	19.38	4.76	4.07	4.12
Range	38.8–48.5	5.4–7.0	6.9–8.8	28.3–37.1	17.0–22.6	4.3–5.5	3.8–4.4	3.9–4.4
S.D.	2.675	0.366	0.505	2.500	1.578	0.318	0.160	0.154
n	12	16	16	14	15	15	15	14

## MATERIAL EXAMINED

*Gastrimargus parvulus* Sjöstedt, holotype ♀, **Java**: Mt Merbaboe, 1500 m, ix.1916 (*Roepke*) (NHM, Maastricht). *Gastrimargus pusillus* Sjöstedt, holotype ♀, **Java** [?]: 'Ned. Oost Indie', no further data (NHM, Maastricht).

**Java**: 4 ♀, West Java, Mt Gede, 1200 m, viii.1892 (*Fruhstorfer*) (IRSNB, Brussels); 1 ♂, 1 ♀, Semarang, 1936 (*Le Moul*) (NHM, Maastricht); 1 ♀, Buitenzorg, 1939 (*Blizdorp*) (NHM, Maastricht); 1 ♀, Djember, iii.1935 (NHM, Maastricht); 1 ♀, Ond., Herboth Bodja, 350 m, 11.i.1941 (*Dupont*) (NHM, Maastricht); 1 ♂, Ond., Tjogreg Buitenzorg, 12.v.1940 (*Wira*) (NHM, Maastricht); 1 ♀, Bogor, 1.xi.1965 (*Stusak*) (BPBM, Honolulu); 1 ♀, Passoeroean, iv.1914 (*Muir*) (BPBM, Honolulu); 1 ♀, no data (*Fruhstorfer*) (MNHN, Paris); 1 ♀, Buitenzorg, 1931 (*Windred*) (ANIC, Canberra). **Kangean Is.**: 1 ♀, Ardjasa I., 17.viii.1954 (*Hoogenvert*) (NHM, Maastricht). **Thailand**: 18 ♂, 5 ♀, Chaibadal, Lopburi, 26.vii.1966 (*Prasartthai*); 1 ♂, 1 ♀, Chonburi, 19.vi.1961 (*Prachua*); 1 ♂, Bang Sue, Bangkok, 20.x.1955 (*Ruchair*); 1 ♀, Soi Ari, Bangkok, 10.vii.1957 (*Student*); 1 ♂, Saraburi, 5.viii.1959 (*Montean*); 1 ♂, Saraburi, 28.viii.1959 (*Sirichai*); 1 ♀, Saraburi, 13.vi.1957 (*Student*); 2 ♂, Nakhonratchasima, 30.vi.1962 (*Phon*); 1 ♂, same data, 4.viii.1964 (*Aroon*); 1 ♀, Muakleg, Nakhonratchasima, 18.viii.1955 (*Suphar*); 1 ♂, same locality, 10.vii.1954 (*Student*); 1 ♀, Dhonburi, 27.iv.1959 (*Prayong*); 1 ♀, Komaiasai, Kalasindhi, 2.viii.1949 (*Chainarouf*); 2 ♀, Lopburi, 4.ix.1963 (*Aroon*); 1 ♀, Udon, 1.viii.1964 (*Chanchai*); 3 ♂, Ubol, 1.viii.1958 (*Phon*); 2 ♂, same data, 1.viii.1955 (all DA, Bangkok). **Burma**: 7 ♂, 1 ♀, Mt Victoria, Chin hills, 1000 m, vi.1938 (*Heinrich*) (MNHU, Berlin). **Vietnam**: 1 ♀, Annam, Langbian Prov., Dran, 900 m, iii–iv.1918 (*Boden Kloss*). **Hong Kong**: 6 ♂, 1 ♀, New Territories, Shatin, 28.i.1977 (*Winney*) (AFD, Hong Kong). **China**: 3 ♀, Fujian, Guangze, 10–25.ix.1937 (*Klapperich*) (MNHU, Berlin); 4 ♀, Yunnan, 'Sannen Kai', (IRSNB, Brussels); 1 ♀, Yunnan, 'nr Chi-Tien', 2100 m (*Gregory*); 1 ♂, Yunnan, 'Feng-Ming-Kai', S. of Lijiang, 2300 m, 9.viii.1922 (*Gregory*); 1 ♂, Yunnan, 'Tacheng Chi-Tsung R.', 2200 m, open valley, 1.viii.1922 (*Gregory*); 1 nymph, same data, 1.vii.22; 1 ♂, Hainan, 'You Boi', 2.vi.1903; 1 ♂, Hainan, Wuzhi Shan, 15.v.1903; 1 ♂, Jiangxi, 10.viii.1924 (*Chang*); 1 ♂, Guangdong, 'Linchow', Linxian distr., 9.viii.1934 (*To*); 1 ♀, Guangdong, Zhongdong, Shangshui, Linxian distr. (*To*).

*Gastrimargus nubilus* Uvarov, 1925

(Figs 8–11, 117, 123)

*Gastrimargus nubilus* Uvarov, 1925a: 325. Holotype ♂, CHINA (BMNH) [examined].

*Gastrimargus africanus chinensis* Willemse, 1933: 15. LECTOTYPE ♂, CHINA (IP, Eberswalde), here designated [examined]. [Synonymised by Uvarov, 1939: 564.]

**DIAGNOSIS.** Fastigium of vertex flat or slightly concave. Pronotum with median carina arcuate, not intersected by posterior sulcus; dorsum smooth; hind margin acutangular. Tegmen reduced, surpassing folded hind knees by one-fifth of hind femur length in male, hardly at all in female. Genitalia (Figs 8–11): similar to *G. africanus*.



Coloration variable, generally more sombre than *G. africanus*. Pronotal  $\times$ -marking often indistinct (Fig. 123). Tegmen with pale cross-banding reduced to one or two variable pale patches on costal margin, two- and four-sevenths along from base (Fig. 123). Hind wing with complete fascia (Fig. 123) and with apical half of wing beyond fascia infumate (less distinctly in female); basal area of wing pale greenish yellow. Hind femur as in *G. africanus africanus*, interior ventral surface blue-black. Hind tibiae red.

## MEASUREMENTS

Sample from China: Yunnan.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	29.03	4.62	6.10	21.04	15.63	3.50	4.47	3.48
Range	26.6–31.4	4.3–4.9	5.5–6.5	19.3–22.6	14.0–17.1	3.2–3.7	4.2–4.7	3.3–3.7
S.D.	1.200	0.175	0.298	0.841	0.942	0.232	0.128	0.107
n	14	14	9	14	12	12	12	9
Females								
Mean	36.49	6.54	8.19	25.63	20.44	4.97	4.12	3.19
Range	28.9–40.4	5.3–7.1	6.7–9.3	20.1–28.7	19.5–22.9	3.6–5.4	3.9–4.4	3.0–3.6
S.D.	2.711	0.398	0.758	2.060	1.769	0.447	0.139	0.190
n	14	15	11	14	12	12	12	10

**AFFINITIES.** The range of this species overlaps with *G. africanus*, a species which it closely resembles and from which it has presumably been derived by the process of adaptation to harsh montane conditions. The reduction of tegmen and wing length, loss of the bright yellow basal area of the hind wing, and darkening of the apical half of the wing are all recurring features of this process. Similar characteristics are found in many montane Oedipodinae, as for example in *G. willemsei* (p. 303).

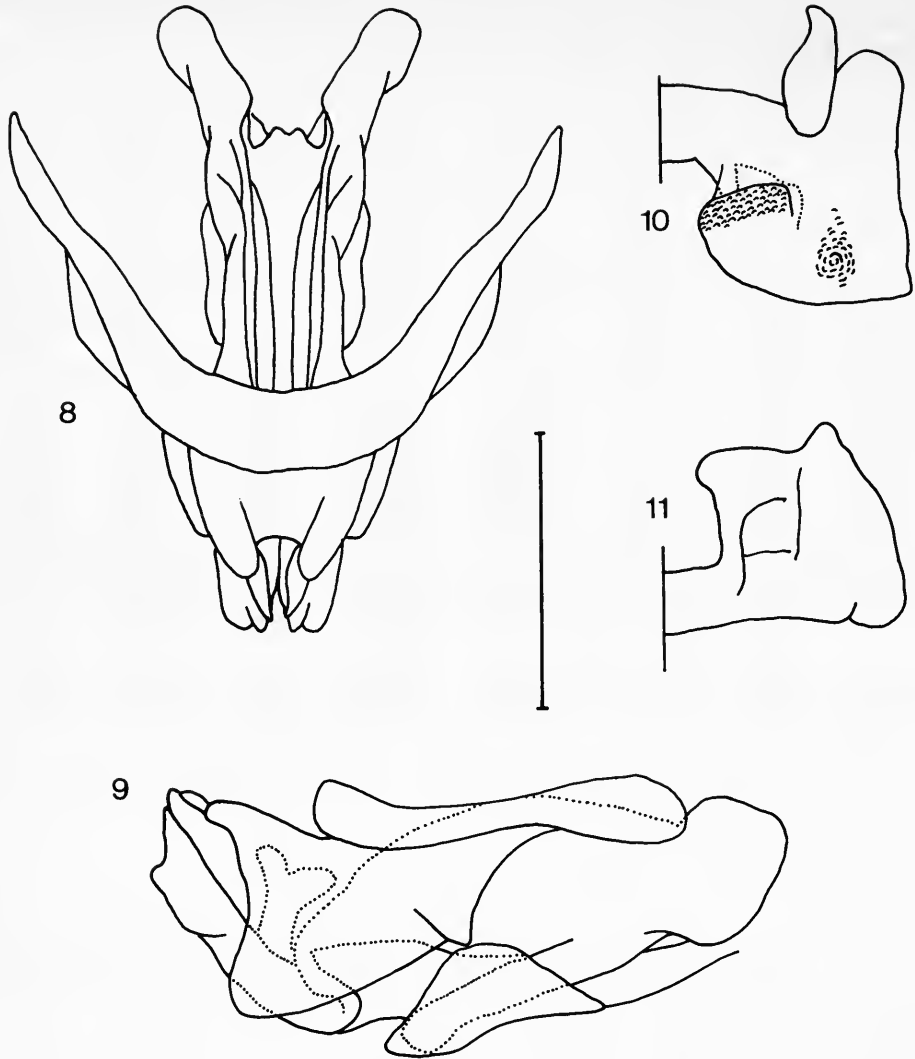
## MATERIAL EXAMINED

*Gastrimargus nubilus* Uvarov, holotype ♂, **China**: Yunnan, Dazheng, 2200 m, 1.viii.1922 (*Gregory*) (BMNH). *Gastrimargus africanus chinensis* Willemse, lectotype ♂, **China**: Sichuan, Zaji distr., 'Tatsienlu', 7.vii.1930 (*Friedrich*) (IP, Eberswalde).

**China**: 5 ♂, 14 ♀, Sichuan, Zaji distr., Kangding, 7.viii.1930 (*Friedrich*) (IP, Eberswalde) (paralectotypes of *G. africanus chinensis*); 1 ♂, same data (paralectotype of *G. africanus chinensis*); 4 ♀, same data, 30.ix.1930 (IP, Eberswalde) (paralectotypes of *G. africanus chinensis*); 1 ♀, same data, 22.vii.1930 (IP, Eberswalde) (paralectotypes of *G. africanus chinensis*); 1 ♀, same data (paralectotypes of *G. africanus chinensis*); 1 ♂, 1 ♀, same data, 7.ix.1930 (paralectotype of *G. africanus chinensis*); 1 ♂, Yunnan, Gadya, 1980 m, 4.viii.1922 (*Gregory*) (paratype of *G. nubilus*); 1 ♂, Yunnan, 'Sekan', 'Jugeh R.', 2200 m, 30.vii.1922 (*Gregory*) (paratype of *G. nubilus*); 1 ♀, W. Yunnan, 'Talifu', viii.–ix.1914, 2200 m (*Mell*) (MNHU, Berlin); 1 ♀, label illegible, 1.viii. (Mell ?) (MNHU, Berlin); 1 ♂, label illegible, 'Yangwong' [?], 'Tafuken-Pupeng' [?], 26.vii.1914 (*Mell* ?) (MNHU, Berlin); 2 ♂, no further data (*Mell*) (MNHU, Berlin); 9 ♂, 13 ♀, Yunnan, 'Sannen Kai', (IRSNB, Brussels); 1 ♂, 1 ♀, E. Tibet, Dzogang, 2700–3600 m, 13–21.ix.1936 (*Kaulback*); 1 ♀, E. Tibet, Poshe, 2700–3600 m, 12–28.viii.1936 (*Kaulback*).

**DISTRIBUTION** (Fig. 117, and Biogeography section, p. 314). *G. nubilus* is a montane species endemic to the mountains of southern China, north of the Burma border.

**DISCUSSION.** The syntype series of *G. africanus chinensis* Willemse originally consisted of 31 males and 55 females. Of these 1 male and 2 females are now in the BMNH, London, and all or most of the remainder are in the IP, Eberswalde. A male from the latter collection is here designated as the lectotype, and the remaining specimens as paralectotypes.



Figs 8–11 *Gastrimargus nubilus*, genitalia. 8, phallic complex, dorsal view; 9, same, lateral view; 10, epiphallus, right half, dorsal view; 11, same, posterior view.

***Gastrimargus lombokensis* Sjöstedt, 1928**

(Figs 12–15, 118, 124)

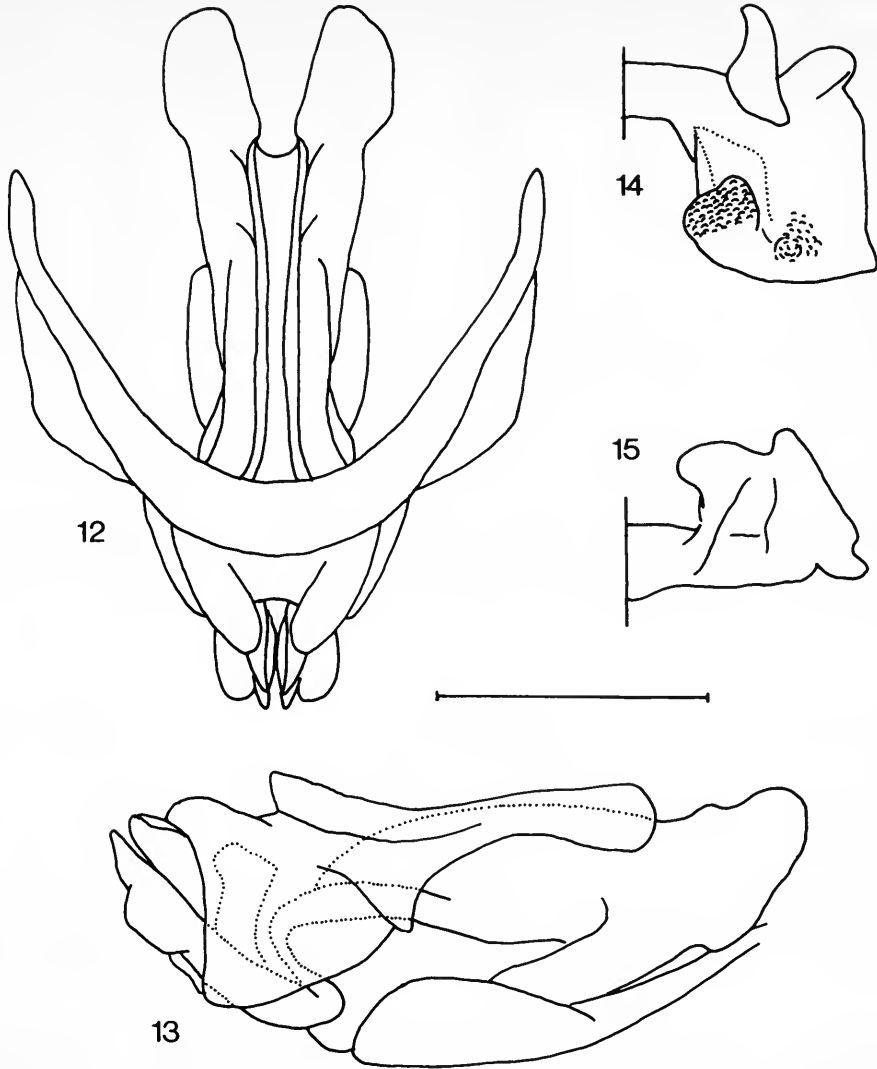
*Gastrimargus lombokensis* Sjöstedt, 1928: 6, 12. Holotype ♀, LOMBOK (MNHU, Berlin) [examined].

*Gastrimargus lombokensis* [sic] Sjöstedt, 1928: 42.

*Gastrimargus floresensis* Sjöstedt, 1928: 43. Holotype ♂, FLORES (MNHU, Berlin) [lost]. **Syn. n.**

**DIAGNOSIS.** Fastigium of vertex convex. Pronotum as in *G. africanus*, not intersected by posterior sulcus; hind margin rectangular to slightly acutangular. Tegmen surpassing folded hind knees by about one-third of hind femur length. Genitalia (Figs 12–15) similar to *G. africanus*.

Coloration similar to *G. africanus*. Hind wing basally pale yellow, and fascia narrowly interrupted between *Cu*2 and 1*A*, with anterior end of anal section noticeably incurved towards wing base along 2*A* (Fig. 124). Hind femur as in *G. africanus* externally; internal surface pale red, sometimes partly obscured by variable dark patch in medial area; dark pigment sometimes absent in green morphs except for rows of black dots on carinulae; ventral surface pale red. Hind tibiae orange-red in male becoming paler on outer sides, duller in female.



**Figs 12–15** *Gastrimargus lombokensis*, genitalia. 12, phallic complex, dorsal view; 13, same, lateral view; 14, epiphallus, right half, dorsal view; 15, same, posterior view.

MEASUREMENTS

Sample from Lesser Sunda Is.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	29.63	4.32	5.89	21.93	14.98	3.47	4.32	3.75
Range	26.1–33.5	3.9–4.8	5.1–7.1	19.1–24.9	13.2–17.0	3.1–3.9	4.0–4.7	3.2–4.2
S.D.	1.847	0.245	0.481	1.442	0.814	0.185	0.160	0.234
n	36	36	36	36	34	34	34	36

## MEASUREMENTS—(cont.)

Females								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	38.90	6.04	7.77	28.29	19.95	4.72	4.23	3.65
Range	33.6–43.3	5.3–6.9	6.3–9.3	22.1–32.0	16.5–22.8	4.2–5.4	3.8–4.5	2.7–4.0
S.D.	2.490	0.414	0.636	2.162	1.451	0.284	0.161	0.241
n	35	37	37	36	35	35	35	36

**AFFINITIES.** *G. lombokensis* occupies a geographical and taxonomic position intermediate between *G. africanus* in Java and *G. musicus* in New Guinea. The male genitalia with their rather short aedeagus are closer to those of *G. africanus* than to *G. musicus*, but the red underside of the hind femur is a character found also in *G. subfasciatus* on neighbouring Timor and *G. musicus* in New Guinea and Australia. However, the form of the hind wing band is peculiar to this species (Fig. 124), suggesting that *G. lombokensis* was not an intermediate stage in the evolution of *G. musicus*.

**MATERIAL EXAMINED**

*Gastrimargus lombokensis* Sjöstedt, holotype ♀, **Lombok**: 1 ♀, Sambalun, 1200 m, iv.1896 (*Fruhstorfer*) (MNHU, Berlin). **Kangean Is.**: 1 ♀, Sepandjang I., 9.xi.1959 (*Hoogerwert*) (NHM, Maastricht). **Lombok**: 3 ♂, 9 ♀, Narmada, 14–18.iii.1927 (*Rensch*) (MNHU, Berlin); 1 ♂, 3 ♀, Sembalun, 1200 m, 30–31.iii.1927 (*Rensch*) (MNHU, Berlin); 1 ♂, 1 ♀, Ekas, 17–20.iv.1927 (*Rensch*) (MNHU, Berlin); 3 ♀, Swela, 3450 m, 22–27.iii.1927 (*Rensch*) (MNHU, Berlin); 1 ♂, Ampenan, iii.1940 (NHM, Maastricht); 1 ♂, Sapit, 600 m, iv.1896 (*Fruhstorfer*) (MHN, Geneva); 2 ♀, Sambalun, 1200 m, iv.1896 (*Fruhstorfer*) (MHN, Geneva). **Sumbawa**: 4 ♂, 3 ♀, Besar, 24.iv.–2.v.1927 (*Rensch*) (MNHU, Berlin); 3 ♂, 2 ♀, Dompu, 2–4.vi.1928 (*Rensch*) (MNHU, Berlin); 1 ♀, same data (BMNH); 1 ♀, Wawo, Südl. d., Maria-Gebirges, 450 m, 2–4.vi.1927 (*Rensch*) (MNHU, Berlin); 1 ♂, 1 ♀, same data (BMNH). **Sumba**: 1 ♂, Prai Jawang, Rende Wai, 13.vi.1949 (*Bühler & Sutter*). **Flores**: 2 ♂, 4 ♀, Ruteng, x.–xii.1968 (*Verheyen*) (NHM, Maastricht); 1 ♂, 1 ♀, Larantuka (*Semmelink*) (MNHU, Berlin); 1 ♂, 1 ♀, Rana Mêsé, 20–30.vi.1927 (*Rensch*) (MNHU, Berlin); 11 ♂, 6 ♀, Ende, 10–16.vi.1927 (*Rensch*) (MNHU, Berlin); 2 ♂, same data (BMNH).

**DISTRIBUTION** (Fig. 118, and Biogeography section, p. 315). Lesser Sunda Is.

**DISCUSSION.** Despite the loss of the unique holotype male of *G. floresensis*, the above synonymy is confirmed both by Sjöstedt's description and plate (1928: 43), and by examination of new material from Flores.

*Gastrimargus subfasciatus* (de Haan, 1842)

(Figs 16–19, 120, 125)

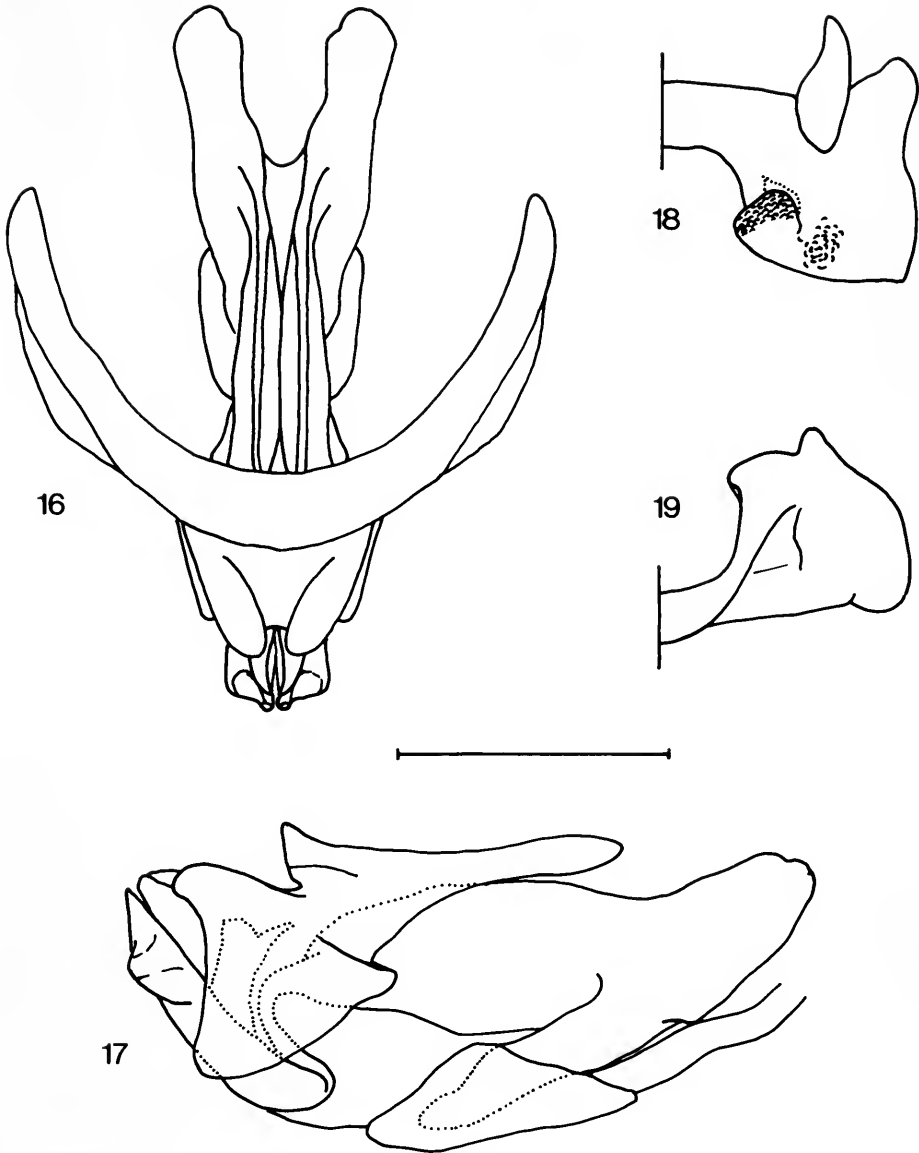
*Acridium* (*Oedipoda*) *subfasciatum* de Haan, 1842: 161. LECTOTYPE ♂, TIMOR (RNH, Leiden), here designated [examined].

*Oedaleus* (*Gastrimargus*) *subfasciatus* (de Haan) Saussure, 1884: 115; 1888: 39 [gives incorrect type-locality].

*Gastrimargus subfasciatus* (de Haan) Willemse, 1928: 14

**DIAGNOSIS.** Antennae long, in male 1.25 times combined length of head and pronotum. Fastigium of vertex flat or slightly concave. Pronotum with median carina arcuate, not intersected by posterior sulcus; hind margin slightly acutangular. Tegmen surpassing folded hind knees by about one-third of hind femur length. Genitalia (Figs 16–19) similar to *G. africanus*.

Coloration similar to *G. africanus*. Metazona of pronotum often with dark brown diamond-shaped area in male, reduced in female to two dark bars flanking median carina on inner sides of posterior arms of ×-marking; ×-marking often indistinct. Tegmen similar to *G. africanus*. Hind wing basally pale blue; fascia interrupted, restricted to posterior margin of wing, not advancing further than 3A (Fig. 125). Hind femur externally as in *G. africanus*, internally with dark brown patch in basal half of medial area; lower internal carinula and ventral surface of hind femur bright red in male, duller in female. Hind tibiae of male bright orange-red on internal lateral surface, paler on outer surface, less pronounced in female.



**Figs 16–19** *Gastrimargus subfasciatus*, genitalia. 16, phallic complex, dorsal view; 17, same, lateral view; 18, epiphallus, right half, dorsal view; 19, same, posterior view.

## MEASUREMENTS

Sample from Timor.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	30.61	4.32	6.15	22.74	14.87	3.52	4.20	3.70
Range	28.2–	4.0–	5.5–	21.0–	13.1–	2.6–	4.0–	3.4–
	33.6	5.0	6.7	24.7	16.7	4.0	5.3	4.0
S.D.	1.700	0.307	0.385	1.270	1.311	0.407	0.406	0.144
n	10	10	10	10	10	9	9	10
Females								
Mean	42.04	6.22	8.39	31.33	19.92	4.93	4.04	3.77
Range	37.6–	5.6–	7.0–	27.7–	17.6–	4.4–	3.7–	3.2–
	45.1	6.8	9.8	34.5	21.7	5.3	4.4	4.2
S.D.	2.087	0.310	0.524	1.784	1.174	0.255	0.172	0.201
n	28	30	28	28	22	22	22	26

AFFINITIES. *G. subfasciatus* is closely allied to *G. lombokensis* on the basis of its genitalia and general appearance, particularly the red undersides of the hind femora. The greatly reduced hind wing fascia and the pale blue basal area are relatively minor modifications of the condition found in *G. lombokensis* (see Biogeography section, p. 316), despite the distinctive appearance which they present.

## MATERIAL EXAMINED

*Acridium (Oedipoda) subfasciatum* de Haan, lectotype ♂, Timor: Semau I. ('Poeloe Samoe') (Muller) (RNH, Leiden).

Timor: 1 ♀, Semau I. (Muller) (paralectotype of *A. subfasciatum*) (RNH, Leiden); 1 ♂, Baucau, v–vi.1949 (Marsden); 4 ♂, 26 ♀, Soë (IRSNB, Brussels); 2 ♂, 2 ♀, same data (BMNH); 1 ♂, Kupang, 6–21.vi.1929 (Mackerras) (ANIC, Canberra); 1 ♂, same, 7–27.i.1966 (Ferreira) (NHM, Maastricht); 1 ♀, same, 15–30.xii.1965 (Ferreira) (NHM, Maastricht); 1 ♂, Roti I., Mokdale, 22.vi.1929 (Mackerras) (ANIC, Canberra); 3 ♀, no locality data (Rensch) (MNHU, Berlin).

DISTRIBUTION (Fig. 120, and Biogeography section, p. 316). Timor.

DISCUSSION. The type-material of *G. subfasciatus* in the RNH, Leiden, consists of one male, here designated lectotype, and one female, designated paralectotype.

*Gastrimargus musicus* (Fabricius, 1775)

(Figs 20–25, 120, 126)

*Gryllus musicus* Fabricius, 1775: 290. Holotype ♀, AUSTRALIA (BMNH) [examined].

*Acrydium musicum* (Fabricius) Olivier, 1791: 222.

*Gryllus pictus* Leach, 1814: 57. Type(s), AUSTRALIA (presumed lost). [Synonymy indicated by coloured plate 25 of male (?) in Leach, 1814. Synonymised by Kirby, 1910: 227.]

*Gryllus stollii* Leach, 1814: 137. [Unnecessary replacement name for *Gryllus pictus* Leach.]

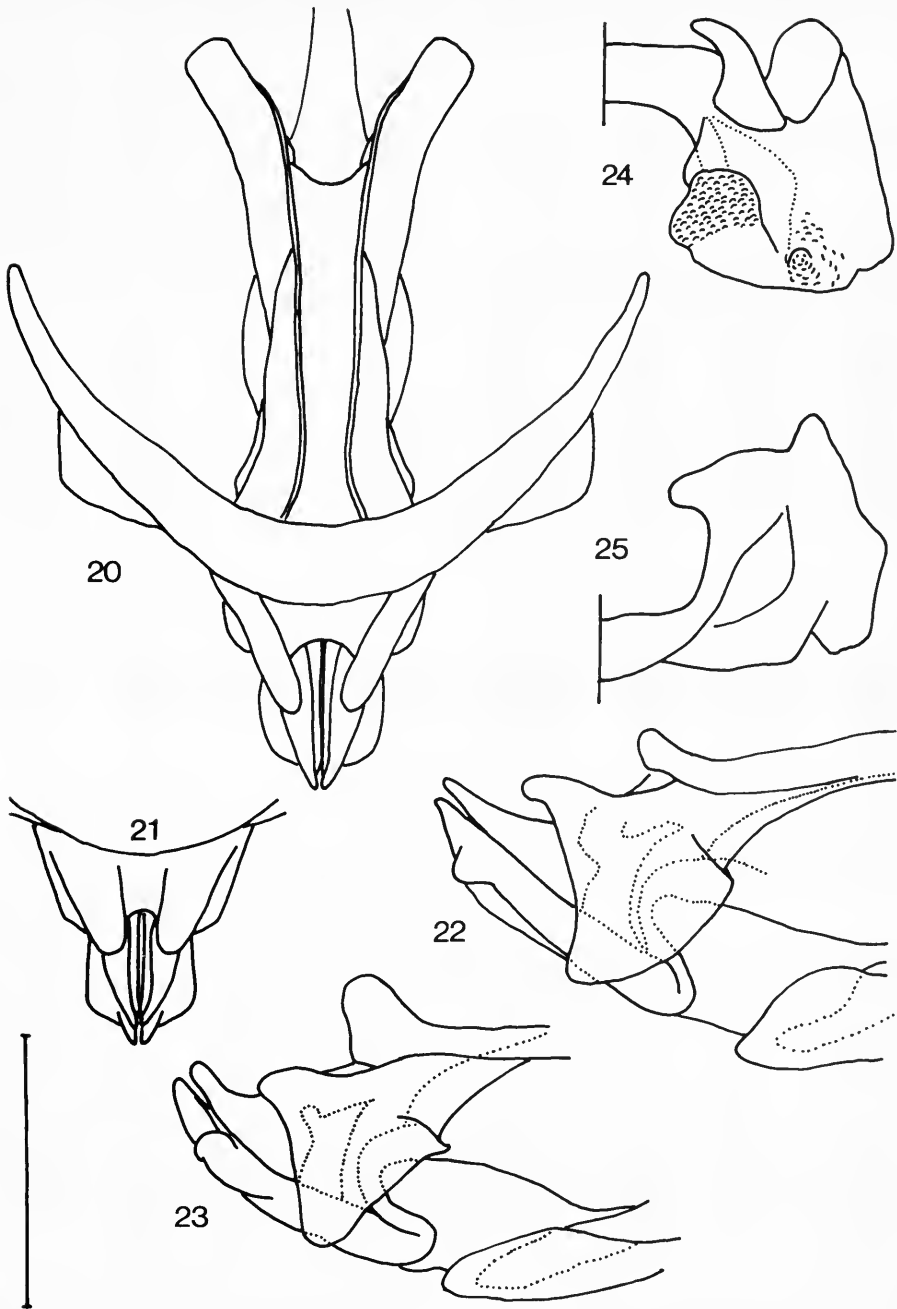
*Oedipoda musica* (Fabricius) Serville, 1838: 720.

[*Locusta danica* Linnaeus; Froggatt, 1903: 1104; 1907: 41; 1910: 9. Misidentifications.]

*Gastrimargus musicus* (Fabricius) Kirby, 1910: 227.

*Gastrimargus musicus* var. *kimberleyensis* Sjöstedt, 1928: 42. Holotype ♂, AUSTRALIA (NR, Stockholm) [examined]. **Syn. n.**

DIAGNOSIS. Fastigium of vertex slightly convex, flat, or slightly concave. Pronotum with median carina arcuate, sometimes intersected by posterior sulcus; hind margin acutangular to rectangular, sharply or bluntly angled. Tegmen surpassing folded hind knees by one-quarter to one-third of hind femur length. Genitalia (Figs 20–25) with strongly projecting aedeagus and variable subapical ventral process, more strongly protruding laterally in pale wing race (E. New Guinea and Solomon Is.).



**Figs 20–25** *Gastrimargus musicus*, genitalia. 20, phallic complex, dorsal view (Australia); 21, same, posterior portion (Solomon Is.); 22, same, lateral view (Australia); 23, same (Solomon Is.); 24, epiphallus, right half, dorsal view (Australia); 25, same, posterior view.

Coloration similar to *G. africanus*. Pronotal  $\times$ -marking usually indistinct, posterior arms usually obscured. Tegmen with variable cross-banding, usually distinct. Hind wing (Fig. 126) with complete fascia, sometimes narrowly interrupted between *Cu2* and *1A*; basal area bright yellow (Australia, central New Guinea) to pale yellow or almost colourless (E. New Guinea, Solomon Is.). Hind femur externally with or without oblique cross-banding, internally dark brown in basal half of medial area; internal ventral carinula and ventral surface red, tending to lose colour in New Guinea, usually straw-coloured in Solomon Is. Hind tibiae usually red, sometimes dull brown or straw (especially in Solomon Is.).

## MEASUREMENTS

Sample from New Guinea (bright yellow winged race).

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	36.27	4.95	7.21	27.56	17.60	3.77	4.63	3.82
Range	33.5–38.9	4.5–5.3	6.6–7.9	25.3–29.3	16.2–19.4	3.2–4.1	4.3–4.9	3.4–4.1
S.D.	1.490	0.227	0.362	1.188	0.902	0.233	0.193	0.149
n	17	19	18	17	19	19	19	16

Females								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	45.12	6.36	8.97	34.16	21.58	4.76	4.53	3.82
Range	42.9–47.7	6.0–6.8	8.2–10.3	32.5–36.3	19.7–24.3	4.3–5.3	4.4–4.6	3.5–4.0
S.D.	1.392	0.254	0.684	1.113	1.363	0.293	0.081	0.179
n	7	7	7	7	7	7	7	7

Sample from New Guinea (pale yellow winged race).

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	37.23	5.29	7.40	28.00	17.78	4.11	4.32	3.79
Range	34.1–41.5	4.5–6.0	6.6–8.3	25.9–31.6	15.5–20.5	3.6–4.6	4.0–4.7	3.4–4.2
S.D.	1.810	0.355	0.451	1.324	1.180	0.218	0.157	0.153
n	37	37	37	37	37	37	37	37

Females								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	46.13	7.03	9.46	34.87	22.16	5.02	4.39	3.69
Range	34.5–50.3	6.2–7.7	8.8–10.5	32.3–37.8	18.7–25.4	4.1–5.8	3.6–4.9	3.3–4.0
S.D.	3.456	0.311	0.420	1.651	1.615	0.384	0.358	0.151
n	19	21	21	19	20	20	20	19



Sample from Solomon Is. (pale race).

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	37.83	5.35	7.33	28.54	18.12	4.17	4.35	3.90
Range	33.7–	5.0–	6.6–	27.0–	16.6–	3.8–	4.1–	3.6–
	41.4	5.6	8.0	31.4	19.2	4.7	4.6	4.2
S.D.	1.782	0.153	0.412	1.453	0.834	0.261	0.160	0.136
n	14	14	14	14	14	14	14	14
Females								
Mean	48.19	7.01	9.21	36.06	22.48	5.20	4.33	3.90
Range	43.3–	6.4–	8.0–	31.8–	19.2–	4.2–	4.0–	3.6–
	55.1	8.0	10.8	42.4	26.2	6.2	4.7	4.4
S.D.	2.943	0.380	0.593	2.336	1.457	0.391	0.202	0.171
n	24	25	25	24	25	25	25	24

**AFFINITIES.** *G. musicus* is allied to *G. africanus* on the basis of the yellow hind wing basal area and uninterrupted fascia, as well as the general form and coloration. The red undersides of the hind femora are common to *G. lombokensis* and *G. subfasciatus*, but *G. musicus* has a distinctly longer aedeagus than any of these species and can be differentiated by the characters given in the key (p. 246).

#### MATERIAL EXAMINED

*Gryllus musicus* Fabricius, holotype ♀, **Australia**: no further data (BMNH). *Gastrimargus musicus* var. *kimberleyensis* Sjöstedt, holotype ♂, **Australia**: Kimberley district (*Mjöberg*) (NR, Stockholm).

In addition to the types, 160 specimens were examined from the following localities. Nominate race (Australia, New Guinea). **Australia**: Tasmania, Launceston or Hobart [specimen bears both labels]; Victoria, Port Philip; New South Wales, Nowra; N.S.W., Parramatta; N.S.W., Casula; N.S.W., Shark I.; N.S.W., Port Jackson; N.S.W., Sydney; N.S.W., Clarence R.; Australian Capital Territory, Paddy's Creek; A.C.T., Thompson's Corner, nr Uriarta; A.C.T., Myponga Swamp, 80 km S. of Adelaide; Western Australia: Mundaring Weir; W.A., Albany, Mt Melville; W.A., 1 ♂, 2 ♀, Kimberley Distr. (*Mjöberg*) (paratypes of *Gastrimargus musicus* var. *kimberleyensis* labelled 'Cotypos', 1 ♂, 1 ♀ in MHN, Geneva, 1 ♀ in NR, Stockholm); Northern Territory, Port Darwin; N.T., Alexandria; N.T., Victoria R.; N.T., Van Diemen Strait; Queensland, Stanthorpe distr, Euky, Happy Valley; Q., Torres straits, Thursday I.; Q., Inkerman, nr Townsville; Q., Cardstone, nr Tully Falls; Q., Kuranda to Mareeba road, Clohesy R.; Q., Acacia Ridge, 24 km from Brisbane; Q., 21 km E. of Croydon, 150 m; Q., Bellenden Ker; Q., Rockhampton; Q., Atherton; 1 ♀, no locality data, 'one of Walker's series of *Pachytylus determinatus*'. **New Guinea**: Irian Jaya, Merauke, 8°30'S 140°22'E; Papua New Guinea, Morehead area, Western distr., 8°42'S 141°38'E, 8°43'S 141°38'E, 8°43'S 141°39'E; P.N.G., W. distr., Morehead R., Rouku; P.N.G., Rouku area, 8°39'S 141°27'E, 8°40'S 141°28'E; P.N.G., W. distr., Mabaduan, 9°17'S 142°44'E; P.N.G., W. distr., 0.5–2.0 km E. of Weam, 8°28'S 141°10'E.

Pale-wing race (E. New Guinea and Solomon Is.) **New Guinea**: Papua New Guinea, Port Moresby, Mt Lawes, 400 m; P.N.G., 14.5 km NNE. of Port Moresby, 9°22'S 147°13'E; P.N.G., Bomana War Cemetery, 14.5 km NE. of Port Moresby, 9°24'S 147°15'E; P.N.G., SE. Milne Bay; P.N.G., Goodenough Is., Milne Bay distr.; P.N.G., Raba Raba, Milne Bay distr.; P.N.G., Red Shield Farm, Central distr.; P.N.G., Central distr., Sogeri Plateau, near Iorowari, 9°27'S 147°26'E, 9°25'S 147°26'E, 9°27'S 147°26'E, 9°28'S 147°27'E; P.N.G., N. distr., Safia, 135 m; P.N.G., Amazon Bay, Magarida Patrol Post; P.N.G., Amazon Bay area, Komania, 1020 m. **Solomon Is.**: Guadalcanal I., Ilu; Aola; Honiara distr.; Kukum; Lunga; Teterere; Tulagi, Lalang on ridge and Sasapi cutting; Wright's Creek; Tambalia, 35 km W. of Honiara, 30 m.

**DISTRIBUTION** (Fig. 120, and Biogeography section, p. 316). *G. musicus* occurs in Tasmania, Australia, New Guinea, and the Solomon Is.

**BIOLOGY.** *G. musicus* frequents tall grass with patches of bare ground, with or without trees (Common, 1948). There are normally two generations in central Queensland and one on the New South Wales tablelands. In suitable conditions eggs may hatch 17 days after laying, though they can remain viable for up to 10 months. The nymphal stages are completed in 39–48 days. Hatching occurs in September–November and January–March (Common, 1948; Key, 1938) and adults are found from October to May. Eggs are laid in firm bare soil, and egg fields may cover 0.4–4.0 ha at densities of up to 36 pods/m<sup>-2</sup> (Common, 1948; Mungomery, 1944). Details of egg pods and eggs are given by Common (1948). Swarms occur periodically in Queensland and move southward and coastward. Individuals from swarms show phase changes in behaviour and morphology, having longer wings and less pronounced sexual dimorphism than solitary insects (Common, 1948). The species is preyed upon by numerous insects and birds (Carrick, 1959; Common, 1948; Mungomery, 1945; Fuller, 1938; Uvarov, 1928). There are many reports of occasional damage by swarms to pasture and a variety of crops (Common, 1948), especially sugarcane. In Queensland in 1962 *G. musicus* was calculated to have caused losses of 4851 t to this crop over a total area of 5346 ha (Wilson *et al.*, 1963). It has been suggested, however, that even spectacular defoliation may ultimately have little effect on yields (King *et al.*, 1953). All the available information on this species relates to Australian populations. There are no data from New Guinea or the Solomon Is.

**DISCUSSION.** The mainland form of *G. musicus* is characterised by the bright yellow basal area of the hind wing and the red ventral surface of the hind femur. The population in central New Guinea, across the straits from Cape York, is identical to the mainland form, but further east there is a noticeable loss of depth of the yellow colour of the hind wing and some reduction in the red colour of the hind femur. This population is intermediate between the mainland form and the extreme condition of the Solomon Is. race which exhibits almost complete loss of colour in both the wing and the hind femur. Comparing the morphometrics of the three forms there are relatively minor differences, but there is a slight trend of increasing size from central New Guinea eastwards to Guadalcanal as judged by both tegmen length and femur length. The formal taxonomic status of the eastern populations is best left undecided until larger samples are available for study, preferably with the back-up of comparative genetic studies.

***Gastrimargus marmoratus* (Thunberg, 1815)**

(Figs 26–32, 119, 127)

*Gryllus marmoratus* Thunberg, 1815: 232. LECTOTYPE ♀, 'Cap.' [incorrectly labelled: actual locality unknown] (ZIUU, Uppsala), here designated [examined].

*Gryllus transversus* Thunberg, 1815: 232. LECTOTYPE ♀, CHINA (ZIUU, Uppsala), here designated [examined]. [Synonymised by Stål, 1873: 124.]

*Gryllus virescens* Thunberg, 1815: 245. Holotype ♂, no locality data (ZIUU, Uppsala) [examined]. [Synonymised by Stål, 1873: 124.]

*Gryllus assimilis* Thunberg, 1815: 246. Holotype ♂, no locality data (ZIUU, Uppsala) [examined]. [Synonymised by Stål, 1873: 124.]

*Pachytylus (Oedaleus) marmoratus* (Thunberg) Stål, 1873: 123.

*Oedaleus (Gastrimargus) marmoratus* (Thunberg) Saussure, 1884: 112.

*Oedaleus (Gastrimargus) marmoratus stirps sundaicus* Saussure, 1884: 113. LECTOTYPE ♀, SUMATRA (MHN, Geneva), here designated [examined]. [Synonymised by Sjöstedt, 1928: 34.]

*Oedaleus (Gastrimargus) marmoratus var. sundaicus* Saussure; Saussure, 1888: 39 [erroneously including material from the Congo].

*Oedaleus (Gastrimargus) marmoratus var. grandis* Saussure, 1888: 39. Holotype ♀, CHINA (NR, Stockholm) [examined]. [Synonymised with *var. sundaicus* by Kirby, 1910: 228.]

*Gastrimargus virescens* (Thunberg) Kirby, 1910: 226.

*Gastrimargus assimilis* (Thunberg) Kirby, 1910: 226.

*Gastrimargus marmoratus* (Thunberg) Kirby, 1910: 226.

*Gastrimargus transversus* (Thunberg) Kirby, 1910: 227.

*Gastrimargus sundaicus* (Saussure) Kirby, 1910: 228.

*Gastrimargus marmoratus var. transversa* (Thunberg); Sjöstedt, 1928: 37.

*Gastrimargus marmoratus var. grandis* (Saussure) Sjöstedt, 1928: 37.

*Gastrimargus marmoratus var. grandis forma rectinotum* Sjöstedt, 1928: 37. Type data unknown. [Unavailable infrasubspecific name.]

**DIAGNOSIS.** Fastigium of vertex slightly convex. Pronotum with median carina arcuate, sometimes intersected by posterior sulcus; hind margin sharply acutangular. Tegmen surpassing folded hind knees by one-quarter to two-fifths of hind femur length. Genitalia (Figs 26–32) variable, similar to *G. africanus*, but with aedeagus more strongly projecting.

Coloration variable. Pronotal  $\times$ -marking with posterior arms usually indistinct or absent. Transverse bands on tegmen sometimes reduced. Hind wing fascia (Fig. 127) complete, with some diffusion of dark pigment towards wing apex along third and subsequent anal veins, more marked in female; basal area of wing pale yellow with pale blue tinge on bases of veins; apex lightly infumate. Hind femora externally with variable oblique transverse banding, often absent except for rows of black dots on upper and lower carinulae; internal surface with dots on carinulae and indistinct brown patch in basal half of medial area only; ventral surface straw-coloured. Hind tibiae light red.

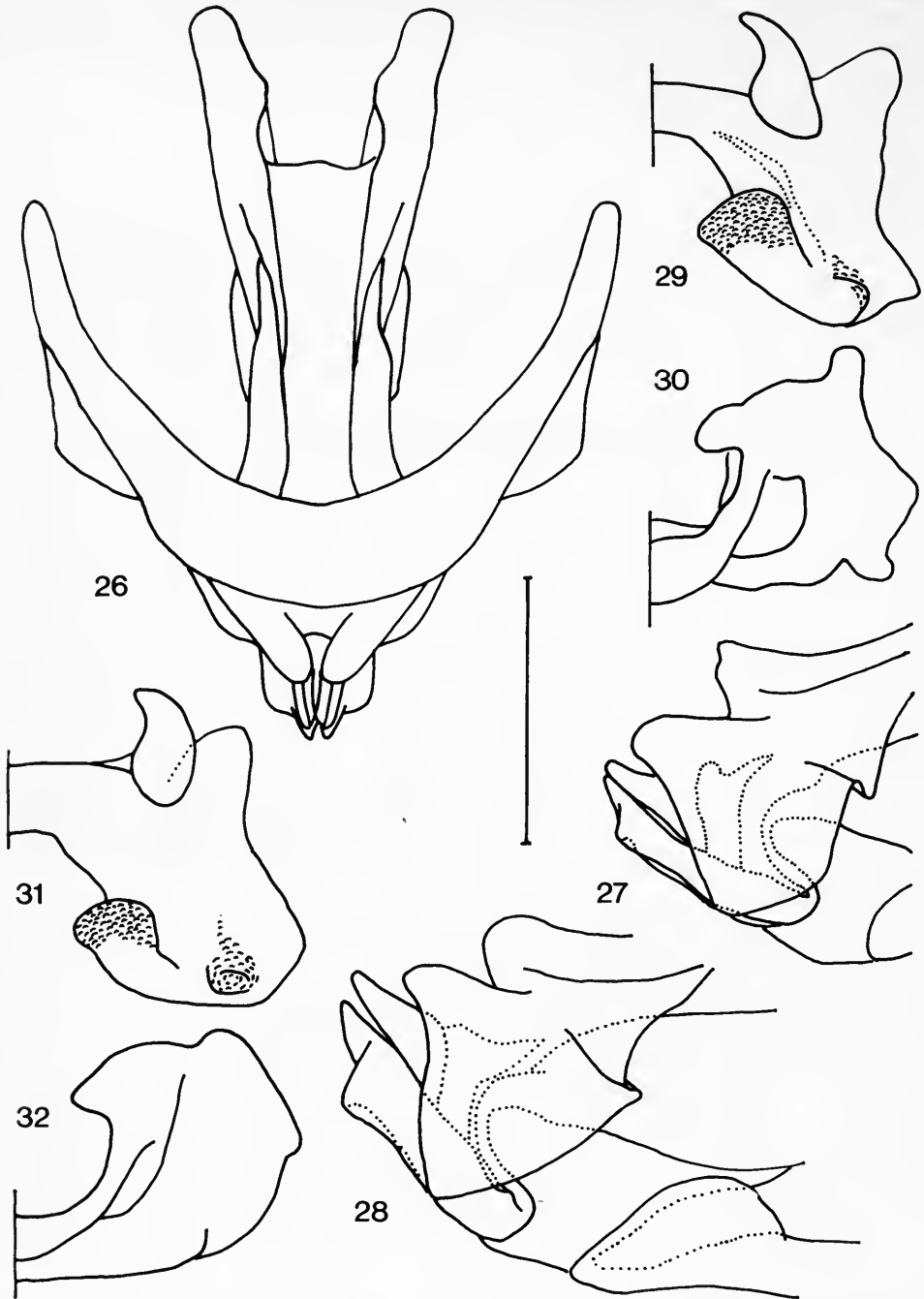
**MEASUREMENTS**

Sample from Thailand.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	39.46	5.19	8.19	29.68	20.27	4.14	4.89	3.63
Range	34.3–43.9	4.5–6.0	6.8–9.3	25.6–33.0	16.8–23.8	3.6–4.6	4.1–5.2	3.3–4.0
S.D.	2.619	0.396	0.759	1.960	2.010	0.305	0.247	0.174
n	22	22	19	22	21	21	21	19
Females								
Mean	57.42	7.65	11.63	43.02	28.62	6.02	4.76	3.72
Range	55.0–61.2	7.0–8.3	10.6–13.1	39.5–46.2	26.6–31.9	5.5–6.8	4.4–5.0	3.4–3.9
S.D.	2.057	0.388	0.805	1.919	1.701	0.363	0.222	0.185
n	10	12	10	11	12	12	12	9

Sample from Malaysia.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	35.89	4.71	7.51	26.91	17.79	3.67	4.75	3.60
Range	31.4–39.7	4.1–5.2	6.5–8.8	23.6–30.2	15.3–20.2	3.2–4.0	4.9–5.3	3.2–4.3
S.D.	2.053	0.252	0.523	1.627	1.220	0.207	0.540	0.196
n	33	33	30	33	30	30	30	30
Females								
Mean	53.48	7.08	11.07	40.49	26.67	5.63	4.74	3.66
Range	49.6–56.7	6.4–7.5	10.2–12.2	43.2–37.7	24.0–28.4	5.1–6.1	4.4–5.1	3.4–3.9
S.D.	2.320	0.263	0.638	1.800	1.268	0.309	0.202	0.119
n	14	16	16	15	15	15	15	15



Figs 26–32 *Gastrimargus marmoratus*, genitalia. 26, phallic complex, dorsal view (New Guinea); 27, same, posterior portion, lateral view (Borneo); 28, same (New Guinea); 29, epiphallus, right half, dorsal view (Borneo); 30, same, posterior view; 31, same, dorsal view (New Guinea); 32, same, posterior view.

**AFFINITIES.** *G. marmoratus* is related to *G. africanus* from which it differs principally by the longer wings and hind femora, the more pointed pronotal hind margin, the pale basal area of the hind wing, and the absence of blue pigment on the underside of the hind femur. In E. China and Burma where *G. africanus* loses the bright yellow hind wing colour and blue underside of the hind femur, there is need of care to distinguish the two species.

#### MATERIAL EXAMINED

*Gryllus marmoratus* Thunberg, lectotype ♀, locality unknown [incorrectly labelled "Cap"] (ZIUU, Uppsala). *Gryllus transversus* Thunberg, lectotype ♀, **China**: no locality data (ZIUU, Uppsala). *Gryllus virescens* Thunberg, holotype ♂, locality unknown (ZIUU, Uppsala). *Gryllus assimilis* Thunberg, holotype ♂, locality unknown, (ZIUU, Uppsala). *Oedaleus (Gastrimargus) marmoratus* stirps *sundaicus* Saussure, lectotype ♀, **Sumatra**: no locality data (MHN, Geneva). *Oedaleus (Gastrimargus) marmoratus* var. *grandis* Saussure, holotype ♀, **China**: Kiang-si (NR, Stockholm).

In addition to the type-material, 550 specimens were examined from the following localities: **India**: Assam, Upper Shillong, 1740 m; Assam, Udalguri. **Burma**: 64 km N. of Rangoon, Hmanbi. **China**: Fujian, Fuzhou, 680 m; Zhejiang, Zhuzhou; Jiangsu Prov., Shanghai, Zuoze; Sichuan Prov., Chongqing; Luzhou; Nanjing, Shouning; Nanjing; Guangzhou, Henan I., Panyu distr.; Guangzhou, Baiyun Shan; Hailing; Zhusan; Dailing Shan, 'nr Nong Po'; 'Dinding Is.'; Sichuan, Zhongjing, Beibei distr.; Sichuan, 'Baian-Kara-Ula Range', Emei Shan, 750 m; Guangdong, Guangzhou; Fujian Prov., 'mts nr Yenping'; Jiangsu, Suzhou; Jiangsu, Wushi; Manchuria, Shenyang; Shandong peninsula, Yantai; Fujian, 'Kuatun', 2300 m, 27°40'N 117°40'E; Fujian, Shaowu, 500 m; Fujian, Guangze. **Hong Kong**: Lantau I.; New Territories. **Korea (South)**: Seoul; Quelpart, S Ichikawa. **Korea (North)**: Pu-wong. **Japan**: Kyoto, Yamashiro I.; Yokohama; Loo Choo Is.; Takikawa. **Taiwan**: Taihorin; Taihauroka; Koroton; Tamsui valley, Tien Mu (Shin Lin). **Thailand**: Trong, Lower Siam; Kedah; Saraburi; Muakleg, Nakhon Ratchasima; Yala; Bangken-Bankok; Ban Bung, 15 km ESE. of Si Lacha; 24 km W. of Vitara Dit; Chomphorn; Roi Ed; Nan Nan Exp Stn; 13 km ENE. of Tak; Nongkhai; Surathani; Ban An Khae. **Vietnam**: Tuyen Quang; Dan Tieng, 60 km WNW. of Saigon. **Malaysia**: Penang; Pulo Penang; Pucong; Kuantan Pahang; 13th km, Pekan road; Serdang; Kuala Slen; Klang gates; Kuala Lumpur; Kedah Peak, 900–1000m; nr Tampin; Parit Buntar, Perak. Singapore. **Philippines**: Luzon, Manila; Karaan, Orion; Luzon, Laguna, Los Baños; Mountain Prov., Abatan, Buguias, 60 km S. of Bontoc, 1800–2000 m; Mt Montalban, Rizal, Wa-Wa dam, 150–200 m; Mt Prov, Mayoyao, Ifugao, 1000–1500 m; Ifugao Prov., Jacmal Bunhian, 24 km E. of Mayoyao, 800–1000 m; Mindanao, Cotabato Prov, Polo, nr base of Mt Matutum, 750 m; Lanao, L. Lanao Tagaya, 470–720 m; Albay Prov, Libon, Cagascos, 200 m; Mindoro; Santa Fé, Bukidnon, Mindanao, 600 m; Olongopa, Luzon, 16 km E., 360 m; Ulu Talia, Batang Ai, on padi; Temudok, on grass. **Borneo**: Sampit; Nanga-Badai; Sintang; S. Peleban; Sabah, Tambunan; Sabah, Liawan; Sabah, W. coast, Residency, Ranau, 500 m; Sabah, Sensuran; Balikpapan, Wain R., 50 m; Kembang Djangut, 75 m; Sabah, Sandakan distr., Rumidi Est., R. Labuk, 15–45 m; Mesilan, Mt Kinabalu; Sarawak, Semongoh, on wild grass; Sarawak, Nanga Pelagus, nr Kapit, 180–585 m, secondary forest; Sarawak, Gunong Natang, 120 m; Sarawak, Ban distr, Bidi, 90–240 m; Sarawak, Kapit distr., Merirai valley, 30–300 m, secondary forest; Sarawak, Kampong Pueh, Lundu distr., 690–1500 m. **Sumatra**: Sungei Penok, Korinchi valley, 780 m; Pasir Ganting, W. coast, 2°S; Batu Sangkar, Padang Bovenld, Goenong Soegi, Lampong; Dabu Singkap, Riouw; Tobameer; Balige, Sawahs; Solok, Rudang Prov; SW. Lampons, Mt Tanggamaes. **Java**: Djakarta; Bogor, botanic gardens; Sukabumi, 600 m; Pengalengan, 1200 m; Preanger; Buitenzorg; Palaboehan Ratoo; Volcan Gede; Tjimerang, Mt Djampang; Bandoeng, 700 m; Djember; Pantjar to Bogor, 500 m. **Sulawesi**: Bua-Kraeng, 1500 m; Lompobatang, 1100 m; Latimodjong Mts, Oeroe, 800 m; Minahassa, Tomohon; Tondano, Minahassa; Marinsow, Minahassa, 100 m; Mapanget, Minahassa, 5 m. **Lombok**: Segare Anak, 2000 m; E. Lombok, Swela, 300–450 m. **Flores**: W. Flores, Rana Mésé; Komodo I.; Ruteng. **New Guinea**: Irian Jaya, Vogel Kop, Kebar valley, W. of Manokwari, 550 m.

**DISTRIBUTION** (Fig. 119, and Biogeography section, p. 316). *G. marmoratus* is widely distributed in SE. Asia from Assam north-east to Japan, south-west to Sumatra, and south-east to the Vogelkop peninsula of New Guinea. Records from India other than Assam (e.g. Katiyar, 1960) should be referred to *G. africanus*.

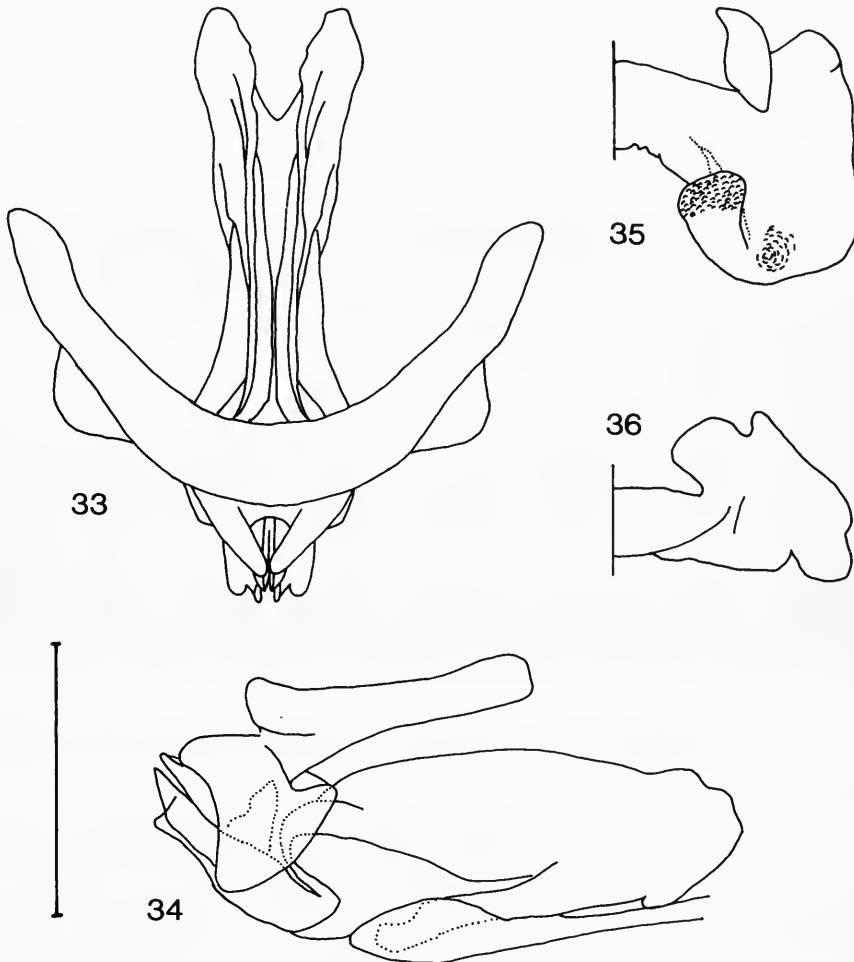
**BIOLOGY.** *G. marmoratus* frequents tall grassland, old cultivations, and grazing land, often with Lalang (*Imperata arundinacea* Cyr.) (Miller, 1932; 1934; Tinkham, 1935b; Roffey, 1979). It is also found around rice paddy, and on shrubs (Tsyplenkov, 1970). There is little information available on the life cycle in nature. In Taiwan there are two generations, with overwintering normally as eggs, rarely as nymphs. There are six nymphal instars occupying 54–102 days in total



## MEASUREMENTS—(cont.)

Females								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	35.87	5.82	7.63	25.61	17.49	4.63	3.79	3.36
Range	33.8– 37.7	5.3– 6.3	6.5– 8.1	24.2– 27.1	15.9– 18.9	5.0– 4.1	3.5– 4.1	3.1– 3.8
S.D.	1.100	0.223	0.374	0.841	0.894	0.237	0.177	0.161
n	19	20	20	19	20	20	20	20

AFFINITIES. *G. immaculatus* is allied to *G. africanus* and its relatives on the basis of the male genitalia. It has, however, lost the bright yellow colour of the hind wing basal area and the blue underside of the hind femur. In this respect it resembles *G. marmoratus*, but there is further reduction in the hind wing fascia and the species is much smaller than any of its near relatives.



Figs 33–36 *Gastrimargus immaculatus*, genitalia. 33, phallic complex, dorsal view; 34, same, lateral view; 35, epiphallus, right half, dorsal view; 36, same, posterior view.

## MATERIAL EXAMINED

*Oedaleus immaculatus*, holotype ♂, **Réunion**: Plaine des Cafres, 29.i.1955 (MNHN, Paris).

**Réunion**: 20 ♂, 11 ♀, Plaine des Cafres, 9.xii.1964 (*Wintrebert*) (MNHN, Paris); 1 ♂, same data (BMNH); 1 ♂, 3 ♀, same data, 11.xii.1964 (MNHN, Paris); 1 ♀, same data (BMNH); 2 ♀, Plaine des Cafres, Majastu, i.1912 (MNHN, Paris); 1 ♂, 2 ♀, Piton des neiges, Mare Kerveguen, 2000 m, 28–29.i.1955 (MNHN, Paris) (paratypes of *G. immaculatus*); 1 ♀, Plaine des Cafres, Piton Mare-à-boue, 29.i.1955 (MNHN, Paris) (allotype of *G. immaculatus*).

DISTRIBUTION (Fig. 116, and Biogeography section, p. 314). Réunion.

*Gastrimargus hyla* Sjöstedt, 1928

(Figs 37–40, 129, 130)

*Gastrimargus hyla* Sjöstedt, 1928: 28. Holotype ♀, ETHIOPIA (MNHN, Paris) [examined].

*Gastrimargus abessinicus* Sjöstedt, 1928: 28. Holotype ♀, ETHIOPIA (MNHN, Paris) [examined]. **Syn. n.**

DIAGNOSIS. Fastigium of vertex flat or slightly concave. Pronotum laterally rugose; median carina low arcuate, intersected by posterior sulcus; hind margin blunt acutangular. Lateral and ventral surfaces of thorax sparsely hairy. Tegmen surpassing folded hind knees by two-fifths of hind femur length in male, barely reaching hind knees in female. Tegmen length/pronotum length ratio 3.26 ♂, 2.38–2.67 ♀. Genitalia (Figs 37–40) similar to *G. rothschildi* (Figs 41–44), but aedeagus with smaller subapical ventral process.

Coloration brown or green. Pronotal × -marking thin, pale, with short, straight posterior arms (Figs 129, 130), not recurved; pronotal pattern may be obsolete in green morphs. Tegmen with cross bands obsolete. Hind wing fascia (Figs 129, 130) indistinct in male, narrowly interrupted by all major veins but otherwise complete, much fainter in female; basal area pale yellow. Hind femur externally with irregular dark brown dots along upper and lower carinulae and in medial area; internal medial and ventral areas unicolorous blue-black except for subapical pale ring above knee in male; blue-black replaced by maroon in female except for carinulae. Hind tibiae red.

## MEASUREMENTS

All known material from Ethiopia, exact locality unknown.

Specimen	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
<i>G. abessinicus</i> , holotype ♀	29.8	5.7	7.9	20.2	16.4	4.3	3.8	2.5
<i>G. abessinicus</i> , paratype ♀	30.0	5.9	8.4	19.9	17.1	4.3	4.0	2.4
<i>G. hyla</i> , holotype ♀	30.7	5.8	8.1	21.5	17.2	4.4	3.9	2.7
Unique ♂	24.3	3.4	5.4	17.7	11.7	3.0	3.9	3.3

AFFINITIES. This species is allied to *G. rothschildi* on the basis of the genitalia and the reduction of the female tegmen length and hind wing fascia. The differences are outlined in the key (p. 244).

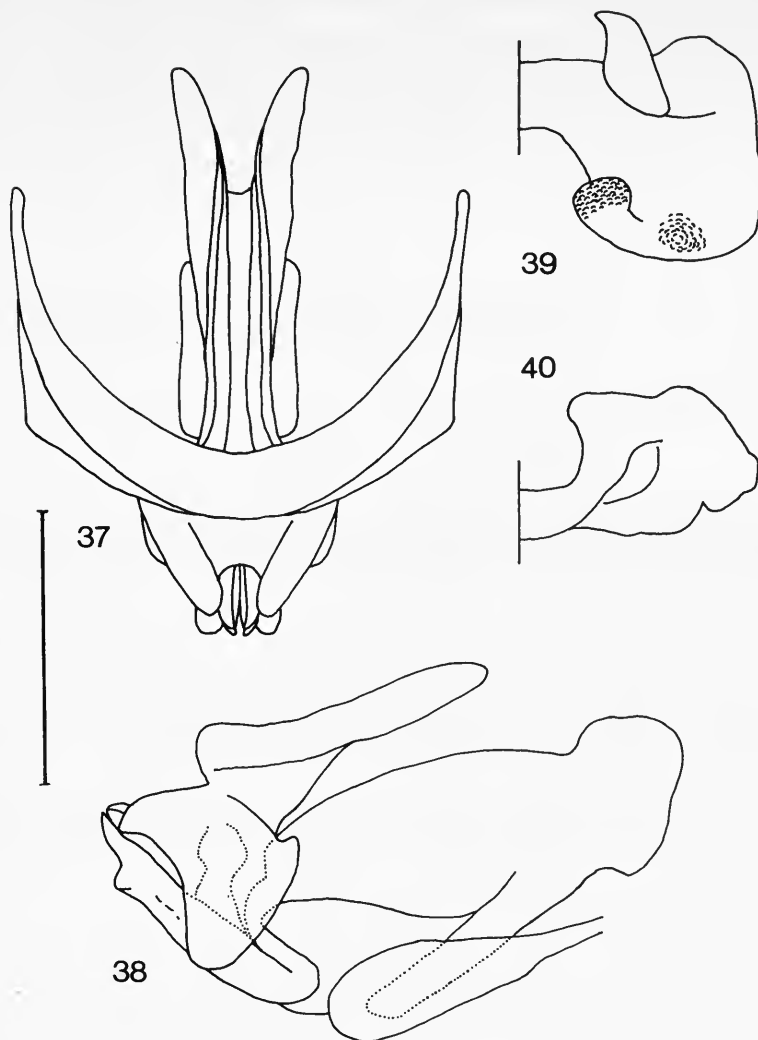
## MATERIAL EXAMINED

*Gastrimargus hyla* Sjöstedt, holotype ♀, **Ethiopia**: no locality data, 1897–98 (*Michel*) (MNHN, Paris). *Gastrimargus abessinicus* Sjöstedt, holotype ♀, **Ethiopia**: no locality data, 1897–98 (*Michel & Potter*) (MNHN, Paris).

**Ethiopia**: 1 ♂, no locality data, 1899 (*Michel & Potter*) (MNHN, Paris); 1 ♀, same data (paratype of *G. abessinicus*) (NR, Stockholm).

DISTRIBUTION. All the known specimens of *G. hyla* were collected from an unknown locality or localities in Ethiopia by members of the ill-fated Bonchamps expedition to Fachoda (*Michel*, 1900). The general similarity of *G. hyla* to *G. abessinicus*, and in particular the short wings of the female, suggest that the species occupies a montane habitat like that of *G. abessinicus*. The expedition travelled west-south-west from Harer in the east to the White Nile at its junction with





**Figs 37–40** *Gastrimargus hyla*, genitalia. 37, phallic complex, dorsal view; 38, same, lateral view; 39, epiphallus, right half, dorsal view; 40, same, posterior view.

the Sobat. Michel (1900: 90) recorded that the expedition's insect collections were already considerable by the time they had reached the junction of the Kesem and Awash rivers. One possible locality for the specimens of *G. hyla* is the eastern part of the Ahmar mountains near Harer, where the expedition spent some time. Another possible site is offered by the mountains along the road from Addis Ababa to Nekemte. It is known that a small collection of birds was made at 'Léka' in the 'Rogué mountains'. This evidently refers to the range just east of Nekemte. The expedition also passed through the mountainous area of the Menagesha National Forest, known to them as Mt Toké. More recent collecting in Ethiopia has so far failed to rediscover this species and its whereabouts remain a mystery.

**DISCUSSION.** Sjöstedt (1928) repeatedly fell into the error of describing the green and brown morphs of the same species as separate taxa. In this instance *G. abessinicus* is merely the brown morph of *G. hyla*. The male of this species, unaccountably overlooked by Sjöstedt (1928), is here described for the first time, by courtesy of Dr M. Donskoff (MNHN, Paris).

*Gastrimargus rothschildi* Bolívar, 1922

(Figs 41–44, 114, 131, 132)

*Gastrimargus rothschildi* Bolívar, 1922: 175.

This species is here divided into two subspecies under which the synonymy is separately listed.

**DIAGNOSIS.** Antennal flagellum short, thick, with bead-like segmentation; segments 8–9 barely longer than wide. Fastigium of vertex convex. Pronotum with median carina low arcuate, not intersected by posterior sulcus; posterior margin narrowly acutangular. Tegmen surpassing hind knee by one-twelfth to one-quarter of hind femur length in male, not reaching hind knees in female. Tegmen length/pronotum length ratio 2.46–3.18 ♂, 1.48–1.83 ♀. Genitalia (Figs 41–44) similar to *G. verticalis*, but smaller and more delicate; aedeagus more weakly protruding.

Coloration vivid green with variable dark maroon markings. Pronotal ×-marking thin, similar to *G. verticalis*, posterior arms elongated and incurved posteriorly (Figs 131, 132). Tegmen in male predominantly dark maroon in basal two-thirds, lighter brown in apical third and clearer, with two or three variable pale blotches or bands; female tegmen with maroon areas reduced to five or six blotches or bands on a green background. Hind wing unfasciated or with faint traces only; basal area pale yellow. Hind femur externally with longitudinal dark purple or maroon stripe extending to variable thickness below dorsal carinula, sometimes obsolete (for internal surface see key to subspecies below). Hind tibia basally dark brown, otherwise red.

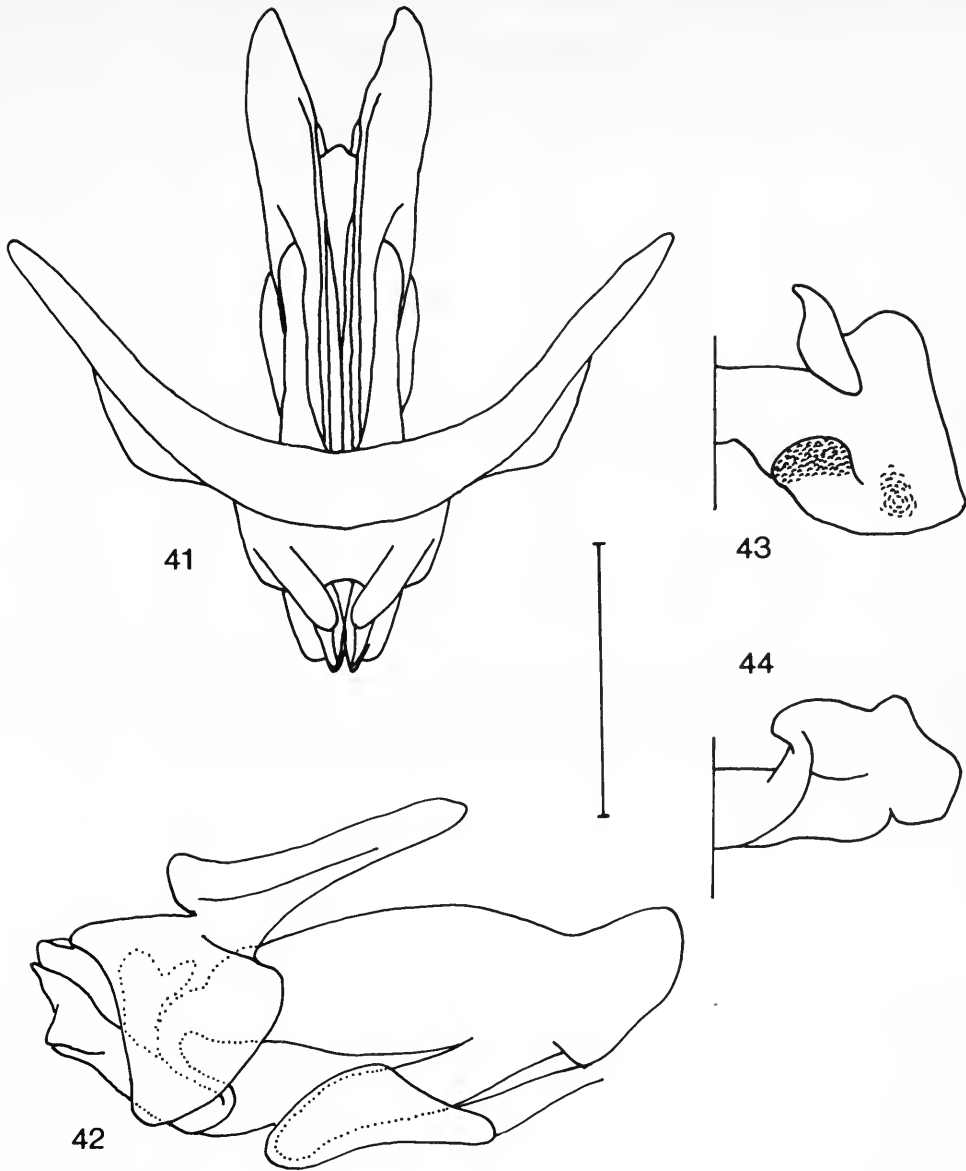
**AFFINITIES.** *G. rothschildi* is allied to *G. verticalis*, Ethiopian material of which exhibits a trend towards complete loss of the hind wing fascia (culminating in '*G. aethiopicus*' Bolívar, p. 275). Longer winged females of *rothschildi* may be difficult to distinguish from those of *G. verticalis* to which they bear a close resemblance, except for their darker tegminal pattern and higher TL/PL ratio. The males are more easily distinguished from those of *G. verticalis* by their smaller size and the absence of any distinct hind wing fascia. It seems probable that this species is a high-altitude derivative of *G. verticalis* (see p. 310). It would be interesting to investigate the ecology and genetics of the two races of *G. rothschildi* and the local population of *G. verticalis*. The relationship of *G. rothschildi* to *G. hyla*, another Ethiopian species, is discussed above (p. 268).

**DISTRIBUTION** (Fig. 114, and Biogeography section, p. 310). *G. rothschildi* is restricted to montane Ethiopia. The nominate 'blue-leg' race occupies the two mountain areas on the east side of the great rift valley south of Asela, separated by the Wabi Shebele river, and also occurs in the Simien National Park area north-east of L. Tana to the west of the rift, where it is separated from the southern population by more than 250 km. In the intervening area the 'yellow-leg' race extends on the west side of the rift valley roughly from Sodo in the south to the Abay (Blue Nile) gorge north of the Goha Tsion in the north. It is not known whether either race is to be found north of the Blue Nile in the Mangestu mountains. The Abay may well bound the distribution of the species in the north as the Omo river valley does in the west. Both races generally occur above the 2000 m contour (shown as a thin continuous line on the distribution map, Fig. 114).

**DISCUSSION.** *G. rothschildi rothschildi* exhibits considerable variation in size, wing length, and coloration within any given population and the newly synonymised taxa reflect this diversity. The newly described subspecies *G. rothschildi luteifemur* is recognised as a geographical race on the basis of the coloration of the hind femur described in the key below. This character is consistent within populations, is easily visible, and shows marked geographical discontinuity (Fig. 114, p. 311). I am indebted to Dr N. D. Jago for drawing my attention to the occurrence of geographical variation in hind femur colour in this species. The morphometrics of the two subspecies are substantially identical.

**Key to subspecies of *Gastrimargus rothschildi***

- 1 Internal ventral carina and internal medial area of hind femur dull straw-coloured, at least partially tinged with blue-grey, blue-black, or mauve, never bright red  
*G. rothschildi rothschildi* Bolívar (p. 271)
- Internal ventral carina and lower half of internal medial area of hind femur bright yellow straw-coloured, often tinged with bright red, never mauve or blue  
*G. rothschildi luteifemur* subsp. n. (p. 273)



**Figs 41–44** *Gastrimargus rothschildi*, genitalia. 41, phallic complex, dorsal view; 42, same, lateral view; 43, epiphallus, right half, dorsal view; 44, same, posterior view.

***Gastrimargus rothschildi rothschildi* Bolívar, 1922**

*Gastrimargus rothschildi* Bolívar, 1922: 175. Holotype ♀, ETHIOPIA (MNHN, Paris) [examined].

*Gastrimargus cristagalli* Sjöstedt, 1928: 46. Holotype ♀, ETHIOPIA (BMNH) [examined]. **Syn. n.**

*Gastrimargus rothschildi montanus* Uvarov, 1934: 607. Holotype ♂, ETHIOPIA (BMNH) [examined]. **Syn. n.**

## MEASUREMENTS

Sample from Ethiopia, Bale Province.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	22.49	3.48	6.03	16.26	12.54	2.93	4.28	2.71
Range	20.3–	3.1–	5.2–	14.1–	11.3–	2.5–	4.0–	2.5–
	24.8	3.8	6.7	17.9	13.9	3.2	4.8	3.2
S.D.	1.250	0.147	0.414	0.977	0.728	0.157	0.195	0.188
n	20	20	20	20	20	20	20	20

Females								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	26.59	5.90	10.18	16.58	17.61	4.79	3.68	1.64
Range	24.6–	5.3–	8.8–	15.1–	16.2–	4.2–	3.4–	1.5–
	29.1	6.4	11.8	18.4	19.9	5.4	4.0	1.8
S.D.	1.380	0.288	0.765	1.003	0.956	0.329	0.159	0.113
n	17	17	17	17	17	17	17	17

## MATERIAL EXAMINED

*Gastrimargus rothschildi* Bolívar, holotype ♀, **Ethiopia**: Kounhi, iv.1905 (*Rothschild*) (MNHN, Paris). *Gastrimargus cristagalli* Sjöstedt, holotype ♀, **Ethiopia**: no data (*Bowring*) ('one of Walker's series of *Pachytylus determinatus*') (BMNH). *Gastrimargus rothschildi montanus* Uvarov, holotype ♂, **Ethiopia**: Mt Chillálo, c. 3000 m, 22.xi.1926 (*Scott*) (BMNH).

**Ethiopia**: 1 ♂, Chillálo, c. 2700 m, 25.viii.1945 (*Guichard*); 7 ♂, 2 ♀, Mt Chillálo, short turf dotted with bush heath, c. 3000 m, 22.xi.1926 (*Scott*) (paratypes of *G. rothschildi montanus*); 4 ♂, Mt Chillálo, c. 2850 m, open short turf, 15.xi.1926 (*Scott*) (paratypes of *G. rothschildi montanus*); 1 ♂, Mt Chillálo, Digaila, c. 2850 m (*Scott*) (paratypes of *G. rothschildi montanus*); 1 ♂, Gondar, 1932 (*Griaule*) (MNHN, Paris); 1 ♂, Simien, camp nr Mecano-Abo, c. 3150 m, 12.xi.1952 (*Scott*); 1 ♂, Atgheba Ghiyorghis, c. 3270 m, 4.xii.1952 (*Scott*); 2 ♂, 2 ♀, Simien, Ambaras, Khabau (nr Ghitché), c. 3240 m, 18.xi.1952 (*Scott*); 40 ♂, 16 ♀, 20 nymphs, Bale prov., Dinchu Park Lodge area, 142 km E. of Shashamene, 3170 m, Juniper-*Hagenia* with swampy streams and giant Lobelia, 30.x.1975 (*Jago & Stretch-Liljer*) (COPR, London); 1 ♂, 1 ♀, same data (MNHU, Berlin); 1 ♂, Arusi/Bale prov., Shashamene-Goba road, 29 km E. of Shashamene, E. of Kofele, 2610 m, rolling grassland with circular hummocks, 29.x.1975 (*Jago & Stretch-Liljer*) (COPR, London); 5 ♂, 4 ♀, Bale prov., Shashamene-Goba road, 64 km E. of Shashamene, E. of Kofele, 2460 m, grass regrowth between fields of new and fallow barley and oats, 27.x.1975 (*Jago & Stretch-Liljer*) (COPR, London); 1 ♂, Bale prov., 162 km E. of Shashamene, just W. of Goba, 2450 m, weeds between fields of barley, 30.x.1975 (*Jago & Stretch-Liljer*) (COPR, London); 2 ♂, 1 ♀, Bale prov., E. of Adaba, 37 km W. of Dinchu, 2860 m, S. facing hill slope with grassland and barley, 2.xi.1975 (*Jago & Stretch-Liljer*) (COPR, London); 2 ♂, Bale prov., Bale Nat. Pk, military road above Goba, 11 km below upper plateau, 3100 m, Juniper woodland with grazed lawn, 31.x.1975 (*Jago & Stretch-Liljer*) (COPR, London); 1 ♂, Bale prov., W. of Adaba, between Adaba and Dodola, 2550 m, riverine acacia woodland, 2.xi.1975 (*Jago & Stretch-Liljer*) (COPR, London); 2 ♂, 2 ♀, Arusi prov., 8 km S. of Asela, Asela-Bekoji road, deeply incised valleys with *Podocarpus*, 19.xi.1975 (*Jago & Casey*) (COPR, London); 1 ♂, 1 ♀, Bale prov., SSE. of Asela, track to Ticho S. of Mt Chillalo, 42 km W. of Ticho, deep volcanic gorge with barley, 20.xi.1975 (*Jago & Casey*) (COPR, London); 2 ♂, Arusi prov., 10 km W. of Ticho, Mt Bada, *Hagenia* forest zone, 21.xi.1975 (*Jago & Casey*) (COPR, London); 4 ♂, 1 ♀, 1 nymph, Arusi prov., 3 km W. of Ticho, juniper zone with lightly grazed pasture, 21.xi.1975 (*Jago & Casey*) (COPR, London); 1 ♂, 1 ♀, Bale reserve, Dinsho, 1600 m, 4–5.xi.1973 (*Rougeot*) (COPR, London).

*Gastrimargus rothschildi luteifemur* subsp. n.

MEASUREMENTS (all available material).

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	22.97	3.63	6.33	16.21	13.36	3.13	4.27	2.66
Range	20.7– 25.7	3.0– 4.3	5.6– 7.3	14.4– 18.2	11.8– 14.6	2.7– 3.5	4.0– 4.6	2.2– 3.2
S.D.	1.205	0.289	0.511	0.929	0.769	0.190	0.136	0.478
n	22	23	23	23	22	22	22	23
Females								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	26.93	6.04	10.17	16.26	18.55	4.70	3.94	1.60
Range	24.3– 29.0	5.5– 6.6	8.9– 11.1	14.6– 17.3	16.2– 19.3	4.3– 5.1	3.8– 4.2	1.5– 1.8
S.D.	1.690	0.399	0.898	1.012	1.369	0.286	0.206	0.096
n	5	5	5	5	5	5	5	5

## MATERIAL EXAMINED

Holotype ♂, **Ethiopia**: Shewa Prov., Addis Ababa–Nkemte road, 22 km W. of Addis Ababa, 2525 m, grazed pasture and *Eucalyptus* forest, 8.x.1975 (*Jago & Stretch-Liljer*) (BMNH).

Paratypes. **Ethiopia**: 1 ♀, same data as holotype (BMNH); 8 ♂, Mt Zuguála, c. 2700 m, 25–25.x.1926 (*Omer Cooper*) (paratypes of *G. rothschildi montanus*) (BMNH); 1 ♂, Addis Ababa,–Debra Marcos road, Abbai Gorge, c. 2100 m, 23.x.1945 (*Guichard*) (BMNH); 2 ♂, Addis Ababa, 2160 m, 8.xi.1945 (*Guichard*) (BMNH); 4 ♂, 1 ♀, Addis Ababa, 2100–2400 m, viii. 1945 (*Guichard*) (BMNH); 2 ♂, 1 nymph, Dessie area, 2400–2640 m, 1–25.iii.1953 (*Bryant*) (BMNH); 1 ♂, Wolamo Prov., Mt Damota, over 3000 m, from grassy slopes on summit and near spring, 5.xi.1948 (*Scott*) (BMNH); 1 ♂, Addis Ababa (MNHN, Paris); 1 ♂, 75 km N. on Fiche Road, 15.vii.1975 (*Stretch-Liljer*) (BMNH); 1 ♀, 10 km N. on Fiche road, 15.vii.1975 (*Stretch-Liljer*) (BMNH); 1 ♀, Wachamacha Mt, 3000–3300 m 23.vii.1947 (*Guichard*) (BMNH).

*Gastrimargus verticalis* (Saussure, 1884)

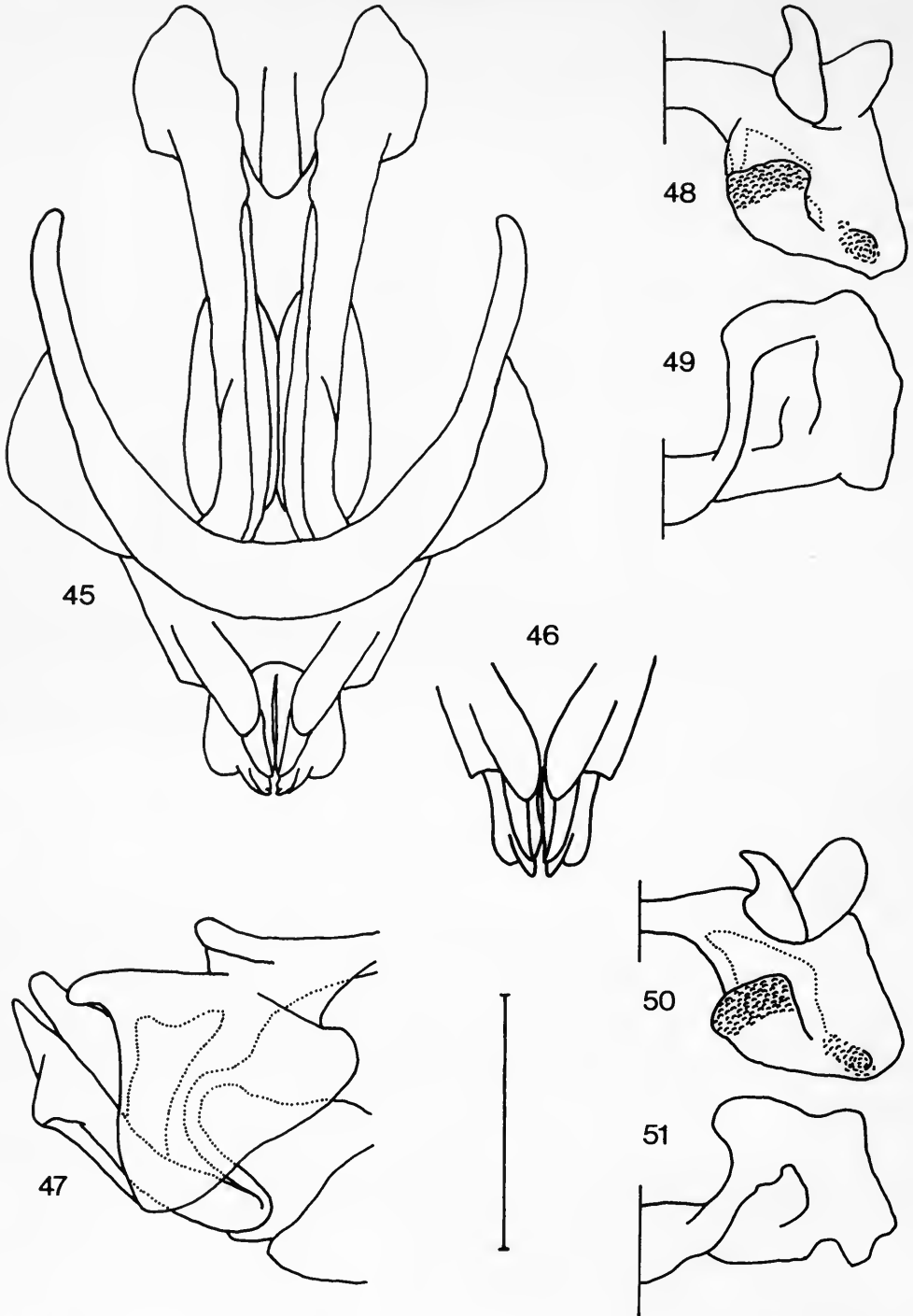
(Figs 45–51, 113, 133, 134)

*Oedaleus* (*Gastrimargus*) *verticalis* Saussure, 1884: 111.

This species is here divided into two subspecies under which the specific synonymy is separately listed.

**DIAGNOSIS.** Fastigium of vertex convex. Pronotum with median carina arcuate, not intersected by posterior sulcus; hind margin acutangular. Tegmen surpassing folded hind knees by about one-eighth of hind femur length. Genitalia (Figs 45–51) with aedeagus moderately strongly protruding; epiphallus with lateral plate widening posteriorly, outer lobes of lophi small, rounded, straight or slightly divergent.

**Coloration.** Pronotal ×-marking with fine lines on dark background. Tegmen with two pale cross bands, basal band sometimes reduced or absent. Hind wing basally pale yellow; fascia (Fig. 133) complete in male, reaching and following hind margin of wing, interrupted between *Cu*2 and 1*A*, and sometimes, especially in Ethiopia, obsolete from costal margin to *Cu*2; fascia reduced in female, occasionally almost obsolete, especially in Ethiopia, ceasing to reach hind margin, thin, sometimes not reaching beyond *Cu*2 anteriorly. Hind femur externally with faint traces of transverse banding in medial area; upper carinula with row of black dots. Internal surface with medial area brown in basal half, upper and lower carinulae with row of dots; ventral surface straw-coloured. Hind tibiae pink or red in male, light brown in female.



**Figs 45–51** *Gastrimargus verticalis*, genitalia. 45, *G. v. verticalis*, phallic complex, dorsal view; 46, *G. v. mpwapwae*, same, posterior portion only; 47, *G. v. verticalis*, same, lateral view; 48, *G. v. verticalis*, epiphallus, right half, dorsal view; 49, same, posterior view; 50, *G. v. mpwapwae*, same, dorsal view; 51, same, ventral view.

**AFFINITIES.** As already noted above (p. 270), *G. verticalis* is allied to the montane *G. rothschildi*. However, it also has affinities with *G. determinatus* and *G. miombo* with both of which it has sometimes been confused. All three species have the hind femur ventrally straw-coloured (except in *G. v. mpwapwae*), a strongly protruding aedeagus with large ventral lobe, and a pronotal × -marking with the anterior and posterior arms of similar thickness.

**DISTRIBUTION** (Fig. 113, and Biogeography section, p. 308 et seq.). Eastern and south-eastern Africa. Two specimens from Nigeria which may belong to this species are discussed below and included on the distribution map (Fig. 113). The nominate subspecies is newly recorded from Madagascar on the strength of a single male in the MNHU, Berlin. This record needs confirmation.

**BIOLOGY.** Unknown. There is one record of damage to pasture in Kenya (Le Pelley, 1952).

**DISCUSSION.** The material of *G. verticalis* in the MHN, Geneva, includes two females from Natal, one of which was figured by Sjöstedt (1928) as the type. For reasons of stability the figured female is here designated lectotype and is labelled as such. It bears Saussure's original labels: 'Natal' and '*verticalis* Sss. Natal'. The other female with identical data is designated a paralectotype but the remaining material is of uncertain status and accordingly no further designations are made.

The holotype male of *G. brevipes* var. *abessina* was figured (Sjöstedt, 1928: pl. 3, fig. 4) and listed as having been deposited in MNHU, Berlin (Sjöstedt, 1928: 48). However, the specimen is not there (K. K. Günther, pers. comm.) and the male paratype in the NR, Stockholm bears a label in Sjöstedt's hand stating that the holotype is in Hamburg and not Berlin. Unfortunately the male specimen in the ZM, Hamburg is labelled as a paratype and not as the holotype (H. Strümpel, pers. comm.), while the single female paratype listed by Sjöstedt (in MCSN, Genoa) is wrongly labelled as the holotype (F. Capra and R. Poggi, pers. comm.). Evidently the type labels were attached to the wrong specimens by Sjöstedt. Labels with the correct information have now been added.

The four newly synonymised species are all based on female holotypes which demonstrate the wide range of variation shown by this species. The profile of the pronotal median carina and the degree of expression of the hind wing fascia are especially variable characters in the female, and unsuitable for characterising new species. The unique holotype of *G. aethiopicus* from Ethiopia represents the extreme condition of the hind wing, with almost complete loss of the fascia.

Males of *G. verticalis mpwapwae* are easily distinguished from the nominate subspecies by the characters given in the key below. In addition the aedeagus of *mpwapwae* appears somewhat more slender in dorsal view (Fig. 46). The female is indistinguishable from the nominate race.

Two specimens from Nigeria, a male from Bambur, and a female from Jakiri, both collected by F. D. Golding in May 1946, appear to be close to this species. The localities are shown on the distribution map (Fig. 113). The two insects are both very pale brownish green with very indistinct markings (♂, Fig. 135). The male aedeagus bears a larger and more rounded subapical ventral process than is normal in *G. verticalis*. A firm assignment of this material must await the discovery of further specimens. However, in the meantime it is certain that these insects do not belong to any of the species presently known from West Africa.

#### Key to subspecies of *Gastrimargus verticalis* (males only)

- 1 Tegmen with distinct pale cross-banding; apical half of hind wing clear, sometimes with faint brown speckling near wing tip (Fig. 133); hind femur ventral surface straw-coloured  
*G. verticalis verticalis* (Saussure) (p. 275)
- Tegmen dark, with pale cross-banding reduced or absent; apical half of hind wing beyond fascia distinct infumate (Fig. 134); hind femur ventral surface tinged with blue-grey  
*G. verticalis mpwapwae* subsp. n. (p. 277)

#### *Gastrimargus verticalis verticalis* (Saussure, 1884)

*Oedaleus* (*Gastrimargus*) *verticalis* Saussure, 1884: 111. LECTOTYPE ♀, SOUTH AFRICA (MHN, Geneva), here designated [examined]. [Incorrectly synonymised with *G. determinatus* by Kirby, 1902: 71.]

*Gastrimargus verticalis* var.; Burr, 1900: 39.

- Gastrimargus aethiopicus* Bolívar, 1922: 175. Holotype ♀, ETHIOPIA (MNHN, Paris) [examined]. **Syn. n.**  
*Gastrimargus longipes* Sjöstedt, 1928: 21. Holotype ♀, SOUTH AFRICA (NR, Stockholm) [examined]. **Syn. n.**  
*Gastrimargus longipes* var. *recta* Sjöstedt, 1928: 22. Holotype ♀ [not cotype as labelled], ZANZIBAR (NR, Stockholm) [examined]. **Syn. n.**  
*Gastrimargus longipes* var. *decliva* Sjöstedt, 1928: 22. Holotype ♀, TANZANIA (BMNH) [examined]. **Syn. n.**  
*Gastrimargus brevipes* Sjöstedt, 1928: 22. Holotype ♀, TANZANIA (NR, Stockholm) [examined]. [Synonymised with *G. verticalis* by Dirsh, 1966: 428.]  
*Gastrimargus brevipes* var. *elgonensis* Sjöstedt, 1928: 23. Holotype ♀, KENYA/UGANDA (NR, Stockholm) [examined]. [Synonymised with *G. verticalis* by Dirsh, 1966: 428.]  
*Gastrimargus brevipes* var. *abessina* Sjöstedt, 1928: 23. Holotype ♂, ETHIOPIA ZM, Hamburg) [not MNHU, Berlin as stated by Sjöstedt, 1928: 48]. [Synonymised with *G. verticalis* by Dirsh, 1966: 428.]  
*Gastrimargus verticalis* var. *fusca* Johnston, 1956: 570. Holotype ♀, SOMALI REPUBLIC: Hargeisa, 25–28.iv.1895 (*Peel*) (lost). [Name given to Burr's (1900: 39) unnamed var. by Johnston and erroneously attributed by him to Burr, synonymised with *G. verticalis* by Dirsh, 1966: 428.]

## MEASUREMENTS

Sample from Uganda.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	31.46	4.62	7.51	23.02	17.94	3.67	4.99	3.07
Range	29.1–33.6	4.2–4.9	6.6–8.2	21.1–24.6	16.0–19.8	3.3–4.1	4.5–5.3	2.8–3.3
S.D.	1.201	0.162	0.428	0.921	0.826	0.164	0.625	0.142
n	30	30	29	30	30	30	30	29
Females								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	48.20	7.93	12.03	34.52	27.00	5.75	4.70	2.87
Range	45.5–52.3	7.3–8.7	11.0–13.4	32.0–40.0	24.5–29.9	5.4–6.3	4.4–5.0	2.6–3.6
S.D.	1.803	0.309	0.668	1.716	1.249	0.209	0.183	0.185
n	29	29	28	29	29	29	29	28

## MATERIAL EXAMINED

*Oedaleus (Gastrimargus) verticalis* Saussure, lectotype ♀, **South Africa**: Natal, no further data (MHN, Geneva). *Gastrimargus longipes* Sjöstedt, holotype ♀, **South Africa**: Natal, Appelbosch, iv. (*Ljungqvist*) (NR, Stockholm). *Gastrimargus longipes* var. *recta* Sjöstedt, holotype ♀, **Tanzania**: Zanzibar (*Hildebrandt*) (NR, Stockholm). *Gastrimargus longipes* var. *decliva*, holotype ♀, **Tanzania**: Kitope, Dodoma, 6.iv.1927 (*Miller*) (BMNH). *Gastrimargus aethiopicus* Bolívar, holotype ♀, **Ethiopia**: Kaussa, 1905 (*de Rothschild*) (MNHN, Paris). *Gastrimargus brevipes* Sjöstedt, holotype ♀, **Tanzania**, Kilimanjaro, 1.i.1905–06 (*Sjöstedt*) (NR, Stockholm). *Gastrimargus brevipes* var. *elgonensis* Sjöstedt, holotype ♀, **Kenya/Uganda**: Mt Elgon, 1700 m, vii (*Lovén*) (NR, Stockholm).

In addition to the type-material listed above, 639 specimens were examined from the following localities. **Sudan**: Arua. **Ethiopia**: Gamo Prov., Nr Ezo, c. 2880 m; Wolamo Prov., points between Sodu and Boroda, 1500–2100 m; W. of Mt Zuquala, Awash R., c. 1800 m; Eritraea, nr Senafe; L. Zwai; Meisso; Mega; Bishoftu, 48 km SE. of Addis Ababa; Wallo, Yezu escarpment; Asba Taffari, 1740 m; 1 ♂, Wonda, nr Maltke, 7.xii.1900 (*Erlanger*) (paratype of *G. brevipes abessina*) (NR, Stockholm); Addis Ababa to Dessie road, S. of Karacori, 1500 m; Marocco; L. Bishoftu, 2100 m; Shewa Prov., SE. of Addis Ababa, km 32 on Debre Zeit road. **Somali Republic**: Hargeisa distr., Tug Wajali; Coralei, 9°36'N 42°50'E; Moccanis, 9°33'N 42°57'E; 9°20'N 43°40'E; 9°25'N 43°50'E; Baba Gob, 9°07'N 44°30'E; Qodah, 9°08'N 45°00'E; Faroweina, 9°40'N 43°00'E. **Kenya**: Kisumu, Kisat; Masai Cis Mara, Kipleleo plain; Ngobit, Aberdare Mts, 2100 m; Ngong; Kibibi basin; Kilimanjaro, 1200–1800 m; Ngatana; Karura forest, Nairobi; Nyeri (S); Kitale; Novosura; Thika, 1350 m; Timbaroa; nr Kericho; nr Naivasha; L. Nakuru; Subukia, nr Nakuru; Nairobi;



Baringo, 1200 m; Chyulu hills, 02°38'5"S 37°51'5"E, 1650–1680 m; Giaki farm, 00°01'5"N 37°46'E; Tebere, C.R.S., 00°39'5"S 37°23'E; Kitui, 01°22'S 37°59'E; Ngariama, 00°34'5"S 37°23'5"E; Marsabit; Rabai; Mt Kulal, N.F.D., 02°35'N 36°55'E, 1650–1950 m; Samburu distr.; Kisumu; Emali Range, Sultan Hamud, 1470–1770 m; Ngong escarpment; Naitalia; Wasin Gisha, 1st beacon camp; Plains W. of Mt Kenya; Marsabit, L. Paradise; Kitito coffee estate, Makuyu, 00°58'S 37°17'E, 1550 m; Mt Margaret to Narok road, 01°06'S 36°06'E, nr Ntulelei village, 2040 m. **Kenya/Uganda**: 1 ♂, 2 ♀, Elgon, 2000 m, vii. (*Lovén*) (paratypes of *G. brevipes* var. *elgonensis*) (1 ♀, MNHN, Paris, 1 ♂, NR, Stockholm); 1 ♀, Elgon, 1700 m, vi. (*Lovén*) (paratype of *G. brevipes* var. *elgonensis*) (MHN, Geneva); 1 ♂, same data, 2000 m (paratype of *G. brevipes* var. *elgonensis*) (MHN, Geneva). **Uganda**: 1 ♂, Entebbe, xi. 1912 (*Gowdey*) (paratype of *G. brevipes*); Mawakota; Kampala; Mbale; Bweya; Kivuvu; Tororo to Jinja; Tororo to Mbale road; Tororo, Tororo hill; Banda, Chagwe; Bulewezi, Luwero; Ankole, Lutobo; Ankole, Bukinda, c. 1650 m; Ankole, L. Karengye; Ankole, Kashenji, 2100–2400 m; Kigezi, Mavungo, 1800–2100 m; Kigezi, L. Bunyoni to Kashenji, 1800–2100 m; Kigezi distr., 1650–1800 m, Mabungo; Kigezi, Bufundi, 1800–2100 m, Mwera. **Ruanda**: Njarugenje. **Zaire**: Ituri distr., N'dele; Nya Ngezi, 1530 m; Kivu, Kadjudju; Bunia, 1350 m. **Tanzania**: 1 ♂, Kilimanjaro, Kibonoto, 1300–1900 m, 14.xi.1905–06 (*Sjöstedt*) (paratype of *G. brevipes*) (NR, Stockholm); 1 ♂, Kilimanjaro, 18.xi.1905–06 (*Sjöstedt*) (paratype of *G. brevipes*) (MHN, Geneva); SE. slope of Kilimanjaro, ab Marangu; Mutindi; Arusha Nat Pk; 1 ♀, Bukoba, xii.1921 (Miller) (paratype of *G. brevipes*); Singida; Old Shinyanga; Meru, 2100–2400 m; W. Kilimanjaro, Ngare to Nairobi, 1200–1500 m; Ngorongo, Rest house, 2400 m; Oldeani distr.; Tukuyu, 1525 m; Manow. **Zimbabwe**: Mt Selinda, 1350 m. **South Africa**: Cape Province, Bizana distr., Pondoland East; C. P., East London; C. P., Keurboom R.; 1 ♀, C. P., Knysna ('one of Walker's series of *P. determinatus*'); C. P., Swellendam; C. P., Knysna, Harkerville, 240 m; C. P., Grahamstown; Natal, Zululand, Nagana Res. Lab.; Natal, Nqutu; Natal, Howick; Natal, Maritzburg; Natal, Zululand, lower Umfolosi R.; 1 ♀, Natal, Durban ('Port Natal') ('one of Walker's series of *P. determinatus*'); 1 ♂, Natal, Appelbosch, iv. (*Ljungqvist*) (paratype of *G. longipes*) (NR, Stockholm); 1 ♀, Natal, no further data (paralectotype of *G. verticalis*) (MHN, Geneva); Orange Free State, Gum Tree; O. F. S., Orange R. Colony; Transvaal, Eureka, nr Barberton. **Madagascar**: Tananarive.

*Gastrimargus verticalis mpwapwae* subsp. n.

Measurements

Sample from Tanzania, Mpwapwa.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	34.10	4.94	8.31	25.29	18.23	3.88	4.70	3.05
Range	32.3–36.8	4.8–5.2	7.7–8.9	23.7–27.8	17.7–19.2	3.7–4.1	4.6–4.8	2.8–3.2
S.D.	1.900	0.155	0.557	1.771	0.674	0.185	0.066	0.188
n	4	4	4	4	4	4	4	4
Females								
Mean	48.10	8.19	11.70	33.70	26.36	5.89	4.49	2.90
Range	47.0–49.2	8.0–8.4	10.1–13.1	32.0–34.6	25.9–27.3	5.5–6.4	4.1–4.8	2.4–3.4
S.D.	0.879	0.144	1.510	1.161	1.634	0.340	0.286	0.476
n	4	4	3	4	4	4	4	3

MATERIAL EXAMINED

Holotype ♂, **Tanzania**: Mpwapwa, Mt Wilkins, 1800 m, 1.xii.1948 (*Burt*) (BMNH).

Paratypes. **Tanzania**: 2 ♂, 2 ♀, same data as holotype (BMNH); 1 ♀, Mpwapwa, Mt Wilkins, 1800 m, 10.iv.1938 (*Burt*) (BMNH); 1 ♂, 1 ♀, Mpwapwa, Mt Kibariani, 1800 m, common, 3.xii.1948 (*Burt*) (BMNH).

*Gastrimargus miombo* sp. n.

(Figs 52–56, 111, 136)

DIAGNOSIS. Fastigium of vertex convex. Pronotum with median carina arcuate, not intersected by posterior sulcus; hind margin acutangular; dorsum of female with scattered globular warts. Tegmen surpassing folded hind knees by one-fifth to one-tenth of hind femur length in male; tegmen variable in female, sometimes failing to reach hind knees (Ufipa plateau). Genitalia (Figs 52–56) with strongly protruding aedeagus and large bulbous subapical ventral process. Ventral ovipositor valves with external lateral margin deeply excavated (Fig. 56).

Coloration typical for genus. Pronotal  $\times$ -marking with anterior and posterior arms similar in length and thickness, meeting at an angle of 90–120° (Fig. 136). Tegmen with distinct pale cross-banding. Hind wing with complete fascia (Fig. 136), widening anteriorly; basal area pale greenish yellow. Hind femur externally with or without indistinct oblique transverse bands. Internal surface straw-coloured; carinulae with dark dots. Hind tibia straw-coloured.

## MEASUREMENTS

Sample from Central Africa, various localities.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	33.28	5.23	8.39	24.55	17.83	3.86	4.62	2.93
Range	29.7–39.6	4.7–6.0	7.4–9.4	21.7–29.6	15.9–21.5	3.3–4.3	4.3–5.1	2.5–3.3
S.D.	2.973	0.379	0.610	2.463	1.621	0.282	0.222	0.257
n	10	10	10	10	9	9	9	10
Females								
Mean	48.91	7.86	12.12	35.06	24.59	5.65	4.36	2.91
Range	44.8–53.2	7.1–9.4	10.1–15.3	30.8–38.6	21.6–28.0	5.1–6.4	4.0–5.0	2.0–3.4
S.D.	3.577	0.734	1.616	2.637	2.171	0.405	0.287	0.370
n	7	11	11	10	11	11	11	10

AFFINITIES. *G. miombo* is allied to *G. verticalis* and *G. determinatus* on the basis of the general form and coloration, especially the absence of dark pigment on the undersides of the hind femora, and the genital morphology. It may be distinguished by the characters outlined in the key.

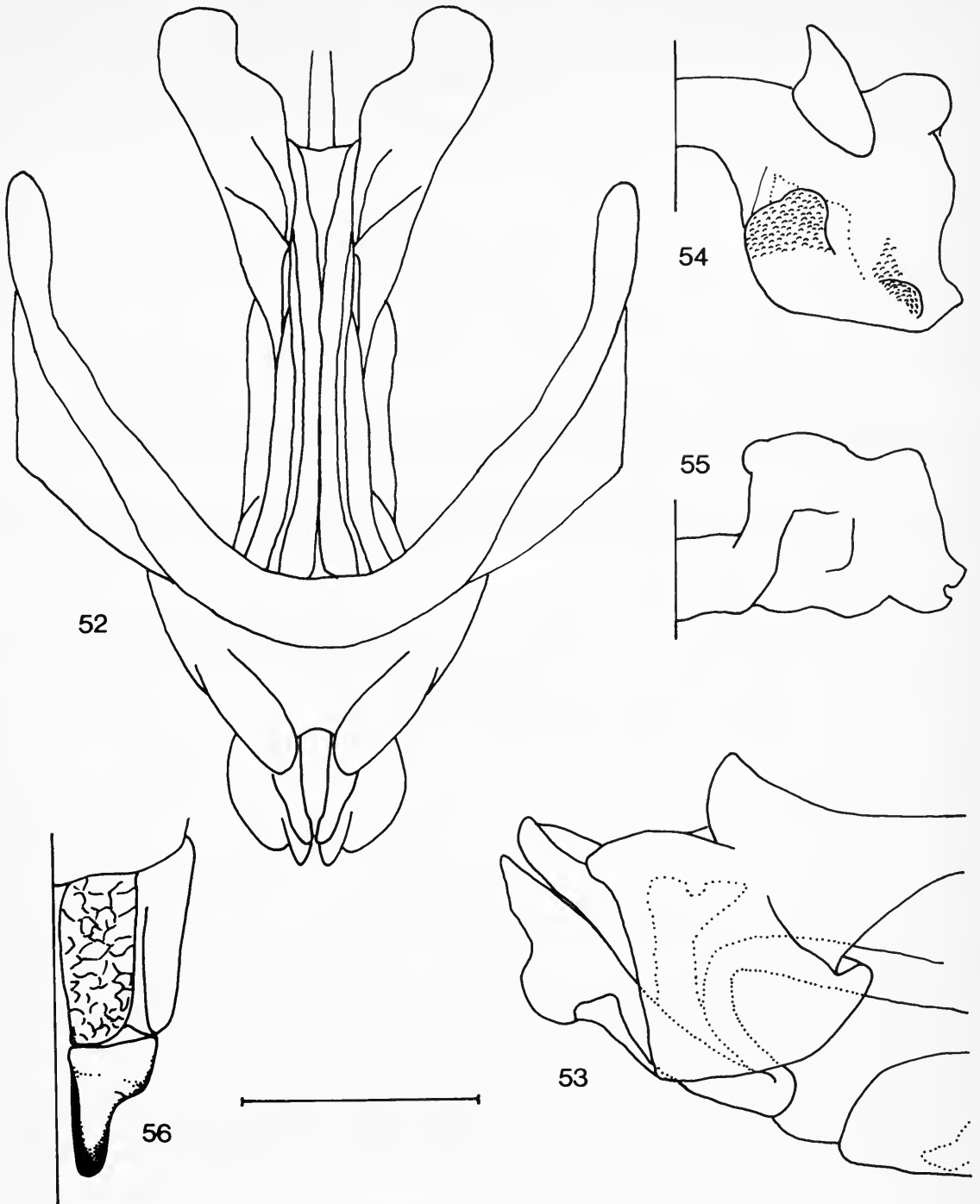
## MATERIAL EXAMINED

Holotype ♂, Angola: Palavange, 2.xi.1930 (Green) (ANS, Philadelphia).

Paratypes. Angola: 3 ♂, 1 ♀, Palavange, 2.xi.1930 (Green) (ANS, Philadelphia); 1 ♀, Moxico distr., Valley of R. Mu-Simoi, 25.x.1927 (Burr). Zambia: 1 ♂, Abercorn, Zombe, Lombwe Place, 26.i.1961 (Vesey-Fitzgerald); 1 ♀, Broken Hill, ii.1931 (ANS, Philadelphia). Tanzania: 1 ♂, Ufipa, Chapota, 3.xii.1949 (Vesey-Fitzgerald); 1 ♀, same data, 4.xii.1949. Zaire: 1 ♂, Katanga, xi–xii.1927 (Burr); 1 ♀, Kapanga, ix.1933 (Overlaet) (MRAC, Tervuren); 1 ♂, 2 ♀, Lomani, Kishinde, x.1931 (Quarré) (MRAC, Tervuren); 1 ♂, Katanga, Kasompi, terr. Jadotville, radioactive hill, x.1956 (Marlier, Laurent, Leleup) (MRAC, Tervuren); 1 ♀, Lulua, Kapanga, ix.1932 (Overlaet) (MRAC, Tervuren).

DISTRIBUTION (Fig. 111, and Biogeography section, p. 312). Angola, Zaire, Zambia, Tanzania.

DISCUSSION. The specimen from Moxico, Angola, collected by Burr was incorrectly identified by Uvarov (1953: 114) as *G. brevipes* Sjöstedt.



Figs 52–56 *Gastrimargus miombo*, genitalia. 52, phallic complex, dorsal view; 53, same, posterior portion, lateral view; 54, epiphallus, right half, dorsal view; 55, same, posterior view; 56, ovipositor, left half, ventral view.

*Gastrimargus determinatus* (Walker, 1871)

(Figs 57–63, 115, 137–140)

*Pachytylus determinatus* Walker, 1871: 72.

This species is here divided into four subspecies under which the specific synonymy is separately listed.

**DIAGNOSIS.** Fastigium of vertex convex. Pronotum with median carina arcuate, not intersected by posterior sulcus; dorsum with variable scattering of small shiny warts; hind margin sharply acutangular. Tegmen surpassing folded hind knees by one-sixth to one-quarter of hind femur length. Genitalia (Figs 57–63) with aedeagus strongly protruding; sub-apical ventral process large, bulbous; epiphallus with variable lateral plate and outer lobe of lophi slightly divergent.

Coloration variable. Pronotal  $\times$ -marking variable in emphasis, sometimes obsolete, with posterior arms of variable length and angle to anterior arms (90–160°). Tegmen light brown with pale cross-bands poorly contrasting (Figs 137–140). Hind wing fascia variable, present or absent according to subspecies (Figs 137–140); basal area pale yellow. Hind femur externally with or without oblique banding, but always with internal and external upper and lower carinulae with row of black dots; medial and ventral areas of internal surface straw-coloured. Hind tibiae light greyish brown becoming reddish in apical half with black-tipped spines.

**AFFINITIES.** *G. determinatus* has affinities with *G. miombo* on the basis of the overall morphology, differing from it by the larger size, less contrasted coloration, and shorter cingular rami (see also characters in the key, p. 245).

**DISTRIBUTION** (Fig. 115, and Biogeography section, p. 310). *G. determinatus procerus* extends eastward and southward across Africa from Senegal to Ethiopia, Uganda and Angola. In eastern and southern Africa it is replaced by *G. d. vitripennis*, with some overlap and intergradation at the boundary. *G. d. determinatus* is probably restricted to Cape Province, but since the precise area is unknown it is not shown on the distribution map (Fig. 115).

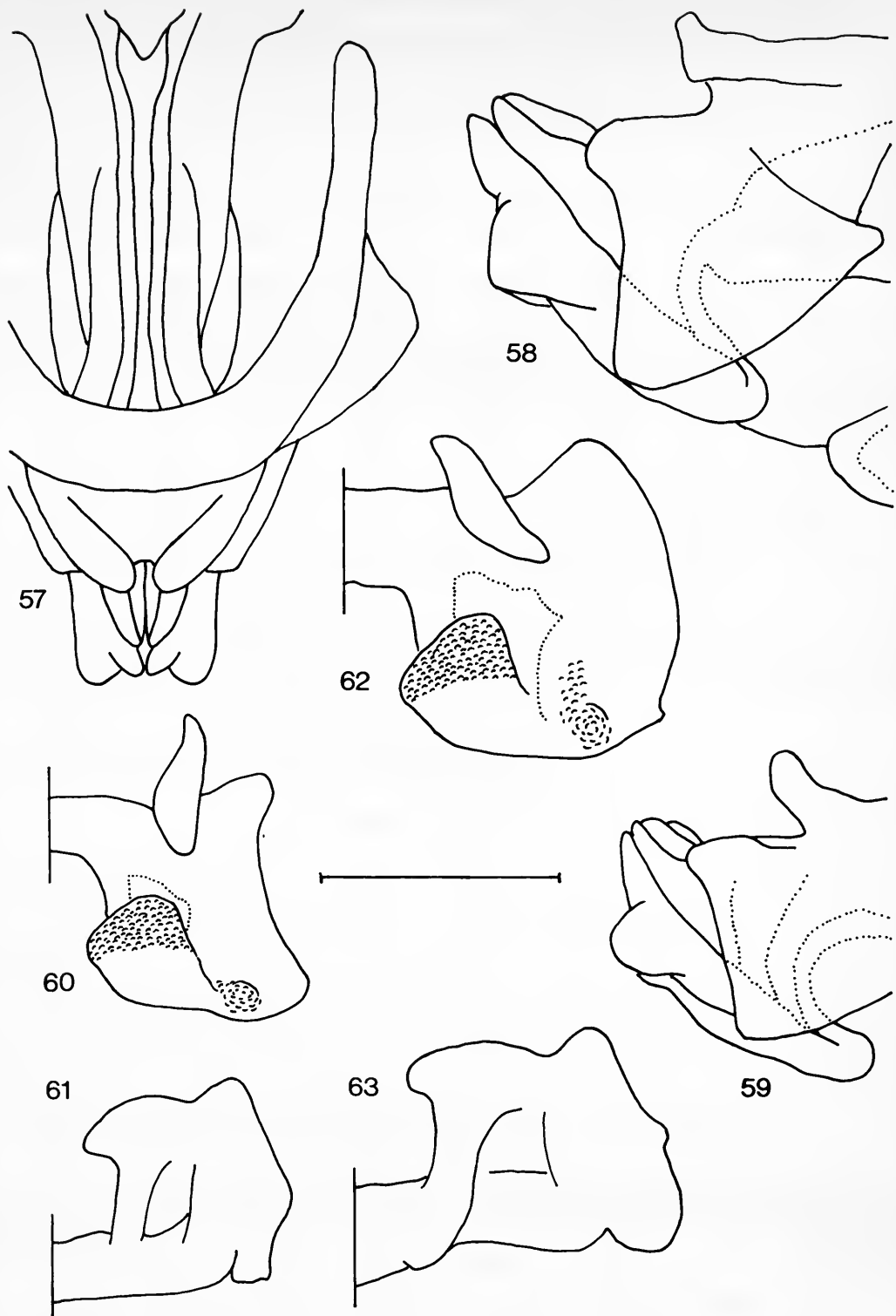
**DISCUSSION.** The variability of the coloration of *G. determinatus* led Sjöstedt (1928) to erect no less than 12 taxa based on material of the same species from different parts of Africa. The unique female holotype and the newly recognised unique male of *G. determinatus determinatus* are both labelled as from 'Cape', presumably indicating collecting sites in SW. Cape Province. However, the precise locality is unknown. Apart from the hind wing fascia this subspecies is identical with *G. determinatus vitripennis*. The intermediate stage in the loss of the fascia is represented by *G. determinatus procerus* in West Africa. The subspecific status of the partly banded race was first recognised by Uvarov (1926: 427) who described it as *G. volkensi nigericus*.

Dirsh (1961a) showed that *G. volkensi nigericus* is a junior synonym of *G. procerus* on the basis of the description of *procerus* and in the absence of the type which he stated was lost. I am informed by Dr K. K. Günther of Berlin and Dr G. Müller of Greifswald that the type is not in either collection. It is therefore certainly lost. To establish the synonymy a male specimen from Ghana has been chosen as neotype of *Oedaleus (Humbella) procerus* Gerstäcker.

The female lectotype of *G. determinatus determinatus* is specimen *a* of Walker's syntype-series *a–e*, and was recognised as the type by Uvarov who labelled it as such and sent a photograph of it to Sjöstedt for his revision of the genus (1928). Since all the remaining syntypes have been referred to other species or subspecies the lectotype is now the sole type-specimen available and it is formally designated to stabilise the nomenclature.

**Key to subspecies of *G. determinatus***

- 1 Hind wing without fascia, but anal veins sometimes darkened medially (Fig. 138) . . . . . 2
- Hind wing with partial fascia posterior to 2A, or with complete fascia (Figs 137, 139, 140) . . . . . 3
- 2 Larger, longer-winged insects (tegmen length 26–32 mm ♂, 40–45 mm ♀) with pronotal pattern variable;  $\times$ -marking usually present (eastern and southern Africa)
  - G. determinatus vitripennis* (Saussure) (p. 283)
  - Smaller, shorter-winged insects (tegmen length 24–26 mm ♂, 36–40 mm ♀) with pronotal pattern fixed as two separate dark longitudinal bands on a straw-coloured background, flanking median carina;  $\times$ -marking absent in females (Arabia) . . . *G. determinatus arabicus* (Uvarov) (p. 285)



**Figs 57–63** *Gastrimargus determinatus*, genitalia. 57, phallic complex, dorsal view, *G. d. procerus*; 58, same, posterior portion, lateral view, *G. d. determinatus*; 59, same, *G. d. procerus*; 60, epiphallus, right half, dorsal view, *G. d. procerus*; 61, same posterior view; 62, same, dorsal view, *G. d. determinatus*; 63, same, posterior view.

- 3 Hind wing fascia of male complete, narrowly interrupted between Cu2 and 1A, not following hind margin of wing beyond 6A (Fig. 139); fascia of female paler, and fading posteriorly (Fig. 140) (Cape Province) . . . . . *G. determinatus determinatus* (Walker) (p. 282)
- Hind wing fascia incomplete, widely interrupted, occupying posterior half of wing beyond 2A at greatest extent, often less advanced (all intermediates occur between this and the unfasciated subspecies *G. d. vitripennis*) (West and Central Africa) . *G. determinatus procerus* (Gerstäcker) (p. 282)

***Gastrimargus determinatus determinatus* (Walker, 1871)**

*Pachytylus determinatus* Walker, 1871: 72. LECTOTYPE ♀, SOUTH AFRICA (BMNH), here designated [examined].

*Gastrimargus determinatus* (Walker) Kirby, 1902: 71.

MEASUREMENTS

Unique male and female from South Africa.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Holotype ♀	—	—	—	36.5	28.1	6.7	4.2	—
Unique ♂	—	5.7	8.6	28.8	22.4	4.7	4.77	3.2

MATERIAL EXAMINED

*Pachytylus determinatus* Walker, lectotype ♀, South Africa: 'Cape of Good Hope' (BMNH).

South Africa: 1 ♂, Cape of Good Hope, 1829 (Reynaud) (MNHN, Paris).

***Gastrimargus determinatus procerus* (Gerstäcker, 1889) stat. n.**

*Pachytylus determinatus* var.; Walker, 1871: 72.

*Oedaleus (Humbella) procerus* Gerstäcker, 1889: 48. Holotype ♀, GHANA (lost). NEOTYPE ♂, GHANA (BMNH), here designated [examined].

*Humbe procera* (Gerstäcker) Kirby, 1910: 216.

*Gastrimargus volkensi* var. *nigericus* Uvarov, 1926: 437. Holotype ♂, NIGERIA (BMNH) [examined]. [Synonymised with *G. procerus* by Dirsh, 1961a: 49.]

*Gastrimargus amplus* Sjöstedt, 1928: 16. Holotype ♀, SIERRA LEONE (NR, Stockholm) [examined]. [Synonymised with *G. procerus* by Dirsh, 1970: 496.]

*Gastrimargus nigericus* Uvarov; Sjöstedt, 1928: 17. [Synonymised by Dirsh, 1961: 49.]

*Gastrimargus silvicola* Sjöstedt, 1928: 17. Holotype ♂, ZAIRE (NR, Stockholm) [examined]. [Synonymised by Dirsh, 1970: 496.]

*Gastrimargus vittatus* Sjöstedt, 1928: 18. Holotype ♂, ZAIRE (NR, Stockholm) [examined]. **Syn. n.**

*Gastrimargus foveolarum* Sjöstedt, 1928: 19. Holotype ♀, CAMEROUN (MNHU, Berlin) [examined]. [Synonymised by Dirsh, 1970: 496.]

*Gastrimargus foveolarum* var. *immaculata* Sjöstedt, 1928: 20. Holotype ♀, ZAIRE (MRAC, Tervuren) [examined]. [Synonymised by Dirsh, 1970: 496.]

*Gastrimargus testaceus* Sjöstedt, 1928: 20. Holotype ♂, CAMEROUN (MNHU, Berlin) [examined]. **Syn. n.**

*Gastrimargus procerus* (Gerstäcker) Dirsh, 1961: 49.

MEASUREMENTS

Sample from West Africa, various localities.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	39.86	5.51	8.38	29.84	20.29	4.17	4.83	3.55
Range	34.1–45.1	5.0–6.0	7.4–9.1	25.0–34.1	17.7–24.0	3.7–4.5	4.5–5.2	3.2–3.9
S.D.	2.284	0.208	0.452	1.878	1.455	0.199	0.209	0.196
n	29	29	28	29	26	25	25	28

## MEASUREMENTS—(cont.)

	Females							
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	59.99	8.48	12.45	45.06	30.60	6.21	5.01	3.61
Range	55.9–	7.4–	10.7–	42.3–	26.9–	5.7–	4.6–	3.3–
	63.6	9.6	13.7	47.3	35.0	6.8	5.5	4.0
S.D.	2.062	0.446	0.679	1.554	1.750	0.556	0.222	0.150
n	26	29	29	26	29	29	29	26

## MATERIAL EXAMINED

*Oedaleus (Humbella) procera* Gerstäcker, neotype ♂, **Ghana**: Accra plain, Nungua, 2.xii.1959 (Jago) (BMNH, London). *Gastrimargus volkensi* var. *nigericus* Uvarov, holotype ♂, **Nigeria**: Azare, vii.1924 (Lloyd) (BMNH). *Gastrimargus amplus* Sjöstedt, holotype ♀, **Sierra Leone**: no data (NR, Stockholm). *Gastrimargus silvicola* Sjöstedt, holotype ♂, **Zaire**: Luluabourg (NR, Stockholm). *Gastrimargus vittatus* Sjöstedt, holotype ♂, **Zaire**: Boko district, (Laman) (NR, Stockholm). *Gastrimargus foveolarum* Sjöstedt, holotype ♀, **Cameroun**: Satsche, 12–21.v.1909 (Riggenbach) (MNHU, Berlin). *Gastrimargus foveolarum* var. *immaculata* Sjöstedt, holotype ♀, **Zaire**: Eala, 2.i.1921 (Schouteden) (MRAC, Tervuren). *Gastrimargus testaceus* Sjöstedt, holotype ♂, **Cameroun**: Mittel-Adamaoua, 300–500 m, m.ü.d. M.V. Garoua u. Rei Buba, n. Monti, x.1912 (Houy) (MNHU, Berlin).

In addition to the type-material listed above, 172 specimens of this subspecies were examined from the following localities: **Senegal**. Dakar. **Sierra Leone**: 1 ♂, no data (paratype of *G. amplus*) (NR, Stockholm); 1 ♀, no data (Morgan) (unique specimen of Walker's '*P. determinatus* var. '); 1 ♀, Jowati, 19.viii.1912 (Simpson) (paratype of *G. volkensi nigericus*); 1 ♂, Kayima, 25.vii.1912 (Simpson) (paratype of *G. volkensi nigericus*); 1 ♂, Mongheri, 15.ix.1912 (Simpson) (paratype of *G. volkensi nigericus*); Makeni; Freetown, Mt Aureol, 300 m; Njala; Karema. **Liberia**: Bomi hills, 380 m; Kakata; N. of Monrovia, Bomi hills, 8 km NE. of mines, Forest Reserve rest house; Zov; Firestone Plantation; 13 km NW. of Belefuanai, S. fork, St Paul R.; Marshall Terr.; Bindah; Bushrod I. **Ivory Coast**: Man to Danane road, nr Zo R. bridge. **Ghana**: Amedzofe; Anfeega; Volta Reg., Likpe Mate; E. Reg. Ofankor; E. Reg. Shai hills; Achimota; N. Reg. Damongo; Katamanso; Ifaks; between Takoradi and Axim; E. Reg., Legon, Botanical Gardens; W. Reg., 10 km NE. of Princes Town; Accra plain, Nungua; Trans Volta, Togoland, Amedzofe; 1 ♀, N. Terr., Sankwalla, 4–7.xi.1915 (Simpson) (paratype of *G. volkensi nigericus*). **Mali**: Middle Niger, Beninigeni; Bamako; Sikasso, Klela. **Nigeria**: 1 ♀, Azare, 1924 (Lloyd) (paratype of *G. volkensi nigericus*); 1 ♀, Azare, 1925 (Lloyd) (paratype of *G. volkensi nigericus*); Dikwa; Chad area, Kalkala; Sherifuri, nr Azare; Zaria, Samaru; Bauchi Prov., Udubo; 45 km SE. of Maiduguri; Igbogun. **Cameroun**: nr Mokolo; 3 ♂, Mittel-Adamaoua, 300–500 m m.ü. d. M, V. Garoua u. Rei Buba, n. Monti, x.1912 (Houy) (paratype of *G. testaceus*) (MNHU, Berlin); Benüe unth. Garoua. **Congo**: Goungourou, 24 km N. of Nola, middle Congo, 620 m; Oka middle Congo, 360 m. **Zaire**: L. Albert, Kasenyi; Gety, 1350 m; Mahagi Port; Kivu; Katanga, R. Lubidi; Nya Ngezi; Nyangchi, Bukavu; 1 ♂ Boko distr. (Laman) (paratype of *G. vittatus*) (NR, Stockholm); 1 ♀, Luluabourg, no data (paratype of *G. silvicola*) (NR, Stockholm); Garamba National Park, Pidigala; Bloando; Leopoldville. **Sudan**: Bahr el Ghazal, 1.6 km S. of R. Lol. **Ethiopia**: 1 ♀, no data ('one of Walker's series of *P. determinatus*') (paratype of *G. volkensi nigericus*); Kefa Prov, 9 km NE. of Gojeb R. Mission, 1350 m. **Uganda**: Tororo; Bukumi; R. Mayanja; Mabira Forest; Jinja; Ankole, Gayaza; Kampala; Tororo to Mbale road; Banda, Chagwe; Mawakota. **Angola**: Luimbale, Mt Moco, 1800–1900 m. **Locality unknown**: 1 ♀ (paratype of *G. volkensi nigericus*). **Zambia**: Mukapa Place, Mpumpu; Musosa.

*Gastrimargus determinatus vitripennis* (Saussure, 1888) stat. n.

*Oedaleus (Gastrimargus) vitripennis* Saussure, 1888: 38. Holotype ♀, SOUTH AFRICA (MHN, Geneva) [examined].

[*Oedaleus (Gastrimargus) acutangulus* (Stål); Saussure, 1884: 109, 114; 1888: 39. Misidentifications: Sjöstedt, 1928: 43.]

*Gastrimargus vitripennis* (Saussure) Kirby, 1902: 233.

*Gastrimargus volkensi* Sjöstedt, 1909: 171. Holotype ♀, TANZANIA (NR, Stockholm) [examined]. **Syn. n.**

*Gastrimargus fallax* Sjöstedt, 1928: 24. Holotype ♀, TANZANIA (MNHU, Berlin) [examined]. **Syn. n.**

- Gastrimargus volkensi* var. *minor* Sjöstedt, 1928: 44. Holotype ♀, KENYA: Victoria Nyanza, Sesse Is., Bugala, vii.08 (*Bayon*) (MCSN, Genoa). [Synonymised with *G. volkensi* by Dirsh, 1966: 429.]
- Gastrimargus volkensi* var. *minor forma rectinotum* Sjöstedt, 1928: 44. Holotype ♀, KENYA: Bugala (MCSN, Genoa). [Unavailable infrasubspecific name.] [Synonymised by Dirsh, 1966: 429.]
- Gastrimargus pallidus* Sjöstedt, 1928: 45. Holotype ♀, KENYA: Victoria Nyanza, Sesse Is., Bugala, 1908 (*Bayon*) (MCSN, Genoa). **Syn. n.**
- Gastrimargus femoralis* Sjöstedt, 1928: 45. Holotype ♀ SOUTH AFRICA (BMNH) [examined]. [Synonymised with *G. volkensi* by Dirsh: 1961b: 395.]

## MEASUREMENTS

Sample from Zimbabwe.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	40.03	5.86	8.85	29.36	21.13	5.03	4.21	3.31
Range	35.4–43.2	5.2–6.3	7.9–10.1	26.0–32.2	18.5–23.4	4.5–5.5	3.9–4.6	3.1–3.6
S.D.	1.786	0.304	0.477	1.459	1.093	0.270	0.164	0.137
n	15	20	20	17	20	20	20	17
Females								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	57.15	8.78	12.98	41.94	29.87	6.87	4.36	3.23
Range	54.4–60.7	8.2–9.7	12.0–14.4	39.7–45.1	27.80–32.0	6.2–7.7	4.1–4.9	3.0–3.5
S.D.	1.933	0.338	0.695	1.560	1.317	0.325	0.218	0.142
n	19	22	22	19	22	22	22	19

## MATERIAL EXAMINED

*Oedaleus (Gastrimargus) vitripennis* Saussure, holotype ♀, **South Africa**: Cape of Good Hope (*Delalande*) (MHN, Geneva). *Gastrimargus volkensi* Sjöstedt, holotype ♀, **Tanzania**: Meru (lowland), Ngare na Nyuki, i. (*Sjöstedt*) (NR, Stockholm). *Gastrimargus fallax* Sjöstedt, holotype ♀, **Tanzania**, no data (MNHU, Berlin). *Gastrimargus femoralis* Sjöstedt, holotype ♀, **South Africa**: [Transvaal, Pretoria,] Masil nek (*Distant*) (BMNH).

In addition to the type-material listed above, 251 specimens of this subspecies were examined from the following localities: **Ethiopia**: Harerge Prov., 33 km N. of Asbe Teferin, NE. of Meisso; nr Addis Alem, 2250 m; Addis Ababa to Debra Marcos road, Abbai Gorge, 2100 m; Nefasit; Adteclesan; El Oha; Addis Taffari, 1740 m; Meisso, nr station; L. Zwai; Addis Ababa to Dessye road, S. of Karacori, 1500 m. **Kenya**: Moyale, NFD; Emali range, Sultan Hamud, 1470–1770 m; Marsabit; CRS, Tebere, 00°39'5"S 37°23'E; 4 km N. of Kitui, 01°08'5"S 37°44'E; Embu distr., 00°41'S 37°28'E; Meru Nat Pk, 00°01'N 38°04'E; Chyulu hills, 02°38'5"S 37°51'5"E; Thika; Nairobi; Lodwar, Rabai; Shimba hills; Kasigau; 1 ♀, Victoria Nyanza, Sese Arch., Bugala, vii.1908 (*Bayon*) (paratype of *G. volkensi minor*) (NR, Stockholm); 1 ♀, same data (paratype of *G. pallidus*) (NR, Stockholm); 20 km N. of Isiolo; Kitito coffee estate, 00°58'S 37°17'E, 1560–1620 m, Taita Hills Lodges game area, 03°32'S 38°14'E, 920 m; Mwangaro (Lion Rock), 03°33'S 38°11'E, 930 m; top of Marinduko hill, 5 km S. of Embu town, 00°35'S 37°27'E, 1385 m; Salt Lick Lodge, 03°33'S 38°13'E, 870 m. **Uganda**: 1 ♀, Ankole, Lwasamaine; Katwe; Masaka, Lwengo; Entebbe; Kepeka; Tororo to Jinja; Mawakota; Koki Lwanda; Mwani; Mabira forest; L. George. **Tanzania**: Old Shinyanga; Ukiriguru, Lake Prov; Tabora; Singida; Mkwemi, Kahama; Dar-es-Salaam; Ufipa plateau; Ilonga; Oldeani distr.; Kigoma; Kilosa; Morogoro; Uluguru Mts; Mkawa, Iringa; Mikumi Nat. Pk. **Malawi**: Kondowe to Karonga. **Zambia**: Kabundi forest, Chingola; Fort Jameson to Nyanji, 900–1050 m; Luano valley, Mulungushi; Luano valley, Chisorwe; Kalulu; Mporokoso distr., Mweru Wa Ntipa; Abercorn, Chiyanga. **Zaire**: Gety, 1350 m; Kasenyi, Petros village; Ituri distr., N'dele; 1 ♂, Plaine du Parc National Albert, 1933 (*Léopold*) (incorrectly labelled as allotype of *G. volkensi* var. *minor*) (IRSNB, Brussels). **Angola**: 13 km NE. of Caçula; Mexico distr., Huamba. **Zimbabwe**: Salisbury, Mashonaland, 1500 m; Selukwe, 1420 m; Umvukwes, 1500 m; Magunje, 16°50'S 29°26'E; Odzi distr.; Amandas, 1260 m; Vuti, 16°30'S 29°30'E; Umtebekwe R., 900 m. **Botswana**: Lobatse area. **Namibia**: Regenstein, 24 km SSW of Windhoek. **South Africa**: Transvaal, SW.



Waterburg distr.; Tvl, Reitspruit, Mauco; Tvl, Kliprieversburg, 24 km S. of Johannesburg; Tvl, Rustenburg; Tvl, Zoutpansberg distr., Koberpan Kopjes, 720 m; Tvl, Johannesburg; Tvl, E. Johannesburg, Bedford Ridge; Tvl, Constantia ranch, 5 km S. of Kaapmuiden; Tvl, Pretoria; Tvl, Barberton; Tvl, Watervaal; Natal, Durban; Natal, Zululand, Conjeni; Natal, Pinetown; Natal Nat. Pk; Natal, Ingogo; Cape Province, Swellendam; C.P., Cape of Good Hope; C.P., Mafeking.

*Gastrimargus determinatus arabicus* Uvarov, 1936

*Gastrimargus volkensi arabicus* Uvarov, 1936: 542. Holotype ♂, YEMEN: Sanaa, vii.31 (*Rathjens*) (ZM, Hamburg).

MEASUREMENTS

Sample from Arabia.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	33.84	4.82	6.78	24.92	17.52	3.91	4.48	3.68
Range	32.4–34.9	4.4–5.1	6.1–7.2	23.8–25.6	16.7–18.5	3.7–4.2	4.3–4.6	3.5–3.9
S.D.	0.824	0.227	0.383	0.560	0.614	0.182	0.117	0.149
n	8	8	9	9	7	7	7	9
Females								
Mean	51.98	8.48	11.48	37.68	27.96	6.35	4.40	3.20
Range	49.4–55.2	8.1–8.9	10.3–12.4	36.0–40.1	26.2–29.2	6.0–6.7	4.2–4.6	2.4–3.8
S.D.	1.857	0.238	0.662	1.586	1.109	0.220	0.156	0.371
n	8	8	9	9	7	7	7	9

MATERIAL EXAMINED

**Saudi Arabia:** 1 ♀, 2 nymphs, Baha, 7.vi.1969 (*Popov*); 5 ♂, 3 ♀, Alaya to Baha, 11.vi.1972 (*Popov*) (COPR, London); 1 ♀, nr Baha, 16.x.1971 (*Popov*) (COPR, London). **Southern Yemen:** 1 ♀, Dhala, x.1935 (*Darling*) (paratype of *G. volkensi arabicus*); 5 ♀, Jebel Jihaf, Wadi Leje [or Lejj], c. 2040 m, 13–15.x.1937 (*Scott & Britten*); 3 ♂, same data, c. 2130 m, x.1937; 1 ♂, same data, c. 2100 m, 1.x.1937; 1 ♂, same data, 6.x.1937; 1 nymph, Jebel Feifa, 17°15'N, 43°05'E, 900 m, 1946 (*Popov*). **Oman:** 1 ♀, Dhofar, Jebel Quarra, 30.x.1943 (*Fitzgerald*); 2 ♂, 3 nymphs, same data, x.1943; 3 nymphs, same data 2.x.1943; 1 ♀, Jebel Quarra, 20–29.x.1945 (*Thesiger*).

*Gastrimargus crassicornis* (Saussure, 1888)

(Figs 64–67, 112, 141)

*Oedaleus* (*Gastrimargus*) *crassicornis* Saussure, 1888: 38. Holotype ♀, SOUTH AFRICA (MHN, Geneva) [examined]. [Incorrectly attributed by Saussure to Blanchard.]

[*Oedaleus assimilis* Thunberg; Kirby, 1910: 226. Misidentification.]

*Gastrimargus transvaalensis* Sjöstedt, 1928: 25. Holotype ♀, SOUTH AFRICA (MNHN, Paris) [examined].

Syn. n.

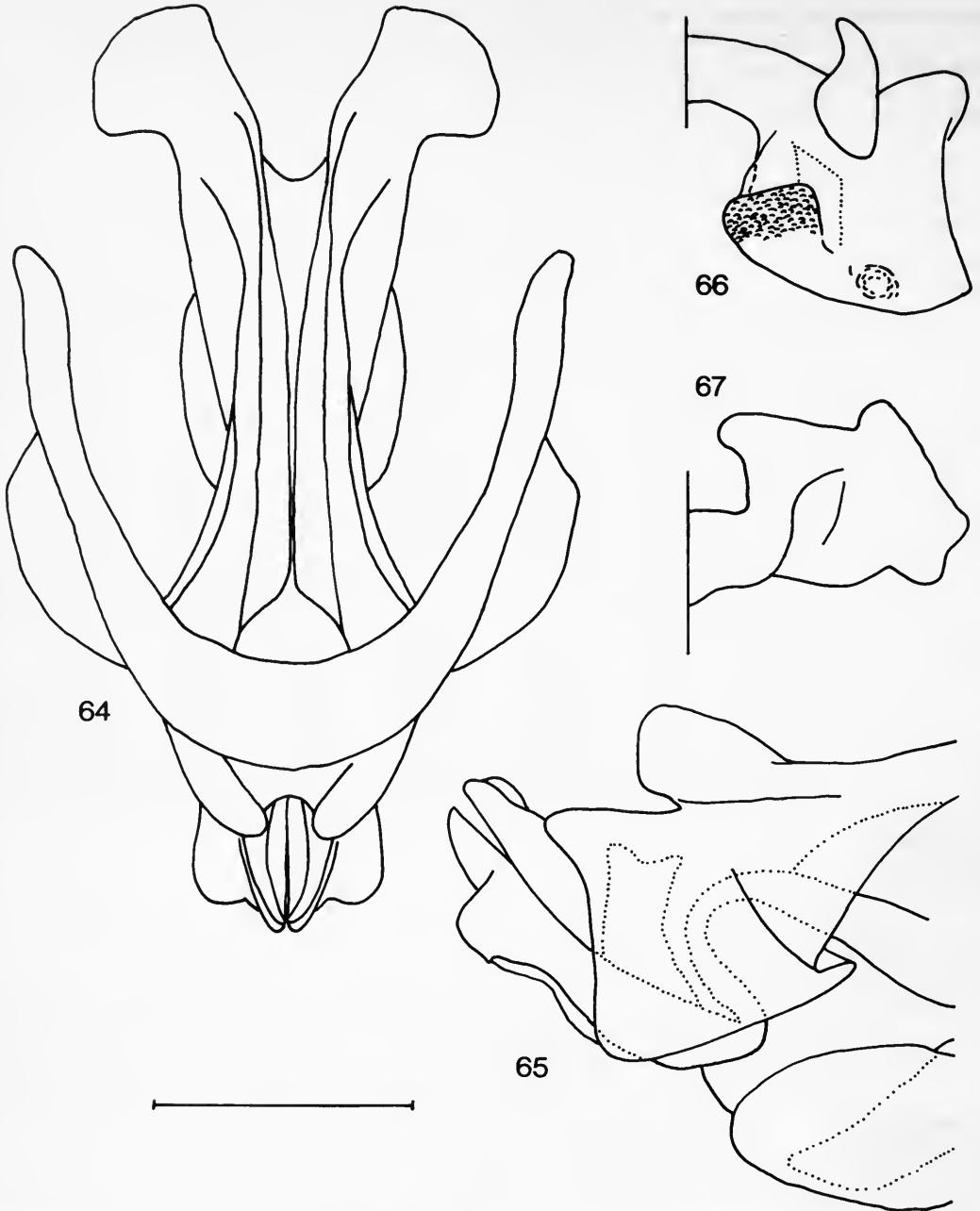
*Gastrimargus crassicornis* (Saussure) Sjöstedt, 1928: 27.

*Gastrimargus clepsydrae* Sjöstedt, 1928: 29. Holotype ♀, SOUTH AFRICA (ZM, Hamburg) [examined]. Syn. n.

*Gastrimargus crassipes* Sjöstedt, 1928: 29. Holotype ♀, SOUTH AFRICA (MNHU, Berlin) [examined]. Syn. n.

*Gastrimargus grossiceps* Sjöstedt, 1931: 25. Holotype ♀, 'Sumatra' [locality data incorrect] (NR, Stockholm) [examined]. Syn. n.

DIAGNOSIS. Fastigium of vertex convex. Pronotum with median carina arcuate, not intersected by posterior sulcus; dorsum with a few small globular warts; hind margin sharply or bluntly acutangular. Tegmen variable, surpassing folded hind knees by one-quarter to one-half of hind femur length in male, less in female. Genitalia (Figs 64–67) similar to *G. miombo* and *G. determinatus*, with short cingular rami, strongly protruding aedeagus, and large subapical ventral process; epiphallus as in *G. d. procerus*.



**Figs 64–67** *Gastrimargus crassicollis*, genitalia. 64, phallic complex, dorsal view; 65, same, posterior portion, lateral view; 66, epiphallus, right half, dorsal view; 67, same posterior view.

Coloration typical for genus. Pronotal  $\times$ -marking variable in thickness and emphasis, sometimes almost obsolete. Tegmen with two pale transverse bands. Hind wing fascia (Fig. 141) complete, of variable width, curving inwards along anal margin in male; in female sometimes faded or obsolete in posterior part of anal area, appearing less curved than male; basal area of wing bright sulphur yellow. Hind femur externally with 2–3 oblique transverse bands; internal surface with basal half of medial area blackish; external and internal upper and lower carinulae with row of irregular black dots; internal ventral carinula and ventral surface of hind femur tinted with blue-grey of variable depth in male, blue-grey to straw-coloured in female. Hind tibiae red.

## MEASUREMENTS

Sample from various localities, southern Africa.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	31.42	4.95	6.66	22.93	17.28	4.29	4.05	3.45
Range	27.9–35.8	4.4–5.7	6.0–7.9	20.0–26.8	15.3–19.7	3.5–5.0	3.5–4.7	3.2–3.7
S.D.	1.733	0.312	0.467	1.458	1.066	0.332	0.334	0.127
n	30	30	30	30	30	30	30	30
Females								
Mean	44.12	7.51	9.76	31.78	23.90	6.01	4.00	3.26
Range	38.6–50.0	6.4–8.4	8.4–11.0	26.7–37.5	21.4–27.3	5.1–6.9	3.6–4.5	3.0–3.5
S.D.	2.839	0.546	0.715	2.226	1.444	0.499	0.276	0.163
n	25	30	30	30	30	30	30	30

AFFINITIES. *G. crassicollis* is allied to *G. drakensbergensis* in general appearance, though less sombre in colour, and with a longer aedeagus, similar to that of *G. determinatus* and *G. verticalis*.

## MATERIAL EXAMINED

*Oedaleus (Gastrimargus) crassicollis* Saussure, holotype ♀, **South Africa**: Cape of Good Hope, no further data (MHN, Geneva). *Gastrimargus transvaalensis* Sjöstedt, holotype ♀, **South Africa**: Transvaal, 1902 (*Bel*) (MNHN, Paris). *Gastrimargus clepsydrae* Sjöstedt, holotype ♀, **South Africa**: Transvaal, Johannesburg, 4.x.1902 (*Willvend*) (ZM, Hamburg). *Gastrimargus crassipes* Sjöstedt, holotype ♀, **South Africa**: Grahamstown, i.1891 (*Schömand*) (MNHU, Berlin). *Gastrimargus grossiceps* Sjöstedt, holotype ♀, 'Sumatra: Solok, (*Stole*)' [incorrect locality data], (NR, Stockholm).

**South Africa**: 1 ♀, Transvaal, Johannesburg (*Brogan*); 3 ♂, 1 ♀, Tvl, Johannesburg, 12.xi.1950 (*Balinsky*); 1 ♀, same data, 23.xii.1950; 1 ♂, Tvl, E. Johannesburg, Bedford Ridge, 26.1.1949 (*Capener*); 1 ♀, same data, 2.iii.1949; 2 ♂, 1 ♀, Tvl, S. Johannesburg, 2.iv.1939 (*Ramsay*); 3 ♂, 3 ♀, Tvl, Pretoria (*Distant*); 1 ♂, 1 ♀, Pretoria, 10.i.1914; 1 ♀, Pretoria (*Donavan*); 1 ♂, 1 ♀, Pretoria, 12.iv.1918; 1 ♂, Pretoria, 26.iii.1932 (*Geyer*) (ANS, Philadelphia); 1 ♀, 29.iii.1925 (ANS, Philadelphia); 1 ♂, Pretoria, 4.iii.1921 (ANS, Philadelphia); 1 ♀, Pretoria, 5.i.1959 (*Venter*) (DATS, Pretoria); 1 ♂, Pretoria, 4.iii.1921 (DATS, Pretoria); 7 ♂, 3 ♀, Tvl, 8 km E. of Dalmanutha, 1680 m, 24.i.1974 (*Middlekauff*) (CAS, San Francisco); 1 ♂, Tvl, Ocuuefsdorp, 12.iv.1951 (*Botha*) (DATS, Pretoria); 1 ♀, Tvl, Humansdorp, iii.1933 (TM, Pretoria); 1 ♀, Natal, Yellow Woods, Balgowan, 2.iv.1960 (*Dickson*) (TM, Pretoria); 1 ♂, Natal, Zululand, St Lucia, 9.v.1944 (*Staden*) (DATS, Pretoria); 6 ♂, 1 ♀, Natal, Drakensberg Mts, Giant's Castle, 1957 (*Jago*) (COPR, London); 2 ♀, Natal, Underberg, 1–29.ii. (*Ilsley*) (COPR, London); 3 ♂, 3 ♀, Natal, Venters Kroon, 2.v.1911 (ANS, Philadelphia); 1 ♂, same data, 1.v.1911 (ANS, Philadelphia); 1 ♀, Natal, Makokoane, 18.1.1932 (*Jacquot-Guillarmod*) (ANS, Philadelphia); 1 ♀, no data (ANS, Philadelphia); 1 ♀, Natal, Mamathes (*Jacquot-Guillarmod*) (ANS, Philadelphia); 1 ♂, Natal, Louwsburg, 18.i.1969 (*Rensburg*) (DATS, Pretoria); 1 ♂, Natal, Zululand, Hluhluwe, 600 m, iv.1946 (*Buxton*); 1 ♂, Natal, Pietpotgietersrust, 13.iv.1906; 1 ♂, Orange Free State, 7 mls E. of Clarens, 23.ii.1962 (*Brown & Fürst*) (DATS, Pretoria); 1 ♀, O.F.S., Witzieshoek, 1830 m, 24.ii.1929 (*Scott*); 2 ♀, O.F.S., Gum Tree, ii.1932 (*Ogilvie*); 2 ♂, 4 ♀, O.F.S., Orange R. Colony (*B-Hamilton*); 2 ♂, O.F.S., Harrismith, 1–20.iii.1927; 1 ♀, Cape Province, Knysna, no further data; 1 ♀, C.P., 22 mls W. of Cofimvaba, 940 m, 14.iv.1958 (*Ross & Leech*) (CAS, San Francisco); 1 ♂, C.P., Knysna, Concordia, (*Longstaff*) (UM, Oxford); 1 ♀, C.P., Humansdorp, iii.1933 (DATS, Pretoria); 1 ♀, C.P., Cape of Good Hope (*Peringuey*) (MHN, Geneva); 1 ♂, C.P., Cape of Good Hope (*Brady*) (MHN, Geneva); 1 ♂, 1 ♀, C.P., Jeffraes Bay, 24.i.61, (*Lea*) (DATS, Pretoria); 2 ♀, C.P., Mt Fletcher, c. 1500 m, in open veldt, 28.iii.1954 (*Balfour-Browne*); 4 ♂, C.P., Queenstown, 1050 m, 16.i–10.ii.1923 (*Turner*); 1 ♂, 1 ♀, C.P., Katberg, 1–18.ii.1933 (*Turner*); 2 ♀, C.P., Bizana, Pondoland E., i.1932 (*Key*); 6 ♂, 2 ♀, C.P., Grahamstown, 23.ii.1955 (*Greathead*); 1 ♀, C.P., Swellendam, ii.1932; 1 ♀, C.P., Swellendam, 17.xii.1931–18.i.1932 (*Turner*); 1 ♀, C.P., 15 mls ENE. of Mt Frère, 6.iii.1951 (*Brinck & Rudebeck*); 1 ♀, C.P., Eland's Height, 15 mls SW. of Mt Fletcher, 9.iii.1951 (*Brinck & Rudebeck*). **Lesotho**: 1 ♂, Simonkong, 23.ii.1959 (*Brown*) (DATS, Pretoria); 2 ♂, Quthing, Mt Hodimonate,

12.iii.1951 (*Brinck & Rudebeck*); 1 ♂, Maluti Mts, Nyakoesuba, 2000 m, 18–19.ii.1929 (*Scott*); 1 ♂, Nazareth M.S., 32 km ESE. of Maseru, 26.iii.1951 (*Brinck & Rudebeck*); 1 ♂, Mt Machache, 40 km E. of Maseru, 25.iii.1951 (*Brinck & Rudebeck*); 1 ♂, Blue Mountain Pass, Maloti Mts, 16.i.1973 (*Vári*) (TM, Pretoria). **Botswana**: 1 ♀, no data. **Zimbabwe**: 1 ♂, Selukwe, 1420 m, 19.iv.1935 (*Miller*); 1 ♀, Vumba, 10–15.xii.1937 (*Van Son*) (TM, Pretoria).

**DISTRIBUTION** (Fig. 112, and Biogeography section, p. 308). Zimbabwe, Lesotho, South Africa. The record from pasture in Kenya (*Zacher*, 1917) is erroneous.

**DISCUSSION.** The holotype female of *G. crassicollis* is a small discoloured specimen in poor condition. This may partly explain why *Sjöstedt* (1928) failed to associate any of his material with this species. *G. crassicollis* varies greatly in general coloration, and *Sjöstedt* mistakenly erected new species on the basis of this variability.

### *Gastrimargus drakensbergensis* sp. n.

(Figs 68–71, 112, 142)

**DIAGNOSIS.** Fastigium of vertex convex. Pronotum with median carina arcuate, not intersected by posterior sulcus; dorsum in female with sparse globular warts. Tegmen surpassing folded hind knees by one-seventh to one-eighth of hind femur length. Genitalia (Figs 68–71) somewhat similar to those of *G. africanus* with very short weakly projecting aedeagus.

Coloration generally sombre dark brown. Pronotal × -marking variable, sometimes obsolete, especially in males. Hind wing fascia complete, of variable width, widening anteriorly (Fig. 142); basal area of wing pale greenish yellow. Hind femur with row of irregular brown dots on external and internal upper and lower carinulae, sometimes absent in males, and with 2–3 variable oblique cross-bands on external medial area; internal surface in male with medial area black, becoming blue-black on ventral surface; female with black area on internal surface reduced or absent, and ventral surface straw-coloured. Hind tibiae reddish.

#### MEASUREMENTS

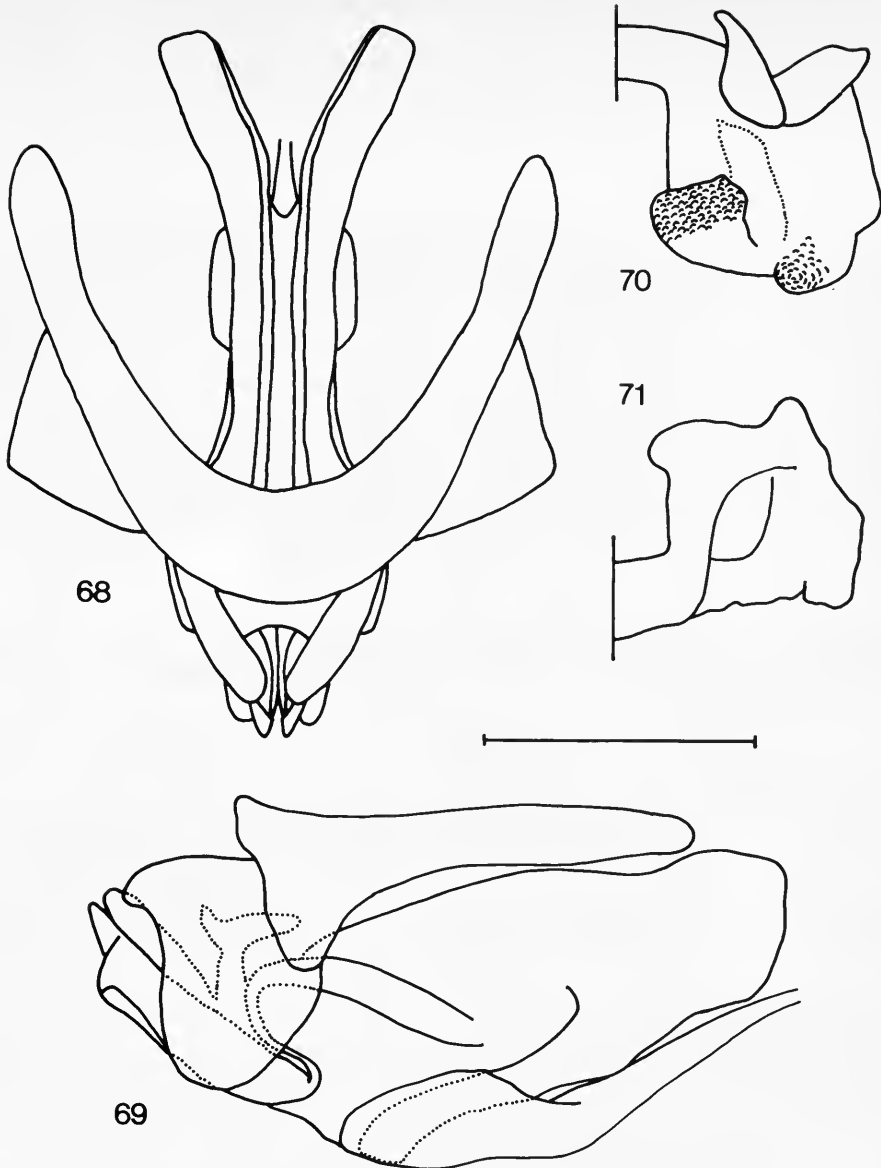
Sample from South Africa.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	32.84	5.00	7.25	23.91	17.96	4.16	4.33	3.31
Range	29.7–	4.6–	6.5–	21.4–	16.3–	3.7–	4.1–	3.1–
	36.1	5.3	7.7	27.1	19.8	4.5	4.7	3.6
S.D.	1.641	0.185	0.416	1.491	0.790	0.218	0.186	0.162
n	13	14	13	14	14	14	14	13
Females								
Mean	41.59	6.93	9.28	30.03	23.08	5.38	4.29	3.21
Range	38.7–	6.5–	8.6–	27.4–	20.9–	5.0–	4.0–	2.9–
	46.4	7.1	10.1	31.0	26.2	5.8	4.8	3.5
S.D.	1.939	0.204	0.422	1.756	1.309	0.247	0.224	0.161
n	12	12	12	12	12	12	12	12

**AFFINITIES.** *G. drakensbergensis* is allied to *G. crassicollis*, differing by the darker coloration and absence of bright yellow colour in the hind wing. These are characteristic features of adaptation to montane habitats. The aedeagus in this species is distinctly shorter than that of *G. crassicollis* (Figs 69, 65). Measurements of the two species are similar.

#### MATERIAL EXAMINED

**Holotype** ♂, **South Africa**: Natal, Drakensberg Mts, Giant's Castle, 1957 (*Jago*) (BMNH).  
**Paratypes**. **South Africa**: 3 ♂, 5 ♀, same data as holotype (BMNH); 1 ♂, Natal, Drakensberg, Van Reenen, 1–22.i.1927; (*Turner*) (BMNH); 1 ♂, Natal, Van Reenen's Pass, 13.xii.1958 (*Dickson*) (BMNH); 1 ♂, Natal,



Figs 68–71 *Gastrimargus drakensbergensis*, genitalia. 68, phallic complex, dorsal view; 69, same, lateral view; 70, epiphallus, right half, dorsal view; 71, same, posterior view.

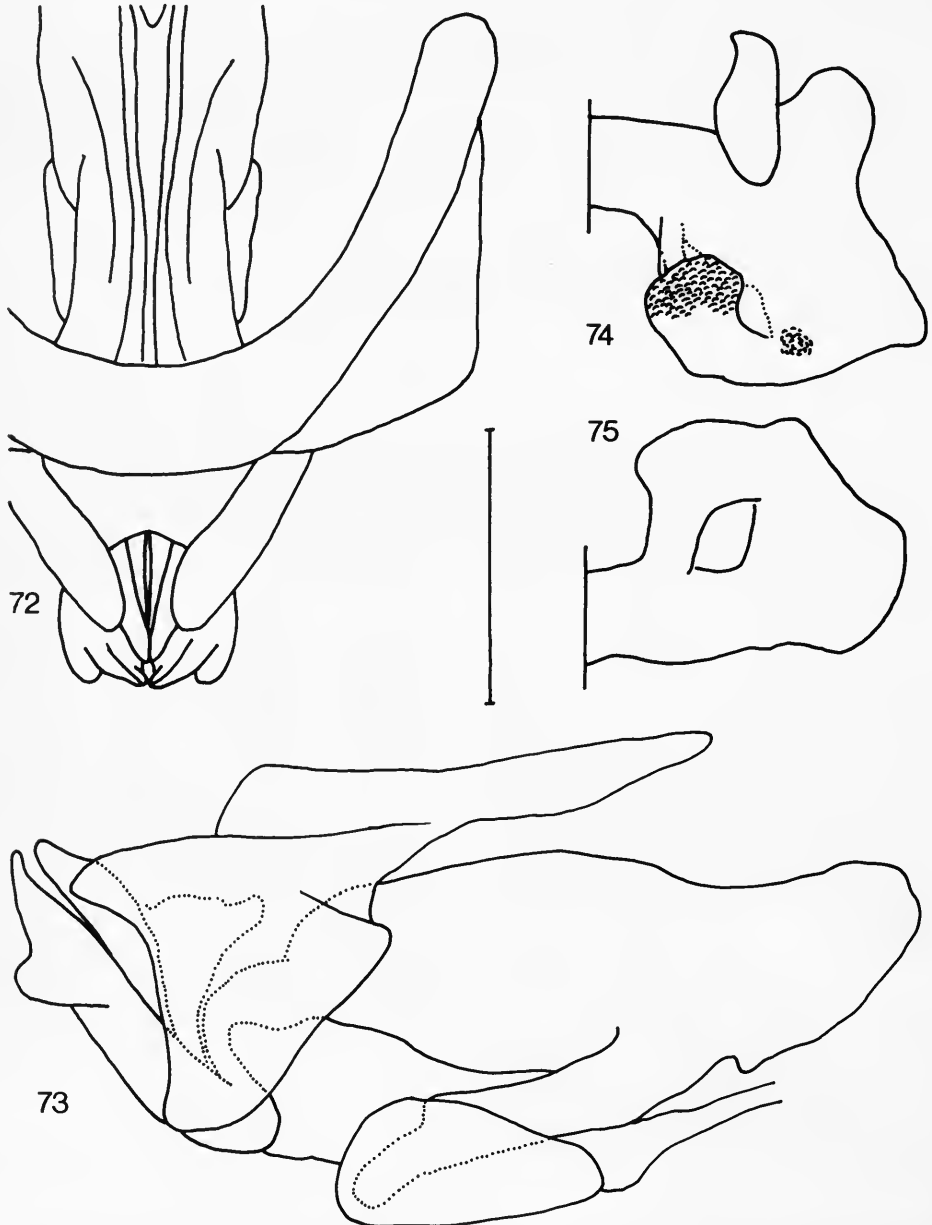
Drakensburg Nat. Pk., 21–2400 m, 27.i.1929 (*Scott*) (BMNH); 2 ♀, Natal, Yellow Woods, Balgowan, 18–28.ii.1960 (*Van Son*) (TM, Pretoria); 1 ♂, Transvaal, N., The Downs, 40 km S. of Tzaneen, 30.iv.1963 (*White*) (DATS, Pretoria); 1 ♂, Tvl, E., 5 km E. of Graskop, 11.x.1964 (*Snyman*) (DATS, Pretoria); 1 ♀, Tvl, Somerset West, 31.xii.1958 (*Dickson*) (TM, Pretoria); 1 ♀, Tvl, Woodbush, i.1923 (*Roberts*) (TM, Pretoria); 1 ♂, Tvl, E., 6 km W. of Graskop, 12.xi.1964 (*Snyman*) (DATS, Pretoria); 1 ♂, same data (*Brown*) (DATS, Pretoria); 1 ♀, Tvl, Jessievale, 58 km E. of Carolina, 18.xi.1970 (*Veenemans*) (DATS, Pretoria); 1 ♂, Tvl, E., 5 km E. of Graskop, 11.xi.1964 (*Brown*) (DATS, Pretoria); 2 ♂, Tvl, Barberton, xi.1902 (*Gould*) (ANS, Philadelphia); 1 ♂, 1 ♀, Tvl, Magoeba's Kloof, nr Tzaneen, Drakensburg Mts, 1200 m, 16.xi.1950 (*Orr*) (ANS, Philadelphia); 1 ♀, Tvl, Pretoria, 26.xii.1913 (BMNH); 2 ♂, Cape Province, Swellendam, 17.xii.1931–18.i.1932 (*Turner*) (BMNH).

DISTRIBUTION (Fig. 112, and Biogeography section, p. 308). South Africa.

*Gastrimargus obscurus* sp. n.

(Figs 72-75, 111, 143, 144)

DIAGNOSIS. Antennae of male lacking. Fastigium of vertex slightly concave, with triangular foveolae. Pronotum with median carina high arcuate, sometimes inflated in prozona, irregular in dorsal view, not intersected by posterior sulcus; median carina and vicinity distinctly rugose; hind margin rounded acutangular. Tegmen surpassing folded hind knees by one-fifth of hind femur length in male, less in female. Genitalia (Figs 72-75) with aedeagus strongly protruding and with large subapical ventral process; epiphallus with outer lobe of lophi small and rounded.



Figs 72-75 *Gastrimargus obscurus*, genitalia. 72, phallic complex, dorsal view; 73, same, lateral view; 74, epiphallus, right half, dorsal view; 75, same, posterior view.

Coloration unusual for genus, blackish brown with lighter markings. Pronotum with blackish ground colour; light  $\times$ -marking with posterior arms much thicker than anterior arms (Fig. 143). Tegmen dark in basal half, with reduced transverse bands three-eighths and five-eighths along from base (Figs 143, 144); apical half dark in male, lighter speckled in female. Hind wing with fascia complete, narrowly interrupted between *Cu*<sub>2</sub> and 1A; basal area pale greenish yellow, apical half of wing with dark shading and darkened veins in male, paler in female. Hind femur externally with two oblique cross-bands in medial and upper marginal areas; chevron pattern of sulci in medial area and external lower marginal area blackish brown; internal surface mostly black continued on ventral surface. Hind tibiae red.

## MEASUREMENTS

Sample from Zaire and Angola.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Holotype ♂	33.0	5.2	8.6	23.7	16.4	3.6	4.6	2.8
Paratype ♀	38.9	8.0	10.9	25.6	20.4	5.4	3.8	2.3
Paratype ♀	40.1	7.7	11.6	27.3	21.3	5.5	3.9	2.4

**AFFINITIES.** *G. obscurus* is allied to *G. angolensis* by the infusate apical half of the hind wing, the form of the pronotal  $\times$ -marking, and the heavily pigmented ventral surface of the hind femur. The degree of rugosity of the pronotum, the generally very dark coloration, and the small rounded outer lobe of the lophi are, however, distinctive characters for this species.

## MATERIAL EXAMINED

Holotype ♂, **Angola**: Bihé Distr., Chitau, 1470 m, 13.i.1931 (*R. & L. Boulton*) (ANS, Philadelphia).

Paratypes. **Angola**: 1 ♀, same data as holotype (ANS, Philadelphia). **Zaire**: 1 ♀, Katanga, Kipopo (Elizabethville), 11.i.1962 (*Maréchal*) (MRAC, Tervuren).

**DISTRIBUTION** (Fig. 111, and Biogeography section, p. 312). Angola, Zaire.

*Gastrimargus wahlbergii* (Stål, 1873)

(Figs 76–80, 111, 145)

*Pachytylus* (*Oedaleus*) *wahlbergii* Stål, 1873: 124. Holotype ♀, SOUTH AFRICA (NR, Stockholm) [examined].

*Pachytylus wahlbergii* Stål; I. Bolívar, 1881: 117 [probably misidentified].

*Oedaleus* (*Gastrimargus*) *wahlbergii* (Stål) Saussure, 1884: 113.

*Oedaleus wahlbergii* (Stål); I. Bolívar, 1889: 103.

*Oedaleus marmoratus wahlbergi* [sic] (Stål); Griffini, 1897: 6.

*Gastrimargus wahlbergii* (Stål) Kirby, 1910: 227.

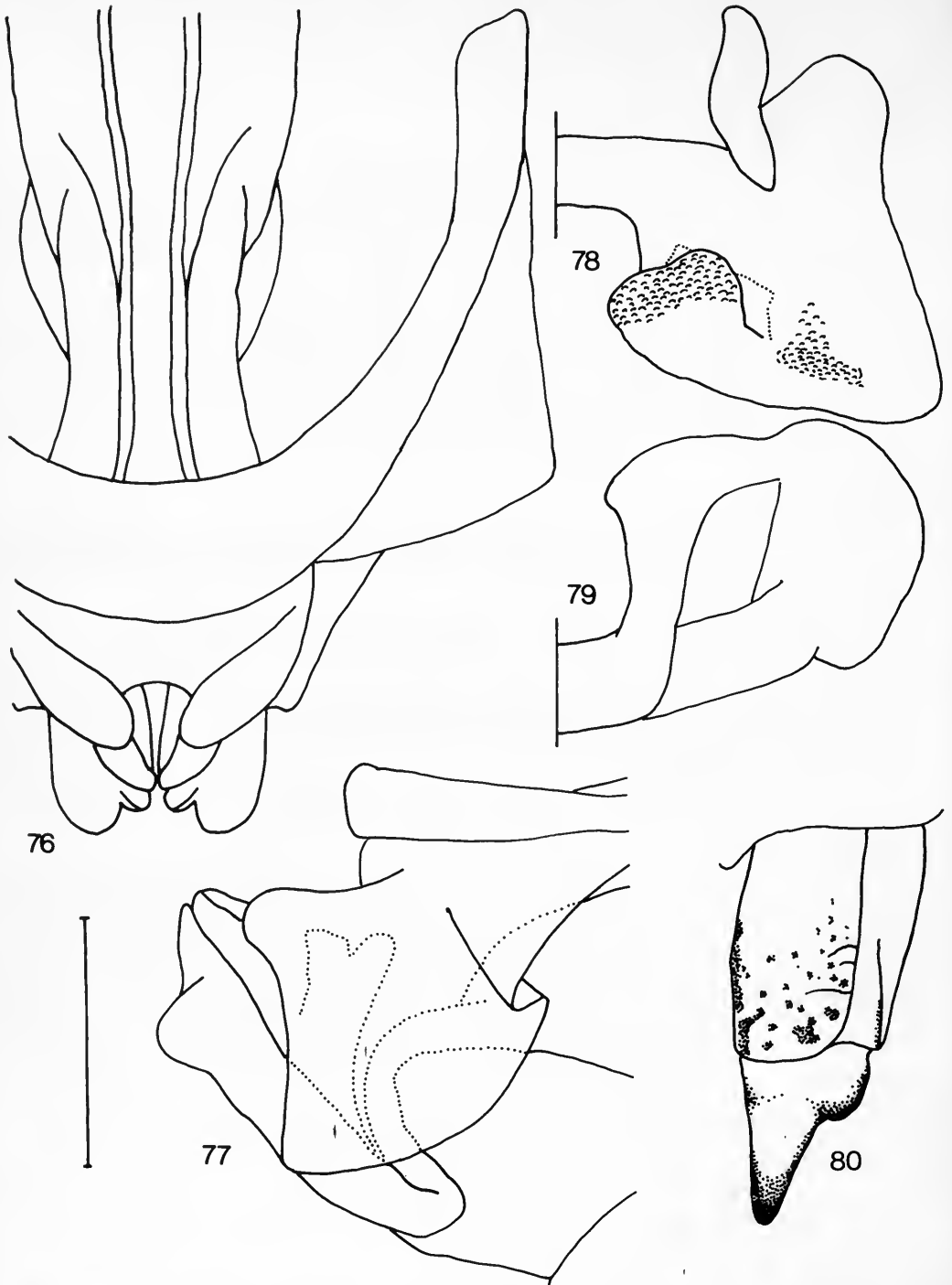
*Oedaleus wahlbergi* [sic] (Stål) Bruner, 1910: 634.

*Gastrimargus wahlbergi* [sic] (Stål) Zacher, 1917: 164.

*Pachytylus* (*Oedaleus*) *wahlbergi* [sic] Stål; Sjöstedt, 1932: 20.

**DIAGNOSIS.** [Antennae lacking in males examined.] Fastigium of vertex convex. Pronotum with median carina high arcuate, sometimes intersected by posterior sulcus; dorsum with numerous pale globular warts, often forming rows; hind margin elongated, rounded acutangular (Fig. 145). Tegmen surpassing folded hind knees by one-fifth of hind femur length. Genitalia (Figs 76–79) with strongly protruding aedeagus and large bulbous subapical ventral process; outer lobe of lophi laterally elongated, forming a low, lozenge-shaped bump (Figs 78, 79). Ventral ovipositor valves with external lateral surface distinctly excavated (Fig. 80).

Coloration typical for genus. Pronotal  $\times$ -marking with posterior arms thicker than anterior arms; metazona with several indistinct pale striae extending outwards and backwards on each side of median carina. Tegmen as in *G. africanus*, with two transverse light bands two-sevenths and four-sevenths along from base. Hind wing with strong complete fascia (Fig. 145); basal area pale greenish yellow with some pale bluish tinting at the bases of main veins, more extensive in females. Hind femur externally with two indistinct oblique bands; internal and external upper and lower carinulae with regularly spaced black dots; internal surface in male with some dark shading in basal half, in female straw-coloured; ventral surface from lower carinula blue-grey. Hind tibia orange red, spines black-tipped.



**Figs 76–80** *Gastrimargus wahlbergii*, genitalia. 76, phallic complex, dorsal view; 77, same, lateral view; 78, epiphallus, right half, dorsal view; 79, same, posterior view; 80, ovipositor, left half, ventral view.



## MEASUREMENTS

Sample from Southern Africa, various localities.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	42.50	6.32	10.82	31.52	22.00	5.85	3.76	2.92
Range	41.7– 43.3	6.3– 6.6	10.3– 11.3	31.0– 32.1	21.9– 22.1	5.6– 6.1	3.6– 3.9	2.8– 3.0
S.D.	—	—	—	—	—	—	—	—
n	2	2	2	2	2	2	2	2

Females								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	53.13	8.85	14.01	40.25	28.07	7.15	3.93	2.89
Range	49.1– 57.1	8.2– 9.6	11.3– 15.6	35.6– 44.3	24.5– 31.8	5.7– 8.1	3.5– 4.3	2.8– 3.0
S.D.	5.622	0.566	1.390	3.723	3.107	0.907	0.282	0.088
n	2	5	5	4	5	5	5	4

**AFFINITIES.** *G. wahlbergii* is allied to *G. angolensis* below on the basis of the genitalia, the rugosity of the pronotum, and the blue tint of the ventral surface of the hind femur.

## MATERIAL EXAMINED

*Gastrimargus wahlbergii* Stål, holotype ♀, South Africa: Caffraria (NR, Stockholm).

**South Africa:** 1 ♂, 1 ♀, Natal, Ndumu, 11–15.xii.1960 (*Van Son*) (TM, Pretoria); 1 ♂, Natal, Lebombo Mts, 11–14.xii.1961 (*Vári & Steenstra*) (TM, Pretoria); 1 ♀, Transvaal, Rosslyn, 17.ii.1957 (*Vári*) (TM, Pretoria); 1 ♀, Transvaal (MHN, Geneva). **Lesotho:** 1 ♀, Mamathes (*Jacot Guillarmod*) (ANS, Philadelphia).

**DISTRIBUTION** (Fig. 111, and Biogeography section, p. 308). *G. wahlbergii* is known from the eastern half of South Africa, and Lesotho. The record from Angola (Bolivar, 1881) is probably erroneous and that from the Comoro Is. (Bruner, 1910; Chopard, 1958) is certainly so.

**BIOLOGY.** Unknown. The record of this species from tobacco (Ballard, 1914; Zacher, 1917) is unconfirmed, and in view of the rarity of the species should be regarded with suspicion.

*Gastrimargus angolensis* Sjöstedt, 1928 sp. rev.

(Figs 81–85, 111, 146)

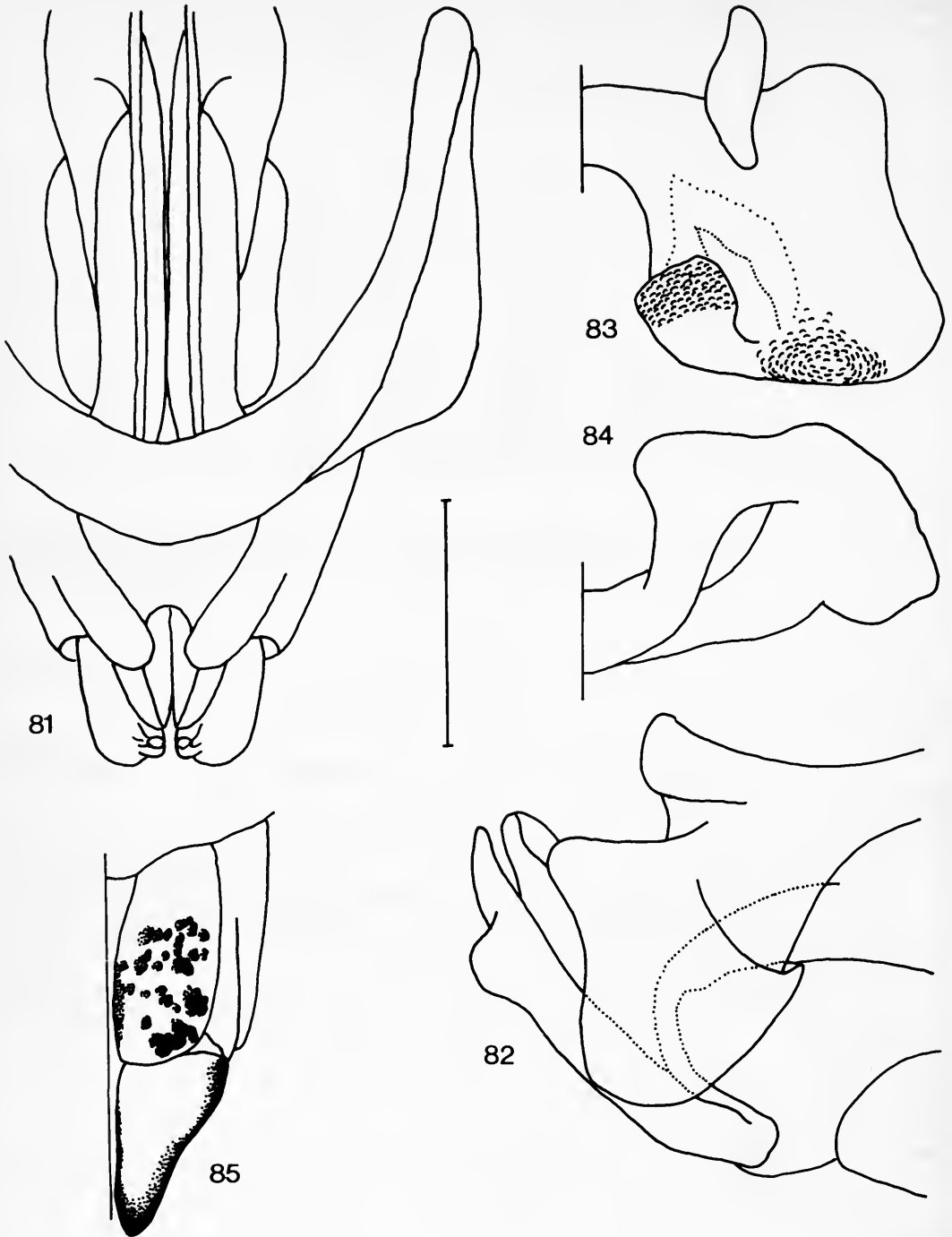
*Gastrimargus angolensis* Sjöstedt, 1928: 30. Holotype ♀, ANGOLA (MNHU, Berlin) [examined].

*Gastrimargus corallipes* Sjöstedt, 1928: 31. Holotype ♀, ZAIRE (MRAC, Tervuren) [examined]. **Syn. n.**

[*Gastrimargus vitripennis* (Saussure) Dirsh, 1966: 429. Misidentification.]

**DIAGNOSIS.** Antennae short, four-fifths as long as head and pronotum together in male. Fastigium of vertex convex. Pronotum with median carina arcuate, not intersected by posterior sulcus; dorsum with some scattered globular warts; hind margin acutangular. Tegmen surpassing folded hind knees by one-fifth of hind femur length. Genitalia (Figs 81–85) similar to *G. wahlbergii*; aedeagus strongly protruding, with large bulbous subapical ventral process; outer lobe of lophi laterally elongated, forming a low lozenge-shaped bump (Figs 83–84). Ventral ovipositor valves (Fig. 85) with external lateral surface shallowly and smoothly incurved.

Coloration typical for genus, similar to *G. wahlbergii*. Pronotal ×-marking green or rarely light brown; posterior arms much thicker than anterior arms; metazona with indistinct pale striae as in *G. wahlbergii*. Tegmen with pale cross-bands about one-third and one-half along from base. Hind wing with fascia complete but very faint (Fig. 146); basal area of wing pale greenish yellow; apical half of wing faintly infumate with darkened veins, paler in female. Hind femur unbanded or occasionally with traces of banding on external surface; external dorsal and ventral carinulae and internal dorsal carinula each with a row of irregular black dots; internal surface blackish brown in medial area of male, female blackish brown in basal half only or not at all; internal ventral surface blue-black. Hind tibia dull light red.



Figs 81–85 *Gastrimargus angolensis*, genitalia. 81, phallic complex, dorsal view; 82, same, posterior portion, lateral view; 83, epiphallus, right half, dorsal view; 84, same, posterior view; 85, ovipositor, left half, ventral view.

## MEASUREMENTS

Sample from Central Africa, various localities.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	34.62	5.74	9.20	25.03	17.23	4.67	3.69	2.72
Range	32.0–35.9	5.3–6.0	8.3–9.8	23.1–26.3	16.2–18.0	4.30–5.0	3.6–3.9	2.6–2.9
S.D.	1.140	0.226	0.344	1.000	0.496	0.155	0.200	0.081
n	14	14	14	14	14	14	14	14
Females								
Mean	50.03	8.87	13.01	36.10	24.50	6.55	3.74	2.80
Range	47.6–53.3	8.7–9.5	12.2–14.0	34.2–39.5	22.7–26.0	6.3–6.9	3.6–4.0	2.6–3.0
S.D.	1.287	0.211	0.544	1.220	0.719	0.172	0.102	0.139
n	17	18	20	17	20	20	20	17

AFFINITIES. As stated above (p. 293), *G. angolensis* is closely allied to *G. wahlbergii*.

## MATERIAL EXAMINED

*Gastrimargus angolensis* Sjöstedt, holotype ♀, Angola: Huila–Humpata (*Nonfried*) (MNHU, Berlin). *Gastrimargus corallipes* Sjöstedt, holotype ♀, Zaire: Kwango, Atene (*Charlier*) (MRAC, Tervuren).

Angola: 7 ♀, Malange distr., Gauca, 32 km E. of Rio Quanza, 1100 m, 7.i.1931 (*Boulton*) (ANS, Philadelphia); 1 ♂, 2 ♀, same data (BMNH); 3 ♂, 5 ♀, same data, 4.i.1931 (ANS, Philadelphia); 3 ♂, same data, 8.i.1931 (ANS, Philadelphia); 4 ♂, 2 ♀, same data, 6.i.1931 (ANS, Philadelphia); 1 ♂, same data (BMNH); 2 ♂, 3 ♀, Chitau, Bihé distr., 1470 m, 17.i.1931 (*Boulton*) (ANS, Philadelphia). Zambia: 1 ♀, Luano valley, i.1928 (*Burr*).

DISTRIBUTION (Fig. 111, and Biogeography section, p. 312). Angola, Zaire, Zambia.

DISCUSSION. This species was synonymised with *G. vitripennis* by Dirsh (1966) without any examination of the holotype. The banded hind wing and the blue-black ventral surface of the hind femur preclude this, however. Sjöstedt (1928) described *G. angolensis* and *G. corallipes*, both from unique female specimens, on succeeding pages of his monograph. They were artificially separated by trivial colour characters in his key, but the distinctions are not longer tenable in the light of more recently discovered material.

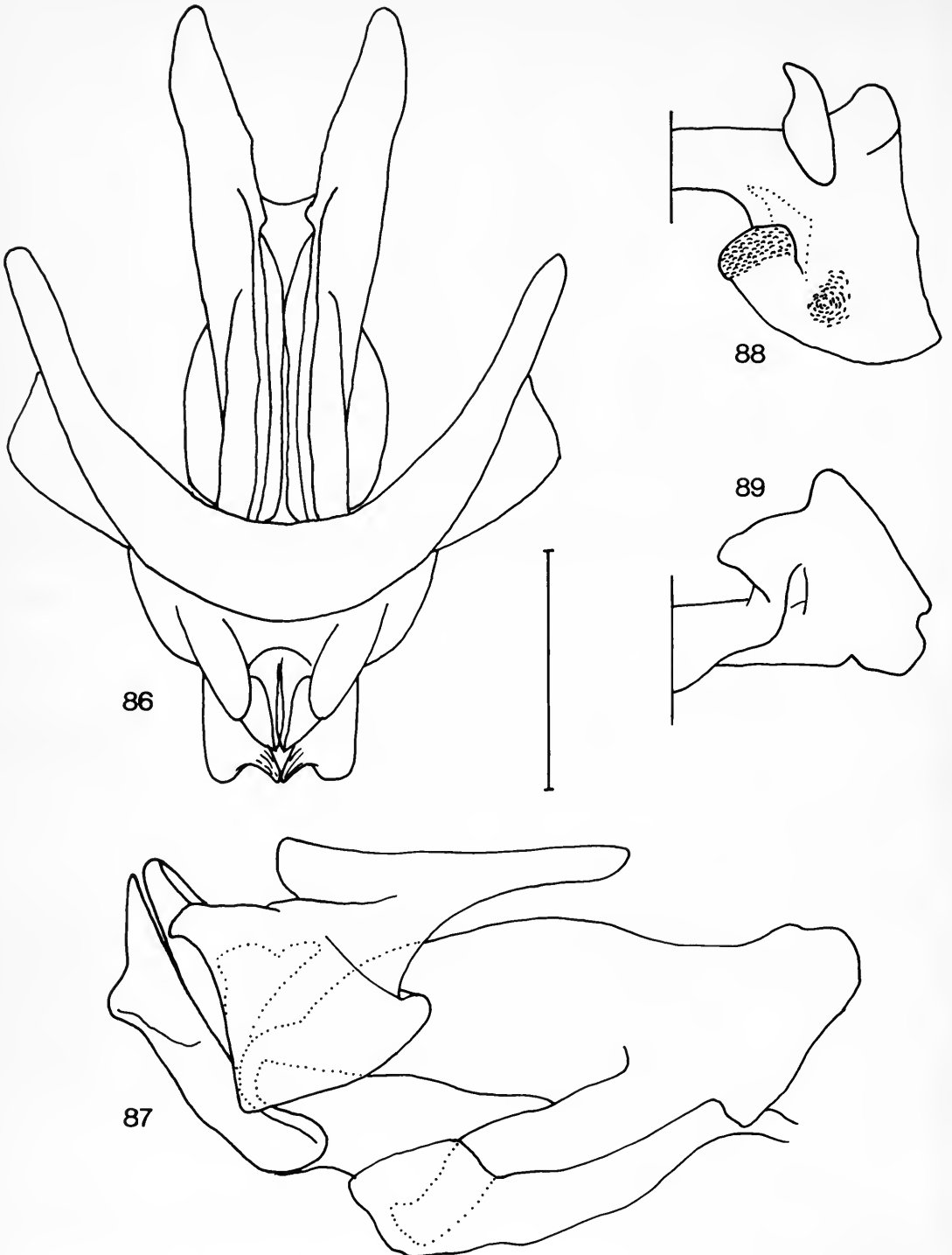
*Gastrimargus mirabilis* Uvarov, 1923

(Figs 86–89, 111, 147)

*Gastrimargus mirabilis* Uvarov, 1923: 675. Holotype ♀, UGANDA (BMNH, London) [examined].

DIAGNOSIS. Fastigium of vertex convex. Pronotum with dorsal surface scattered with globular warts; median carina high arcuate, forming a blade-like crest, not intersected by posterior sulcus; hind margin very elongated and sharply acutangular, forming an angle of less than 45°. Tegmen surpassing folded hind knees by about one-third of hind femur length. Hind femur long and thin, length/depth ratio 5.16–5.71 ♂, 4.89–5.72 ♀. Genitalia typical for genus, with aedeagus strongly protruding and with prominent subapical ventral process; epiphallus with small protruding outer lobe of lophi.

Coloration normal for genus. Pronotal × -marking with lateral angles very obtuse, posterior arms sometimes obliterated; sides of raised pronotal crest always brown. Tegmen dark, rarely with faint transverse bands. Hind wing fascia complete (Fig. 147), fading anteriorly in female; basal area of wing pale yellow. Hind femur unmarked except for rows of irregularly spaced dots on inner and outer dorsal and ventral carinulae. Hind tibia dull reddish in male, brown or reddish brown in female.



**Figs 86–89** *Gastrimargus mirabilis*, genitalia. 86, phallic complex, dorsal view; 87, same, lateral view; 88, epiphallus, right half, dorsal view; 89, same, posterior view.

## MEASUREMENTS

Sample from Central Africa, various localities.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	32.90	4.44	9.93	24.35	15.67	2.85	5.51	2.46
Range	31.3–34.4	4.2–4.6	9.3–10.3	23.3–25.8	15.2–16.0	2.7–3.1	5.2–5.7	2.3–2.6
S.D.	1.154	0.160	0.372	0.991	0.382	0.180	0.302	0.105
n	5	5	5	5	3	3	3	5
Females								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	52.93	7.87	15.08	38.31	25.69	4.87	5.29	2.51
Range	47.4–59.6	7.1–8.9	14.0–15.7	34.0–44.0	23.2–30.6	4.3–5.9	4.9–5.7	2.4–2.7
S.D.	3.947	0.679	0.604	3.187	2.370	0.514	0.259	0.100
n	6	7	6	7	7	7	7	5

**AFFINITIES.** *G. mirabilis* is not closely allied to any other member of the genus. However, it has affinities with *G. wahlbergii* and its allies in the large aedeagus with pronounced subapical ventral process, and the warty integument of the pronotum with its raised carina.

## MATERIAL EXAMINED

*Gastrimargus mirabilis*, holotype ♀, **Uganda**: Entebbe, 26–29.vi.1912 (*Gowdey*) (BMNH).

**Uganda**: 1 ♂, 1 ♀, Entebbe, 12.x.1914 (*Gowdey*) (paratypes of *G. mirabilis*); 1 ♂, Buddu, Kakuto, seasonal swamp, 12.i.1936 (*Johnston*). **Kenya**: 1 ♀, Kakamega Forest, 0°15'N, 34°52'E, 1530 m, 18–22.i.1972 (*Huggins*). **Zaire**: 1 ♀, Leopoldville, 11.x.1957 (*Jobels*) (MRAC, Tervuren); 1 ♂, 1 ♀, Luluabourg (MHN, Geneva); 1 nymph, Upemba National Park, Kilwezi, 750 m, 2–21.viii.1948 (*de Witte*) (IRSNB, Brussels); 4 ♂, 1 ♀, Upemba National Park, R. Kafwi, tributary of R. Lufwa, 1780 m, 15.iii.1948 (*de Witte*) (IRSNB, Brussels); 5 ♂, 1 ♀, U.N.P., R. Kenia, tributary of R. Lusinga, 1585 m, 5.v.1949 (*de Witte*) (IRSNB, Brussels); 1 ♂ U.N.P., Mukana, 1810 m, 22–23.iv.1949 (*de Witte*) (IRSNB, Brussels); 1 ♀, same data, 18.iii.1948 (IRSNB, Brussels); 1 ♂, U.N.P., Mukana, Lusinga, 1810 m, 19.iv.1949 (*de Witte*) (IRSNB, Brussels); 1 ♀, same data, 2.viii.1947 (IRSNB, Brussels); 11 ♂, U.N.P., Lusinga, 1760 m, 22.iv.–4.v.1949 (*de Witte*) (IRSNB, Brussels); 7 ♀, U.N.P., Mbuye-Bala, 1750 m, 24–31.vi.1948 (*de Witte*) (IRSNB, Brussels); 1 ♂, 2 ♀, U.N.P., Kamitungulu, 1700 m, 14.vii.1947 (*de Witte*) (IRSNB, Brussels); 1 ♂, U.N.P., Kankunda, 1300 m, 14–24.vi.1927 (*de Witte*) (IRSNB, Brussels); 5 ♂, 2 ♀, U.N.P., Kabwekanono, 1815 m, 25.iv.–6.v.1947 (*de Witte*) (IRSNB, Brussels); 32 ♂, 20 ♀, U.N.P., Kabwoe sur Muye, 1320 m, 20.iv.–25.v.1948 (*de Witte*) (IRSNB, Brussels); 1 ♂, 4 ♀, U.N.P., R. Mubale, 1480 m, 1–20.v.1947 (*de Witte*) (IRSNB, Brussels); 3 ♂, U.N.P., Mundi, Lupiala, tributary of R. Lufira, 28.v.–5.vii.1948 (*de Witte*) (IRSNB, Brussels). **Zambia**: 1 ♀, Broken Hill, ii.1931 (ANS, Philadelphia). **Angola**: 1 ♂, 3 nymphs, Luchase distr., R. Quango, 1500 m, 16.x.1927 (*Burr*); 2 nymphs, Moxico distr., valley of R. Mu-Simoi, 25.x.1927 (*Burr*); 1 nymph, Moxico distr., R. Lungue Bungu, 3.x.1927 (*Burr*); 2 ♂, 3 ♀, Palavange, 2.xi.1930 (*Green*) (ANS, Philadelphia).

**DISTRIBUTION** (Fig. 111, and Biogeography section, p. 312). Uganda, Zaire, Zambia, Angola.

*Gastrimargus insolens* sp. n.

(Figs 111, 148)

**DIAGNOSIS** (based on unique female; male unknown). Antennae about two-thirds as long as combined length of head and pronotum. Fastigium of vertex convex. Pronotum with median carina arcuate, not intersected by posterior sulcus; hind margin acutangular. Tegmen surpassing hind knees by one-seventh of hind femur length. Ventral ovipositor valves short, less than one and a quarter times as long as perpendicular basal width.

Coloration generally greenish brown. Pronotal  $\times$ -marking thin. Tegmina green with large irregular brown blotches separated by green cross-banding in basal two-thirds, becoming clear with brown speckles in apical third (Fig. 148). Hind wing fascia (Fig. 148) indistinct, with darkened cells diffused along costal margin from fascia towards wing tip; basal area of wing pale yellow. Hind femur externally green with bluish tinge in medial area, unmarked; internal medial area blue-black, becoming blue-grey apically; ventral surface brownish red; interior ventral carina orange-red. Hind knee green. Hind tibia orange.

#### MEASUREMENTS

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Holotype ♀	39.7	6.7	9.8	28.5	21.2	4.9	4.3	2.9

**AFFINITIES.** *G. insolens* has similar pronotal markings to *G. verticalis*, but is otherwise differentiated from that species by its short ovipositor, the coloration of the hind femur, and the form of the reduced wing fascia. Without the male it is impossible accurately to assess the relationships of the species. However in the context of a revision of all the known species of the genus, it is clear that the unique female belongs to a previously undescribed species of *Gastrimargus*.

#### MATERIAL EXAMINED

Holotype ♀, **Angola**: Sá da Bandeira, Huila distr., 12–14.iv.1971 (*Brown*) (DATS, Pretoria).

**DISTRIBUTION** (Fig. 111, and Biogeography section, p. 312). Sá da Bandeira, SW. Angola.

### *Gastrimargus acutangulus* (Stål, 1873)

(Figs 90–97, 111, 149)

*Pachytylus (Oedaleus) acutangulus* Stål, 1873: 125.

This species is here presented as two subspecies under which the specific synonymy is separately listed.

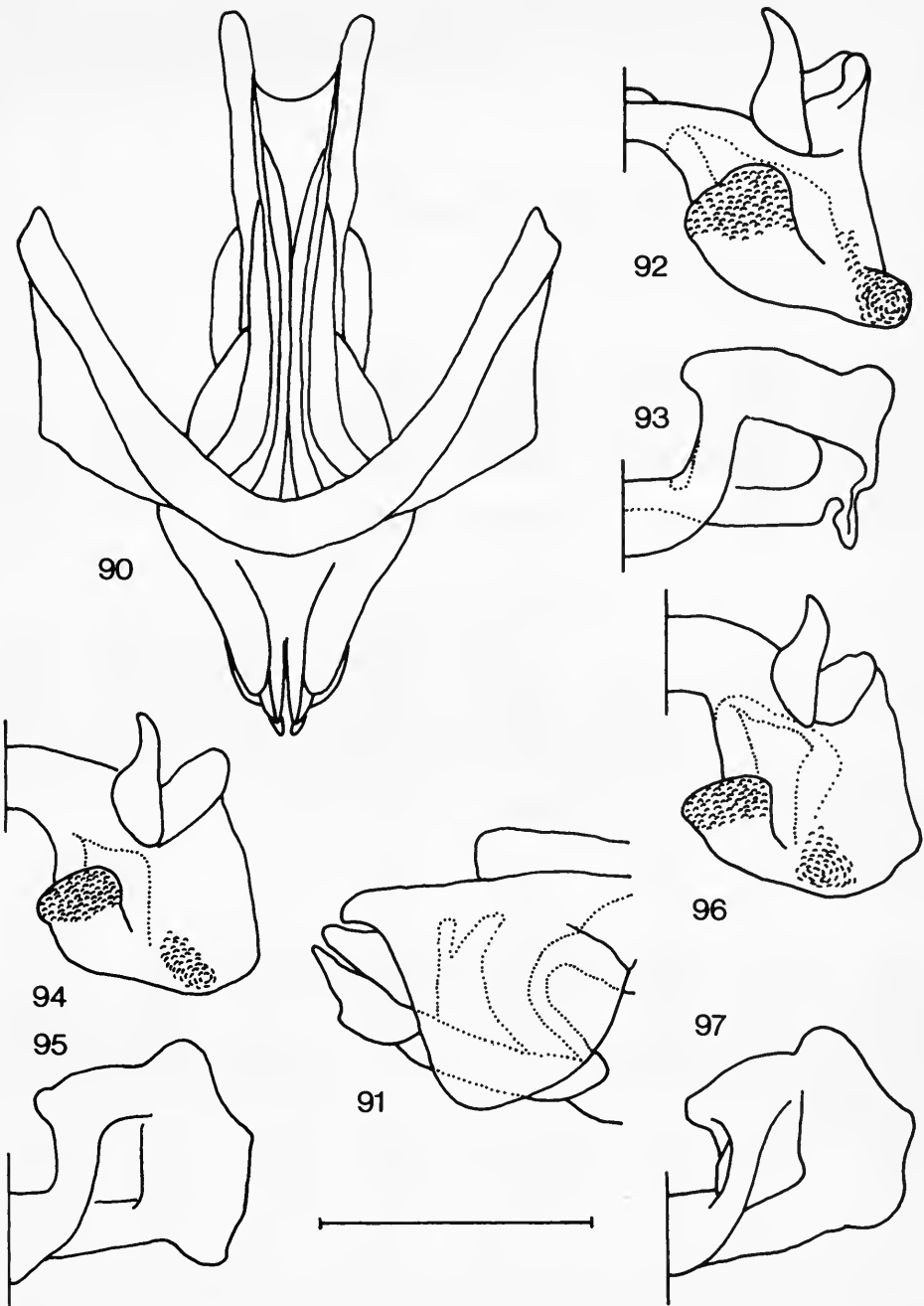
**DIAGNOSIS.** Fastigium of vertex convex with distinct medial carinula. Pronotum with median carina high arcuate, almost blade-like, not intersected by posterior sulcus; dorsum scattered with small pale globular warts; hind margin elongate acutangular. Tegmen exceeding hind knees by about one-quarter to one-third of hind femur length. Intercalary vein shiny, not serrated. Genitalia (Figs 90–97) with long cingular rami, aedeagus weakly protruding with small subapical ventral process; epiphallus with lophi varying according to locality (Figs 92–97).

**COLORATION.** Green morphs with a more bluish tinge than in other species. Pronotal  $\times$ -marking with anterior arms thinner than posterior arms. Tegmen with three to five pale cross-bands of variable extent. Hind wing with fascia (Fig. 149) complete and very broad; basal area of wing bright blue. Hind femur externally with three indistinct oblique cross-bands in medial area; internal surface with large dark brown patch in basal half, overlaid in places by opaque pale bluish sheen; internal ventral surface red.

**AFFINITIES.** There does not appear to be any close relationship between this species and other members of the genus.

**DISTRIBUTION** (Fig. 111, and Biogeography section, p. 308). *G. acutangulus* occurs in the highlands of Kenya (subspecies *flavipes*) and the eastern part of South Africa (subspecies *acutangulus*). In addition there is a population on the Nyika plateau of Malawi and Zambia which has genitalia intermediate between the two subspecies and coloration typical of *G. a. acutangulus*. The records of *G. acutangulus* from Guinea (Saussure, 1888: 39; Dirsh, 1966: 426), Ivory Coast (Dirsh, 1966: 426) Angola (Bolívar, 1889: 103; Dirsh, 1966: 426) and Zanzibar (Saussure, 1884: 114; Dirsh, 1966: 426; Johnsen & Forchammer, 1975: 51) are erroneous. Sjöstedt (1928: 51) incorrectly refers to Saussure's misidentified specimen from Zanzibar as a type.

**DISCUSSION.** The type of *G. dohrnianus* Saussure has proved impossible to locate. However, the synonymy established by Sjöstedt (1928) is not in doubt. Dirsh (1966: 426) synonymised *G. acutangulus flavipes* on the grounds that it differed from the nominate subspecies only by the yellow colour of the hind tibiae and that this was not a consistent character. Both these suppositions are incorrect. The key to subspecies given here employs pronotal colour pattern as well as



**Figs 90–97** *Gastrimargus acutangulus*, genitalia. 90, phallic complex, dorsal view, *G. a. acutangulus*, South Africa; 91, same, posterior portion, lateral view; 92, epiphallus, right half, dorsal view, *G. a. acutangulus*, South Africa; 93, same, posterior view; 94, same, dorsal view, Malawi; 95, same, posterior view; 96, same, dorsal view, *G. a. flavipes*, Kenya; 97, same, posterior view.

the colour of the hind tibiae as reliable characters to distinguish the disjunct northern and southern populations. Dirsh evidently overlooked the geographical basis of the observed variation in this species.

### Key to subspecies of *Gastrimargus acutangulus*

- 1 Pronotum with posterior arms of ×-marking forming an angle between themselves of about 70° and recurving posteriorly to meet pale marking on pronotal shoulders without forming a distinct angle before continuing round hind margin; enclosed dark triangles flanking median carina in metazona with rounded outer angles (Fig. 149). Outer lobes of epiphallic lophi strongly divergent (Figs 92, 93). Hind tibiae bright orange, at least on inner surface (South Africa, Malawi, Zambia) . . . . . *G. acutangulus acutangulus* (Stål) (p. 300)
- Pronotum with posterior arms of ×-marking forming an angle between themselves of about 80–90°, and meeting pale markings on pronotal shoulders at a distinct obtuse angle before continuing round hind margin; enclosed dark triangles flanking median carina in metazona with sharply obtuse outer angles. Outer lobes of epiphallic lophi weakly convergent or weakly divergent (Figs 94–97). Hind tibiae straw-coloured to pale orange-yellow (Kenya)  
*G. acutangulus flavipes* Johnston (p. 301)

### *Gastrimargus acutangulus acutangulus* (Stål, 1873)

- Pachytylus (Oedaleus) acutangulus* Stål, 1873: 125. Holotype ♀, SOUTH AFRICA (NR, Stockholm) [examined].  
*Oedaleus (Gastrimargus) acutangulus* (Stål) Saussure, 1884: 114.  
*Oedaleus (Gastrimargus) dohrnianus* Saussure, 1888: 166. Holotype ♀, SOUTH AFRICA: Transvaal (lost?).  
 [Synonymised by Sjöstedt, 1928: 33.]  
*Oedalus [sic] acutangulus* (Stål); Distant, 1892: 257.  
*Gastrimargus acutangulus* (Stål) Kirby, 1902: 72.

### MEASUREMENTS

Sample from South Africa.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	37.68	5.45	9.11	28.72	20.06	4.97	4.04	3.16
Range	35.9–	5.2–	8.3–	27.4–	18.5–	4.7–	3.9–	3.0
	39.1	5.7	9.6	29.9	21.0	5.1	4.2	3.3
S.D.	1.070	0.136	0.492	0.825	0.780	0.140	0.090	0.111
n	10	12	11	11	12	12	12	10
Females								
Mean	47.53	7.26	12.25	36.10	25.93	6.69	3.90	2.94
Range	45.3–	6.2–	11.6–	34.6–	23.3–	5.9–	3.5–	2.8–
	50.7	7.6	13.1	39.7	27.3	7.7	4.3	3.4
S.D.	1.980	0.253	0.499	1.604	1.176	0.560	0.259	0.164
n	5	11	11	10	10	10	10	10

### MATERIAL EXAMINED

*Pachytylus acutangulus* Stål, holotype ♀, South Africa: 'Caffraria' (*Wahlberg*) (NR, Stockholm).  
 South Africa: 2 ♂, 2 ♀, Orange Free State, Orange River Colony (*B-Hamilton*); 1 ♀, no data (*Distant*); 2 ♂, 2 ♀, Transvaal, Pretoria (*Distant*); 1 ♀, Tvl, Bloksberg, Johannesburg, Observatory Ridge, iv. 1938 (*Burt*); 1 ♂, Tvl, Johannesburg, 17.ix.1950 (*Balinsky*); 1 ♀, same data, 10.ix.1950; 1 ♀, Tvl, Klipriviersburg, 24 km S. of Johannesburg, 3.v.1938 (*Burt*); 1 ♂, Tvl, Witwatersburg, NE. of Krugersdorp, 2.v.1938 (*Burt*); 1 ♂, Natal, Bergville dist., Mont-aux-sources, 1950 m, rough scrub, 5.ix.1954 (*Balfour-Browne*); 3 ♂, Natal, Lydenburg



distr., 1896 (*Krantz*) (Ans, Philadelphia); 1 ♂, 1 ♀, Natal, Amanzimtoti, 19.iv.1935 (*W.P.*) (ANS, Philadelphia); 1 ♀, Natal, Estcourt (*Havil*) [also labelled, probably incorrectly: 'Cap, M. Peringuey'] (MHN, Geneva); 1 ♂, Natal, Ladysmith, Spion Kop, lower slopes, N. side, 25.viii.1905 (*Dixey*) (UM, Oxford). **Malawi:** 1 ♂, Nyika Plateau, 9.xi.1970. **Zambia:** 1 ♀, Nyika Plateau, 10°35'S 33°45'E, 2190 m, viii.1962 (*Newman*).

*Gastrimargus acutangulus flavipes* Johnston, 1937 subsp. rev.

*Gastrimargus acutangulus flavipes* Johnston, 1937: 220. Holotype ♂, KENYA (BMNH) [examined]. [Incorrectly synonymised by Dirsh, 1966: 426.]

MEASUREMENTS

Sample from Kenya.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	34.66	5.16	8.30	26.15	17.82	4.46	3.99	3.19
Range	31.2–35.9	4.6–5.6	7.6–9.4	23.5–27.4	15.9–18.9	4.1–4.8	3.9–4.2	2.9–3.4
S.D.	1.805	0.334	0.643	1.417	1.236	0.245	0.109	0.219
n	6	7	6	6	7	7	7	5
Females								
Mean	42.88	6.54	10.74	31.99	22.80	5.94	3.85	3.00
Range	39.0–45.2	6.0–7.1	10.0–11.6	28.8–33.6	21.3–24.1	5.4–6.8	3.5–4.0	2.8–3.2
S.D.	2.163	0.347	0.651	1.766	1.111	0.474	0.139	0.135
n	6	8	8	6	8	8	8	6

MATERIAL EXAMINED

*Gastrimargus acutangulus flavipes* Johnston, holotype ♀, Kenya: Mt Kenya, grassy places in forest, 2600–2940 m, v.1935 (*Hancock*) (BMNH).

Kenya: 4 ♂, 4 ♀, 1 nymph, Mt Kenya, grassy places in forest, 2600–2940 m, v.1935 (*Hancock*) (paratypes of *G. acutangulus flavipes*); 2 ♂, 2 ♀, Mau, 1935 (*Buxton*) (1 ♂, 1 ♀, paratypes of *G. acutangulus flavipes*); 2 ♀, Kinangop, vi.1930 (*Turner*) (1 ♀, paratype of *G. acutangulus flavipes*); 1 ♂, Lamu and Malindi, 1974–75 (*Pfau*) (COPR, London).

*Gastrimargus ochraceus* Sjöstedt, 1928

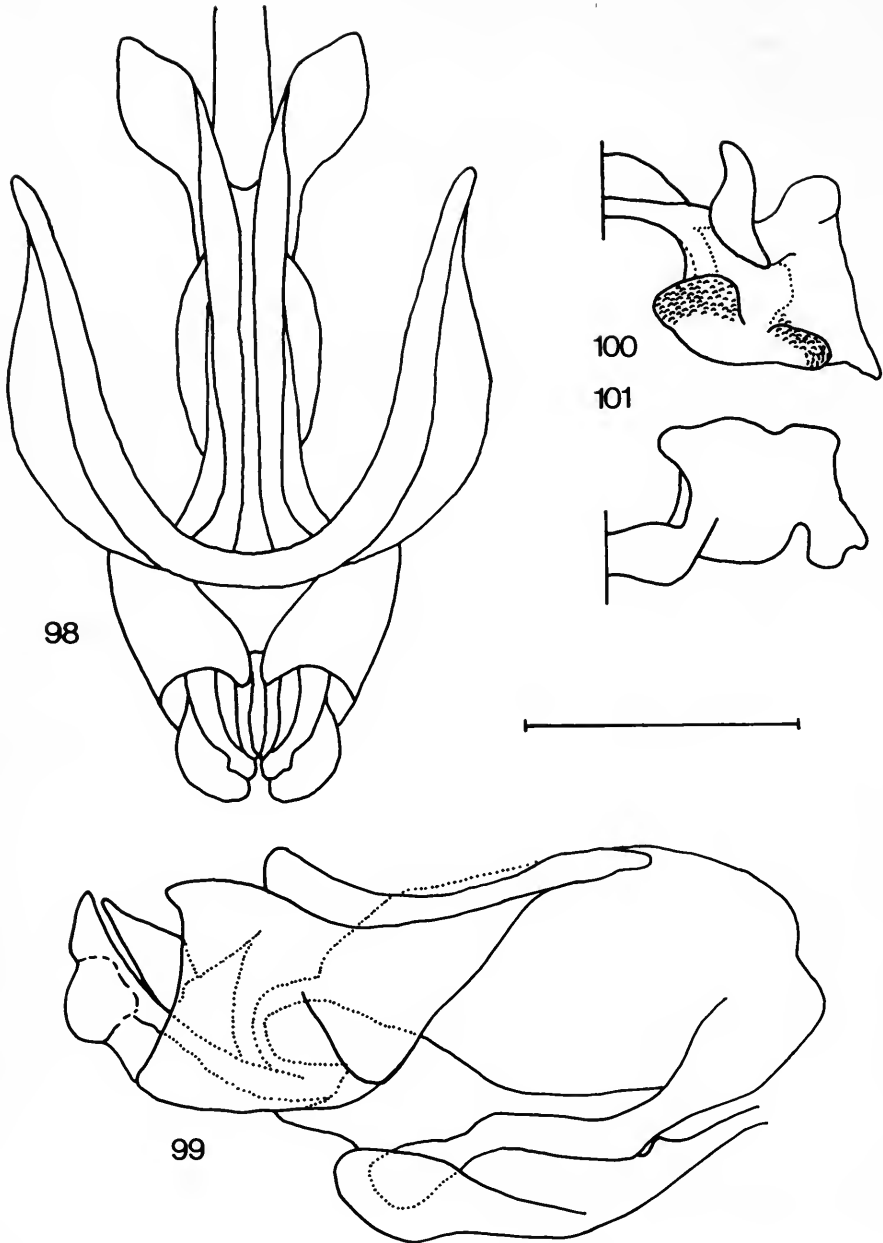
(Figs 98–101, 111, 150)

*Gastrimargus ochraceus* Sjöstedt, 1928: 47. Holotype ♀, GHANA: (BMNH) [examined].

*Gastrimargus ochraceus* Sjöstedt; Gillon, 1974: 158. [Description of previously unknown male.]

**DIAGNOSIS.** Fastigium of vertex convex. Pronotum with median carina low arcuate, straight in profile, not intersected by posterior sulcus; hind margin rectangular in male, obtusangular in female. Tegmen surpassing folded hind knees by one-seventh of hind femur length in male, failing to reach hind knees by one-fifth of hind femur length in female. Genitalia (Figs 98–101) with aedeagus strongly projecting, and with very large bulbous subapical ventral process; aedeagal apodemes short, rounded in profile, not elongated anteriorly.

Coloration generally mottled brown. Pronotal ×-marking with anterior arms distinct, thin, curved; posterior arms usually obsolete, occasionally faintly visible. Tegmen brown with variable pale cross-banding in basal half; apical half pale, opaque, with large rounded brown patches, clearing towards apex. Hind wing fascia (Fig. 150) variable, narrowly interrupted between *Cu*2 and 2*A*, or restricted to posterior half of wing beyond 3*A*. External surface of hind femur with 2–3 oblique cross-bands in medial area; upper and lower marginal areas sometimes with an irregular row of small dark dots; internal surface dark brown; ventral surface light reddish brown in male, red in basal half in female. Hind tibiae brown.



Figs 98–101 *Gastrimargus ochraceus*, genitalia. 98, phallic complex, dorsal view; 99, same, lateral view; 100, epiphallus, right half, dorsal view; 101, same, posterior view.

## MEASUREMENTS

Sample from West and Central Africa, various localities.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	25.33	3.88	5.02	18.02	13.75	2.70	5.10	3.60
Range	23.7–27.7	3.4–4.3	4.4–5.5	17.2–19.6	12.2–15.4	2.3–2.9	4.8–5.3	3.4–3.9
S.D.	2.062	0.404	0.530	1.371	1.602	0.304	0.272	0.202
n	3	3	3	3	3	3	3	3
Females								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	30.97	6.83	8.00	19.62	19.48	4.12	4.73	2.47
Range	28.6–33.6	6.3–7.7	7.0–9.4	17.9–21.6	17.7–22.0	3.8–4.7	4.7–4.8	2.3–2.6
S.D.	2.490	0.718	1.201	1.864	2.231	0.465	0.065	0.136
n	3	3	3	3	3	3	3	3

**AFFINITIES.** *G. ochraceus* has no apparent close affinities with other members of the genus. The unusual male genitalia (Figs 98–101), and the distinctive pronotal pattern suggest that the species is not nearly related to other species.

## MATERIAL EXAMINED

*Gastrimargus ochraceus* Sjöstedt, holotype ♀, **Ghana**: N. Territories, Sankwalla, 4–7.xi.1915 (*Simpson*) (BMNH).

**Ivory Coast**: 1 ♂, 1 ♀, Lamto, Toumodi, 18.xi.1964 (*Gillon*) (ORSTOM, Abidjan); 1 ♀, same data (BMNH); 1 ♂, same data, 22.iii.1965 (BMNH); 1 nymph, Lamto, 1.x.1963 (*Gillon*) (ORSTOM, Abidjan). **Zaire**: 1 ♂, Lumu, 7–15.iv.1975 (*S.B.Z*) (MZDS, Florence).

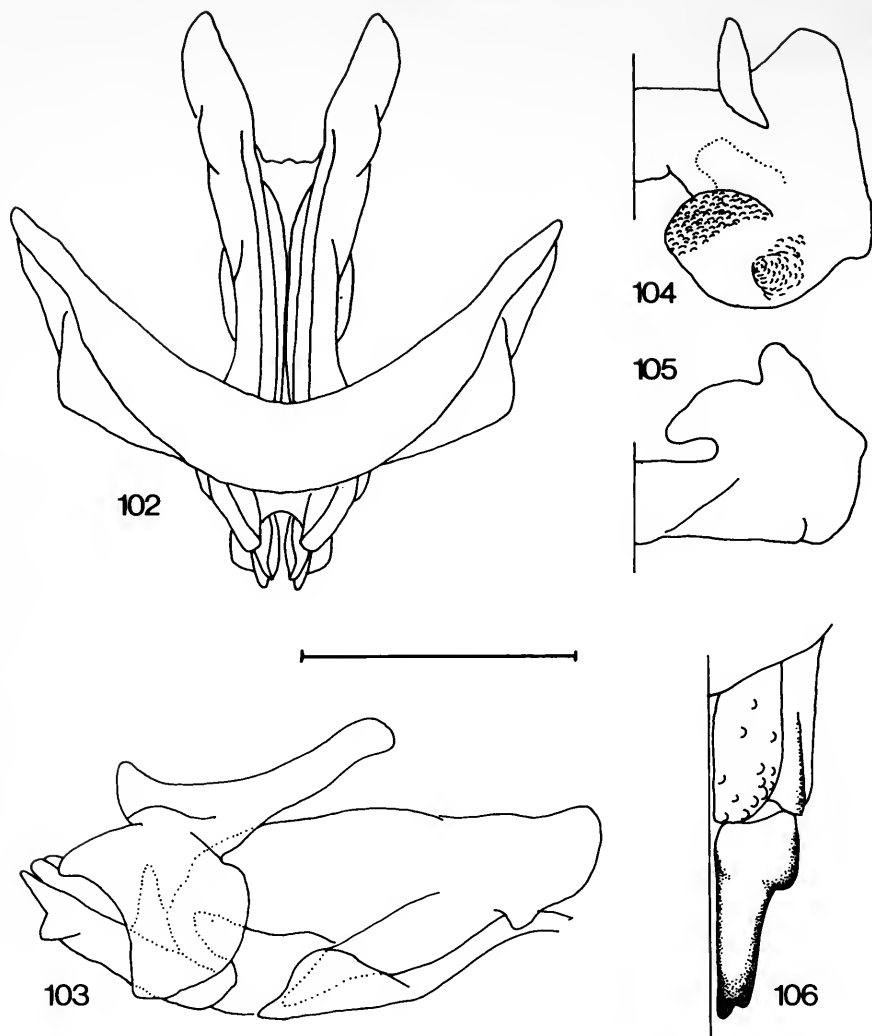
**DISTRIBUTION** (Fig. 111, and Biogeography section, p. 313). Ghana, Ivory Coast, Zaire, Habitat information for Ivory Coast is given by *Gillon* (1974).

*Gastrimargus willemsei* sp. n.

(Figs 102–106, 120, 151)

**DIAGNOSIS.** Antennae short, four-fifths as long as head and pronotum together. Fastigium of vertex concave. Pronotum with median carina low arcuate, flat or concave in profile, not intersected by posterior sulcus in male, sometimes intersected in female; hind margin blunt acutangular. Tegmen surpassing folded hind knees by one-third of hind femur length in male, barely surpassing knees in female. Genitalia (Figs 102–106) with thick circular arch and weakly protruding aedeagus; epiphallic lophi with relatively large bulbous inner lobes and strongly protruding convergent outer lobes. Ventral ovipositor valves elongated and distinctly bifurcated at apex (Fig. 106).

Coloration generally dark brown. Pronotal ×-marking sometimes almost obsolete. Tegmen with 2–3 variable cross-bands, often reduced, sometimes obsolete. Hind wing fascia (Fig. 151) complete, approaching wing base along costal margin; apical half of wing densely infumate, sometimes less so in female; basal area of wing pale yellow to colourless. Hind femur externally with 3 oblique transverse dark bands; internal surface with large dark brown patch in basal half; internal and external ventral surfaces dark brown to blue-black. Hind tibia dark red.



Figs 102–106 *Gastrimargus willemsi*, genitalia. 102, phallic complex, dorsal view; 103, same, lateral view; 104, epiphallus, right half, dorsal view; 105, same, posterior view; 106, ovipositor, left half, ventral view.

#### MEASUREMENTS

Sample from New Guinea.

	Males							
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	30.18	4.56	6.64	22.17	15.58	3.85	4.05	3.43
Range	27.2–32.7	4.2–4.7	6.4–7.1	19.6–24.3	13.7–16.6	3.7–4.2	3.7–4.2	3.0–4.0
S.D.	2.020	0.148	0.216	1.711	0.968	0.160	0.187	0.356
n	8	8	6	8	8	8	8	6

## MEASUREMENTS—(cont.)

Females								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	30.46	5.86	8.06	20.71	17.81	4.52	3.95	2.57
Range	28.4–	5.4–	7.4–	19.5–	17.0–	3.9–	3.7–	2.3–
	33.7	6.2	8.6	22.1	19.2	4.9	4.4	3.0
S.D.	1.657	0.290	0.439	1.016	0.867	0.265	0.218	0.214
n	9	9	8	9	9	9	9	8

**AFFINITIES.** *G. willemsei* appears only distantly related to any other species of the genus. The form of the epiphallus and the bifurcated apex of the ventral ovipositor valves are unlike those of other species, although the clouded apical half of the hind wing is a character which recurs independently in several isolated montane species. It is likely, however, that *G. willemsei* has its origins in the *africanus-musicus* group which has radiated widely in Australasia, despite having evolved a number of unique features, not found in other members of the group.

**MATERIAL EXAMINED**

Holotype ♂, **New Guinea**: Irian Jaya, L. Habbema, 3250–3300 m, 3.viii.1938 (*Toxopeus*) (NHM, Maastricht).

Paratypes: **New Guinea**: 1 ♂, 1 ♀, L. Habbema, 3250–3300 m, 5.viii.1938 (*Toxopeus*) (NHM, Maastricht); 2 ♂, same data, 29.vii.1938 (NHM, Maastricht), 2 ♂, 1 ♀, same data, 4.viii.1938 (NHM, Maastricht); 1 ♂, same data (BMNH); 1 ♀, same data, 8.viii.1938 (BMNH); 1 ♀, same data, 12.viii.1938 (NHM, Maastricht); 1 ♀, same data, 7.viii.1938 (NHM, Maastricht); 1 ♀, same data, 13.viii.1938 (NHM, Maastricht); 1 ♀, L. Habbema, 3400 m, 24.viii.1938 (*Toxopeus*) (NHM, Maastricht); 1 ♂, 1 ♀, Letterbox Camp, 4 km E. of Wilhelmina Top, 3600 m, 7.ix.1938 (*Toxopeus*) (NHM, Maastricht); 1 ♂, same data (BMNH); 1 ♀, same data, 16.viii.1938 (NHM, Maastricht); 1 ♂, Oostzijde, Letterbox Camp, 4100 m, 28.ix.1938 (*Toxopeus*) (NHM, Maastricht).

**DISTRIBUTION** (Fig. 120, and Biogeography section, p. 317). Highlands of W. New Guinea.

**DISCUSSION.** This new species is named in honour of Dr Fer Willemse who kindly loaned the type-material.

*Gastrimargus sarasini* (Saussure, 1884)

(Figs 107–110, 120, 152)

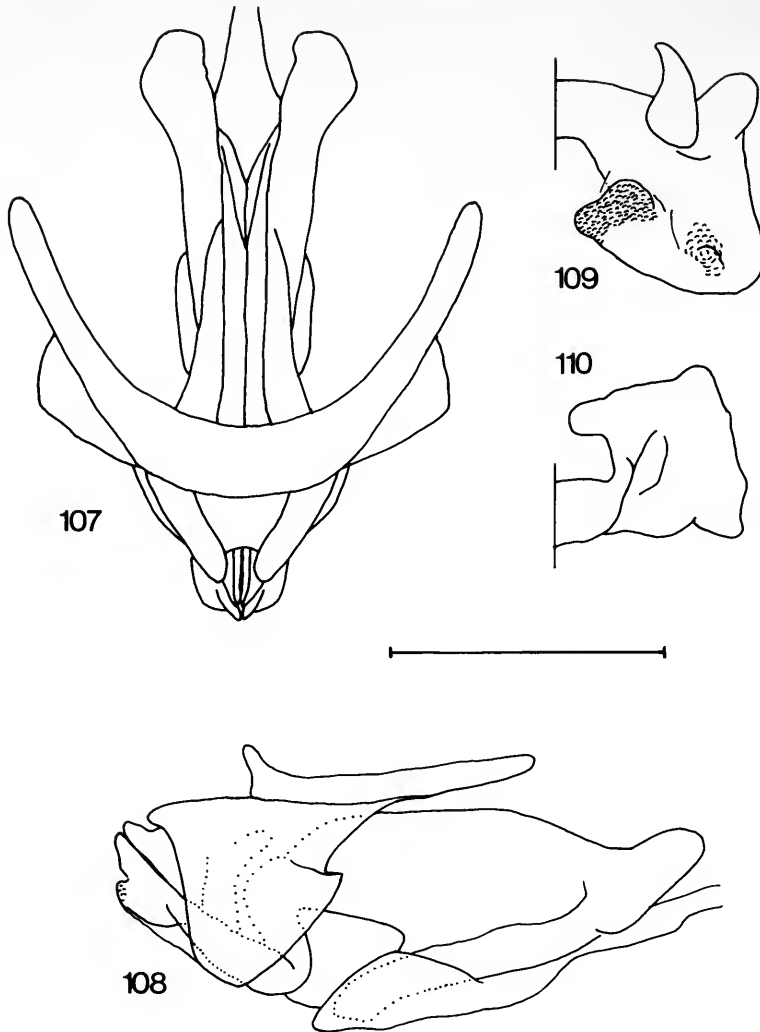
*Oedaleus* (*Gastrimargus*) *sarasini* Saussure, 1884: 1914. LECTOTYPE ♀, NEW CALEDONIA (NR, Stockholm), here designated [examined].

*Gastrimargus sarasini* (Saussure) Kirby, 1910: 228.

*Gastrimargus sarasini* (Saussure); Willemse, 1923: 102.

**DIAGNOSIS.** Fastigium of vertex concave, with triangular foveolae. Frons in profile straight, not convex. Pronotum with median carina arcuate, slightly inflated in prozona, sometimes narrowly intersected by posterior sulcus; hind margin sharply acutangular. Tegmen surpassing folded hind knees by one-quarter of hind femur length. Genitalia (Figs 107–110) with weakly protruding aedeagus.

Coloration dark brown with lighter markings. Pronotal ×-marking not usually visible, obscured by lighter colour on lateral margin of dorsum (Fig. 152). Tegmen blackish brown with 2 reduced pale cross-bands. Hind wing fascia (Fig. 152) complete; apical half of wing densely infumate in male, lighter in female; basal area of wing bright sulphur yellow. Hind femur externally mottled with indistinct banding; lower marginal area dark brown to black; internal medial area and ventral surface black. Hind tibia coral orange-red.



Figs 107–110 *Gastrimargus sarasini*, genitalia. 107, phallic complex, dorsal view; 108, same, lateral view; 109, epiphallus, right half, dorsal view; 110, same, posterior view.

#### MEASUREMENTS

Sample from New Caledonia.

Males								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	28.31	3.90	5.74	21.41	15.11	3.42	4.42	3.68
Range	26.4–	3.6–	5.0–	19.3–	13.8–	3.0–	4.2–	3.2–
	31.8	4.2	6.6	23.7	16.7	3.8	4.8	4.1
S.D.	1.327	0.149	0.385	1.935	0.665	0.183	0.143	0.180
n	29	30	30	29	30	30	30	29

## MEASUREMENTS—(cont.)

Females								
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	39.56	5.79	8.49	29.30	21.20	4.80	4.42	3.45
Range	37.1–43.7	5.4–6.2	7.5–9.8	26.4–32.6	19.9–23.1	4.3–5.1	4.0–4.7	3.1–3.7
S.D.	1.655	0.184	0.589	1.458	0.902	0.200	0.163	0.165
n	24	25	24	24	25	25	25	23

**AFFINITIES.** *G. sarasini* is presumably derived from the *africanus-musicus* stock which has produced a radiation of species in Asia and Australasia. The general dark coloration is a recurrent response to isolated montane or island habitats.

## MATERIAL EXAMINED

*Oedaleus (Gastrimargus) sarasini* Saussure, lectotype ♀, New Caledonia: no locality (*Deyrolle*) (NR, Stockholm).

**New Caledonia:** 1 ♂, no locality (*Deyrolle*) (paralectotype of *G. sarasini*) (NR, Stockholm); 1 ♂, no data (paralectotype of *G. sarasini*) (MHN, Geneva); 1 ♀, Koinde (*Sarasin & Roux*) (MHN, Geneva); 1 ♀, no data (MHN, Geneva); 1 ♂, 1 ♀, Yahoué (MNHN, Paris); 4 ♂, 1 ♀, 1 nymph, no data (*Montague*); 1 ♂, 1 nymph, Canala, 1.vii.1914 (*Montague*); 1 ♀, Mt Canala, 11–15.vi.1914 (*Montague*); 9 ♂, 5 ♀, Mt Mou, 9–22.iii.1914 (*Montague*); 1 ♂, 4 ♀, Mt Mou, 12.iii.1914 (*Montague*); 1 ♂, Nouméa, v.1916 (*Cockerell*); 1 ♂, Nouméa, 20.i.1914 (*Montague*); 1 ♂, same data, 17.i.1914; 2 ♂, 1 nymph, Poya, near caves, xii.1965 (*Moore*) (ANIC, Canberra); 1 ♂, same data, i.1966 (ANIC, Canberra); 1 ♀, Moindou, 6–8.i.1966 (*Moore*) (ANIC, Canberra); 3 ♂, Hienghene, 0–50 m, i.1969 (*Krauss*) (BPBM, Honolulu); 1 ♂, Hienghene, 25.xi.1958 (*Joyce*) (BPBM, Honolulu); 2 ♂, Col des Roussettes, 350–450 m, 3.ii.1971 (*Krauss*) (BPBM, Honolulu); 1 ♂, Vallée d'Amoa, 7.ii.1963 (*Krauss*) (BPBM, Honolulu); 1 ♂, 1 ♀, La Crouen, 16.iii.1961 (*Sedlacek*) (BPBM, Honolulu); 1 ♂, same data, 12.iii.1961 (BPBM, Honolulu); 3 ♂, La Crouen, 150–250 m, ii.1973 (*Krauss*) (BPBM, Honolulu); 3 ♂, La Crouen, iii.1959 (*Krauss*) (BPBM, Honolulu); 2 ♂, 1 ♀, Col d'Amien, 750 m, 3.iii.1960 (*Gressitt*) (BPBM, Honolulu); 1 ♂, Nouméa, 26.viii.1940 (*F.X.W.*) (BPBM, Honolulu); 1 ♀, Nouméa, 27.ix.1940 (BPBM, Honolulu); 1 ♂, Noumea, i.1962 (*Krauss*) (BPBM, Honolulu); 1 ♂, Nouméa (BPBM, Honolulu); 1 ♀, La Foa, 17.iii.1961 (*Sadlacek*) (BPBM, Honolulu); 1 ♂, Sarramea, 12.iii.1963 (*Krauss*) (BPBM, Honolulu); 1 ♂, Bourail to Honailou, forest along road, iii.1959 (*Krauss*) (BPBM, Honolulu); 1 ♀, Plateau, 1.i.1963 (*Krauss*) (BPBM, Honolulu) 1 ♂, 3 ♀, Nepoui, viii.1940 (*F.X.W.*) (BPBM, Honolulu); 1 ♂, Mokone to Dothio, 150–500 m, 20,22.iii.1968 (*Gressitt*) (BPBM, Honolulu); 1 ♂, St Louis valley, 5.iv.1945 (*Milliron*) (BPBM, Honolulu); 3 ♂, 1 ♀, same data, 17.iii.1945 (BPBM, Honolulu); 1 ♀, Thi Forest, 29.x.–1.xi.1967 (*Sedlacek*) (BPBM, Honolulu); 1 ♂, same data, 100–300 m, 29.iii.1961 (*Sedlacek*) (BPBM, Honolulu); 2 ♂, same data, 28.iii.1961 (BPBM, Honolulu); 1 ♀, same data, 100–200 m, 9.iii.1961 (BPBM, Honolulu); 1 ♀, Mokone, 150 m, 20,22.iii.1968 (*Gressitt*) (BPBM, Honolulu); 1 ♂, Dothio, 7.i.1969 (*Krauss*) (BPBM, Honolulu); 1 ♂, Dogny Plateau, 9.iv.1973 (*Gressitt*) (BPBM, Honolulu); 1 ♂, Anse Vata, 21.iii.1961 (*Sedlacek*) (BPBM, Honolulu); 2 ♂, same data, 6.iii.1961 (BPBM, Honolulu); 1 ♀, Anse Vata, 27.x.1958 (*Joyce*) (BPBM, Honolulu); 3 ♂, same data, 23.x.1958 (BPBM, Honolulu).

**DISTRIBUTION** (Fig. 120, and Biogeography section, p. 319). New Caledonia.

**DISCUSSION.** The newly designated lectotype of *G. sarasini* was labelled as type by Saussure, but in his paper (1884: 114) he failed to designate a holotype from his syntype-series. Sjöstedt (1928: 33) refers to 'cotypes' in the NM, Vienna, and there is one male so labelled (not by Saussure) from Brunner's collection at Vienna, now deposited in the NR, Stockholm. All the original series in Vienna, Geneva, and Stockholm, should now be considered as paralectotypes.

## Biogeography of *Gastrimargus*

### The African fauna

Species of *Gastrimargus* exploit a wide range of climatic zones and vegetation types in Africa south of the Sahara. One area of species concentration is the temperate and subtropical montane grassland of south-eastern Africa where *G. wahlbergii* and *G. acutangulus acutangulus* are endemic (Fig. 111). Two other species, *G. crassicollis* and *G. drakensbergensis*, are also centred on this region (Fig. 112) but extend their ranges northwards into the Mopane woodland and westward along the south coast into the Cape macchia. The eastern plateau of southern Africa has provided a buffer zone for grassland species when lowland habitats have been wiped out by adverse climatic conditions. There is some evidence that similar grassland types have been more widespread in the past (Ratray, 1960). At the present day there are widely separated pockets of montane *Themeda*-dominated grassland on the Mozambique/Zimbabwe border and in Malawi between the large montane area of South Africa and the more dissected montane and semi-montane relicts of Kenya and Tanzania. The northern race of *G. acutangulus*, *G. a. flavipes* is associated with this type of vegetation in Kenya, and an intermediate form also occurs on the Nyika plateau of Malawi and Zambia (Fig. 111).

Another species, *G. verticalis*, shows a preference for savannah (Fig. 113). It is found in East Africa mainly east of the rift valley and crosses the *Brachystegia* belt by means of grassland 'stepping-stones' north of L. Malawi and on the Mozambique/Zimbabwe border. At times when the East African 'dry corridor' was open there would have been free interchange between the northern and southern savannahs (Winterbottom, 1967; Van Zinderen Bakker, 1976). The Kibariani mountains at Mpwapwa, Tanzania, are situated on the east side of a narrow tongue of savannah extending south-westwards into the woodland zone at the northern end of the 'dry

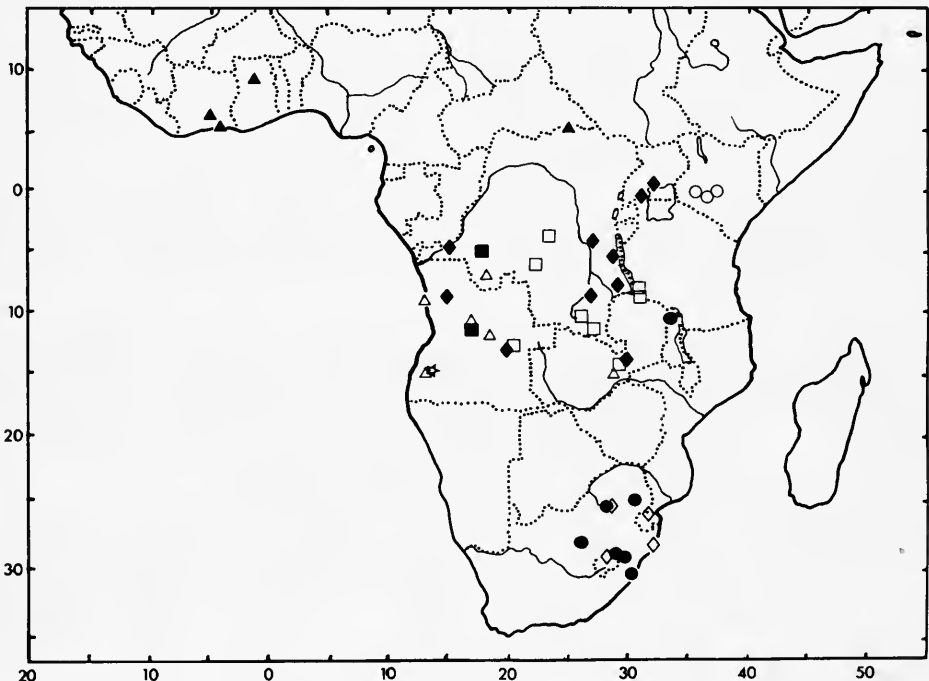
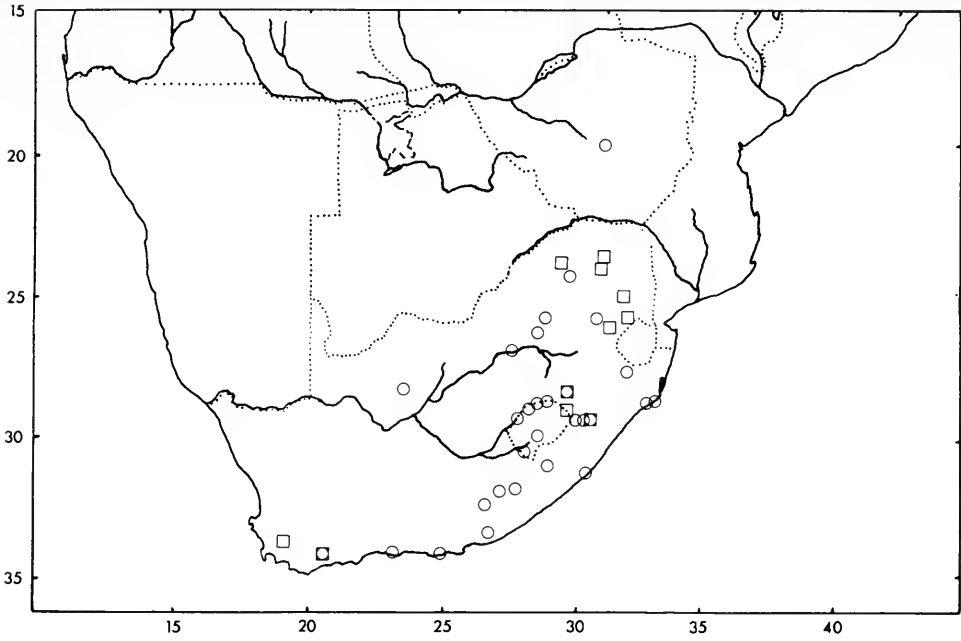
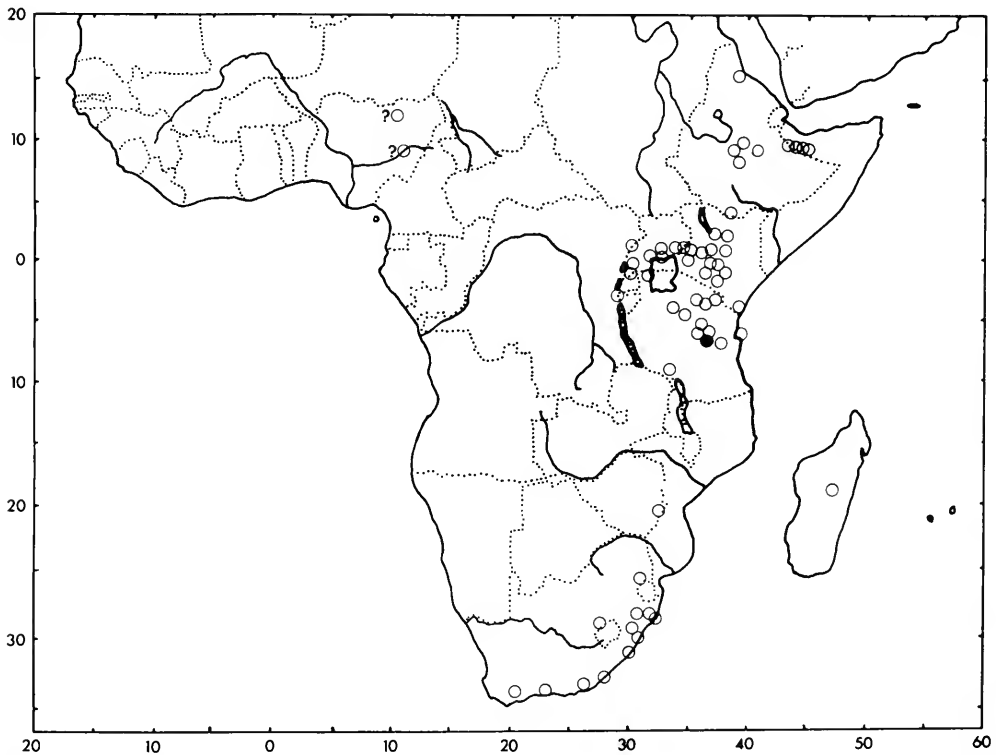


Fig. 111 Distribution of *Gastrimargus* species in Africa. Closed circles, *G. acutangulus acutangulus*; open circles, *G. a. flavipes*; star, *G. insolens*; open triangles, *G. angolensis*; closed triangles, *G. ochraceus*; open squares, *G. miombo*; closed squares, *G. obscurus*; open diamonds, *G. wahlbergii*; closed diamonds, *G. mirabilis*.





**Fig. 112** Distribution of *Gastrimargus crassicollis* (circles) and *G. drakensbergensis* (squares) in southern Africa.



**Fig. 113** Distribution of *Gastrimargus verticalis verticalis* (open circles) and *G. verticalis mpwapwae* (closed circles) in Africa.

corridor'. Except for the two relict patches of *G. verticalis* further south mentioned above, Mpwapwa is the furthest point in a south-westerly direction reached by the species in East Africa. It is therefore significant that a distinct race, *G. verticalis mpwapwae*, is found on these mountains. Greenway (1933) has given a brief description of their vegetation. The *Brachystegia* zone contains rare forest trees along stream margins, relicts from a past period of heavier rainfall. The summit carries a patch of evergreen forest (1830 m) which is encircled by *Protea-Dombeya* highland grassland, overlooked by Greenway. The highland grassland commences at 1650 m and is thought to have been derived from the forest, perhaps through the influence of fire (Burt, 1942). Unfortunately the collector of the type-series of *G. v. mpwapwae*, Eric Burt, did not specify the type of vegetation in which his specimens were found, but from the altitude (1800 m) it is probable that it was the *Protea* zone.

The vegetation of Mpwapwa has not apparently been compared in detail with that of the two isolated mountains less than 50 miles to the south and south-east (Gillman, 1949), but it is probable that there are considerable similarities. At times of recession of the *Brachystegia* the Kibariani mountains would have been surrounded not by the thin ring of woodland that exists today, but by savannah from which *G. verticalis* could have colonised directly. During times of expansion of the *Brachystegia*, the area would have been isolated, providing an opportunity for divergence and speciation among the endemic fauna. It is remarkable that nine species of Acridoidea are known only from Mpwapwa despite extensive collecting by E. Burt and others all over Tanzania. The list includes one species each of Pneumoridae, Pamphagidae, Pyrgomorphidae and Lentulidae, and four Acrididae. A more intensive examination of the montane areas of Tanzania will no doubt reveal a more complex pattern of relict and endemic species since some at least of the Mpwapwa endemics must have had a wider distribution in the past.

At the northern extremity of the range of *G. verticalis* in Ethiopia there occur two species adapted to high montane habitats. The exact distribution of one of these, *G. hyla*, is unknown (see p. 268), but the other, *G. rothschildi* (Fig. 114), is found above the 2000 m contour. The range of this species has been discussed in detail on p. 270 in relation to geographical races. *G. rothschildi* and possibly *G. hyla* have been derived from *G. verticalis* in the relative isolation of the Abyssinian mountains, and the reduced wing length of the females in these species reflects their montane habitats.

*G. determinatus vitripennis* (Fig. 115) has a distribution in eastern and southern Africa sympatric with, but more extensive than that of *G. verticalis*. It is apparently unhindered by the *Brachystegia* zone and extends westwards to a line running north-east to south-west through Ethiopia, Uganda, and Angola, where another subspecies, *G. d. procerus* takes over, occurring on both the northern and southern fringes of the rain forest, and extending westwards to Senegal. This type of distribution is interesting and can be accounted for by reference to past climatic changes in the area. During glacial periods (Van Zinderen Bakker, 1976) the northward movement of the cold Benguela current and the associated decline in precipitation and increase in wind desiccation were responsible for the redistribution of Kalahari sand as far as the Zaire river. The miombo woodland was pushed northwards and the western Congo basin forest may have been breached. The present-day intrusion of tall grass savannah/forest mosaic into the forest in the Congo Republic (Keay, 1959) is largely rooted in Kalahari sand with grass associations dominated by *Loudetia* spp. (Ratray, 1960). From this it may be inferred that a north to south savannah/woodland corridor was created which facilitated the interchange of species between western and southern Africa across the Congo forest. This corridor was not as well-defined or as arid as that in east Africa but would have permitted species like *G. determinatus* with a wide tolerance of vegetation and climate to cross. It is not clear in which direction the movement took place. The nominate subspecies, *G. d. determinatus*, occurs in Cape Province, though precise localities are unknown, and it has a fully banded hind wing (Figs 139, 140), probably the 'primitive' condition for the species. *G. d. procerus* has a partial band (Fig. 137) which is generally most developed in males from the Congo region ('*G. silvicola*' Sjöstedt) and *G. d. vitripennis* (Fig. 138) has no band on the hind wing. The most reasonable model for the development of the three subspecies is that *procerus* arose from *determinatus*, and *vitripennis* from *procerus*, with the progressive loss of the hind wing fascia in the process. In Arabia a fourth subspecies, *G. d.*

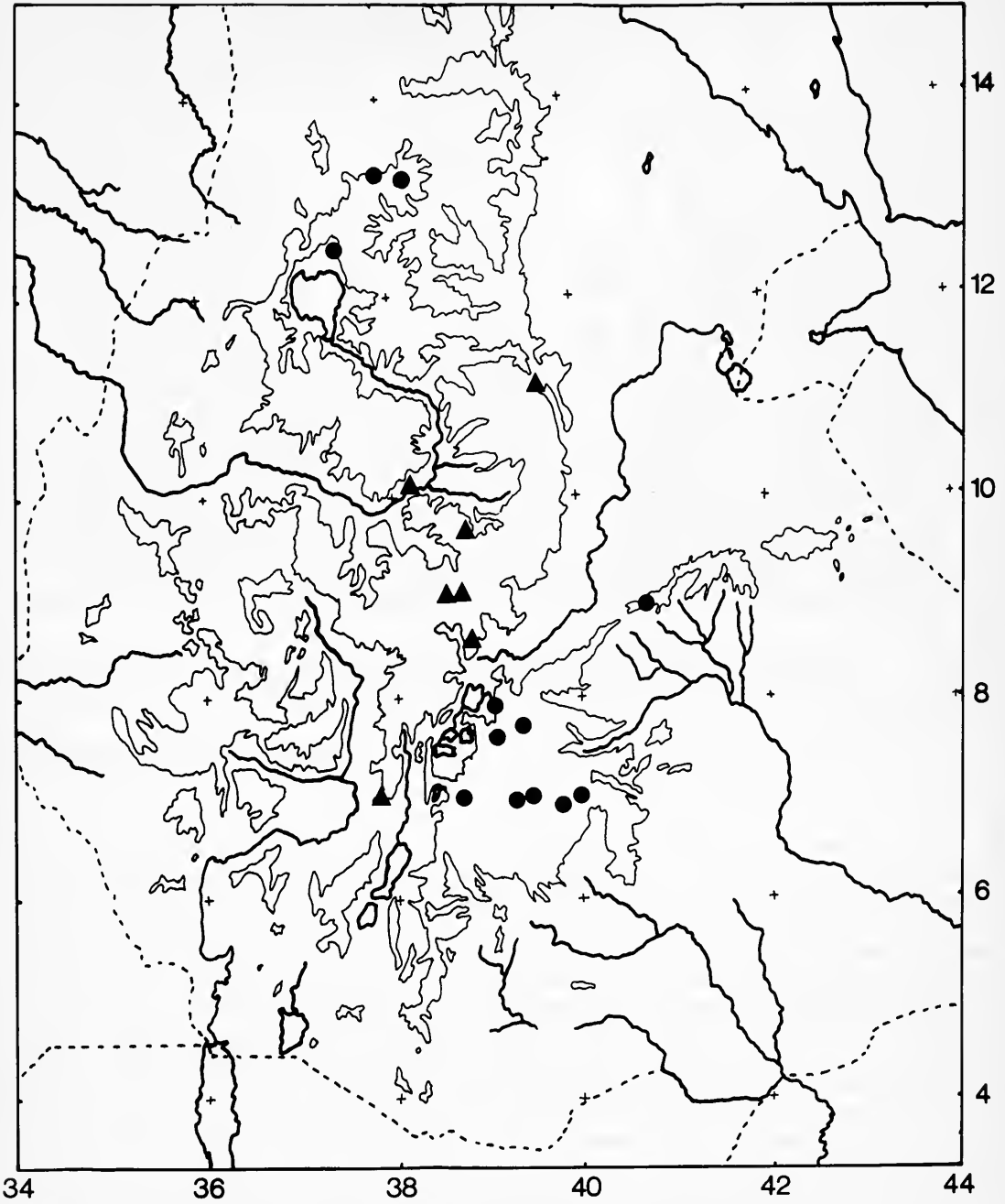
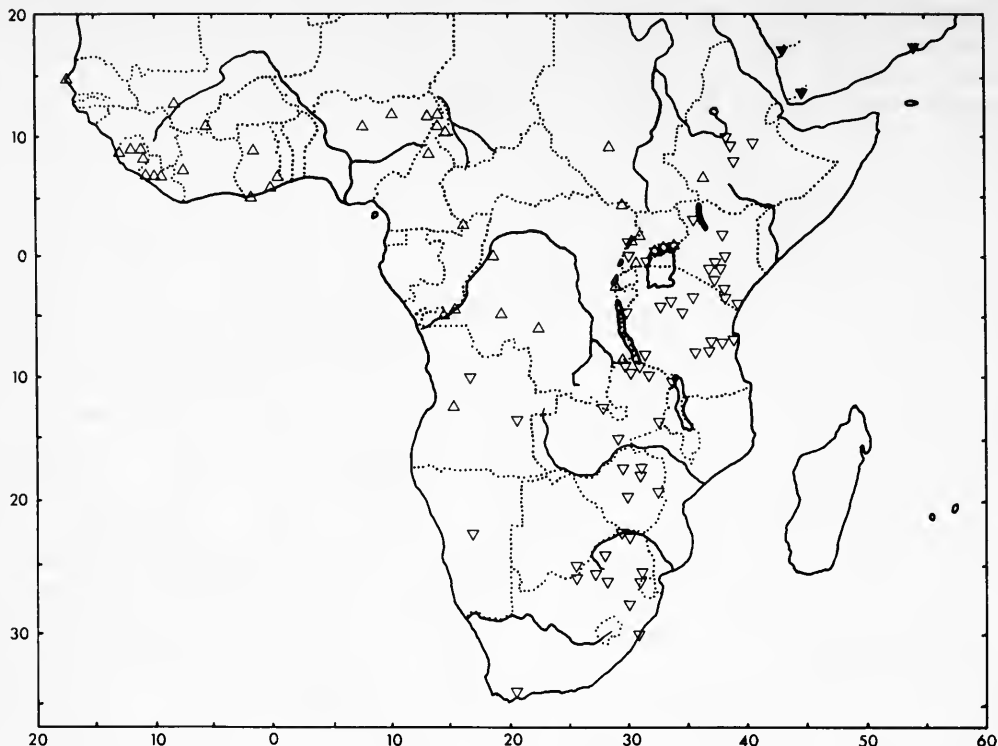


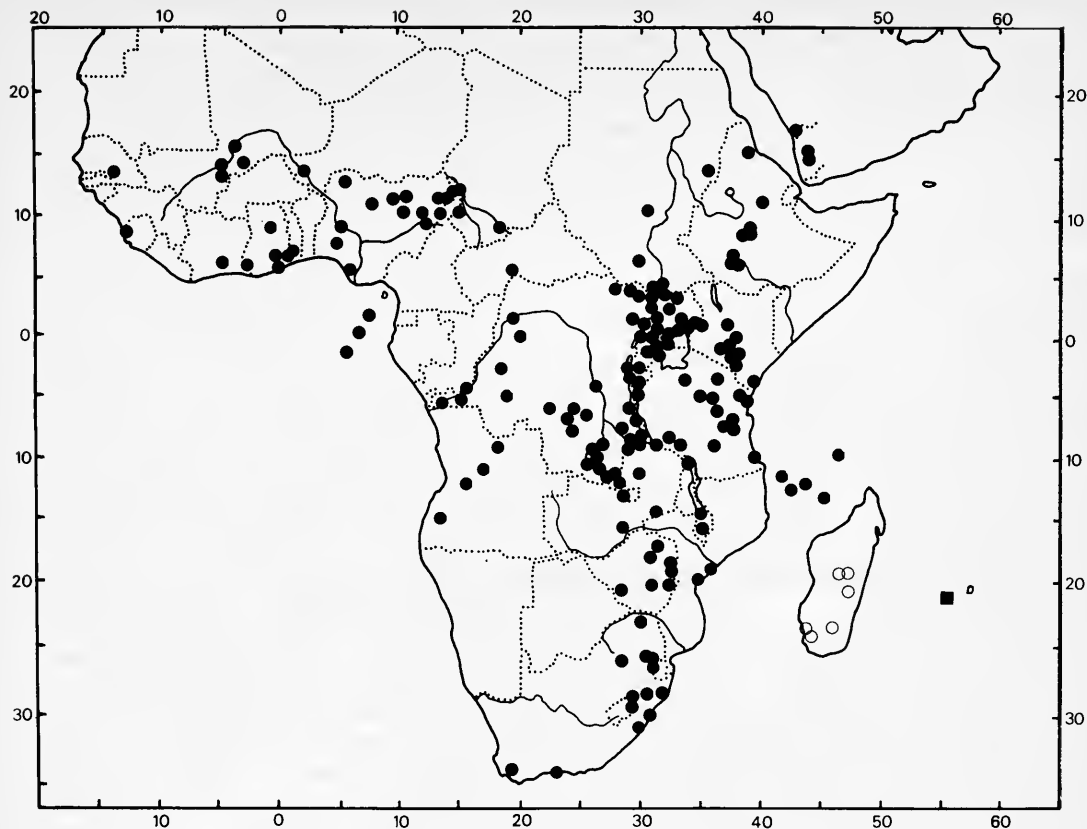
Fig. 114 Distribution of subspecies of *Gastrimargus rothschildi* in Ethiopia. *G. r. rothschildi*, circles; *G. r. luteifemur*, triangles. The 2000 m contour is represented by a thin continuous line.



**Fig. 115** Distribution of subspecies of *Gastrimargus determinatus* in Africa and Arabia. *G. d. procerus* (upright open triangles), *G. d. vitripennis* (reversed open triangles), and *G. d. arabicus* (reversed closed triangles).

*arabicus*, which also lacks the hind wing band, has been derived from the north-east fringe of the distribution of *G. d. vitripennis* across the Red Sea in Ethiopia.

The largest concentration of *Gastrimargus* species occurs in central Africa south of the equator, in and around the *Brachystegia* woodland and the moist woodland and forest/savannah mosaic zones (Keay, 1959) (Fig. 111). The members of this geographical assemblage are morphologically diverse. The most extensive range is that of *G. mirabilis*, the only member of the group to cross the rift valley, penetrating as far east as SW. Uganda. *G. angolensis*, *G. miombo*, and *G. obscurus* are more restricted in range, but their relative rarity precludes any meaningful discussion of their precise distribution. The unique locality of *G. insolens*, Sá da Bandeira, is situated on an isolated massif at the south-western extremity of the Angolan plateau. The mountain is capped with forest but otherwise the vegetation is *Brachystegia* woodland with a *Hyparrhenia* grass association different from that of the lower altitude, lower rainfall areas around. At present it is not certain that this species is absent from similar vegetation in the montane area further north, west of Nova Lisboa. However, the isolated location of Sá da Bandeira at the tip of a peninsula of miombo projecting into the hotter, drier 'mopane' belt suggests that the species may be a relict from one of the periods of Kalahari expansion mentioned above. During such a period the miombo woodland would have receded further north except for an isolated patch on this mountain acting as a refuge for species of more humid habitats. None of the *Gastrimargus* species endemic to the *Brachystegia* zone have been recorded east of a line from the east end of L. Rukwa south along the Luangwa valley to the Zambezi. This line follows the course of the 'arid corridor' which divided the woodland during glacial periods. The absence of these species in similar vegetation to the east of the corridor suggests either that they evolved in the west during a period when the woodland was divided and have failed to expand their ranges since, or that they have been wiped out east of the corridor by even more severe conditions at glacial maxima.



**Fig. 116** Distribution of *Gastrimargus* species in Africa, Arabia and neighbouring islands. *G. africanus africanus* (closed circles), *G. africanus madagascariensis* (open circles); *G. immaculatus* (square).

West Africa is relatively poor in endemic non-forest species of Acrididae, presumably as a result of the climatic instability of the area during the Pleistocene (Moreau, 1966; Ritchie, 1981). *G. ochraceus*, the only species of the genus endemic to this region, was known until recently only from Ghana and Ivory Coast where it extends from the *Isoberlinia* woodland (northern Guinea savannah) to the forest/savannah mosaic. It is now reported from similar country on the northern border of Zaire in the centre of the continent. This species and many other non-arid faunal elements occurring in West Africa today have probably moved westwards from central Africa where there have been suitable refuges on the northern fringe of the Congo forest when similar habitats in West Africa were reduced or destroyed by desert encroachment.

*Gastrimargus africanus*, the most ecologically tolerant species in the genus, is found very widely in Africa (Fig. 116), even occurring, presumably in clearings, deep in the Congo forest. However, it avoids dry savannah and semi-desert, as for example in Namibia, Botswana, and Somalia. The wide tolerance and high vagility of the species have uniquely equipped it for expansion not only within Africa but across Asia as well. Around the continental margin of Africa *G. africanus* extends, apparently unaltered, into the Comoro Is., Aldabra and the SW. corner of Arabia, but in Madagascar it has given rise to a separate subspecies *G. a. madagascariensis*.

#### The Asian fauna

*G. africanus* reappears in western India (Fig. 117), the nominate sub-species being replaced by *G. a. sulphureus* in Pakistan, Kashmir and Nepal, and NE. India above 2000 m. In east Asia there is a gradual replacement of the nominate subspecies by *G. a. parvulus* which tends to lose the bright yellow wing colour and the blue underside of the hind femur. The distribution of this subspecies is

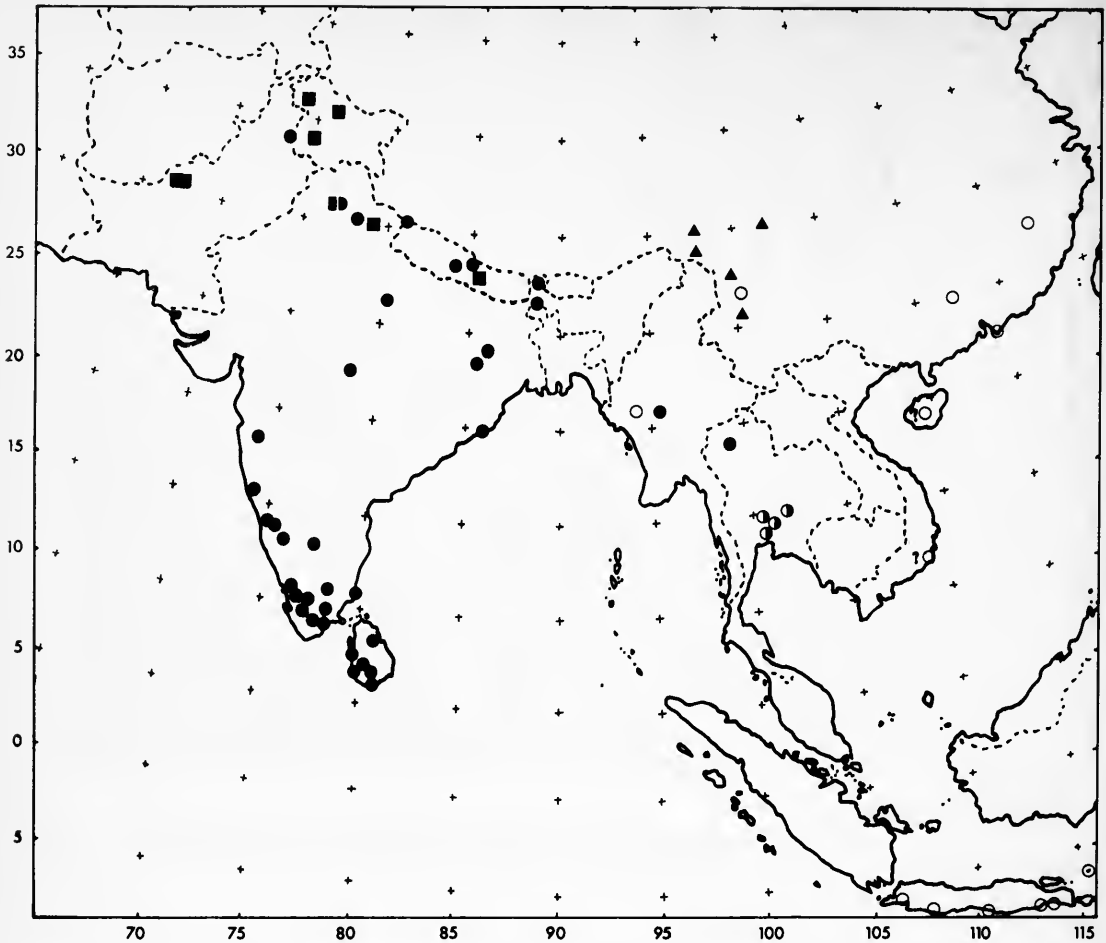


Fig. 117 Distribution of *Gastrimargus* species and subspecies in Asia. *G. a. africanus* (closed circles), *G. a. parvulus* (open circles), intermediates (half-closed circles), *G. a. sulphureus* (squares), and *G. nubilus* (triangles).

disjunct between Indo-China and the south coast of Java, avoiding the intervening rain forest areas of Malaya and Sumatra. The remaining species endemic to mainland Asia, *G. nubilus*, is closely allied to *G. africanus* and is adapted to the mountains of southern China north of the Burma border on the NE. edge of the range of that species (Fig. 117). As stated on p. 253, *G. nubilus* has probably been derived from *G. africanus* under the influence of montane conditions. *G. immaculatus*, an island endemic species from Réunion in the Indian Ocean (Fig. 117), is presumably also related to *G. africanus*, but the relationship is not very close (see p. 267). The subspeciation of *G. africanus* in Asia and the existence of a closely related species there, as against the absence of any distinct subspeciation in Africa, suggests that the species may have originated in Asia and moved into Africa rather than the reverse. The question remains open.

### The Malesian fauna

The name Malesia has been coined to describe the area between the mainland of Asia, bounded by the Kra isthmus of the Malay peninsula and the Bashi channel north of the Philippines, and Australia, bounded by the Torres strait (Whitmore, 1975). The islands of Malesia have been the setting for a radiation of *Gastrimargus* species best understood against the background of the

physical characteristics and vegetation of the region, both past and present. The flora of Malesia is highly distinct, with more than 40 per cent of the species endemic, and with a total of more than 2000 genera retained or excluded by the barriers described above (Whitmore, 1975).

Within Malesia, the 200 m submarine contour defining the Sunda shelf, the Asian continental shelf, includes the islands of Sumatra, Java, and Borneo. Sumatra and Borneo carry a floristically similar type of rain forest, but Java with its seasonally dry climate has a more open monsoon forest. At certain times during the Pleistocene the sea level in this area has dropped about 100 m, uniting these islands (Haile, 1971) and presumably producing drier conditions in Malesia. Botanical evidence for the past extension of seasonally dry habitats is provided by drought-loving species of Papilionaceae which are now not found anywhere between monsoon Asia and Java, but which must have had continuous distributions in the past. They probably crossed the intervening space via the Philippines, the Celebes, and the Moluccas, which even today form a north to south sequence of seasonally drier climates between the ever wet Sunda and Sahul shelves (Whitmore, 1975). However, the fact that *G. africanus* has only become established in Java and not in any of the northern islands suggests that it reached there via the Malay peninsula from the mainland when seasonally drier climates were more widespread. Specimens from Java closely resemble those from the mainland, possibly indicating that the species has become established fairly recently, perhaps during the last glaciation when rain forest in N. Queensland is known to have been temporarily replaced by sclerophyll forest, evidence of drier conditions in the region at that time (Walker, 1970).

Java and Bali mark the eastern boundary of the Sunda shelf and the area which was part of continental Asia during glacial maxima. Further east the islands of Lombok, Sumbawa, and Flores were separate from Bali though joined to each other. This separation is largely responsible for the striking impoverishment of the fauna to the east of the dividing line known as Wallace's line. For example, 68 species of birds found on Bali are absent from Lombok (Mayr, 1944). In addition to permanent separation from the continental shelf, the volcanic nature of the islands must have hindered the dispersal of animal species along the chain of islands. Flores and the eastern islands emerged during the late Miocene after Lombok and Sumbawa and many of the volcanoes of eastern Flores and the smaller islands between Flores and Alor are still active today (Norvick, 1979).

Wallace's line is not a distinct limit for plants, as shown above, nor for insects at genus level (Gressitt, 1961). However, at species level and below there are interesting changes. *G. africanus* does not reach Lombok and has not yet been recorded from Bali. It does, however, occur on Kangean, the largest and most westerly island of the Kangean archipelago, on the edge of the continental shelf. *G. lombokensis*, a species closely related to *G. africanus* and to the Australian species, *G. musicus*, occurs on Lombok, Flores, Sumba and Sumbawa (Fig. 118). It is now also

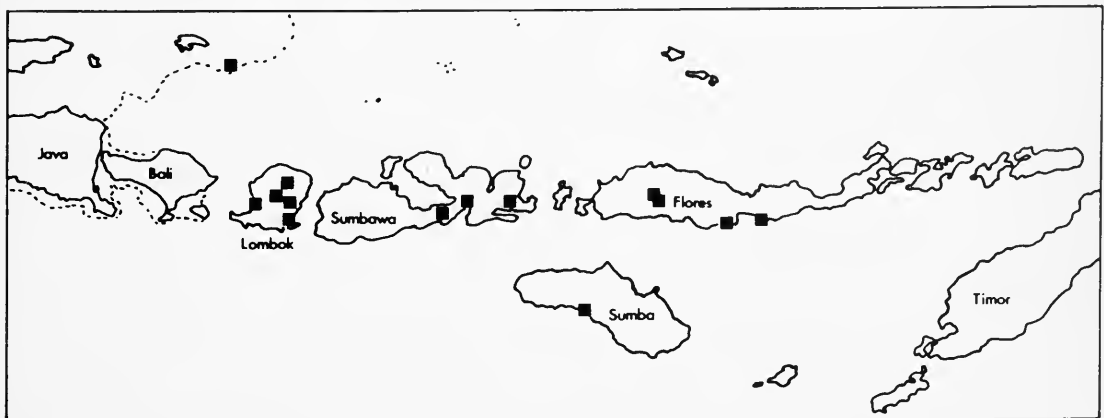


Fig. 118 Distribution of *Gastrimargus lombokensis* in the Lesser Sunda Is. The 200 m marine contour delimiting the Sunda shelf is shown as a broken line.

known from Sepandjang, the most easterly of the Kangean Is., demonstrating the ability to cross 130 km of open water, probably blown by the southern monsoon. The prevailing monsoon winds blowing from Australia are responsible for the relatively dry conditions in all the Lesser Sunda Is. including Timor.

In contrast to the inner arc of islands from Lombok to Alor, the outer arc, including Timor and Roti, is now thought to have been part of the Australian continental margin since the Palaeozoic era (Audley-Charles *et al.*, 1972), originally separated from the islands to the north by more than 1000 km. After starting to move northwards at the end of the Mesozoic on the leading edge of the Australian plate, Timor arrived at its present position in the middle Pliocene, emerging above water in the late Pliocene and continuing to rise until the present (Norvick, 1979). Despite being part of the Australian continental plate, Timor is not part of the Sahul shelf defined by the 2000 m submarine contour surrounding Australia and New Guinea, and is separated from Australia by a deep trench. It has therefore never formed part of the continental land mass during periods of Pleistocene sea level depression. This isolated island has its own distinctive species of *Gastrimargus*, *G. subfasciatus* (Fig. 120), which has, however, strong links with *G. lombokensis*. The unusual blue pigmentation of the hind wing of *G. subfasciatus* replaces the pale yellow wing of *G. lombokensis* but this is probably a simple development in evolutionary terms. Both *G. marmoratus* and *G. wahlbergii* possess a very faint blue tint at the wing base on an otherwise pale yellow or greenish yellow wing. *Oedaleus decorus* bears similar coloration although its near relative *O. senegalensis* has no trace of blue pigment.

O'Toole (1975), discussing the dispersal of the velvet ant *Timulla oculata* (F.) to the east of Wallace's Line, noted that the most distinctive subspecies were found on Timor and Tanimber Larat which are furthest away from the putative source area. He concluded that the populations on these islands must have undergone the most rapid evolution. Their distant origin and the consequent exotic fauna carried by these islands prior to their arrival in proximity to the islands of the inner Banda arc have no doubt strongly influenced the adaptive modification of later colonising species.

In contrast to the pattern of insular speciation in Malesia discussed above, the distribution of *G. marmoratus* (Fig. 119) is geographically and ecologically wide. The species is able to tolerate both the everwet climates of Borneo and Malaya and the seasonally dry regime of Sumbawa and Flores. This is a large, long-winged species of high vagility, attested by its presence in areas as remote from each other as the Vogelkop peninsula of New Guinea and Hokkaido island, Japan. In mainland Asia the distribution map suggests a preference for coastal areas, but the known range, especially in China, is probably very incomplete.

### The Australasian fauna

The only *Gastrimargus* species endemic to Australia, *G. musicus* (Fig. 120), is widespread and common in areas with 500–1500 mm of annual rainfall, and also occurs less commonly in drier areas. To some extent the collecting localities reflect the distribution of roads and population rather than of the insects themselves, as for example the line of records across the southern end of the Cape York peninsula, following the road from Normanton to Clarke River. In New Guinea the species is only found in the drier areas of the southern coast opposite Cape York and along the eastern peninsula. Specimens from eastern New Guinea and the Solomon Is. differ in colour from the main population (see p. 262), indicating that separation by rain forest and by a wide tract of open sea respectively have initiated the process of subspeciation. At present *G. musicus* is only known from Guadalcanal in the Solomons group but it may also occur on neighbouring islands.

*G. musicus* bears a strong resemblance to *G. africanus* to the extent that some specimens of the two species from the Solomon Is. and Java respectively may be almost indistinguishable (see p. 243). It is likely that *G. musicus*, *G. lombokensis* and *G. subfasciatus* all evolved from a common ancestor which had the red undersides to the hind femora which these species all share. How this ancestor was related to *G. africanus* is not clear. It is less likely that *G. musicus* is derived from *G. lombokensis* which must also have evolved from an ancestor close to *G. africanus* by a process which has included the loss of the bright yellow basal area of the hind wing and the modification



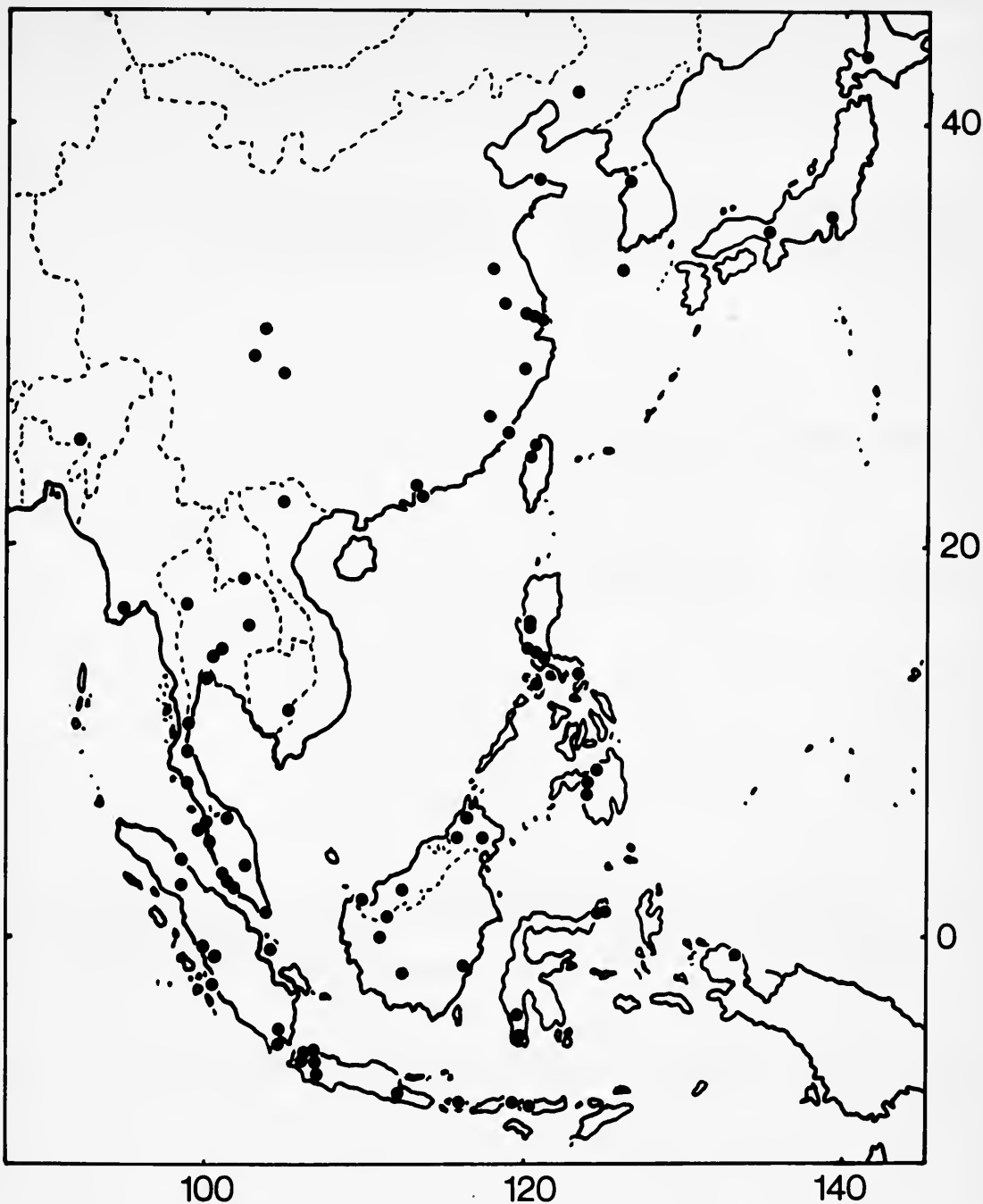


Fig. 119 Distribution of *Gastrimargus marmoratus* in South East Asia.

of the wing band. It is unlikely that *G. musicus* could have regained these features just as they are found in *G. africanus* when once they had been lost.

The remaining species known from New Guinea, *G. willemsei* (Fig. 120), is apparently restricted to the central mountains of Irian Jaya between 3250 and 4100 m. It appears to be only distantly allied to the other South East Asian species, and exhibits the familiar wing reduction and dark

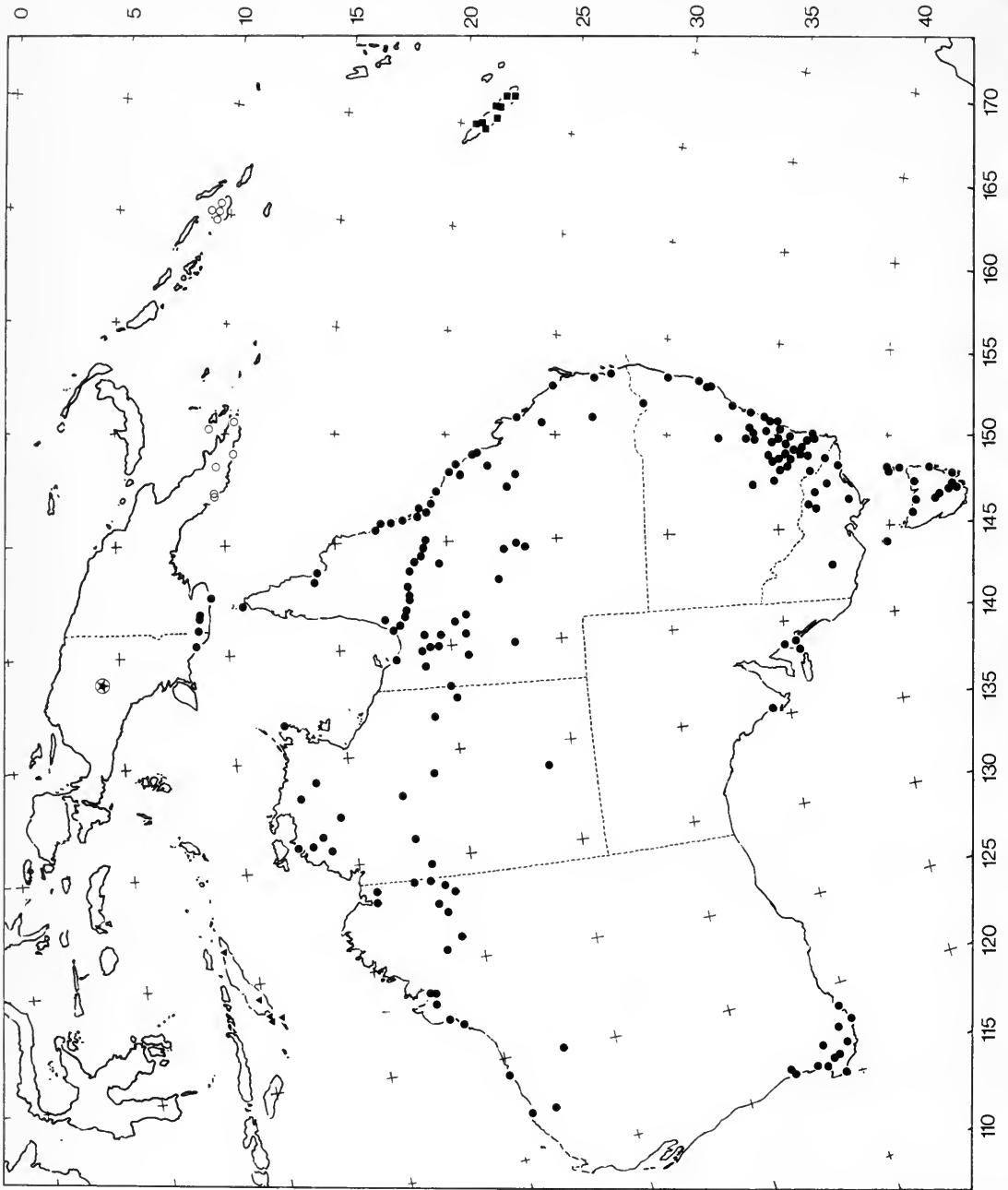


Fig. 120 Distribution of *Gastrimargus* species in Australasia. *G. musicus* (closed circles), pale-winged race (open circles); *G. sarasini* (squares); *G. subfasciatus* (triangles); *G. willemsei* (circled star).

pigmentation associated with a montane existence. New Caledonia is the furthest point reached by *Gastrimargus* in its eastward radiation from its putative source areas in Africa and Asia. Here, 1200 km east of the coast of Australia, there is one species, *G. sarasini* (Fig. 120). This species also is not closely allied morphologically to its neighbours but presumably represents an early offshoot from the *africanus-musicus* stock. It is not at present certain that this or some other species does not occur on the islands of the New Hebrides to the north east of New Caledonia, since collections from this part of the world tend to be aggregated around the more populous administrative centres.

### General discussion

The distribution of the genus *Gastrimargus* offers some interesting points of comparison with that of *Oedaleus* (Ritchie, 1981). In both genera there are several species centred on the high grasslands of eastern South Africa, Lesotho and Swaziland. However, in *Oedaleus* the most intense speciation has occurred in the East African savannah and semi-desert, whereas *Gastrimargus* in Africa is centred on the *Brachystegia* woodland south of the Congo forest, a habitat which supports only one species of *Oedaleus*, *O. nigeriensis*. This area has been little studied by acridologists and may be expected to yield further new species of grasshoppers.

Outside Africa the contrast between the two genera is even more marked. In *Oedaleus* there is a clear discontinuity between the eastern seaboard of Indo-China and the south-east coast of New Guinea where the unique Australasian endemic, *O. australis*, is first encountered. For *Gastrimargus* with its greater tolerance of humid habitats, the intervening islands of Malesia have been the setting for a secondary radiation of species.

Overall there is a clear tendency for *Gastrimargus* to occupy more humid habitats than those favoured by *Oedaleus*. This is strikingly illustrated by a comparison of the number of montane species with restricted ranges in the two genera, excluding the species of the high veldt of eastern Africa. In *Oedaleus* there is only one species, *O. formosanus*, in this category, whereas there are five species and one subspecies of *Gastrimargus*. This figure reflects the effect of past periods of low rainfall when montane refuges have trapped populations of non-savannah species. *Oedaleus*, with its more xerophilous habitat preferences, is not susceptible to this effect since dry glacial periods would have increased its range rather than the reverse. In both genera adaptation to montane conditions is associated with shortening of the tegmina and wings and darkening of the body coloration, notably the hind wings. This latter effect is independent of the morphometric changes and only occurs in some cases. It may also be observed in long winged populations on islands, as for example in *G. sarasini* on New Caledonia.

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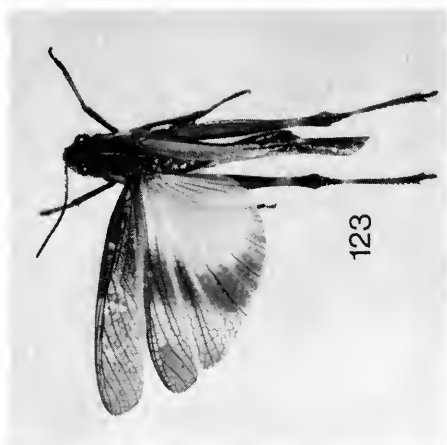
I am indebted to the Trustees of the British Museum (Natural History) and to the Keeper of Entomology for access to the collections which form the basis of this work, and to the following individuals for the loan of specimens and other assistance: Dr P. Basilewsky (Tervuren), Dr H. D. Brown (Pretoria), Dr F. Capra (Genoa), Dr G. Demoulin (Brussels), Dr F. N. Dingemans-Bakels (Maastricht), Dr P. H. van Doesburg (Leiden), Dr M. Donskoff (Paris), Dr D. Duviard (Abidjan), Dr K. K. Günther (Berlin), Dr A. Gurney (Washington), Dr B. Hauser (Geneva), Dr L. Hedström (Uppsala), Mr J. Houston (Church Stretton), Dr P. Johnsen (Aarhus), Dr K. H. L. Key (Canberra), Dr T. Kronstedt (Stockholm), Mrs B. Laosinchai (Bangkok), Dr G. Messana & Ms S. Mascherini (Florence), Dr L. L. Mishchenko (Leningrad), Dr G. M. Nishida (Honolulu), Dr D. Otte & Dr H. R. Roberts (Philadelphia), Dr G. Petersen (Eberswalde), Dr D. R. Ragge (London), Dr D. Rentz (San Francisco), Prof. H. Strümpel (Hamburg), Mr E. Taylor (Oxford), Dr F. Willemse (Eygelshoven). Thanks are also due to Mrs G. Colquhoun and Mr P. Turner for photography.

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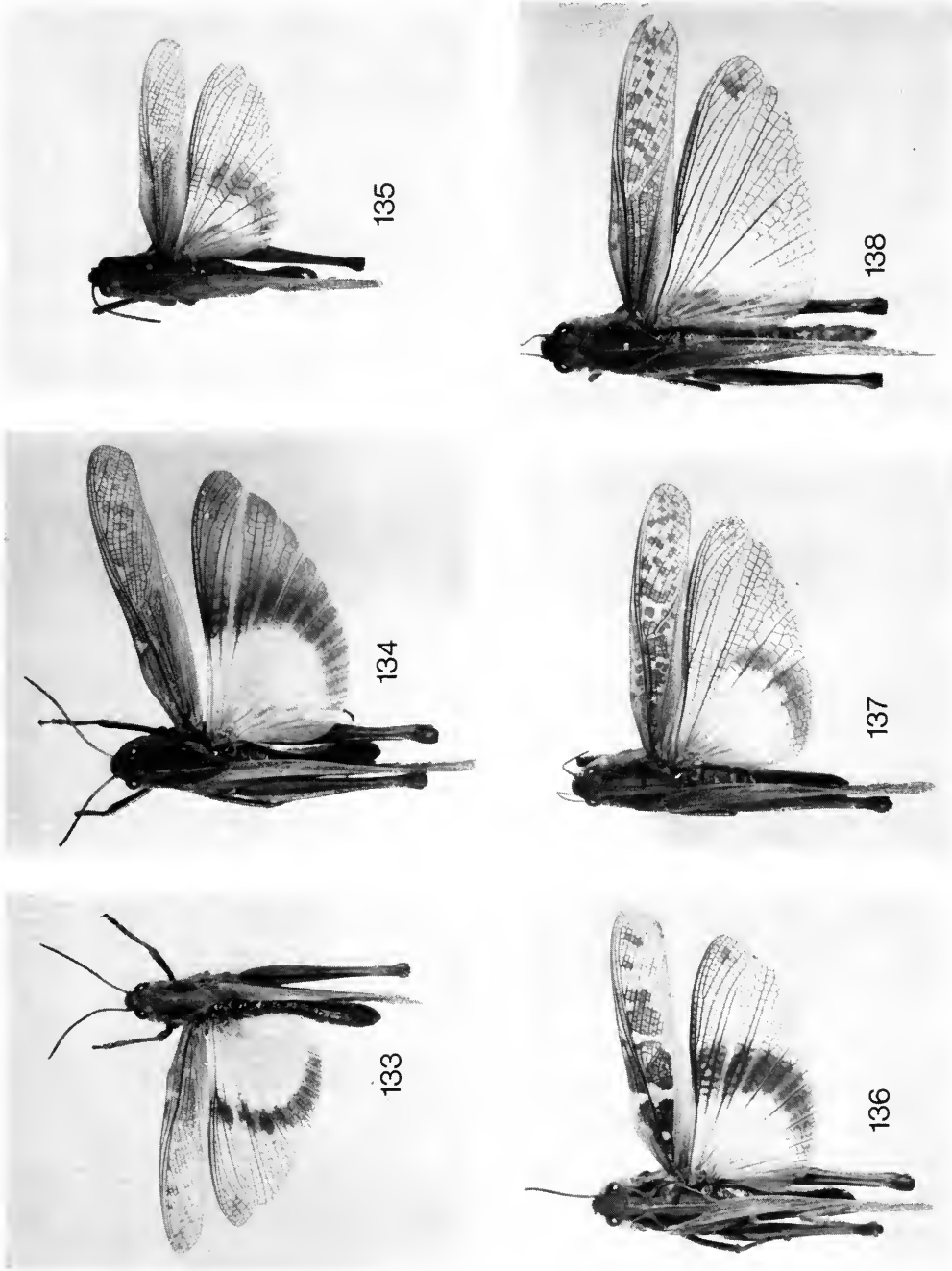


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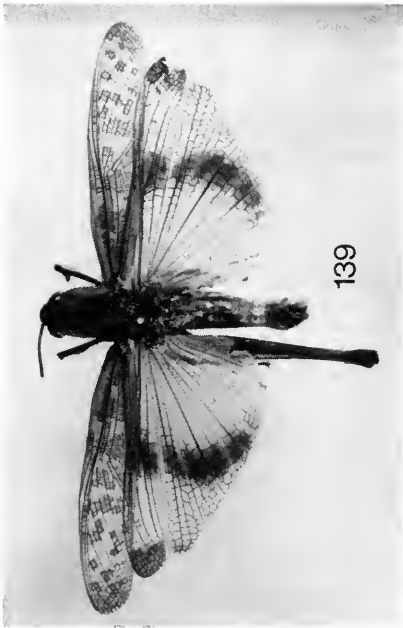


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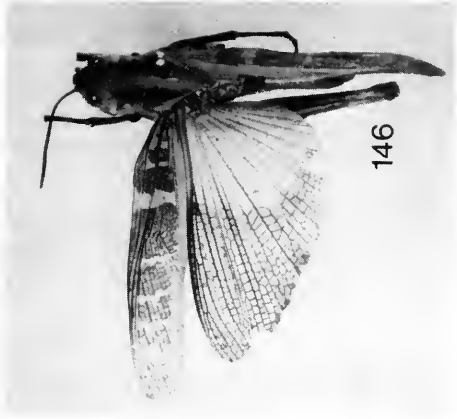


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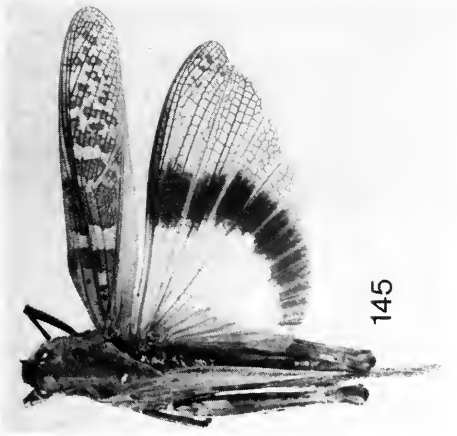
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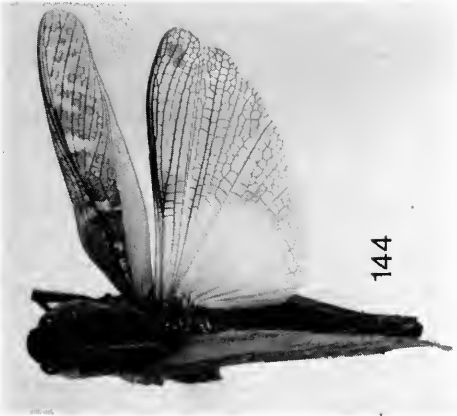
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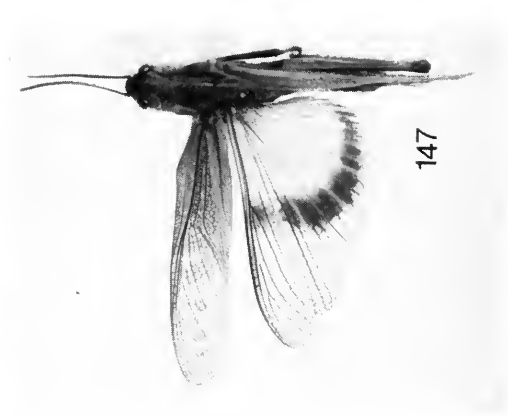
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