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DISTRIBUTION AND ECOLOGY OF *HYDRAENA* KUGELANN IN THE NETHERLANDS (COLEOPTERA: HYDRAENIDAE)

Cuppen, J. G. M., 1993. Distribution and ecology of *Hydraena* in The Netherlands. – Tijdschrift voor Entomologie 136: 1-10, figs. 1-16, tables 1-5. [ISSN 0040-7496]. Published 1 July 1993.

The distribution patterns of the species of the genus *Hydraena* in The Netherlands are figured. Their habitats are briefly described and compared with references. Physical/chemical data, phenologies and co-existence of species, based on observations by the author, are presented.
Hydraena species mainly living in stagnant waters have relatively wide distributional areas in The Netherlands. *Hydraena* species from running waters are confined to the most eastern and southern part of the country and some of them may have disappeared at the beginning of this century. Chlorinity explains best the different distribution patterns of the stagnant water *Hydraena*. All stagnant water species can co-exist and their phenology is more or less the same with a high (early) spring maximum and most often a (lower) autumn maximum, indicating an univoltine life cycle.

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Key words. – *Hydraena;* distribution maps; ecology; co-existence; The Netherlands.

Beetles of the genus *Hydraena* Kugelann are small water beetles (1.5-2.5 mm) characterised by parallel sides, club-shaped antennae and very long maxillary palps. Sexes can be distinguished easily as males have six visible abdominal sternites, while females have seven. Many species show secondary sexual differences, which sometimes offer useful characters for the identification of the species. Many species, however, can only be reliably identified in the male sex by their genitalia. In the past the study of genitalia has been neglected in The Netherlands owing to the lack of illustrated (Dutch) keys and by the former practice of relying entirely on external characters. An illustrated key to the Dutch species is now available (Cuppen 1992) to which one is referred for identification.

The present survey is the first covering all species of *Hydraena* in The Netherlands and gives distribution maps based on old records, which have been checked in relation with taxonomic uncertainties, and recently collected material. A survey of phenology and ecology is presented on the basis of literature and own field-work on mainly the stagnant water *Hydraena*.

Material and methods

The material of this study includes the collections of the National Museum of Natural History, Leiden (RMNH), the Zoological Museum, Amsterdam (ZMA), the Departments of Entomology and Nature Conservation of the Wageningen Agricultural University, and the private collections of H. Cuppen (Apeldoorn), B. Drost (Wadenoyen), G. van Ee (Haarlem), J. Huijbregts (Leidschendam), B. van Maanen (Wageningen), H. Vallenduuk (Boxtel), C. Visser (Wageningen), B. van Vondel (Hendrik-Ido-Ambacht), O. Vorst (Utrecht) and the author. Some data from the Provincial Water Authorities of Noord-Holland and Utrecht, and from the Research Institute for Nature Management are also included. The maps are based on specimens, identified by the author. For *Hydraena riparia* Kugelann, *Hydraena assimilis* Rey and *H. melas* Dalla Torre in the *H. riparia*-complex (see Jäch 1988), the maps are based on records of males only.

The distribution of the *Hydraena* species in The Netherlands is plotted in the 10 km-squares of the UTM-grid (figs. 1-12) in which small dots refer to records before 1950 and large dots to records since 1950.

On most localities visited by the author a water sample has been taken, which has been analysed the same or the next day on pH, electrical conductivity, chlorinity and total hardness. The results, viz. the ranges, 90% ranges and median values are presented in tables 1-4.

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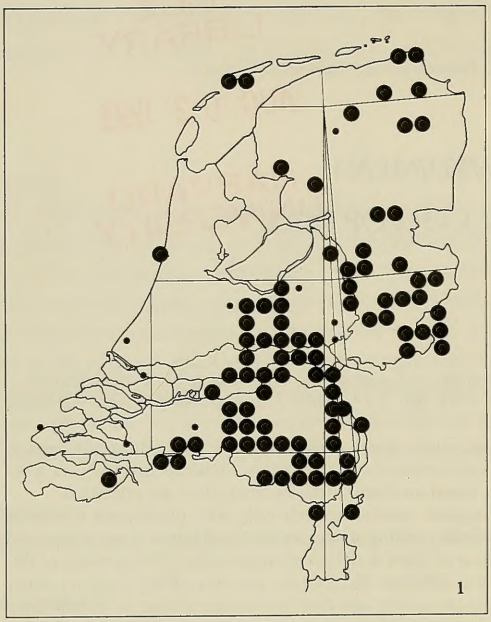
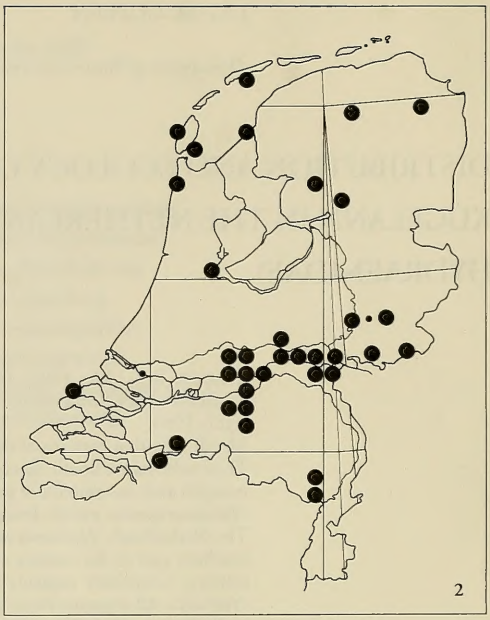
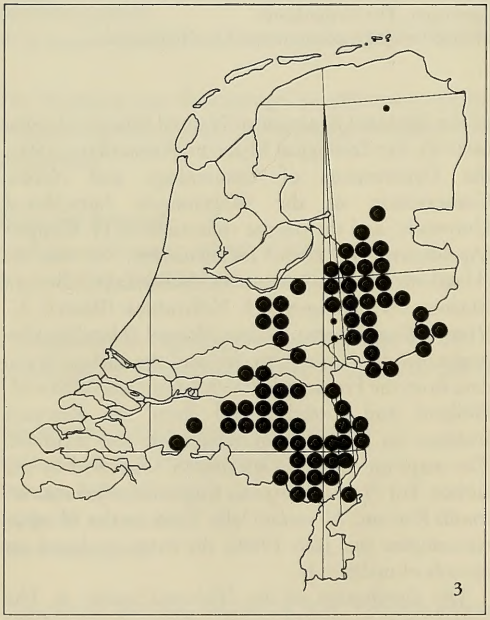
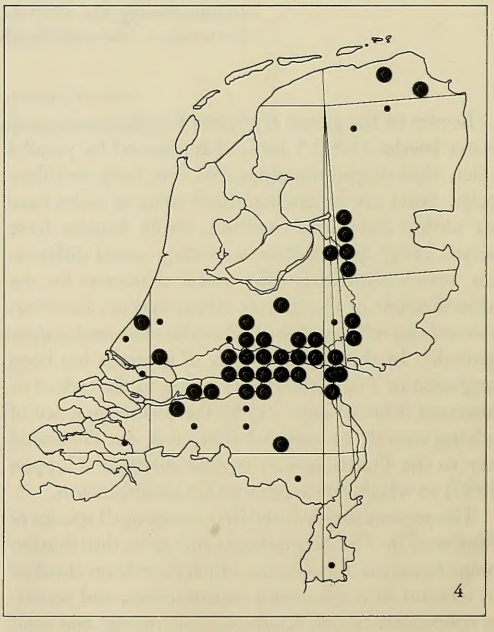








Figs. 1-4. Distribution of *Hydraena* species in the Netherlands. – 1, *Hydraena testacea* Curtis; 2, *Hydraena palustris* Erichson; 3, *Hydraena britteni* Joy; 4, *Hydraena riparia* Kugelann (males only).

Data on phenology and ecology are mainly based on the author's observations from The Netherlands and are compared with data from literature. Owing to the paucity of records for most species, statistical treatment of ecological data was not possible. For some species only old records are available and there is little information concerning ecology as labelling was insufficient in the past.

HABITAT AND DISTRIBUTION

All Dutch *Hydraena* species are widely distributed in Europe (Ienistea 1978, Hebauer 1980, Horion 1949, Berthélemy 1986, d'Orchymont 1925, Jäch 1988). Detailed distribution maps for *Hydraena*, using any grid system, are given by Nilsson (1984) for the northern part of Sweden (50 km-squares) and Foster (1990) for the British Isles (10 km-squares).

Relatively small on an European scale are the distribution areas of *H. assimilis*, *H. melas*, *H. belgica* d'Orchymont and *H. excisa* Kiesenwetter. The Dutch localities of *H. excisa* form an extreme western outpost of this eastern European species.

Running waters including spring-fed streams are confined to the southern, central and eastern part of The Netherlands and therefore many rheophilic species of *Hydraena* are restricted to these parts of the country. Stagnant waters, however, occur all over the country. Brackish waters are mainly found in the south-western and northern part of the country (and before 1950 also around the Zuiderzee). The sandy soils in the southern, central and eastern part of the country, and the coastal dune area have usually a chlorinity of less than 100 mg/l, while the clay soils in the western and northern part have a chlorinity of more than 50 mg/l and gradually pass into the brackish areas. The main soil types per 10 km UTM gridsquare are presented by Van Tol (1981).

NOTES PER SPECIES

H. testacea Curtis
(fig. 1).

This species is recorded from 89 squares since 1950 and additionally from 10 squares before 1950. It is the commonest species of the genus *Hydraena* in The Netherlands, collected mainly in the northern, eastern and southern part of the country. From the western part of the country there is only one recent record, apart from some pre 1950 records, despite large sampling programmes in recent years. The lack of records from Flevoland is probably due to undersampling. South-Limburg apparently has no proper habitats for this species.

Most records of *H. testacea* in the present investigation are from temporary, semi-permanent and permanent stagnant waters with a well developed marginal vegetation dominated by *Carex*, *Glyceria maxima* (Hartman) Holmberg, *Phragmites australis* (Cav.) Steudel, *Calamagrostis canescens* (Weber) Roth or *Juncus effusus* L. Certainly the marginal vegetation is not a necessity as the species was frequently found in waters without any marginal vegetation or with only a submerged vegetation. Also, in slowly running waters such as regulated streams, *H. testacea* occurs frequently. In fast running waters the species is extremely rare in The Netherlands. This species is generally mentioned from stagnant waters, often with a well developed marginal vegetation as well as slowly running waters (d'Orchymont 1925; Horion 1949; Hrbáček 1951; Balfour-Browne 1958). Derenne (1952) mentions its occurrence in slowly running waters dominated by algae. The occurrence in fast running waters is only mentioned by Cuppen (1985) and Horion (1949) in *Fontinalis* in clear mountainbrooks. The habitat investigations by the author fairly well agree with literature for this species.

H. palustris Erichson
(fig. 2).

This is an uncommon species recorded from 35 squares since 1950 and additionally from two squares before 1950. The general distribution pattern of *H. palustris* resembles that of *H. testacea*, but with much larger gaps and some isolated populations in the coastal dune area. The only area with a more or less continuous cover of squares is formed by the fresh water part of the river district.

With one exception (in a regulated stream), all Dutch records of *H. palustris* are from temporary, semi-permanent and permanent stagnant waters. The species prefers temporary and semi-permanent, overgrown ditches and pools with *Carex*, *Phragmites australis*, *Phalaris arundinacea* L., *Calamagrostis canescens* and *Glyceria maxima*, in which the soil is covered by organic debris of the dominant plants. Most localities are unshaded or only partly shaded by *Salix*. In permanent ponds, ditches and canals *H. palustris* has been found only where a well developed marginal vegetation of helophytes is present. Generally *H. palustris* is considered to be a species of stagnant waters (d'Orchymont 1925; Derenne 1952), which are covered by aquatic macrophytes (Horion 1949; Hebauer 1980) or mosses (Balfour-Browne 1958) as forestpools, fens, ponds and ditches. The rare occurrence in running water is only mentioned by Horion (1949) and Hebauer (1980). Hebauer (1980) mentions a preference for acid waters, which could not be confirmed in the present investigations.

H. britteni Joy
(fig. 3).

This species was recorded from The Netherlands from 18 squares in 1982 by Cuppen & Cuppen. At present this rather common species is known from 73 squares since 1950 and additionally from three squares before 1950. The low number of specimens in museum collections in comparison with other *Hydraena* species is very remarkable. The large increase of the number of records is caused by specific

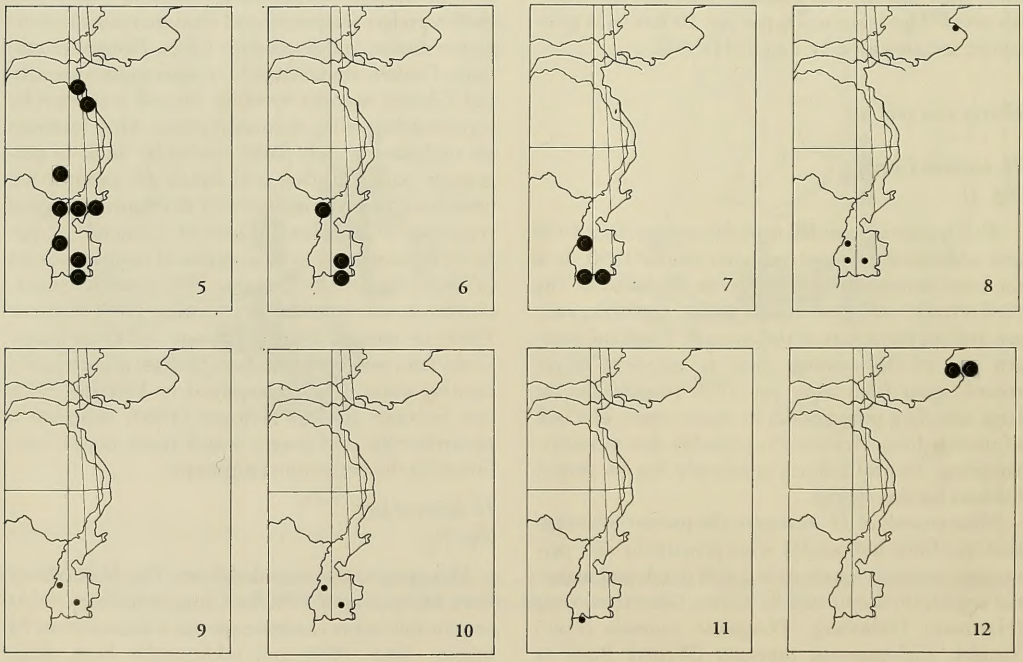
sampling in autumn, winter and early spring. *H. britteni* is confined to the southern and eastern part of the country with one old record from the province of Groningen (Haren; coll. ZMA). *H. britteni* fails in South-Limburg and occurs locally in the river area behind dikes of the rivers Rhine and Waal (Drost 1989). Records of *H. nigrita* by Everts (1898; 1922) belong to this species.

H. britteni is considered to inhabit smaller stagnant waters, such as vegetation-rich pools and ditches, often rich in mosses or with decaying leaves (Hrbáček 1951; Derenne 1952; Hebauer 1980; Nilsson 1984). Dutch habitats of *H. britteni* are characterized by Cuppen & Cuppen (1982) as temporary, weakly acid, stagnant waters with peaty soils covered by coarse organic debris. Such habitats are alder-brooks, forest-drains and -pools, marshes and swampy ditches dominated by *Phragmites australis, Phalaris arundinacea, Calamagrostis canescens, Glyceria maxima* or *Carex*. The acidophilic character of the habitat of *H. britteni* mentioned by Hebauer (1980) is confirmed above. The occurrence in a variety of running waters (Hebauer 1980; Balfour-Browne 1958), especially those with grassy edges in partial shade (Foster 1990) and cold springs (Nilsson 1984) is only confirmed for small sluggish streams receiving seepage-water. The incidental records in The Netherlands in larger streams most probably concern specimens that are washed out from their normal habitats during high water or flyers from habitats which have been dried out during the summer. There are some records of *H. britteni*, sifted from litter, in the summer period in dried out habitats (Vorst, pers. comm.). Landin (1976) mentions the presence of *H. britteni* and larvae of *Hydraena* above the water line.

H. riparia Kugelann
(fig. 4).

After the splitting up of *H. riparia* and *H. assimilis* by Jäch (1988), a comparison between literature and the present data is difficult. *H. riparia* is known from 38 squares since 1950 and additionally from 13 before 1950. The map gives only records of males and the species can be considered as rather common. Most records are confined to the river area with some recent records from the northern and western part of the country, and some old records from the south.

Jäch (1988) mentions *H. riparia* from very fast flowing streams and not in stagnant waters, while Nilsson (1984) mentions exposed lakeshores among



Figs. 5-12. Distribution of *Hydraena* species in The Netherlands. – 5, *Hydraena assimilis* Rey (males only); 6, *Hydraena melas* Dalla Torre (males only); 7, *Hydraena pygmaea* Waterhouse; 8, *Hydraena pulchella* Germar; 9, *Hydraena minutissima* Stephens; 10, *Hydraena gracilis* Germar; 11, *Hydraena belgica* d'Orchymont; 12, *Hydraena excisa* Kiesenwetter.

sand and gravel in Sweden. In England Balfour-Browne (1958) records the species from both stagnant and running waters. The Dutch data contradict the findings of Jäch (1988) and Nilsson (1984): there are no records of *H. riparia* in fast flowing waters nor on exposed lake shores. The species is mainly confined to stagnant waters and is occasionally found in slowly running, small streams. In fact most records are from temporary and semi-permanent habitats with a well developed vegetation of *Phragmites australis*, *Glyceria maxima* or *Carex* and soils covered by coarse organic debris or, in the case of running waters, small shady brooklets less than one meter wide. The occurrence in larger ditches and ponds has been found only when there exists a well developed marginal vegetation or, single specimens have been found, when the appropriate habitats are within close vicinity.

H. assimilis **Rey**
(fig. 5).

This very rare species is recorded from 9 squares since 1950 in the south-eastern part of the country (provinces of Limburg and Gelderland), but very probably some pre-1950 females from Limburg belong to this species. The map gives only records of males.

The few Dutch records of this species originate from small ditches and pools, receiving seepage-water, with or without vegetation, and from some small, relatively fast flowing streams. The only reference (Jäch 1988) mentions the same habitats as for *H. riparia* as the most probable.

H. melas **Dalla Torre**
(fig. 6).

This very rare species was recorded for the first time from The Netherlands by Cuppen (1981) from Beertsenhoven. There are additional records of single males from Epen (coll. RMNH and coll. O. Vorst) and the Middelsgraaf near Echt (coll. J. Cuppen).

The few Dutch records of *H. melas* are from spring-fed, small streams and, in one case, a larger, sun-exposed, slowly running stream. The references for *H. melas* are contradictory: Hrbáček (1951) and Hebauer (1980) mention preference for cold streams in mountainous areas, as well as acid ditches with much detritus in river valleys, while Jäch (1988) mentions mainly stagnant waters and small springs, but occasionally in larger streams and rivers.

[*H. nigrita* Germar]

The specimens from Warnsveld and Breda, mentioned by Everts (1898, 1922), are deposited in the RMNH-collection and appear to belong to *H. britteni*. For this reason *H. nigrita* has to be removed from the Dutch list.

H. pygmaea **Waterhouse**
(fig. 7).

This very rare species is recorded from three squares since 1950 in South-Limburg (Bunde, Epen, Houthem, Noorbeek en Cottessen) with the last record from 1991.

The few recent Dutch records of *H. pygmaea* are from small (width less than 1 m), relatively fast flowing streams, which are heavily shaded in one case and unshaded in two. Generally this species is confined to running waters in hills and mountains (Horion 1949; Hrbáček 1951; Derenne 1952; Balfour-Browne 1958). Apparently *H. pygmaea* prefers sites with aquatic mosses and periphyton on wires and boulders (Hebauer 1980, Foster 1990). Hebauer (1980) refers to the species as cold-stenotherm and crenophilic, confined to the upper courses of streams and rarely found in the middle course. The Dutch data confirm the restriction of *H. pygmaea* to the smallest streams.

H. pulchella **Germar**
(fig. 8).

Forty specimens of this very rare species were taken in four squares in South-Limburg and the vicinity of Winterswijk, all at the end of the 19th century or the beginning of the 20th century. A large series from 1921 (Wylre) represents the last record. *H. pulchella* is regarded to be extinct in The Netherlands.

The Dutch records of *H. pulchella* suggest that, in the past, this species mainly occurred in the larger, fast-flowing streams (rivers Geul, Gulp and Ratumse Beek). Generally *H. pulchella* is confined to running waters, especially mossy stones and grassy edges (Hrbáček 1951; Derenne 1952; Balfour-Browne 1958; Hebauer 1980). Foster (1990) mentions exposed muddy pools in a small stream with riffles and pools, and amongst fine tree roots in a clayey gorge in a river. In comparison with *H. pygmaea*, this species is more restricted to middle courses and open, exposed parts of a stream. Hebauer (1980) refers to it as a rheobiontic, eurythermous species.

H. minutissima **Stephens**
(fig. 9).

This very rare species is only known from two squares with 15 specimens altogether. The last record is from 1920 (Gulpen) and the species is regarded to be extinct in The Netherlands.

The few (old) records from The Netherlands probably all originate from the middle courses of the Geul and the Gulp, which are relatively fast flowing streams. Abroad this running water species has been found in small and large streams between gravel and aquatic mosses (Hrbáček 1951; Derenne 1952; Balfour-Browne 1958; Hebauer 1980; Valladares

1989). The distribution of *H. minutissima* seems to depend on strong current, rather than on temperature-regime (Hebauer 1980).

***H. gracilis* Germar**
(fig. 10)

There are only three specimens from two squares known from The Netherlands. A record from 1923 (coll. ZMA) is the last and the species is regarded to be extinct in The Netherlands. Most records of this species by Everts (1898, 1922) appear to belong to either *H. belgica* or *H. excisa.*

Generally *H. gracilis* is considered to be the most common running water *Hydraena* in western and central Europe, which occurs from the upper course till the lower course, as well in cold as in exposed streams and as well in mountains as on plains (Pretner 1930, Hebauer 1980, Valladares 1989). Also, with reference to the current velocity, the species shows a wide amplitude as Derenne (1952) even mentions stagnant waters. In these habitats the species can be found in mosses, under stones and in gravel (Horion 1949, Balfour-Browne 1958, Nilsson 1984). Despite this wide ecological amplitude *H. gracilis* has only been found twice in probably the middle and lower course of the Geul.

***H. belgica* d'Orchymont**
(fig. 11)

The only Dutch record is from the middle course of the Voer river (width of 3-5 m), probably from the beginning of the 20th century (coll. RMNH). No further details are known. *H. belgica* most probably no longer occurs in The Netherlands. Everts (1922) refers to these specimens as *H. gracilis.*

The habitat of *H. belgica* in The Netherlands corresponds with Derenne (1952), who simply refers to streams as its habitat. Hrbáček (1951) mentions small (shady) streams with a moderate slope.

***H. excisa* Kiesenwetter**
(fig. 12).

This very rare species is known from only two squares since 1950 in the vicinity of Winterswijk. Tolkamp (1980) lists *H. excisa* for the first time for The Netherlands, without mentioning it as an addition to the Dutch fauna. However, Everts (1898) already recorded *H. gracilis* var. *erosa* and var. *excisa* from Winterswijk, but the material could not be found in the museum collections. The first specimens from Winterswijk, labelled as *H. gracilis*, in these collections date from 1918 and all later references (Everts 1922, Laijendecker & Nieser 1971) belong to *H. excisa.*

The recent Dutch records are from the Ratumse Beek (width about 3-5 m with shaded and unshaded sections) and some smaller tributaries. The species has been found here amongst gravel in relatively fast flowing parts of the stream (Laijendecker & Nieser 1971, Tolkamp 1980). Elsewhere in Europe *H. excisa* occurs in small, shady streams with a moderate slope (Hrbáček 1951) or sun-exposed streams (Hebauer 1980). According to the latter author the species is not cold-stenotherm and has no preference with respect to calcium. Within the streams it can be found in mosses or between and under stones (Knie 1974; Hebauer 1980).

Table 1. Range, 90% range and median of observed pH-values on localities of *Hydraena* species in The Netherlands. N is the number of observations.

	range	90% range	median	N
Hydraena assimilis	6.3 - 9.0		6.8	6
Hydraena britteni	4.7 - 7.8	5.5 - 7.3	6.5	88
Hydraena melas	7.1 - 9.0			2
Hydraena palustris	3.5 - 9.2	5.3 - 7.7	6.8	45
Hydraena pygmaea	7.9			1
Hydraena riparia	3.3 - 8.3	6.2 - 7.8	7.0	174
Hydraena testacea	3.5 - 9.9	5.5 - 8.0	6.8	151

Physical and chemical data

The ranges of the observed pH-values (table 1) are large for most *Hydraena* species. However, the median values of pH for all frequently encountered *Hydraena* species are between 6.5 and 7.0, with 90% of the observed values within 1.3 pH-unit above or below the median pH of that species. *H. britteni* has the lowest median pH-value and *H. riparia* the highest. As the 90% ranges of pH for the different species considerably overlap and the median values are very close to each other, the pH can not be considered a very important factor for the explanation of the different geographic distribution patterns of these *Hydraena* species in The Netherlands.

Ranges for the values of the electrical conductivity (table 2) are very large for *H. riparia* and *H. testacea* and large for *H. britteni* and *H. palustris.* The 90% ranges for the most common species reduce the upper limit for electrical conductivity considerably with the smallest range for *H. britteni* and a larger, more or less the same, range for the other species. The median value of electrical conductivity is distinctly higher for *H. riparia* in comparison with the other species, which partly can be explained by the different distribution patterns of these species. However, also in this respect there is a considerable overlap in ranges.

Ranges, 90% ranges and median values of total hardness (table 3) are more or less the same for the common *Hydraena* species and certainly cannot explain their different geographic distribution patterns.

Table 2. Range, 90% range and median of observed values of electrical conductivity (µS cm^{-1}) on localities of *Hydraena* species in The Netherlands. N is the number of observations.

	range	90% range	median	N
Hydraena assimilis	330 - 710		490	6
Hydraena britteni	107 - 1260	192 - 730	450	88
Hydraena melas	420 - 620			2
Hydraena palustris	124 - 1590	150 - 1030	440	45
Hydraena pygmaea	580			1
Hydraena riparia	55 - 2030	228 - 1140	560	174
Hydraena testacea	87 - 2030	174 - 1030	460	151

Table 3. Range, 90% range and median of observed values for total hardness (°D) on localities of *Hydraena* species in The Netherlands. N is the number of observations.

	range	90% range	median	N
Hydraena assimilis	6 - 14		10	6
Hydraena britteni	1 - 23	3 - 16	8	46
Hydraena melas	9			1
Hydraena palustris	2 - 25	3 - 21	6	33
Hydraena riparia	1 - 26	4 - 21	9	77
Hydraena testacea	1 - 25	2 - 16	6	88

Based on only 6 observations, *H. assimilis* has a relatively small range with a high median value.

Of the four investigated parameters, chlorinity is the most informative with respect to the distribution patterns of *Hydraena* (table 4). All species are confined to fresh water with only one sample with a chlorinity of more than 200 mg/l for *H. britteni*, *H. palustris* and *H. testacea*, while for *H. riparia* there are five. Chlorinity is certainly highly responsible for the absence of *Hydraena* species in the western and northern part of the country of which the coastal dune area is excluded due to the presence of fresh waters. Median and 90% ranges of the most common *Hydraena* species are also in agreement with their general distribution patterns: *H. riparia* occurs mainly between the large river systems, *H. palustris* is scattered all over the country with the exception of brackish parts, *H. testacea* occurs on sandy soils in the eastern, southern and northern parts of the country and between the large rivers and *H. britteni* is mainly found on the sandy soils in the southern, central and eastern part of the country.

Table 4. Range, 90% range and median of Cl--values (mg l^{-1}) on localities of *Hydraena* species in The Netherlands. N is the number of observations.

	range	90% range	median	N
Hydraena assimilis	36.5 - 102.8		41.9	6
Hydraena britteni	6.8 - 270.0	14.5 - 92.7	36.5	88
Hydraena melas	19.8 - 41.9			2
Hydraena palustris	6.8 - 355.0	17.1 - 130.0	60.7	45
Hydraena pygmaea	19.6			1
Hydraena riparia	7.1 - 534.0	18.8 - 172.2	64.4	174
Hydraena testacea	6.9 - 492.4	16.6 - 126.3	49.2	151

CO-EXISTENCE

In table 5 the co-existence of five *Hydraena* species in The Netherlands is shown. The number of co-existences for each species exceeds the total number of occurrences because more than two species often co-exist. *H. assimilis* is found alone or in company with *H. testacea*. *H. britteni* lives most often alone or in co-existence with *H. testacea*. *H. palustris* lives most often in company with *H. riparia* and/or *H. testacea*, and only occasionally alone. *H. riparia* occurs most often alone, very frequently with *H. testacea* and frequently with *H. palustris*. *H. testacea* most often lives alone, very frequently with *H. riparia* and frequently with *H. britteni* and/or *H. palustris*.

Proportionally *H. britteni* is most often the only *Hydraena* species at a locality, indicating that its habitat requirements may be more exclusive than those of the other *Hydraena* species. *H. palustris* rarely occurs alone, and it shares its habitat quite often with *H. riparia* and/or *H. testacea*. *H. testacea*, though frequently occurring alone, co-exists quite often with all other *Hydraena* species, indicating that it can live in quite different habitats. *H. testacea* can be considered as the most euryoecious *Hydraena* species in The Netherlands.

Table 5. Association of *Hydraena* species in The Netherlands. N is the number of observations.

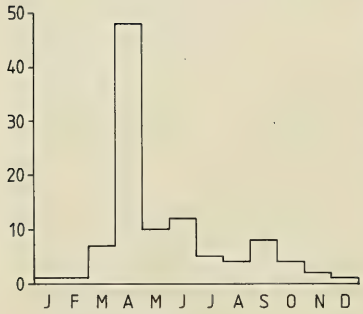
	N	Alone	with *H. assimilis*	with *H. britteni*	with *H. palustris*	with *H. riparia*	with *H. testacea*
Hydraena assimilis	10	4	–	2	–	1	6
Hydraena britteni	104	78	2	–	3	5	21
Hydraena palustris	52	11	–	3	–	28	19
Hydraena riparia	196	126	1	5	28	–	51
Hydraena testacea	164	82	6	21	19	51	–

Phenology

Phenological data at monthly intervals of adult *Hydraena* species are given for *H. palustris, H. britteni, H. riparia* and *H. testacea* (figs. 13-16). For the remaining species the number of records of adults is too low to present meaningful diagrams. Keys for the identification of the larvae of *Hydraena* are not available and the larvae of only very few *Hydraena* species have been described so far (Hrbáček, 1943-44). As the number of collected larvae of this genus is very low and the above mentioned species quite often coexist, it is impossible to include these data in the figures.

H. palustris has been collected throughout the year with a distinct maximum in April, which probably coincides with the breeding period. Cuppen (1983) reports a different phenology for *H. palustris* with a spring maximum in May and a (lower) autumn maximum in October. The same phenology was found by Landin (1976) in Lake Sagsjøn near Stockholm, though the autumn peak occurred in September. Adults in copula, however, have never been observed. Teneral adults have been observed between 7.viii and 18.xi, indicating a rather long emergence period, and without a clear autumn maximum. This type of life cycle agrees with life cycle type I of Nilsson (1986).

H. britteni can be collected throughout the year with clear maxima in March/April and November (the absence of records in January is certainly artificial). A similar phenology has been reported by Cuppen (1983) in a study of a population of *H. britteni* in a seepage-marsh near Apeldoorn (The Netherlands) during one year. Landin (1976) found a spring maximum in the beginning of May and a (lower) autumn maximum in September. The spring maximum coincides with the breeding period as many adults in copula have been observed between



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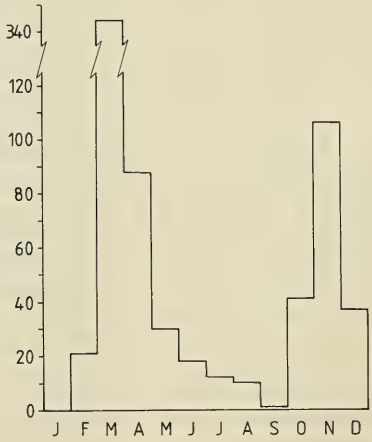

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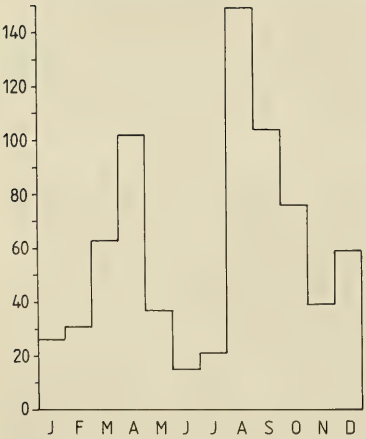

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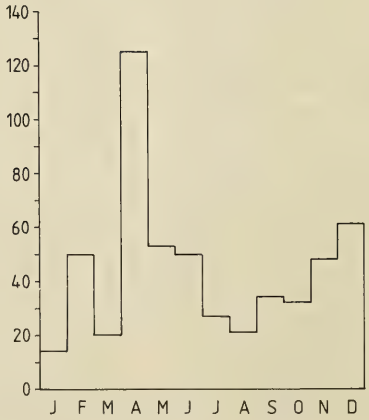

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Figs. 13-16. Number of specimens *Hydraena* species at monthly intervals. – 13, *Hydraena palustris* Erichson; 14, *Hydraena britteni* Joy; 15, *Hydraena riparia* Kugelann; 16, *Hydraena testacea* Curtis.

28.xii and 10.iv and the species can be considered as a winter breeder. Some pairs in copula even have been found in ice-covered pools. Teneral adults have been found in a very few occasions between 30.vii and 13.x before the November maximum. Cuppen (1983) mentions teneral adults in October and November. This low number of observations of teneral adults can be explained by the drying out of most habitats of *H. britteni* in the summer period. Adults probably leave their pupal chambers after the rising of the water level due to autumn rains, when they are already fully developed. The November maximum coincides with the filling up with water of the habitats of *H. britteni* during the period in which their gonads develop. This type of life cycle with winterbreeding is not mentioned by Nilsson (1986).

H. riparia has been collected throughout the year with two peaks in abundance in April and August/October. The spring maximum probably coincides with the breeding period but pairs in copula have been found only once on 4.iii. Teneral adults have been observed in great numbers between 23.vii and 13.xi (mainly August and the beginning of September), and therefore coinciding with the late summer maximum. The life cycle agrees with the life cycle type I of Nilsson (1986).

H. testacea has been collected quite evenly throughout the year with a maximum in April. This April maximum probably coincides with the breeding period though pairs in copula never have been found. Teneral adults have been found in abundance between 24.vii and 14.xi with a distinct maximum in September. Also in this species its life cycle is in agreement with type I of Nilsson (1986).

Based on the museum material, all other species have been collected mainly between May and September indicating more the activity of the collectors than the activity of the beetles. This also applies to the data for the above-mentioned species in the museum collections. The low number of records of *Hydraena* in museum collections is certainly partly based on the low activity of collectors in autumn, winter and spring.

Discussion

The various distribution patterns of *Hydraena* in The Netherlands are in the first place determined by stream-velocity or a parameter associated with it. Most species are rheophilic or rheobiontic and therefore confined to the southern and eastern part of The Netherlands. The maps suggest that nearly all species of this group are restricted to areas with fast running waters and do not occur in areas with more slowly running lowland streams. Paucity of recent records of these species permits no further conclusions about their preferred habitats. As running water species of *Hydraena* have no obvious morphological adaptations to that type of habitat it is difficult to judge which parameters are responsible for their restricted occurrence. A permanent high oxygen content of the water could be a main factor, as most species disappeared after pollution and subsequent decrease of oxygen.

For the stagnant water species chlorinity seems to be an important parameter for the explanation of their distribution patterns. All species are mainly restricted to waters with a chlorinity less than 200 mg/l. Other, less well known parameters, as soil type or the occurrence of seepage, probably also play an important role in their distributions. Quite often, however, two or three species can co-exist in the same locality, indicating that the different distribution patterns are not gouverned by the measured parameters.

Until 1991 twelve species of the genus *Hydraena* have been found in The Netherlands. Most of them, if not all, have been collected before 1950, but many of them were not recognized until recently after dissection of the male genitalia. From these twelve species only eight can be considered to occur at present in The Netherlands. *H. pulchella*, *H. minutissima*, *H. gracilis* and *H. belgica* have been collected for the last time at the beginning of this century and probably these species were confined to large streams as the Geul, Gulp, Voer (and Ratumse Beek) in the southern (and eastern) part of the country. Their disappearance is probably due to water pollution and, to a minor extent, to regulation of streams. Some of these species can, after improvement of water quality, return to The Netherlands from neighbouring streams in Belgium and Germany. However, colonisation power of *Hydraena* species seems to be limited. The remaining running water species (*H. melas*, *H. excisa*, *H. assimilis* and *H. pygmaea*) are all very rare and under serious threat. Especially *H. excisa*, which occupies an extreme western outpost in The Netherlands, will not easily return after extinction. The chances for survival of the other three species, which occur mainly in smaller streams or ditches receiving seepage-water, seem to be better, as most localities are situated in nature reserves. *Hydraena* species of stagnant waters are widely distributed and are not under threat. However, a decline of *H. testacea* and *H. riparia* in the western parts of The Netherlands is suggested by the available data.

Acknowledgements

This study would not have been possible without the many specimens, set at my disposal, from private and museum collections mentioned under material. Dr. G. N. Foster and anonymous referees are thanked for commenting on a first draft of this paper.

References

Balfour-Browne, F., 1958. British water beetles III. – Ray Society, London, 210 pp.

Berthélemy, C., 1986. Remarks on the genus *Hydraena* and revision of the subgenus *Phothydraena* (Coleoptera: Hydraenidae). – Annales de Limnologie 22: 181-193.

Cuppen, H. P. J. J., 1983. Een oecologisch onderzoek naar de macrofauna van een temporair kwelmoeras op de Oost-Veluwe. I. De waterkevers. – Regionale Milieuraad Oost-Veluwe, Apeldoorn, 17 pp.

Cuppen, J. G. M., 1981. *Hydraena bohemica* Hrbáček, nieuw voor België en Nederland (Coleoptera, Hydraenidae). – Phegea 9: 61-64.

Cuppen, J. G. M., 1985. Rediscovery of *Hydraena testacea* Curtis (Coleoptera: Hydraenidae) in Scotland. – Entomologist's Gazette 36: 181-182.

Cuppen, J. G. M., 1991. Genus *Hydraena* Kugelann. In: De waterkevers van Nederland (Coleoptera) (eds B. Drost, H. P. J. J. Cuppen, E. J. van Nieukerken & M. Schreijer). – Natuurhistorische Bibliotheek Koninklijke Nederlandse Natuurhistorische Vereniging 55: 280 pp.

Cuppen, J. G. M. & H. P. J. J. Cuppen, 1982. *Hydraena britteni* Joy new for The Netherlands (Coleoptera: Hydraenidae). – Entomologische Berichten, Amsterdam 42: 45-48.

Cuppen, J. G. M. & K. Dettner, 1987. The larvae of the predaceous water beetle *Laccornis oblongus* (Stephens) (Coleoptera: Dytiscidae), with notes on ecology and distribution. – Aquatic Insects 9: 211-220.

Derenne, E., 1952. Les *Hydraena* de Belgique. – Bulletin et Annales de la Société Entomologique de Belgique 88: 195-218.

Drost, M. B. P., 1989. *Helophorus croaticus* and *H. pumilio* in The Netherlands, with description of their larvae (Coleoptera: Hydrophilidae). – Entomologische Berichten, Amsterdam 49: 1-7.

Everts, E., 1898. Coleoptera Neerlandica. I.: i-viii, 1-676. – Nijhoff, 's Gravenhage.

Everts, E., 1922. Coleoptera Neerlandica. III.: i-xviii, 1-667. – Nijhoff, 's Gravenhage.

Foster, G. N., 1990. Atlas of British water beetles. Preliminary edition. Part 6. – Balfour-Browne Club Newsletter 48: 1-18.

Hebauer, F., 1980. Beitrag zur Faunistik und Ökologie der Elminthidae und Hydraenidae in Ostbayern (Coleoptera). Mitteilungen der Münchener Entomologischen Gesellschaft 69: 29-80.

Horion, A., 1949. Faunistik der Mitteleuropäischen Käfer II. – Vittorio Klostermann, Frankfurt am Main, 388 pp.

Hrbáček, J., 1943-44. O larvách rodu *Hydraena* (Coleoptera, Hydrophilidae). – Sbornik Entomologického Oddeleni Národniho Musea v Praze 21-22: 84-89.

Hrbáček, J., 1951. Revue des espèces du genre *Hydraena* Kug. sur le territoire de la république Tchecoslovaque (Col. Hydroph.). – Casopis Ceskoslovenske Spolecnosti Entomologická 48: 201-226.

Ienistea, M. A., 1978. Hydradephaga und Palpicornia. – In: Illies, J., Limnofauna Europaea. Gustav Fischer Verlag, Stuttgart, 532 pp.

Jäch, M. A., 1988. Revisional notes on the *Hydraena riparia* species complex (Coleoptera: Hydraenidae). – Aquatic Insects 10: 125-139.

Knie, J., 1974. Ein Beitrag zur Verbreitung und Ökologie von *Hydraena excisa* Kiesw. – Decheniana 127: 263-264.

Landin, J., 1976. Seasonal patterns in abundance of water beetles belonging to the Hydrophiloidea (Coleoptera). – Freshwater Biology 6: 89-108.

Laijendecker, G. & N. Nieser, 1971. Waterkevers en waterwantsen uit de omgeving van Winterswijk (Coleoptera et Heteroptera aquatica). – Entomologische Berichten, Amsterdam 31: 3-12.

Nilsson, A. N., 1984. The distribution of the aquatic beetle family Hydraenidae (Coleoptera) in northern Sweden, with an addenda to the Elmidae. – Fauna Norrlandica 4: 1-12.

Nilsson, A. N., 1986. Life cycles and habitats of the northern European Agabini (Coleoptera, Dytiscidae). – Entomologica Basiliensia 11: 391-417.

d'Orchymont, A., 1925. Les *Hydraena* de Belgique. – Bulletin et Annales de la Société Entomologique de Belgique 65: 45-53.

Pretner, E., 1930. Ueber die angebliche Variabilität der *Hydraena gracilis* Germar. – Coleopterologisches Zentralblatt 5: 81-105.

Tol, J. van, 1981. An introduction to The Netherlands. – Nieuwsbrief European Invertebrate Survey - Nederland 10: 5-12.

Tolkamp, H. H., 1980. Organism-substrate relationships in lowland streams: 1-211. Centre for Agricultural Publishing and Documentation, Wageningen.

Valladares, L. F., 1989. Los Palpicornia acuaticos de la provincia de Léon. II. *Hydraena* Kugelann, 1794 y *Limnebius* Leach, 1815 (Coleoptera: Hydraenidae). – Boletin de la Asociacion Española de Entomologia 13: 313-330.

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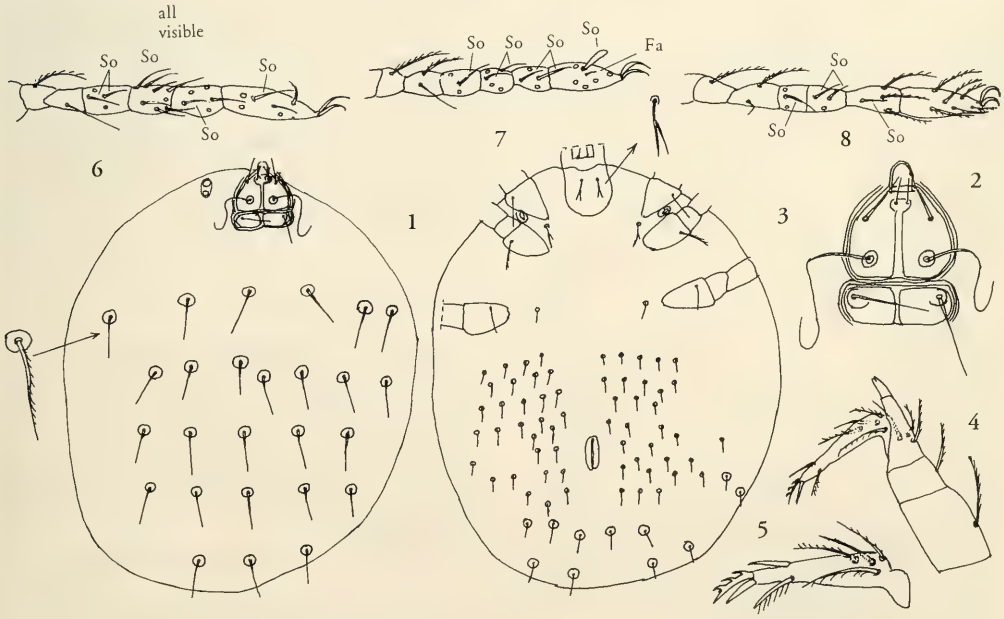
A NEW SPECIES OF THE GENUS *DIPLOTHROMBIUM* BERLESE (ACARI, PROSTIGMATA, JOHNSTONIANIDAE) FROM POLAND, BASED ON THE LARVA

Haitlinger, R., 1993. A new species of the genus *Diplothrombium* Berlese (Acari, Prostigmata, Johnstonianidae) from Poland, based on the larva. – Tijdschrift voor Entomologie 136: 11-13, figs. 1-8. [ISSN 0040-7496]. Published 1 July 1993.
Diplothrombium ludwinae sp. n. (larva) is described from Poland and a key is provided to the larval stages of the genus.
Dr. R. Haitlinger, Department of Zoology, Wroclaw Academy of Agriculture, ul. Cybulskiego 20, 50-205 Wroclaw, Poland.
Key words. – Acari, Johnstonianidae, new species, Poland.

The genus *Diplothrombium* Berlese was established in 1910. Since then, only four species based on larvae have been described, viz. *D. monoense* Newell, *D. cascadense* Newell, both from the U.S.A., *D. moldavicum* Feider from Romania and *D. newelli* Robaux from the U.S.A.(Newell 1957, Feider 1959, Robaux 1977, Southcott 1987). Larvae of *Diplothrombium* were found attached to aquatic beetles (Coleoptera) (Newell 1957) and Tipulidae (Diptera) (Feider 1959). Up to now, only one species was known from



Figs. 1-8. *Diplothrombium ludwinae* sp. n. -- 1, idiosoma, dorsal view; 2, scutum; 3, idiosoma, ventral view; 4, palp; 5, palp-tarsus; 6, leg I, tarsus-trochanter; 7, leg II, tarsus-trochanter; 8, leg III, tarsus-trochanter.

Table 1. Measurements in mμ of *Diplothrombium ludwinae* sp. n., larva, holotype.

Length of idiosoma	904
Width of idiosoma	752
Length of scutum	108
Width of scutum	76
Distance between bases of AL (AW)	46
Distance between bases of PL (PW).	56
Length of anterior scutala (AL)	42
Length of posterior scutala (PL)	60
Distance between ASE (SBa)	10
Distance between PSE (SBp)	40
Length of anterior sensilla (ASE)	16
Length of posterior sensilla (PSE)	134
Distance between ASE ans PSE (ISD)	38
Distance between AL and PL (AP)	48
Distance between AL and ASE (AAS)	20
Ocular sclerite	34
Length of dorsal setae (DS)	78-90
Coxala I	56
Coxala II	58
Coxala III	40
fd	44
gd	36
Ta I	104
Ti I	46
Ge I	44
Tf I	52
Bf I	46
Tr I	40
Cx I	88
Ta II	84
Ti II	44
Ge II	40
Tf II	40
Bf II	40
Tr II	34
Cx II	76
Ta III	92
Ti III	62
Ge III	46
Tf III	32
Bf III	62
Tr III	46
Cx III	86
Ta I (L) : Ta I (H)	3.25
Ti I : Ge I	1.04
Ti II : Ge II	1.10
Ta III : Ge III	2.00
AW : ISD	1.21
ISD : AP	0.79
Ti I : AW	1.00
Ti III : AW	1.35
AW : AL	1.09

Europe. In the present paper a new species is described from Poland, and a key to the larvae of *Diplothrombium* is provided. Terminology for setae and structures follows Southcott (1988). All measurements are in micrometers (μm).

Diplothrombium ludwinae sp. n.
(figs. 1-8)

Type material. – Holotype larva: Poland, Zawoja-Markowe, 800m (voi. Bielsko-Biala), 9.VI.1983, beech-coniferous forest from plants, leg. R. Haitlinger (in Museum of Natural History, Wroclaw University).

Description

Idiosoma longer than wide, oval, anterior part of idiosoma somewhat deformed. Dorsum with 27 barbed setae arranged in five rows: 6, 7, 6, 5 and 3; each setae placed on oval and small platelet (fig. 1). Eyes small. Scutum longer than wide; behind bases of PSE with transverse crista which divides scutum into unequal parts. Scutum with two pairs of scutalae (AL, PL); posterior setae PL longer than AL; further with two pairs of sensilla (ASE, PSE) from which posterior sensilla PSE many times longer than ASE. Between basis of ASE and posterior margin of scutum a longitudinal crista. All scutalae and sensilla smooth. Anterior margin with nasus (fig. 2). Ventral side of idiosoma with 74 setae, each placed on small platelet; posterior setae somewhat longer and placed on larger platelets. Anus located in middle part of opisthosoma. Two setae between coxae III.

Gnathosoma short, its base with two bifurcate setae. Palpfemur and palpgenu each with one barbed seta; palptibia with three setae, two of these are barbed. Palptarsus long and with eight setae, five of which are barbed (figs. 4, 5).

Legs short, length (including coxae, excluding claws): I 420, II 358, III 426; coxa I with one slightly barbed setae; medial coxala I bifurcate and separate from coxa; coxa II with one barbed seta; coxa III with one smooth seta. Tarsus II with enlarged solenidion and small famala. Number of solenidions and other setae on tibia, genu, telofemur, basifemur and trochanter: I - Ti 2 So + 6, Ge 7 So + 3, Tf 2 So + 4, Bf 1, Tr 1; II - Ti 2 So + 6, Ge 2 So + 4, Tf 1 So + 4, Bf 2, Tr 1; III - Ti 1 So + 6, Ge 2 So + 4, Tf 1 So + 3, Bf 2, Tr 1.

Measurements of holotype, see table 1.

Remarks. – *D. ludwinae* sp. n. is similar to *D. moldavicum* Feider and *D. cascadense* Newell. It can be distinguished from the first species by the absence of a transverse bar on scutum above the posterior sensilla, barbed coxalae II, shorter legs I-III and tarsi I-III, especially I and III; from the second species by the shape of the posterior part of the scutum and the smooth scutalae.

Etymology. – Name derived from Ludwina.

Key to species of *Diplothrombium* larvae

1. Scutum with three transverse bars, two of them placed before the bases of posterior scutal sensilla .....*D. moldavicum* Feider, 1959

– Scutum without transverse bars before the bases of posterior scutal sensilla 2
2. Scutum with longitudinal and transverse bars below the bases of posterior sensilla 3
– Scutum without transverse and longitudinal bars below the bases of posterior sensilla 4
3. Scutalae barbed, distance between bases of posterior scutalae PW distinctly larger than the distance between bases of anterior scutalae; AW = 1.85 .....*D. cascadense* Newell, 1957
– Scutalae smooth, distance between bases of posterior scutalae somewhat larger than the distance between bases of anterior scutalae; AW = 1.22.... .....*D. ludwinae* sp. n.
4. Medial coxala I separated from coxa, genua I with 8 solenidions .....*D. newelli* Robaux, 1977
– Medial coxala I on coxa I, genua I with 15 solenidions .....*D. monoense* Newell, 1957

References

Feider, Z., 1959. Prima specie a genului *Diplothrombium* (Acari) din R. P. R. si Europa sub forma de larva (*Diplothrombium moldavicum* n. sp.). – Academia R. P. R. Filiala Iasi Studii si Cercetari Stiintifice si Stiinte Agricole 10: 261-268.

Newell, I. M., 1957. Studies on the Johnstonianidae (Acari, Parasitengona). – Pacific Science 11: 396-466.

Robaux, P., 1977. Observations sur quelques Actinedida (=Prostigmates) du sol d'Amérique du Nord. IX. Nouvelles formes larvaires de trombidions (Acari). – Acarologia 19: 258-271.

Southcott, R. V., 1987. The classification of the mite families Trombellidae and Johnstonianidae and related groups, with the description of a new larva (Acarina: Trombellidae: *Nothrotrombidium*) from North America. – Transactions of the Royal Society of South Australia 111: 25-42.

Southcott, R. V., 1988. Two new larval mites (Acarina: Erythraeidae) ectoparasitic on north Queensland cicadas. – Records of the South Australian Museum 22: 103-116.

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BOOK REVIEW

Ossiannilsson, F., 1992. The Psylloidea (Homoptera) of Fennoscandia and Denmark. – Fauna Entomologica Scandinavica 26: 1-346, figs. 1-1415 + 1-9. [ISBN 90 04 09610 8]. Published by E. J. Brill, Leiden. Price NLG 180.00 (appr. USD 105.00).

The important series 'Fauna Entomologica Scandinavica', with much more relevance to other NW European countries than can be expected from the title, continues with another volume on Homoptera, viz. the Psylloidea. The author, F. Ossiannilsson, is a well-known specialist of this group and an author of Homoptera studies for more than fifty years. He also contributed earlier to this series with three volumes on the Auchenorrhyncha (1978-1983).

The present volume includes for each species synonymy, descriptions, including of larval stages, distributional data and biology. Especially from the biology paragraphs, it is clear that the author is able to summarize his knowledge, based on the literature and on his own experience as well, in a concise and yet easily readible form. Moreover, a wealth of original data are provided for many of the species.

Terminology is clearly explained in the introductory chapters, while various keys guide the reader to the names of families, subfamilies, genera and species. Not less than 1424 figures illustrate all kinds of relevant characters of the 98 species included.

Psyllids can cause, directly or indirectly, considerable damage to their host-plants, and some species are specific to host-plants of economic importance (carrot, pear). The present work is, therefore, not only strongly recommended to museums or amateur entomologists, but also to libraries of applied entomologists. Unfortunately, the publisher seems to discontinue his policy of producing this series for a reasonable price, although I certainly understand the connection with the limited number of copies that can be sold. Nonetheless, the price will inevitably affect the possibilities for the individual entomologist to purchase a personal copy.

[J. van Tol]

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Oxford University Museum, United Kingdom

STRONGYLOVELIA (VELIIDAE) AND *METROBATOPSIS* (GERRIDAE) AND ASSOCIATED PLEUSTON HEMIPTERA OF WEST NEW BRITAIN

I. Lansbury, 1993. *Strongylovelia* (Veliidae) and *Metrobatopsis* (Gerridae) and associated pleuston Hemiptera of West New Britain. – Tijdschrift voor Entomologie 136: 15-22, figs. 1-26 [ISSN 0040-7496]. Published 1 July 1993.
A brief survey of the pleuston bugs of the Von River, West New Britain are given. *Strongylovelia priori* sp. n. is described (Veliidae: Haloveliinae) with distributional data from other localities. Two species of *Rhagovelia* (Veliidae: Rhagoveliinae) are listed. *Metrobatopsis flavonotatus* Esaki (Gerridae) is described and figured as its specific identity is uncertain. Other gerrid genera and species are listed, viz. *Ptilomera*, *Limnometra* and *Tenagogonus*.
Dr. I. Lansbury, The University Museum, Parks Road, Oxford OX1 3PW, United Kingdom.
Key words. – Hemiptera; *Strongylovelia*; *Metrobatopsis*; New Britain; new species.

During a single visit to the Von River near Dami, West New Britain, the pleuston species diversity was found to be rather unusual as it included species characteristic of both lentic and lotic habitats. The river runs through a deeptly cut channel of what appears to be volcanic debris and silt. Substrate varying between coarse sand and gravel in slower shallow stretches and much deeper extremely fast stretches with large stone and boulders. The banks are steep, banded alternately with black layers and broader intervening pale brown bands of silt. The habitat is deeply shaded by overhanging secondary forest and in places a dense sub-shrub layer.

Supplementary data from other regions of Papua New Guinea are given for *Strongylovelia priori* sp. n., *Metrobatopsis flavonotatus* Esaki and other species of Veliidae and Gerridae. Data for *Rhagovelia* (Veliidae), *Ptilomera*, *Metrobatopsis* and possibly some species of *Tenagogonus* are found on slow-fast lotic habitats, whereas *Limnometra* species (all Gerridae) most commonly found on lentic habitats. Published data on *Strongylovelia* give no indication of habitat preferences.

Systematics

Veliidae, Haloveliinae

Strongylovelia priori sp. n.
(figs. 1-19, table 1)

Type material. – Holotype ♂: Papua New Guinea, West New Britain, Balima River near Ulamo, 19.viii.1989, R. N. B. Prior. – Paratypes (all Papua New Guinea, West New Britain): Von River, Banaule near Dami, 21.iii.1990, 12♀; Tamari Creek, freshwater/saline habitat, 11.xii.1988, R. N. B. Prior, 1♀. The holotype and a series of paratypes in OXUM, other paratypes in RMNH.

Description

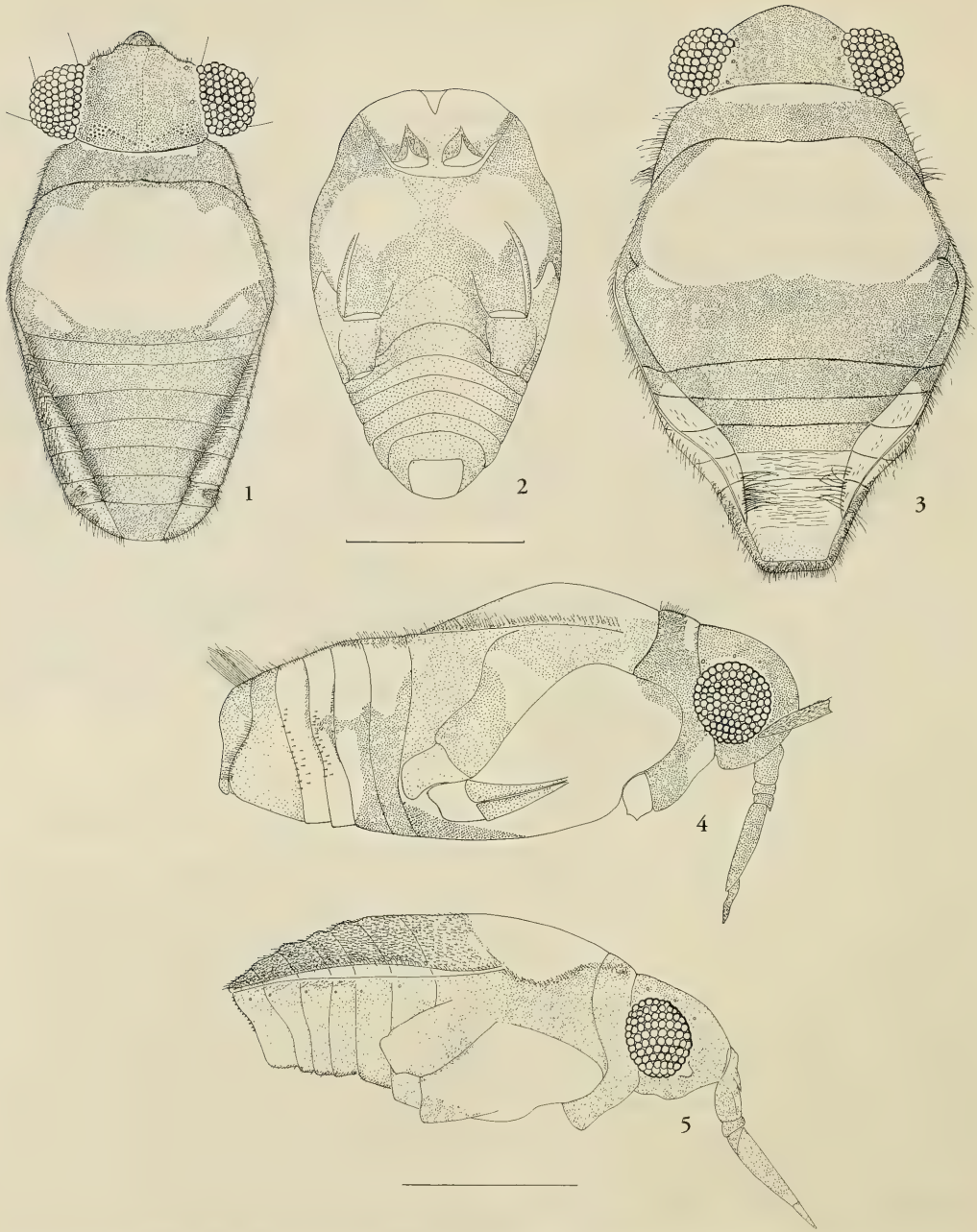
Adult apterous. Male 1.6 mm long, maximum width 0.77 mm, female 1.58-1.76 mm long, maximum width 0.86-0.99 mm.

Coloration. – Female: Head black, latero-posterior margins and cephalic trichobothria dark yellow tinged pale red. Eyes silvery grey. Antennae black, first segment ventrally pale yellow. Rostrum shining dark brown to black. Pronotum black, anterior margin narrowly pale yellow. Mesonotum broadly pale yellow, lateral margins black. Metanotum with two (1+1) yellow-orange blotches narrowly separated from yellow mesonotum. Anterior tergites uniformly black, distal tergites faintly iridescent. Connexivum posteriorly broadly pale yellow. Propleura narrowly black posterior of eyes, mesopleura broadly pale yellow with upper margin and most of metapleura black. Metasternum pale yellow. Sternites laterally yellow, posteriorly uniformly blackish-brown, ventrally black (fig. 3).

Legs: Front leg, trochanter and femur pale yellow, distally femur narrowly annulated dark brown. Inner margin of tibia anteriorly pale yellow, remainder and tarsi dark brown. Middle and hind legs black, trochanter and proximal part of hind femur pale yellow.

Male similar to female, but pale yellow pronotal band narrower. Meso and metanotum and meso and metapleura as in female. Tergites black, not iridescent posteriorly. Connexivum and sternites black.

Structure. – Female subovate, length 1.82x greatest



Figs. 1-5. *Strongylovelia priori* sp. n., 1-2, 5 holotype ♂, 3-4 paratype ♀. – 1, dorsal habitus; 2, ventral aspect; 3, dorsal habitus; 4, side view; 5, side view Scale line 0.5 mm.

width across thorax. Head length about 1.6x greatest width. Eye width about 0.4x width of head between eyes. Thoracic dorsum clearly raised above tergites (fig. 4). Mesonotum and metanotum with sparse adpressed pubescence. Pro and mesopleura with much longer prominent curled black pubescence. Apical tergites broad, covered with adpressed greyish pubescence, distal tergites less pilose, shining greenish iridescent. Connexivum clearly raised above tergites, apically sinuate, curving and more erect posteriorly. Connexivum with long black curled hairs. Viewed laterally, connexivum posteriorly with a cluster of erect black hairs (figs. 3-4).

Female genitalia (figs. 18-19). Tergum 8 large, first gonocoxae elongate. First gonapophyses distally with scattered prominent spines. Second gonapophyses

Figs. 6-9. *Strongylovelia priori* sp. n. – 6, holotype ♂, antenna; 7, same, hind leg; 8, paratype female, antenna; 9, same, hind leg. Scale line 0.5 mm.

connected by a lightly sclerotised bridge, distally with fringes of fine hairs. Proctiger viewed laterally elongate, subquadrate from dorsal aspect.

Male elongate, about 2x greatest width across thorax. Head length slightly less than greatest head width between eyes. Greatest eye width about 0.4x head width. Tergites slightly raised, connexivum continuous with tergites. Lateral margins of prothorax, tergites and connexivum covered with long hairs. Sternites not pilose with scattered minute spicules, more prominent and in organised row on distal segment (figs. 1, 2, 5).

Male genitalia (figs. 14-17): Genital segment hidden within abdomen and moderately sclerotised, proctiger prominent. Parameres symmetrical, viewed laterally long and slender, from dorsal aspect sinuate.

Legs: Male front femur moderately incrassate, tibia distally with a row of fine spinose hairs (fig. 10).

Table 1. Proportions of leg segments of *Strongylovelia priori* sp. n.

	Femur	Tibia	Tarsi I	Tarsi II
Male front leg	60	60	8	20
Female front leg	63	63	8	22
Male middle leg	130	108	44	25
Female middle leg	141	105	40	25
Male hind leg	87	77	13	20
Female hind leg	80	72	13	15

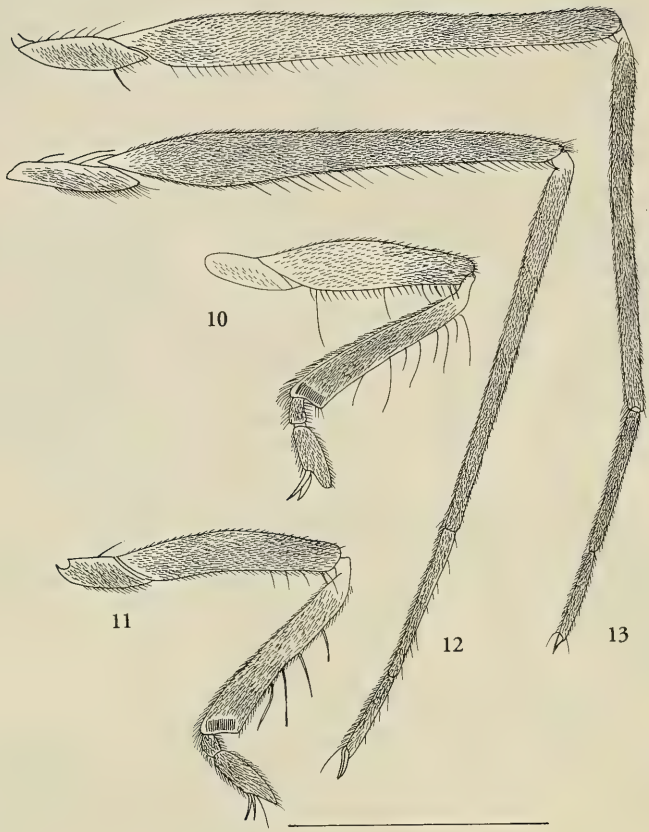
Middle femur about half length of male (21:41) (fig. 12). Hind femur slightly more robust than middle femur, ventrally with numerous long spine-like hairs (fig. 7). Female front femur slightly curved, tibia distally with a row of fine spinose hairs (fig. 11). Middle femur about half length of female (fig. 13). Hind femur not noticeably thicker than middle femur, ventrally fringed with fine hairs (fig. 13).

Antennal segments 1-4 male (fig. 6) 26 : 37 : 63 : 52. First segment about 0.66x head length, second segment very robust. Female segments 1-4 (fig. 8) 27 : 33 : 50 : 42. First segment just over half median head length.

Remarks

Strongylovelia priori sp. n. is similar in general appearance to *S. formosa* Esaki (1924) described from two females from Taihoku, Northern Formosa. The hind femora of *formosa* are almost entirely pale and the pronotum and connexivum of the female are uniformly dark brown to black. Lundblad (1933) figured the male of *formosa* from Central Sumatra, Singkarak. The parameres of *formosa* sensu Lundblad are proximally very broad compared with *priori*. Lundblad gives the relative lengths of male antennal segments 1-4 as 50 : 53 : 92 : 67. He states 'In his Figure 1, Esaki, has shown the 1st segment too short, because it has apparently been drawn from an antenna that has not been detached. The condyle is therefore not visible. In fact the 1st and 2nd segments agree so closely in their length that no differences can be detected except by measuring them'. Figures 6 and 8 of *priori* are drawn from slide mounted partially cleared preparations.

Esaki described a second species, *S. albicollis* from New Guinea, Erima, Astrolabe Bay, based on a apterous female 1.5 mm long and a macropterous female 2 mm long. The apterous *albicollis* is distinguished from *priori* by the broadly yellowish white pronotum and the two yellowish white blotches on the black mesonotum. The yellowish white coloration of part of the connexivum is similar to *priori*. The variation of coloration between male and females of



Figs. 10-13. *Strongylovelia priori* sp. n. – 10, holotype ♂, front leg; 11, paratype female, front leg; 12, holotype male, middle leg; 13, paratype female, middle leg. Scale line 0.5 mm.

Strongylovelia and iridescence of the distal tergites have not previosuly been commented upon. Andersen (1982) figures the apterous female of *S. formosa* and forewing of macropterous form showing the extreme reduction of the venation.

The longest series of *Strongylovelia* were collected from shaded moderately slow lotic stretches of the Von River, occurring with *Metrobatopsis* (Gerridae). Because of their small size, they were impossible to see on the surface of the river.

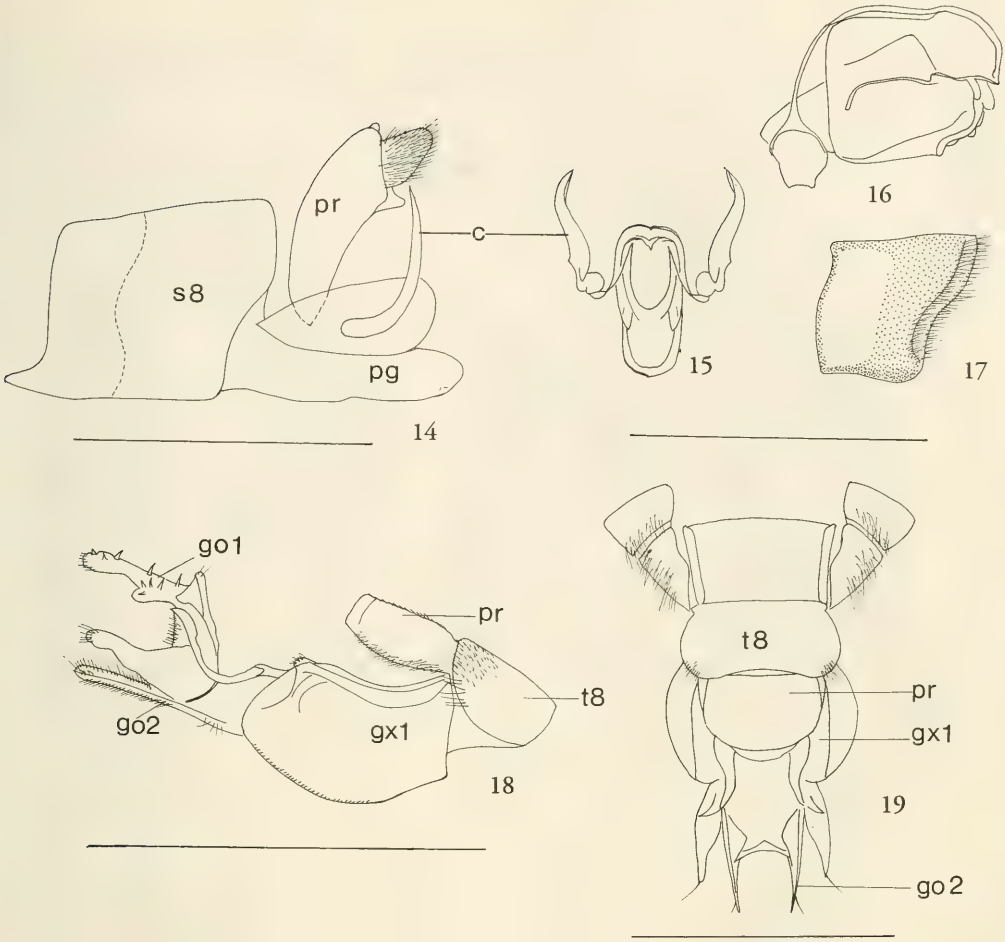
Etymology. – A noun in the genitive case. This elusive haloveline is dedicated to Dr. R. N. B. Prior for his invaluable assistance whilst in West New Britain and for the collections he made for me during his tenure at Kimbe, West New Britain.

Rhagoveliinae

Rhagovelia biroi Lundblad

Rhagovelia biroi Lundblad, 1936: 13-14: type series New Guinea, Erima, Astrolabe Bay and Stephansort and East New Britain, Herbertshöhe [Kokopo near Rabaul] in HNHM [not examined]; Polhemus & Polhemus 1988: 165.

Material. – Papua New Guinea, West New Britain, Von River, Banaule near Dami, 21.iii.1990, I. Lansbury, 17♂ 10♀, all apterous. This series were found principally along the margins amongst fallen branches. It is moderately common at Tamari, Bialla and Bilomi River, Kimbe Bay, West New Britain. Polhemus & Polhemus (1988) place *biroi* in the '*novacaledonica* group'.



Figs. 14-19. *Strongylovelia priori* sp. n., 14-17, holotype ♂ genitalia; 18-19, paratype female – 14, segment 8 and ancilliary structures, scale line 0.25 mm; 15, genital capsule dorsal aspect; 16, same, side view; 17, part of segment 8. (Abbreviations S8, 8th segment; Pr, proctiger; pg, pygophore; c, clasper (paramere)). – 18, side view of ovipositor; 19, dorsal aspect of ovipositor. (Abbreviations t8, tergite 8; gx1, first gonocoxa; go1-go2, first and second gonapophysis; pr, proctiger). Scale lines 0.5 mm.

Rhagovelia papuensis Lundblad

Rhagovelia papuensis Lundblad, 1936: 28-30: type series New Guinea, Erima, Astrolabe Bay and Stephansort and East New Britain, Herbertshöhe [Kokopo near Rabaul] in HNHM [not examined]; Andersen 1982: 152; Polhemus & Polhemus 1988: 165.

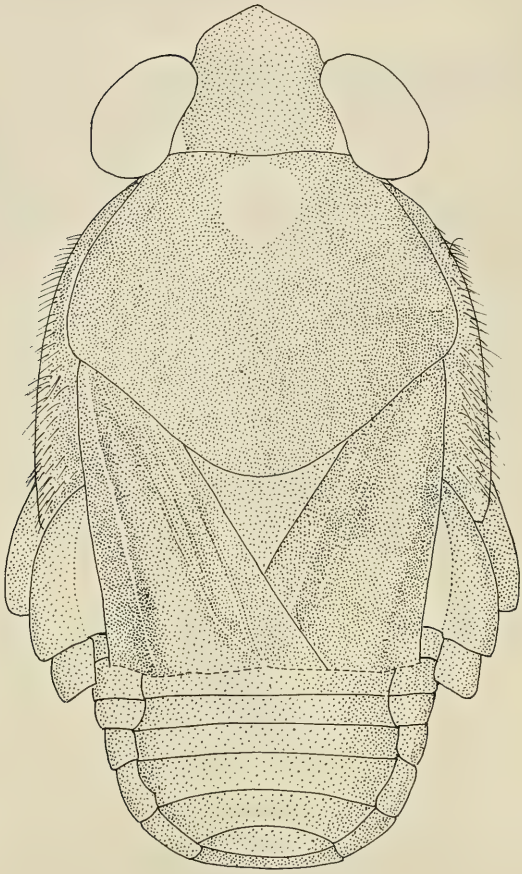
Material. – Papua New Guinea, West New Britain, Von River, Banaule near Dami, 21.iii.1990, I. Lansbury, 1♀ apterous. Found in small numbers at Tamari Creek and Balima River, Bialla where it was found in dense shade. Andersen (1982) figures the apterous male of *papuensis*. Polhemus & Polhemus (1988) include about twenty species in the '*papuensis* group', which includes also *R. australicus* Kirkaldy, an australian endemic found in the N. Queensland rain forest habitats.

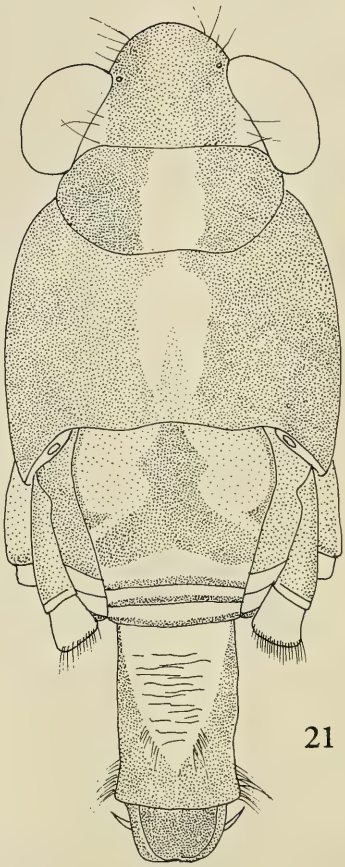
Gerridae, Trepobatinae

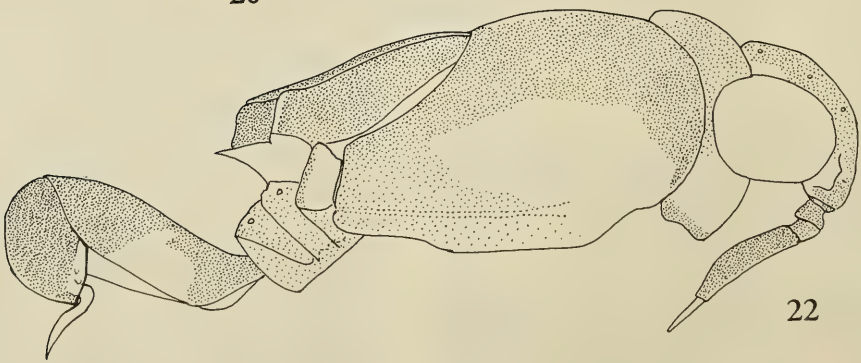
Metrobatopsis flavonotatus Esaki
(figs. 20-26)

M. flavonotatus Esaki, 1926: 144-146: type series New Guinea, Erima, Astrolabe Bay, in HNHM [not examined]; Hungerford & Matsuda 1959: 31-35 [lectotype ♂ designated]; Matsuda 1960: 367-371, 628-629.

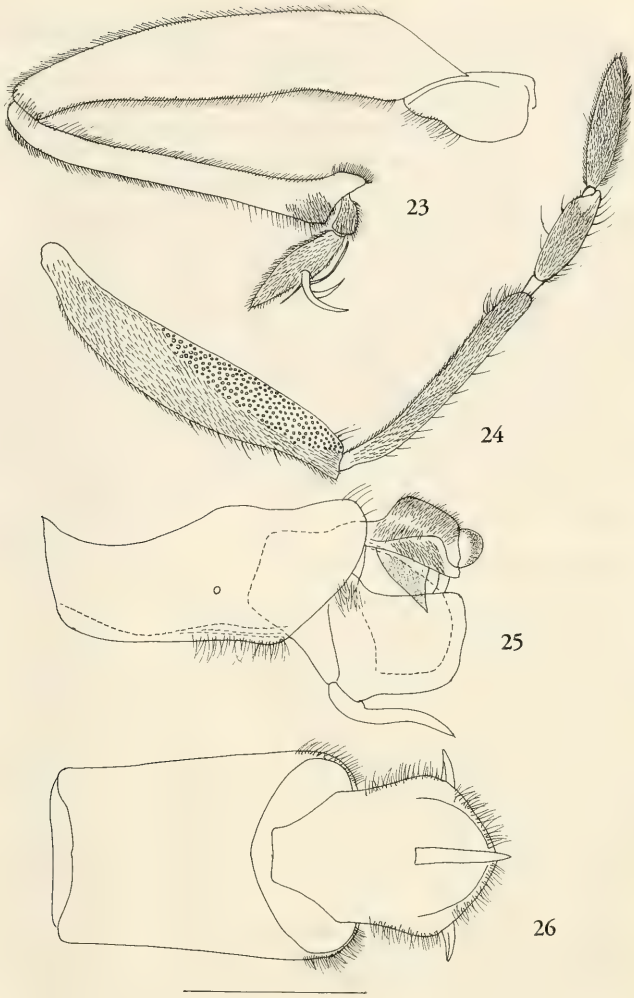
Material. – Papua New Guinea, West New Britain, Von River, Banaule near Dami, 21.iii.1990, I. Lansbury, 13♂ 1♀ apterous, 1♀ macropterous and immatures; New Hanover, Lavonga Mission, small freshwater stream, 31.x.1989, R. N. B. Prior, 4♂ 2♀ apterous and numerous immatures.







Figs. 20-22. *Metrobatopsis flavonotatus* Esaki. – 20, macropterous female; 21, apterous male, dorsal habitus; 22, apterous male, side view. Scale line 1 mm.



Figs. 23-26. *Metrobatopsis flavonotatus* Esaki, male. – 23, front leg; 24, antennae; 25, genital capsule side view; 26, genital segment, ventral aspect.

Esaki (1926) and Hungerford & Matsuda (1959) describe the variation in colour pattern and general structural features, the latter describing the male genitalia. The series from West New Britain and New Hanover differ slightly in the structure of the male genitalia.

Description. – Adult apterous. Male 2.34-2.64 mm long, maximum width 1.0-1.1 mm; females including macropterous form with damaged wings (fig. 20) 2.6 mm long, 1.32 mm wide.

Coloration: Male. Head, pronotum and mesonotum velvety black. Basal inner margin of head adjacent to eyes reddish brown. Pronotum and mesonotum with a prominent pale yellow longitudinal stripe, distal margin of mesonotal stripe evanescent blue. Metanotum, tergites, connexivum and metacetabulae velvety black with bluish evanescent patches, very noticeable on metanotum and tergites. Genital segments black, proximally iridescent blue, lateral margins pale yellow (figs. 21-22). Pro and mesopleura pale yellow, distally the latter black overlaid with iridescent blue. Lateral margins of sternites blackish brown becoming paler ventrally. Genital segment ventrally pale yellow, distally black. Process of pygophore, suranal plate and paired processes shining black. Antennae black, proximal third of first segment pale yellow. The pale band is much more conspicuous when the gerrid is alive, likewise the proximal pale yellow band on front femur. Trochanter of middle and hind legs pale yellow, remainder of legs black.

Macropterous female (fig. 20) similar to male. Pronotum with a yellowish patch antero-mesially. Remnants of wings dark brown, venation black.

Male structure. Antennal segments 1-4 (fig. 24) 39.5 : 25 : 11.5 : 14. The ratios agree with Hungerford & Matsuda (1959); they are however, rather more robust than those of the the female, contrary to Hungerford & Matsuda (1959). The inner median and distal surface of first segment with an area of pit-like structures. Front leg (fig. 23) femur proximally robust, narrowing distally, tibia with a very prominent blunt pilose projection distally. Eighth segment long, laterally slightly sinuate, but not constricted as figured by Hungerford & Matsuda (1959), but does resemble figure by Matsuda (1960). Segment dorso-anteriorly with transverse striations (fig. 21). Ninth segment (figs. 25-26) with a prominent curved process usually ventrally but in some males the process is in a latero-ventral position. Suranal plate with a pair of sharply acuminate processes usually not visible (fig. 25).

Gerrinae

Tenagogonus (*T.*) *kampaspe* (Kirkaldy)

Gerris kampaspe Kirkaldy, 1900: 804: type series New Guinea, Rigo and Kellesi in SNOW [not examined].
Limnometra kampaspe; Lundblad 1933: 371 [listed].
Tenagogonus kampaspe; Hungerford & Matsuda 1958: 386-388 [redescription, locality Dilo Loria, vi, vii. 90]; Matsuda 1960: 212, 501 [species groups].

Material. – Papua New Guinea, Milne Bay Province, Naura, lotic stony river, 29.ix.1989, R. N. B. Prior, 1♂ macropterous; West New Britain, Von River, Banaule near Dami, 21.iii.1990, I. Lansbury, 3♀ apterous. Overall length of male including wings 5.39 mm, apterous female between 5.8-6.0 mm long.

Limnometra monochroma Nieser & Chen

Limnometra monochroma Nieser & Chen, 1992: 21-23.

Material (type series). – Papua New Guinea, West New Britain, Buluma nr Dami, rain water pit, 17.i.1989, R. N. B. Prior, 2♂ 1♀ (incl. 1♂ holotype) (OXUM); West New Britain, Von River, Banaule near Dami, torrential habitat, 21.iii.1990, I. Lansbury, 2♀ (OXUM).

Ptilomerinae

Ptilomera breddeni Hungerford & Matsuda

Ptilomera breddeni Hungerford & Matsuda, 1965: 451-454: types New Guinea, SE Haveri; SE Paumenu River; Milne Bay (SNOW); Andersen 1982: 183, 191, 211.

Material. – Papua New Guinea, West New Britain, Von River, Banaule near Dami, 21.iii.1990, I. Lansbury, 1♂ macropterous, 10♂ 10♀ apterous. Collected in small numbers on faster stretches and easily able to evade capture.

References

Andersen, N. M., 1982. The semiaquatic bugs (Hemiptera Gerromorpha). – Entomonograph 3: 1-455, figs.

Esaki, T., 1924. On a new genus and species of the Gerridae from Formosa. – Annals Entomological Society of America 17: 228-230.

Esaki, T., 1926. The water-striders of the subfamily Halobatinae in the Hungarian National Museum. – Annales Musei Nationalis Hungarici 23: 117-164.

Hungerford, H. B. & R. Matsuda, 1958. The *Tenagogonus* - *Limnometra* complex of the Gerridae. – University of Kansas Science Bulletin 39: 371-457.

Hungerford, H. B. & R. Matsuda, 1959. Concerning the genus *Metrobatopsis* Esaki with descriptions of a new species (Heteroptera: Geriidae). – Bulletin Brooklyn Entomological Society 44: 29-36.

Hungerford, H. B. & R. Matsuda, 1965. The genus *Ptilomera* Amyot and Serville (Gerridae: Hemiptera). – University of Kansas Science Bulletin 45: 397-515.

Kirkaldy, G. W., 1900. On some Rhynchota, principally from New Guinea (Amphibicorisae and Notonectidae). – Annali del Museo Civico di Storia Naturale G. Doria 20: 804-810.

Lundblad, O., 1933. Zur Kenntnis der aquatilen und semiaquatilen Hemipteren von Sumatra, Java and Bali. – Archiv für Hydrobiologie, Supplement 12: 1-195, 263-489, pls. 1-21, figs. 1-142.

Lundblad, O., 1936. Die altweltlichen Arten der Velidengattungen *Rhagovelia* and *Tetraripis*. – Arkiv för Zoologi 28A: 1-63.

Matsuda, R., 1960. Morphology, evolution and a classification of the Gerridae (Hemiptera-Heteroptera). – University of Kansas Science Bulletin 41: 25-632.

Nieser, N. & P. Chen, 1992. Revision of *Limnometra* Mayr (Gerridae) in the Malay Archipelago. Notes on Malesian aquatic and semiaquatic bugs (Heteroptera), II. – Tijdschrift voor Entomologie 135: 11-26, figs. 1-60, tab. 1

Polhemus, J. T. & D. A. Polhemus, 1988. Zoogeography, ecology and systematics of the genus *Rhagovelia* Mayr (Heteroptera: Veliidae) in Borneo, Celebes and the Moluccas. – Insecta Mundi 2: 161-230.

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RHAGOVELIA OF PAPUA NEW GUINEA, SOLOMON ISLANDS AND AUSTRALIA (HEMIPTERA-VELIIDAE)

Lansbury, I., 1993. *Rhagovelia* of Papua New Guinea, Solomon Islands and Australia (Hemiptera-Veliidae). – Tijdschrift voor Entomologie 136: 23-54, figs. 1-150, tables 1-26. [ISSN 0040-7496]. Published 1 July 1993.
Three species of *Rhagovelia* are known from 'New Guinea'. *R. papuensis* Lundblad and *R. biroi* Lundblad are redescribed and figured. *R. peggiae* Kirkaldy is only known by the apterous female from Moroka and remains unrecognised at present.
New species described from Papua New Guinea, *R. priori* sp. n.; *R. hirsuta sp.* n.; *R. aureospicata* sp. n.; *R. herzogensis* sp. n.; *R. crinita* sp. n.; *R. thysanotos* sp. n. and *R. caesius* sp. n. No records have so far been published of *Rhagovelia* from the Solomon Islands, *R. browni* sp. n. described from Guadacanal; *R. amnicus* sp. n. and *R. fulvus* sp. n. described from Malaita.
I. Lansbury, Hope Entomological Collections, University Museum, Oxford, OX1 3PW, United Kingdom.
Key words. – Papua New Guinea; Solomon Islands; Veliidae; *Rhagovelia*; key; new species.

The *Rhagovelia* (Veliidae) are highly specialised pleuston bugs of lotic waters throughout most of the tropics. Andersen (1982) describes the general morphology and biology of *Rhagovelia*. Polhemus & Polhemus (1988) discuss the relative merits of various interpretations of the thoracic and abdominal structure and their interpretation is followed in this review.

The *Rhagovelia* of the 'northern' region of Papua New Guinea described in this review are from West Sepik (Torricelli Mountains), Madang, Eastern Highlands, Morobe, Oro or Northern, Milne Bay and West Britain Provinces. Additionally series from Malaita and Guadalcanal (Solomon Islands) are included.

Lundblad (1936) described *R. papuensis* and *R. biroi* from Madang and East New Britain Provinces. Kirkaldy (1901, 1908) described *R. peggiae* and *R. australica* from Papua New Guinea and Australia, north Queensland, respectively. Polhemus & Polhemus (1988) revised the genus from Borneo, Celebes and the Moluccas adding 26 new species. They divided the *Rhagovelia* of the region into eight monophyletic infrageneric species groups using wing venation, thoracic morphology of macropterous forms and genitalia, and included some extralimital species in their groups. Of the taxa included in this review, *R. papuensis, R. biroi* Lundblad, *R. amnicus* sp. n., *R. browni* sp. n., *R. herzogensis* sp. n. and *R. caesius* sp. n. are known by both macropterous and the more common apterous forms. The remaining species described are only known by the apterous form.

The Papua New Guinea species are tentatively assigned to the 'Polhemus'-groups (1988):

Papuensis-group: broadly characterised by the greatly enlarged pronotum covering all but the posterior margin of the mesonotum. Included species *R. papuensis* Lundblad and *R. priori* sp. n. Additional species from the Solomon Islands *R. fulvus* sp. n., *R. browni* sp. n. and *R. amnicus* sp. n., and the australian endemic *R. australica* Kirkaldy.

Bacanensis-group: Polhemus & Polhemus (1988) suggest that this group is closely allied to the *papuensis*-group. The forewing venation is similar to *R. papuensis*. Included species *R. herzogensis* sp. n., and also *R. aureospicata* sp. n., as the apterous males of *R. herzogensis* and *R. aureospicata* are similar. The females are much easier to distinguish. The dark areas of the dorsum of both sexes having prominent fields of golden or silvery spicules.

Novacaledonica-group. Included species *R. novacaledonica* Lundblad, *R. biroi* Lundblad and possibly *R. hirsuta* sp. n. may belong to this group. As defined by Polhemus and Polhemus (1988) macropterous forms have four closed cells and an adventitious fifth cell on the forewing. The *R. biroi* from Papua New Guinea examined in this study agree in all respects with Lundblad's original description of the apterous form, but the forewing venation differs considerably from that figured by Polhemus & Polhemus (1988).

Rhagovelia crinita sp. n. and *R. thysanotos* sp. n. differ from other known species from Papua New Guinea. The male front tibiae are explanate with a cluster of long hairs / spines along the inner margin. Neither species is known by the macropterous form. Both have short pronotums compared with the me-

sonotum, the males are dorsally hairy and the genital capsules are very large. The female distal tergites are laterally variably pilose and the 8th and 9th abdominal segments are sharply depressed.

Rhagovelia caesius sp. n. Polhemus & Polhemus (1988: 167) comment on this group in northern New Guinea and mention another species from Negros in the central Philippines. Data relating to material collected by R. N. B. Prior suggests that *R. caesius* is found in slow flowing habitats in shady areas. It is a remarkable species which differs from other Papua New Guinea *Rhagovelia* by the absence of prominent projections on the hind femora of both sexes. Unlike other species, *caesius* is sexually dimorphic. The males dorsally are covered with long hairs, the females finely tumescent, lacking long hairs. Females are abnormally flattened compared with males. The males riding on the females, such phoretic behaviour has not been observed in other *Rhagovelia* species. There is some doubt that *caesius* can be included in the same section of *Rhagovelia* s.s. as other species from this region of Papua New Guinea.

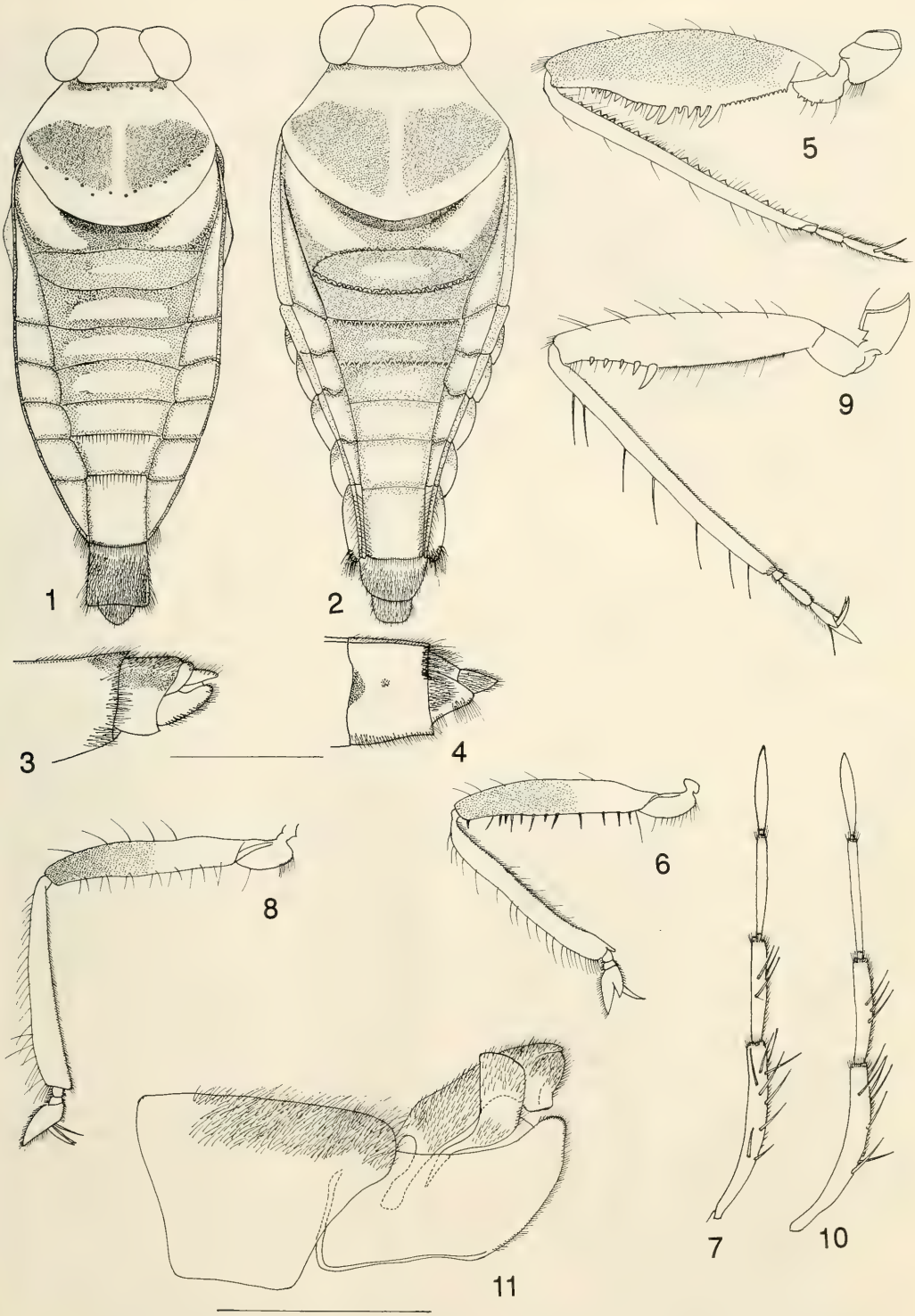
Kirkaldy (1901) described *Rhagovelia peggiae*, 'Type' apterous female from Central Province, Moroko [sometimes Meroka] 1300 m, 7.xi.1893, Loria. The type is thought to be in Genoa (MCSN). It is described as being very hairy and pubescent. Pronotum distinctly sutured from mesonotum, this suggests that the mesonotum may be longer than pronotum. Anterior margin of prontum yellow other than lateral margins. The hind femora are 'blue-greenish lustre'. The connexivum is much reflexed inwards, meeting about the apex of the 7th connexival segment and continuing in contact up to the apex [somewhat as in *R. distincta* Champion, except that they do not diverge after meeting]. The description suggests that *peggiae* shares some features with *hirsuta* sp. n.

A key to species excluding *R. peggiae* is given which will only work for apterous forms of both sexes. The australian endemic *R. australica* Kirkaldy is included in the key.

Key to the species of *Rhagovelia* of Papua New Guinea, Solomon Islands and Australia

1. Pronotum covering all but a transverse narrow band of mesonotum (figs. 39, 63, 69) 2
– Median pronotal length shorter than median length of mesonotum (figs. 73, 84) 7
2. Pro-mesopleura and proepisternum bare lacking fields of minute black spicules *australica* Kirkaldy
– Areas of propleura, pro-meso and metasternum and jugum or lateral margins of pro-meso and metanotum with fields of black spicules 3
3. Anterior lateral margins of pro-meso and metanotum with fields of black spicules 4
– Anterior lateral margins of pro-meso and metanotum lacking fields of black spicules 6
4. Pronotum anteriorly with a pale transverse band. First antennal segment proximally pale, remainder black. Connexivum and tergites dark brown-black 5
– Pronotum more or less uniformly coloured, pale anterior band obsolete, antennae pale, connexivum and tergites pale .....*fulvus* sp. n.
5. Sternites 2-5 with scattered black spicules, male connexivum either slightly reflexed outwards or almost erect (fig. 51). Female connexivum sinuate (fig. 59) .....*browni* sp. n.
– First two visible sternites with black spicules, male connexivum anteriorly flattened, distally reflexed (fig. 39). Female connexivum reflexed over tergites 5-7 (fig. 47) .....*amnicus* sp. n.
6. Males 2.88-3.48 mm long, male 7th sternite depressed (fig. 34). Paramere truncate (fig. 34). Female connexivum sinuate, distally convergent (fig. 27) .....*priori* sp. n.
– Males 3.48-3.76 mm long, male 7th sternite evenly rounded (fig. 18). Paramere reniform (fig. 16). Female connexivum not convergent distally. .....*papuensis* Lundblad
7. Proepisternum, pro-meso and metasternum with black spicules 8
– Proepisternum, pro-meso and metasternum lacking black spicules 9
8. Pronotum anteriorly transversely orange, not reaching inner margin of eyes. Eye length 1.5x median pronotal length .....*biroi* Lundblad
– Pronotum anteriorly transversely orange, surpassing inner eye margin. Eye length subequal to median pronotal length . .....*hirsuta* sp. n.
9. Hind femora of both sexes lacking prominent projections, not incrassate (figs. 141, 148). Body size sexually dimorphic (males 2.32-2.52 mm long, females 3.28-3.36 mm long. ..*caesius* sp. n.
– Hind femora of both sexes variably incrassate with one or more prominent ventral projections. Males and females not sexually dimorphic ... .10
10. Dark areas of dorsum with prominent fields of adpressed gold spicules 11
– Dark areas of dorsum lacking noticeable fields of adpressed gold spicules 12

Figs. 1-11. *Rhagovelia australica* Kirkaldy. – 1, male dorsal habitus; 2, ibid female; 3, male external genitalia; 4, ibid female; 5-7 male, 8-10 female: 5, 9, hind leg; 6, 8, front leg; 7, 10, antennae; 11, male genital capsule. Figs. 1-4, scale line 1 mm, figs. 5-10 scale line 1 mm, fig. 11 scale line 0.5 mm.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11. Male front tibia not explanate medianly, inner margin uniformly fringed with short hairs (fig. 102). Female connexivum not sinuate (fig. 95) ... .*aureospicata* sp. n.
– Male front tibia explanate medianly, inner margin with a cluster of hairs/spines (fig. 119). Female connexivum sinuate (fig. 118) ....*crinita* sp. n.
12. Anterior pronotal margin transversely pale yellow (figs. 106, 107). Male front tibia not explanate, inner margin fringed with short hairs (fig. 109). Female connexivum converging at 7th tergite (fig. 107) .....*herzogensis* sp. n.
– Anterior pronotal margin transversely pale yellow not reaching lateral margins (figs. 126, 132). Male front tibia medianly explanate, inner margin with a cluster of hairs/spines (fig. 129). Female connexivum sinuate, distally fringed with very long hairs (fig. 132) .....*thysanotos* sp. n.

Table 1. Proportion of antennal segments of *Rhagovelia australica* Kirkaldy.

	I	II	III	IV
Apterous male	60	35	37	29
Apterous female	60	36	40	29.5

Table 2. Proportions of leg segments of *Rhagovelia australica* Kirkaldy.

	Femur	Tibia	Tarsus I	Tarsus II	Tarsus III
♂ front leg	66.5	69	3.5	16	-
♀ front leg	71	71	3.5	16	-
♂ middle leg	113	86	6	37.5	45.5
♀ middle leg	111	90	5	40	49
♂ hind leg	88	96	4	8.5	18
♀ hind leg	97	101	4	5	20

SYSTEMATICS

Rhagovelia australica Kirkaldy
(figs. 1-11, tabs. 1-2)

Rhagovelia australica Kirkaldy, 1908: 783-784; Hale 1925: 5; Hale 1926: 203; Lundblad 1933: 286; Lundblad 1936: 25-26; Polhemus & Polhemus 1988: 165.

Material. – Australia: Queensland, Mt. Lewis NW of Rumula, 1200 m., 6-15.vi.1966, G.A. & S.L. Samuelson (BPBM) 32 ♂, 16 ♀ and 15 immature, all apterous.

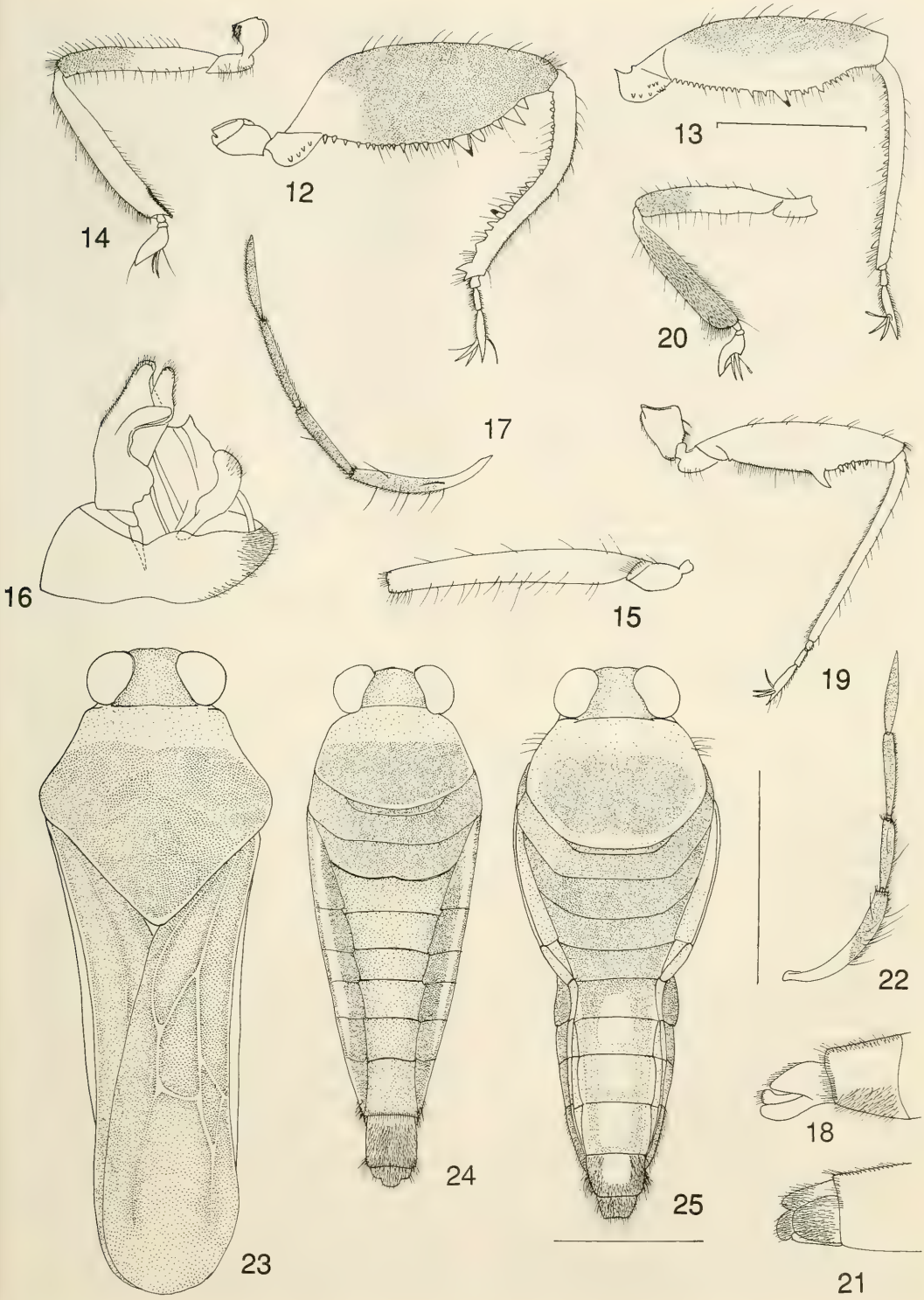
Redescription

Adult apterous. – Males (fig. 1) 4-4.2 mm long, maximum width 1.6-1.72 mm, females (fig. 2) 4.04-4.4 mm long, maximum width 1.68-1.88 mm.

Coloration. – Male (fig. 1): dorsum bright yellow and dark reddish brown-black. Head yellow to dark reddish brown, basally almost invariably yellow. Pronotum anteriorly narrowly black, mesially with a broad dark brown-black transverse bar, usually narrowly divided by a yellowish brown longitudinal stripe. Anterior and posterior margins with scattered brown pits. Adjacent to posterior pronotal margin, a narrow black shining bar which may be the mesonotum. Metanotum yellow, mesially reddish brown-black, posterior margin black. Tergites 1-4 either uniformly black or with varying areas reddish brown. Tergites 5-7 yellowish brown, marginally variably black. Eigth tergite black. Connexivum bright yellow with margins dark reddish brown. Jugum, pro, meso and metaepisterna, coxae, trochanters and part of femora pale yellowish brown. Metasternum and 2nd sternite black, sternites 3-8 reddish brown, distally pale yellow. Pleural margins of sternites narrowly margined black. Front femora (fig. 6) distally and middle legs dark brown-black. Hind leg (fig. 5) broadly dark reddish brown-black. Antennae (fig. 7) dark reddish brown, 1st segment basally pale yellow, ventrally more broadly pale.

Structure. – Male: Median pronotal length 2.23-2.4x eye length. Pronotal width 1.35-1.44x median length, posteriorly covering all but a narrow band of 'mesonotum' and between 6-9x length of metanotum. Tergites 1-6 subequal, 7th longer, 8th shorther than 7th; 1-8 are 12.5 : 13; 3 : 12.8 : 12.1 : 12.1 : 13.7 : 22.7 : 18.5. Distal margins of 5-7 fringed with short hairs, 8th pilose, genitalia distinctly hairy (fig. 3). Connexivum slightly raised, distal segment fringed with short conspicuous hairs. Jugum clearly distinct from antenniferous tubercles. Propleura, proepisternum and mesopleura without fields of minute black spicules. Distal margins of propleura with a row of black punctures, lateral margins with sparse semi-erect hairs, upper margins of mesopleura with a field of semi-erect brown hairs. Front femora with a variable number of fine black spines along ventral margin, tibia sinuate. Hind trochanter with four or more blunt nodules. Femora variably incrassate, proximal ventral margin with a row of even-sized setae, medially with prominent acuminate and blunt projections, distally becoming smaller. Inner margin of tibia with a row of irregular spaced triangular setae. Male genitalia (fig. 11) capsule distally produced.

Figs. 12-25. *Rhagovelia papuensis* Lundblad. – 12-18, 23-24 male, 19-22, 25 female. 12, 13, 19, hind leg; 14, 20, front leg; 15, mid-femora; 16, genital capsule; 17, 22, antennae; 18, 21, external genitalia; 23, male macropterous; 24, male apterous; 25, female apterous. Figs. 12-15, 17-22 scale line 1 mm, fig. 16 scale line 0.5 mm, figs. 23-25 scale line 1 mm.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Coloration. – Female (fig. 2): Tending to resemble male, dark brown-black pigmentation of tergites sometimes more extensive than in males. Front femora (fig. 8) anterior dorsal third pale yellow, ventrally pale coloration extending about two thirds femoral length. Coxae and trochanters of all legs pale yellowish brown.

Structure. – Female: Median pronotal length 2.27-2.52x eye length. Pronotal width 1.37-1.46x median length, posteriorly covering all but a narrow band of 'mesonotum'. Pronotum at midline greatly exceeding length of 'mesonotum' and between 8-10x length of metanotum. Tergites 1-4 more or less subequal, 5-7 progressively slightly longer, 8th shorter than proceeding. Seventh tergite slightly depressed, proctiger reaching beyond 1st gonocoxa (fig. 4). 1-8 are 12.6 : 12.8 : 12.7 : 13; 5 : 15.9 : 18.1 : 20.1 : 15.1. Tergites 2-8 with conspicuous slightly flattened shining areas. Pronotum, metanotum and tergites 1-6 with adpressed dark brown hairs, especially noticeable on pale areas of metanotum. Eighth tergite laterally pilose. Connexivum anteriorly slightly reflexed outwards, converging and becoming more erect and pilose posteriorly, upper margins shining black. Venter similar to male. Front femora (fig. 8) with a variable number of fine spines ventrally. Tibia slightly sinuate. Hind femora (fig. 9) moderately incrassate, spinose distad ventrally. Tibia straight, not spinose along inner margin. Antennae (fig. 10) 1st segment curved, remaining segments straight.

Remarks. – Described from Queensland, Kuranda, apterous female type in BPBM. Hale (1925) lists Malanda, Lundblad (1936) briefly commented on the macropterous form from Kuranda. This species has so far only been recorded from the Atherton Tablelands region near Cairns, Queensland.

The apterous form is immediately recognisable by its striking dorsal bright yellow-brown-black pattern which is rather variable, especially the spread of the dark pigmentation. The male genital capsule is distally turned upwards, parameres elongate almost parallel-sided (fig. 11). Female with two (1+1) clusters of black hairs along the distal margin of the 8th segment.

Rhagovelia papuensis Lundblad
(figs. 12-25, tabs. 3-4)

Rhagovelia papuensis Lundblad, 1936: 28-30; Polhemus & Polhemus 1988: 170-173.

Material. – Papua New Guinea: West Britain: Tamari Creek, 300 m., 14.vii.1989, R. N. B. Prior, 12♂, 12♀ apterous, 1♀ macropterous; Von River, Banaule, torrential stream, 21.iii.1990, I. Lansbury 1♀ apterous; Bialla, Balima River, 3.iii.1989, in dense shade, R.N.B.P. 8♂, 13♀ apterous, 1♂ 1♀ macropterous.

Table 3. Proportions of antennal segments of *Rhagovelia papuensis* Lundblad.

	I	II	III	IV
Apterous male	42	26	27	26.5
Apterous female	41	29	31	31
Macropterous male	42.5	25	30	27
Macropterous female	43	26	30	26

Table 4 Proportions of leg segments of *Rhagovelia papuensis* Lundblad.

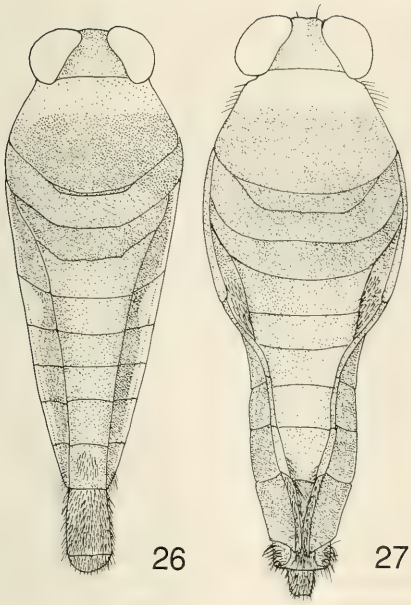
	Femur	Tibia	Tarsus I	Tarsus II	Tarsus III
Apterous					
♂ front leg	47	49	3.5	13.5	-
♀ front leg	48	50	3	14	-
♂ middle leg	77	55	3	23	36
♀ middle leg	81	57	4	23	36
♂ hind leg	70	66	3	7	16
♀ hind leg	70	71	3	6	16
Macropterous					
♂ front leg	50	54	3	12.5	-
♀ front leg	51	52	4	15	-
♂ middle leg	83	60	3	22	38
♀ middle leg	81	55	4	23	39
♂ hind leg	76	72	3	7	16.5
♀ hind leg	70	70	3	7	16

Redescription

Adult apterous. – Males (fig. 24) 3.32-3.48 mm long, maximum width 1.2-1.28 mm, females (fig. 25) 3.48-3.76 mm long, maximum width 1.2-1.4 mm. Adult macropterous. Male (fig. 23) 4.12 mm, maximum width 1.52 mm, female 3.88 mm long, maximum width 1.48 mm.

Coloration. – Male (fig. 24): Dorsum head, most of pronotum, meso, metanotum and basal tergites black. Remainder of tergites dark brown, 7th tergite basally faintly shining. Anterior margin of pronotum broadly orange and tending to widen laterally. Propleura faintly bluish black over orange coloration. Posterior pronotal margin narrowly orange. Connexivum broadly margined pale brown. Mesopleura and metapleura bluish black evanescent. Metasternum and sternites 2-6 laterally black, ventrally pitchy red, 7th sternite pale yellow. Coxae and trochanters of all legs pale yellow. Front femora (fig. 14) pale yellow, apically dark brown, tibia and tarsi of front leg and all middle leg greenish black iridescent. Hind femora (fig. 12) dark brown-black dorsally, ventrally pale yellow, tibia and tarsi dark brown-black. Antennae (fig. 17) basal segment broadly pale yellow, remaining segments black.

Structure. – Male: Median pronotal length just over 2x eye length and covering most of 'mesono-



Figs. 26-27. *Rhagovelia* spp. dorsal habitus. – 26-27 *priori* sp. n., 26, male apterous; 27, female apterous. Scale as for fig. 25.

tum'. Pronotal width 1.4x median eye length. Tergites 1-5 subequal, 6th slightly longer, 7th longer and shining, 8th shorter:10 : 11 : 12 : 11 : 11 : 13 : 18 : 14.5. Tergites and connexivum with adpressed brown hairs, denser and longer along margins of 6th tergite and tip of connexivum. Genital capsule (fig. 16). Jugum barely separated from antenniferous tubercles. Propleura, proepisternum, meso and metasternum and jugum with fields of black spicules. Ventrites 2-4 carinate, laterally sternites bare, 6th with scattered brown adpressed hairs. Front femora (fig. 14) finely spinose, middle femora (fig. 15) dorso-ventrally flattened, finely spinose. Hind femora (fig. 12) ventrad-distally spinose, tibia sinuate inner margin distally with prominent triangular projections.

Coloration. – Female (fig.25): Head and thoracic coloration similar to male. Connexivum more broadly margined pale yellowish brown. Antennae, front and middle legs similar to male, hind leg (fig. 19) dark brown on all surfaces.

Structure. – Female: Black denticules on propleura, pro-meso and metasternum more prominent. Tergites 1-3 reflexed downwards, 1-4 pilose, 5-8 with large shining areas, 10 : 10 : 9 : 11 : 14 : 15 : 16 : 13. Proctiger truncate and slightly depressed (fig. 21). Connexivum partially raised converging along margins of tergites 1-3, more elevated distally and converging at tergite 8. Ventrites with fields of shining semi-erect hairs covering median areas of sternites 2-3 gradually decreasing in length and density distally, lateral margins of sternites with similar hairs increasing in length and density distally. First visible sternite obtusely raised. Hind femora moderately incrassate with large spine ventrad, tibia straight, not spinose along inner margin.

Macropterous male (fig. 23). – Similar to apterous male, pronotum lengthened caudad, posterior margin orange yellow. Wings extending well beyond the end of abdomen with four closed cells, two in distal half. Wings brown, venation slightly darker. Hind femur (fig. 13) not as incrassate as apterous male.

Macropterous female. – Similar to male. Venation more conspicuous especially subcosta and radius, inner margins near anal vein much paler.

Remarks. – Described from Papua New Guinea, Astrolabe Bay, (Stephensort and Erima) and Ralum in New Britain. Type series in HNHM. The enlarged pronotum, ventral conspicuous fields of black spicules and shape of the male parameres shows a close relationship with species from the Solomon Islands. The female connexivum is more or less elevated its entire length (fig. 25) and the shining distal tergites are visible. *Rhagovelia papuensis* males are consistently smaller than *R. fulvus* sp. n. and *browni* sp. n. (Solomon Islands), *papuensis* is superficially similar to *priori* sp. n.

Rhagovelia priori sp. n.
(figs. 26-38, tabs. 5-6)

Type material. – Holotype male: Papua New Guinea, Oro Province, Popondetta, Ambogo Plantation, small stream, 29.iv.1989, R. N. B. Prior (OXUM). Paratypes 3♂, 14♀, same data; 12♂ 9♀ P. N. G., Oro Prov. Popondetta, Iseveni, small stream, 2.v.1989, R. N. B. P.; 1♀ P. N. G. Oro Prov. Popondetta, Sambogo River, 30.iv.1989, R. N. B. P. (OXUM).

Description

Adult apterous. – Males (fig. 26) 2.88-3.48 mm long, maximum width 1-1.6 mm, females (fig. 27) 3.2-3.48 mm long, maximum width 1.2-1.24 mm.

Coloration. – Male (fig. 26): Head most of thorax dorsally black. Tergites greyish black, 7th tergite and lateral margins of connexivum shining pale brown. Anterior margin of pronotum pale yellow, laterally rather wider. Propleura dark grey merging into reddish brown. Meso and metapleura greyish black. Pro, meso and metasternum and sternites 2-3 bluish grey, coxal cavities tending to be tinged reddish brown. Sternites 3-5 reddish brown, 6th paler. Coxae and trochanters pale yellow. Front femora with extensive pale yellow coloration especially along inner margin. Remainder of front and all middle legs dark shining

brown. Hind femur shining dark brown with lateral pale areas same colour as trochanter along ventral margin. Antennae (fig. 33) 1st segment basally pale yellow, ventrally surface more broadly yellow, remaining segments black.

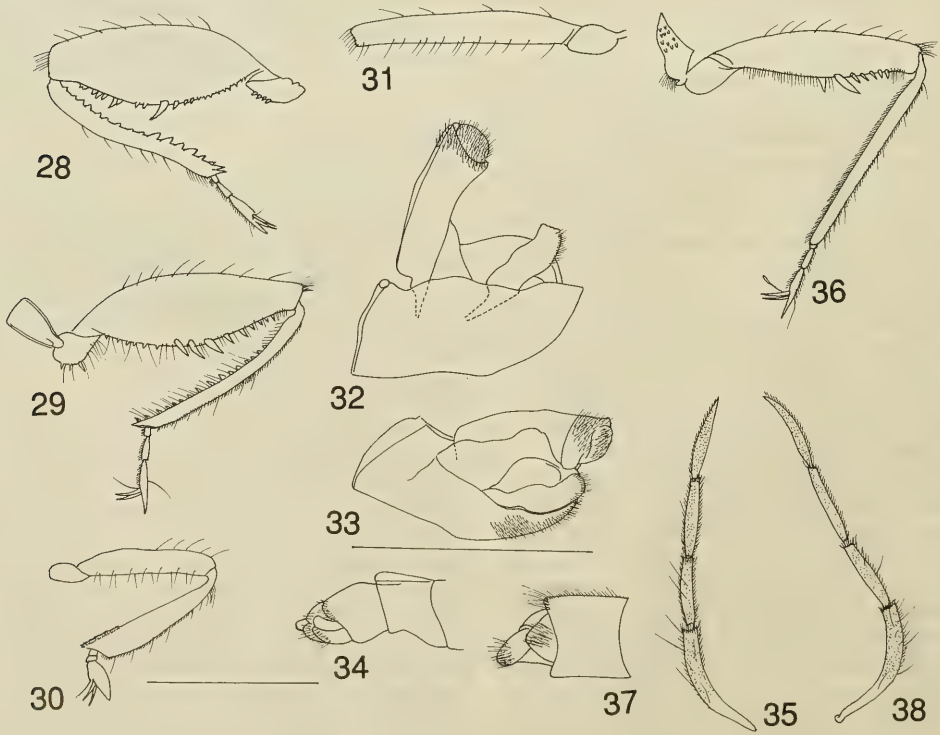
Structure. – Male: Median pronotal length 2x eye length and covering almost all mesonotum. Pronotal width 1.44x median length and 5-6x length of metanotum. Tergites 1-5 subequal, 6 and 8 slightly longer, 7th longest with a variably shaped shining area; 9 : 10 : 10 : 10 : 10.5 : 12 : 17 : 12. Thoracic dorsum covered with fine golden hairs. Shining lateral connexival margins and tergites 1-6 with longer adpressed hairs. Connexivum either flat or slightly raised distally with tufts of hairs. Jugum very close to antenniferous tubercles. Propleura, pro, metaepisternum and jugum with fields of minute black spicules. Sternites anteriorly with a median keel with pale yellow hairs overlying fine adpressed hairs. Seventh sternite depressed posteriorly, lateral margins obtusely carinate and pilose, 8th with a conspicuous keel (fig. 34). Front leg (fig. 30) mid femora ventrally with two rows of fine hairs (fig. 31). Hind femora variably incrassate (figs. 28, 29). Ventral margin variably spinose with many fine setae, distally with triangular setae. Tibia either straight or slightly sinuate with triangular setae along inner margin, length increasing distally. Genital capsule (figs. 32, 33), distal lateral aspect of 7-8th segments (fig. 34).

Table 5. Proportions of antennal segments of *Rhagovelia priori* sp. n.

	I	II	III	IV
Apterous male	37	22	26	26
Apterous female	37	21	24	24

Table 6. Proportions of leg segments of *Rhagovelia priori* sp. n.

Apterous	Femur	Tibia	Tarsus I	Tarsus II	Tarsus III
♂ front leg	40	45	3	11	-
♀ front leg	41	44	3	12	-
♂ middle leg	71	53	4	21	33
♀ middle leg	72	53	4	22	35
♂ hind leg	67	60	3	5	14
♀ hind leg	59	60	2	5	14



Figs. 28-38. *Rhagovelia priori* sp. n. – 28-35 male, 36-38 female. 28, 29, 36 hind leg; 30, front leg; 31, mid-femora; 32, 33, genitalia; 34, 37, external genitalia; 35, 38, antennae. Figs. 28-31, 34-38 scale line 1 mm, figs. 32-33 scale line 0.5 mm.

Coloration. – Female (fig. 27): Head and pronotal coloration similar to male. Mesonotum postero-laterad sometimes with brown shining areas. Tergites 5-7 sometimes shining tending to resemble *R. papuensis* (fig. 25). Upper margins of connexivum narrowly shining brown. Legs and antennae similar to male other than hind femora which tend to be paler ventrally.

Structure. – Female: Median pronotal length about 2x eye length. Mesonotal length variable, pronotum about 5-7x length of mesonotum. Metanotum slightly longer than mesonotum. Tergites 1-4 subequal, 5-7 progressively longer, 8th short; 1-8 are: 10 : 10 : 10 : 10 : 12 : 17 : 20 : 8. Connexivum anteriorly reflexed outwards with fields of hairs on inner margins. From 4th tergite abruptly turned inwards and converging distally. Upper distal margins pilose and 8th tergite densely pilose. Underside of thorax similar to male. Anterior sternites with clusters of golden hairs medianly. Proctiger reflexed downwards (fig. 37). Hind femur (fig. 36) moderately incrassate with a prominent curved spine in distal third. Hind tibia straight without prominent setae along inner margin. Antennae (fig. 38) first segment slightly more curved than male (fig. 33).

Etymology. – A noun in apposition. This species is dedicated to Mr. R. N. B. Prior who has collected aquatic Hemiptera-Heteroptera from various localities in Papua New Guinea, especially West New Britain.

Remarks. – *Rhagovelia priori* sp. n. is superficially much like *papuensis*. The apterous females of former are easily distinguished by stronger convergent connexiva with fields of hairs along anterior inner margins and prominent distal clusters of hairs. Males of *priori* tend to be smaller than *papuensis* (2.88-3.48 : 3.32-3.48 mm). Genital capsule of *priori* distally acuminate, of *papuensis* distally convergent and rounded. Parameres of *priori* slightly sinuate, of *papuensis* reniform.

Rhagovelia amnicus sp. n.
(figs. 39-50, tabs. 7-8)

Type material. – Holotype male: Solomon Islands, Malaita, Raiako Nafinua, in forest stream c 3 yards wide, much shaded, fast running with shingle bottom, 27.v.1955, E. S. Brown (BMNH). – Paratypes: same data as holotype, 18♂ 40♀; same data, except 'larger stream with a few slow flowing areas', 3♂ 7♀ (BMNH, OXUM).

Additional material. – Solomon Islands: Malaita: River Aluta just west of Maelegwasu, in forest. A rather large rapid river with shingle bottom, 26.v.1955, E. S. B., 13♂ 12♀ apterous, 1♂ 1♀ macropterous (BMNH, OXUM); same, inland east of Kwailasi. Small running stream shaded in forest, 25.v.1955, E. S. B., 19♂ 13♀ (BMNH, OXUM); same, near Kwailasi, large rocky stream, 25.v.1955, E. S. B., 10♂ 6♀ (-BMNH, OXUM).

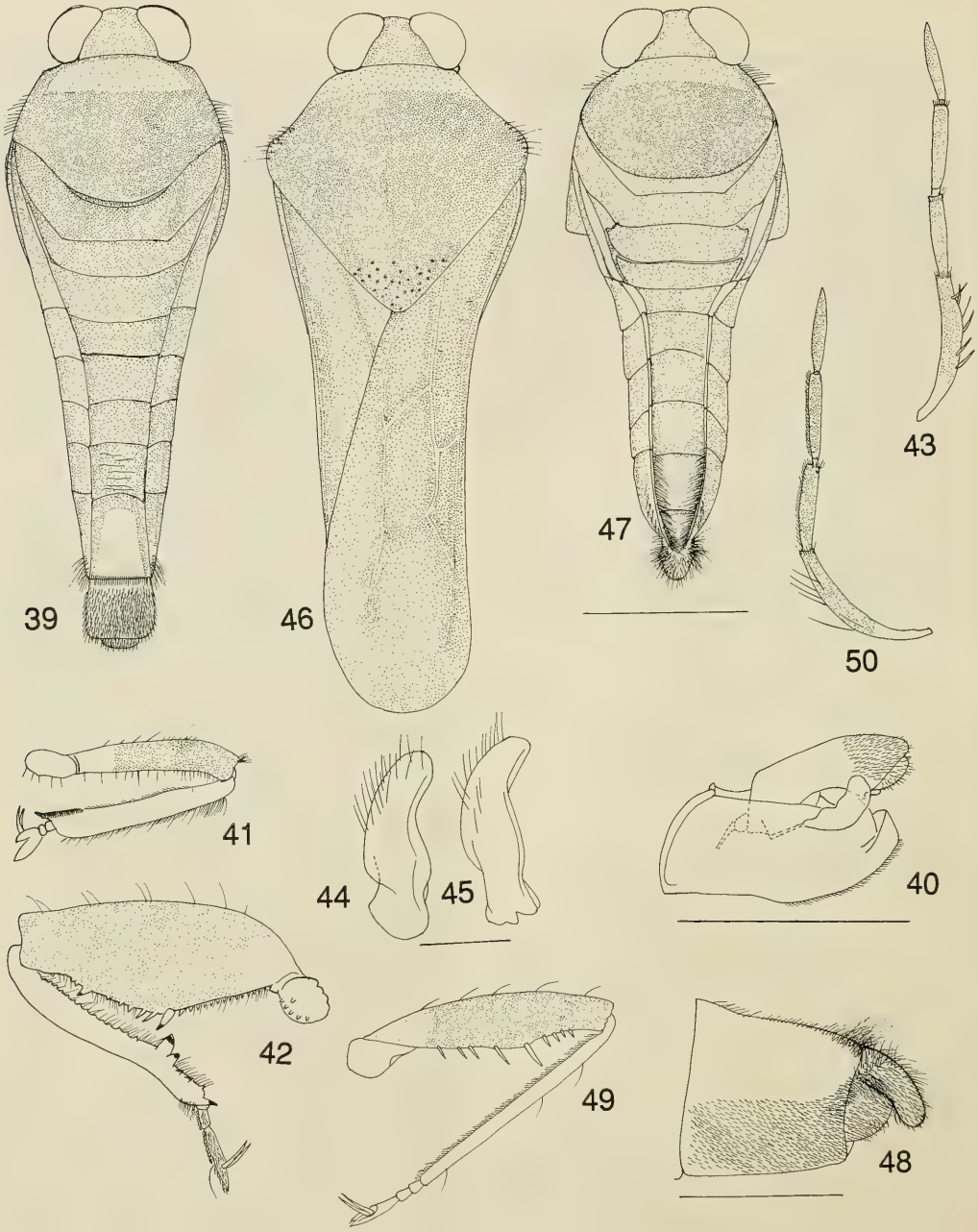
Description

Adult apterous. – Males (fig. 39) 3.32-3.96 mm long, maximum width 1.16-1.44 mm, females (fig. 47) 3.16-3.84 mm long, maximum width 1.22-1.44 mm. Adult macropterous. Male (fig. 46) 4.12 mm long, maximum width 1.58 mm, female 4.12 mm long, maximum width 1.68 mm.

Coloration. – Male (fig. 39): Ground colour black, anterior pronotal margin pale yellow, not reaching lateral margins. Tergites dark brown-black, 7th tergite shining. Connexivum narrowly shining pale brown anteriorly. Legs mostly black. Coxae, trochanters, proximal margins of front tibia and inner proximal margin of hind femur pale yellow. Jugum brown, pro-meso and metasternum black. Sternites dark reddish brown, laterally black. Antennae black, proximal 0.2-0.25 of first segment pale yellow.

Structure. – Male: Median pronotal length 2.2x eye length, posteriorly converging most of mesonotum. Pronotal width 1.47x median length. Metanotum 2x length of mesonotum. First tergite shorter than remainder, tergites 2-6 subequal, 7th longest, 8th shorter and densely hairy. 1-8 are 10 : 14 : 13 : 12.5 : 14 : 15 : 23 : 17. Tergites 2-6 and basal margin of connexivum with many pale hairs, 7th sparsely pilose, distal margin fringed with longer hairs. Connexivum anteriorly slightly flattened, becoming more reflexed upwards distally. Anterior lateral pronotal margins, lateral margins metanotum, and first two tergites with fields of black denticles. Jugum barely separated from antenniferous tubercles. Propleura, proepisternum and mesopleura with a single row of deep black punctures, upper margins with prominent erect hairs. Meso and metasternum with scattered black denticles, overlying them long semi-erect fine yellowish hairs. First two sternites with black denticles. Anterior sternite bluntly acuminate. Anterior sternites with long fine hairs, distal sternites with short hairs which increase in density distally. Seventh sternite depressed posteriorly, lateral margins with tufts of hairs (fig. 39). Genital segment ventrally carinate with a narrow fringe of fine hairs, laterally smooth and shining (fig. 40) parameres different aspects (figs. 44-45). Front femora with a variable number of fine spines along ventral margin, tibia straight (fig. 41). Hind trochanter with circa 5 blunt nodules. Femur incrassate, proximal ventral margin with a row of even-sized setae, medially with a prominent spine, distally with irregular smaller spines in two rows. Tibia sinuate, inner margin armed with triangular setae, distally with a prominent bifurcate projection (fig. 42).

Coloration. – Female (fig. 47): Resembling male, pronotal anterior yellow band more intense. Tergites 5-8 with shining elongate areas. Propleura dark yellowish brown. External connexival margins anteriorly



Figs. 39-50. *Rhagovelia amnicus* sp. n. – 39-46 male, 47-50 female. 39, 47, dorsal habitus; 40, genital capsule; 41, front leg; 42, 49, hind leg; 43, 50, antennae; 44, 45, parameres; 46, macropterous dorsal habitus; 48, external genitalia. Figs. 39-43, 46, 47, 49-50 scale line 1 mm, figs. 44-45 scale line 0.1 mm, fig. 48 scale line 0.5 mm.

broadly yellow, upper margins shining brown, distally dark brown. Sternites covered with bluish silvery pubescence. Legs and antennae similar to male, but front tibia are more extensively yellow.

Structure. – Female: Median pronotal length 2.5x eye length, pronotal width 1.4x median length, posteriorly covering most of mesonotum, the latter 0.11x pronotal length. Metanotum 2.2x length of mesono-

Table 7. Proportions of antennal segments of *Rhagovelia amnicus* sp. n.

	I	II	II	IV
Apterous male	43	28.5	29	27
Apterous female	43	26	27.5	25
Macropterous male	42	26	28	27
Macropterous female	43	26	28	26

Table 8 Proportions of leg segments of *Rhagovelia amnicus* sp. n.

	Femur	Tibia	Tarsus	Tarsus	Tarsus
Apterous					
♂ front leg	53	53	3	13	–
♀ front leg	49	49	4	14	–
♂ middle leg	88	63	5	26	38
♀ middle leg	79	57	4	25	37
♂ hind leg	81	64	4	5	16
♀ hind leg	70	65	2.5	6	16
Macropterous					
♂ front leg	52	56	4	16	–
♀ front leg	54	57	3.5	16	–
♂ middle leg	90	65	5	27.5	40
♀ middle leg	85	66	5	26	40
♂ hind leg	89	70	4	7	18
♀ hind leg	75	75	3	7	17

tum. Lateral margins of pronotum, meso and metanotum with fields of black denticles. Tergites 1-3 depressed, tergites 4-7 darker than preceeding, tergites 5-7 mostly shining. Tergites 1-2 with scattered long black semi-erect hairs. 1-8 are: 11 : 9 : 8.5 : 12 : 11 : 13 : 26 : 10. Connexivum anteriorly raised almost erect, thickened and shining and sharply converging along 3rd tergal margin, curving and strongly reflexed over tergites 5-7, sometimes posteriorly completely covering distal tergites. Upper distal margins densely hairy, posteriorly with a prominent tuft of hairs, proctiger reflexed downwards (fig. 48). Lower margin of jugum, proepisternum and mesosternum with fields of black denticles. Sternites faintly rugose, 7th shining, laterally and distally fine yellowish pilose. Hind femur moderately incrassate, ventrally spinose, tibia not armed along inner margin (fig. 49).

Macropterous male (fig. 46). – Pronotum at widest subequal to median length. Caudad depressed, humeral angles slightly elevated. Forewings brown, venation black with four cells. Membrane of elytra just surpassing genital segment. Hind femur incrassate.

Macropterous female. – Similar to male, membrane rather longer than in male exceeding proctiger and 8th segment.

Etymology. – Name derived from 'amnis' stream of water, *amnicus* 'inhabitant of stream'.

Remarks. – This species is similar to *R. priori*; males differing by not having lateral margins of 7th sternite laterally obtusely carinate. Genital capsule truncate distally. Females have connexivum and distal abdominal segments are much more pilose. The anterior pronotal yellow band not usually reaching lateral margins.

***Rhagovelia browni* sp. n.**
(figs. 51-62, tabs. 9-10)

Type material. – Holotype ♂: Solomon Islands, Guadacanal, Sorvohio River near Gold Ridge, rapid water over boulders with calm pools, small shaded river, 20.iii.1955, E. S. Brown (BMNH). – Paratypes: same data as holotype, 6♂, 6♀ apterous; same data except, Gold Ridge, 1000-1500 feet, clean fast running water with boulders mainly shaded by forest, 25.vi.1956, E. S. B., 17♂ 6♀ apterous, 1♂ 2♀ macropterous; same data as preceeding, 30.vi.1956, E. S. B., 3♂ 5♀ (BMNH, OXUM).

Additional material. – Solomon Islands, Guadacanal: Suta, Sutakiki River, c. 2300 feet, 26.vi.1956, 4♂ 9♀ apterous, 1♀ macropterous; Sangava River near Suta. Strong stony trickling stream, mostly rather shaded, 27.vi.1956, 4♂ 5♀; Kokumbona River 13.v.1956, 14♂ 5♀ apterous, 1♂ macropterous; Tsarivonga River, rapid stony river with quiet backwaters, 1000 feet, 22.iii.1955, 19♂ 13♀ apterous, 1♂ 1♀ macropterous; Tenaru River. Between Mission and Tenaru Falls, mostly from comparatively calm water along margin and in backwaters, 7.xi.1954, 4♂ 4♀ apterous, 2♂ 1♀ macropterous; Matanikao, pools in rocks downstrem of Matanikao Caves, shaded 31.x.1954, 15♂ 6♀ apterous; Honiara, Matanikoa River, 6♂ 2♀ apterous, 1♂ macropterous (all leg. E. S. Brown) (BMNH, OXUM); Guadacanal, Gold Ridge 600 m. 22.vi.1956, J.L. Gressitt, 1♂ apterous; Santa Ysabel, Tamatahi-Molao Maringe Distr. 28.vi.1960, Jungle track C.W. O'Brien, 1♂ 4♀ apterous, 2♀ macropterous (BPBM).

Description

Adult apterous. – Male (fig. 51) 3.88-4.12 mm long, maximum width 1.36-1.44 mm, females (fig. 59) 4.12-4.24 mm long, maximum width 1.48-1.52 mm. Adult macropterous. Males (fig. 52) 4.64 mm long, maximum width 1.72 mm, females 4.52-4.8 mm long, maximum width 1.72-1.76 mm.

Coloration. – Male (fig. 51): General dorsal coloration dark brown-black. Head black, anterior margin of pronotum yellow, lateral margins bluish black or reddish brown. Seventh tergite and genital segment shining black. Jugum, coxae and trochanters yellowish brown. Sternites dark reddish brown, 7-8th ventrites pale yellow. Pro, meso and metapleura reddish brown. Lateral margins of sternites black. Antennae black, basal fifth of 1st segment pale yellow, dorsally dark brown. Middle and hind legs dark brown-black.

Structure. – Male: Median pronotal length 2.36x eye length. Pronotal width 1.44x median length, posteriorly covering almost all mesonotum, metanotum 0.2x length of pronotum. Tergites 1-6 more or less

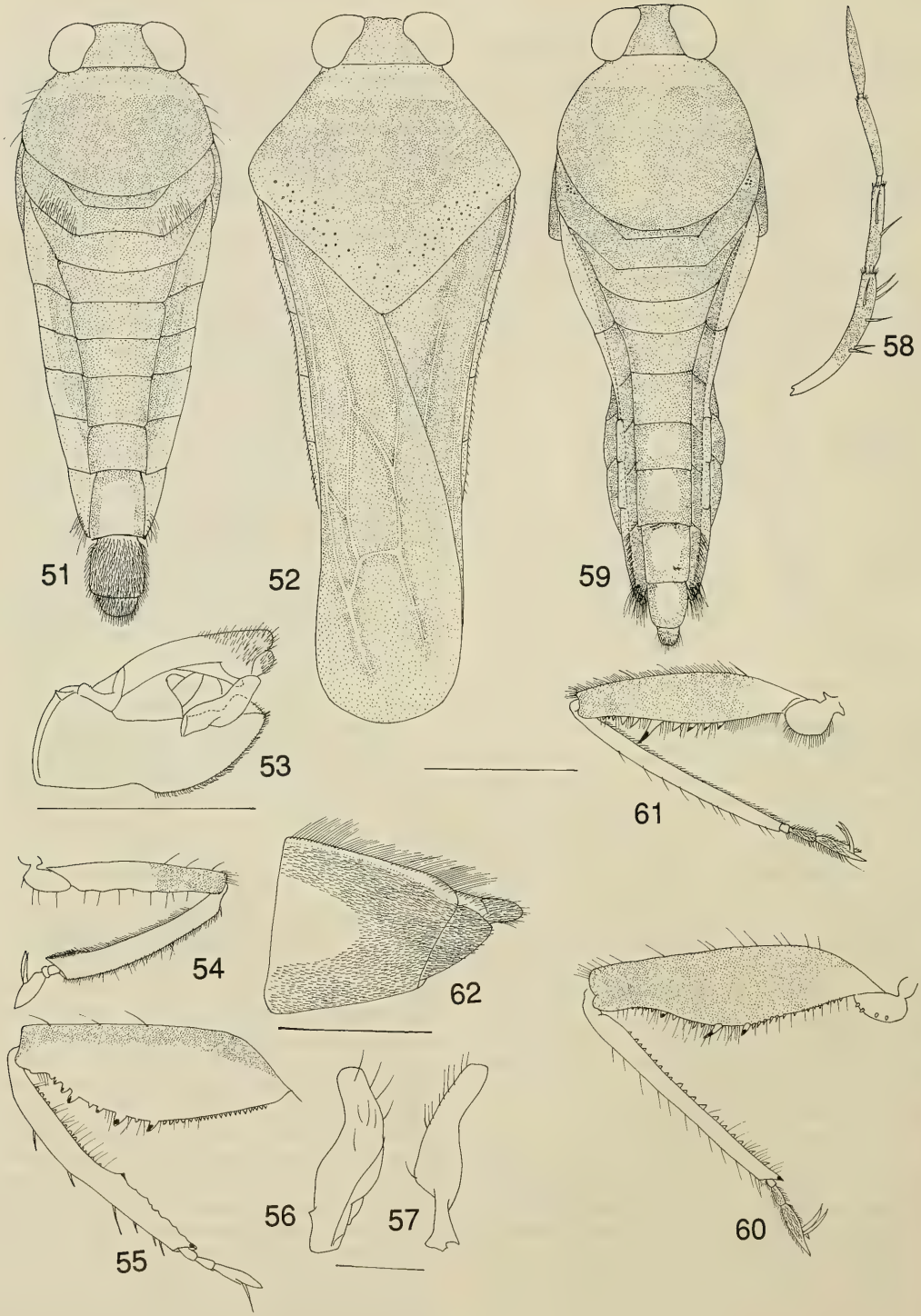

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Table 9 Proportions of antennal segments of *Rhagovelia browni* sp. n.

	I	II	III	IV
Apterous male	52	31	35	30
Apterous female	47.5	28	32	28
Macropterous male	44	27.5	30	26
Macropterous female	48	30	32	30

Table 10. Proportions of leg segments of *Rhagovelia browni* sp. n.

	Femur	Tibia	Tarsus I	Tarsus II	Tarsus III
Apterous					
♂ front leg	60	67	4	16.5	–
♀ front leg	57.5	57	5	18	–
♂ middle leg	105	76	5	31	42
♀ middle leg	91	67	5	28	41
♂ hind leg	105	96	4	8.5	20
♀ hind leg	82	83	4	8	20
Macropterous					
♂ front leg	53	58	3	15.5	–
♀ front leg	58	58	5	17	–
♂ middle leg	88	64	5	27	40
♀ middle leg	92	70	5	28	41
♂ hind leg	89	75	4	7.5	19
♀ hind leg	84	86	4	9	20

subequal, dull, lateral margins finely pilose and distal margins fringed with hairs. Seventh longest, shining, transversely rugose, posterior margin fringed with fine hairs. Genital segment (8th) shining, covered with fine hairs, denser along lateral margins. 1-8 are 13 : 13 : 14.5 : 14 : 15 : 12 : 23 : 20. Anterior lateral margins of pronotum, meso and metanotum with fields of black spicules. Connexivum either slightly reflexed outwards or almost erect, upper margins shining dark brown. Propleura anteriorly with a scattered field of black spicules, posterior margin with several short continguous rows of punctures. Meso and metapleura with short black hairs directed caudad. Jugum almost touching antenniferous tubercles. Lateral margins of jugum, proepisternum, meso and metasternum with prominent fields of black spicules. Sternites 2-5 with scattered black spicules, 2nd ventrite obtusely carinate. Seventh sternite depressed towards gentital segment. Latero-distal margins pilose. Genital segment carinate and fringed with short hairs. Genital capsule (fig. 53) parameres different aspects (-figs. 56-57). Front leg (fig. 54). Hind leg (fig. 55) femur incrassate, trochanter with 3-4 blunt nodules. Femoral ventral margin anteriorly with two rows of uniform sized setae, posteriorly with larger spinose projections. Tibia sinuate with two rows of blunt spines, medially with a large spine, distally with a large spine.

Coloration. – Female (fig. 59): Resembling male, pronotum black other than yellowish brown anterior margin reaching inner margin of eyes. Tergites 5-8 shining. Upper margins of connexivum shining reddish brown. Pro-meso and metapleura varying between dark reddish brown and bluish black. Jugum, coxae and trochanters pale yellowish brown. Meso and metaepisternum and sternites 2-6 dark reddish brown, lateral margins dark brown-black, 7th sternite shining pale reddish brown. Antennae black, 1st segment basally and ventrally pale yellow. Front femur ventrally pale yellow, tibia black. Middle leg dark reddish brown. Hind leg (fig. 61) femur proximally pale yellow, remainder of leg reddish brown.

Structure. – Female: Median pronotal length 2.4x eye length. Pronotal width 1.5x median length, posteriorly covering all but a narrow strip of mesonotum. Metanotum 2x length of mesonotum. Tergites 1-3 subequal, 4-7 increasing in length, 8th shorter. 1-8 are 12.5 : 12 : 12.5 : 14 : 17.5 : 19 : 20 : 13.5. Shining areas of tergites 5-8 increasing in size distally and faintly transversely rugose. Distal margin of 8th tergite fringed with long hairs. Anteriorly connexivum reflexed outwards, along margins of tergites 3-4 more erect, distally slightly reflexed outwards forming a sinuate line, connexivum distally pilose. Lateral margins of mesonotum with scattered black spicules, metanotum with larger fields. Propleura and thorax ventrally similar to male. Sternites with black spicules, not carinate. Seventh sternite shining, laterally with fine yellowish hairs. Genital segment more pilose, connexival hairs almost reaching end of genital segment (fig. 62). Hind femur moderately incrassate, spinose posteriorly, tibia straight, inner margin not spinose.

Macropterous male (fig. 52.). – Pronotum anteriorly yellow, lateral margins bluish black. Pronotal width subequal to median length, humeral angles and posterior tip depressed with scattered black punctures, pronotal disc raised. Forewings brown, venation black with four closed cells, anteriorly inner margin of anal vein narrowly pale yellow. Membrane of elytra surpassing end of abdomen and genitalia. Coloration of legs and antennae similar to apterous

Figs. 51-62. *Rhagovelia browni* sp. n. – 51-58 male, 59-62 female. 51, dorsal habitus; 52, dorsal habitus macropterous; 53, genital capsule; 54, front leg; 55, hind leg apterous; 56-57, parameres; 58, antenna; 59, dorsal habitus apterous; 60, hind leg macropterous; 61, hind leg apterous; 62, external genitalia. Figs. 51-55, 58-61 scale line 1 mm, figs. 56-57 scale line 0.1 mm, fig. 62 scale line 0.5 mm.

form. Hind leg (fig. 60) femur moderately incrassate, tibia straight, inner margin with triangular setae.

Macropterous female. – Similar to macropterous male, membrane slightly shorter just surpassing the 1st gonocoxa.

Etymology. – This species is dedicated to the late E. S. Brown, an enthusiastic hemipterist who collected extensively in the Solomon Islands.

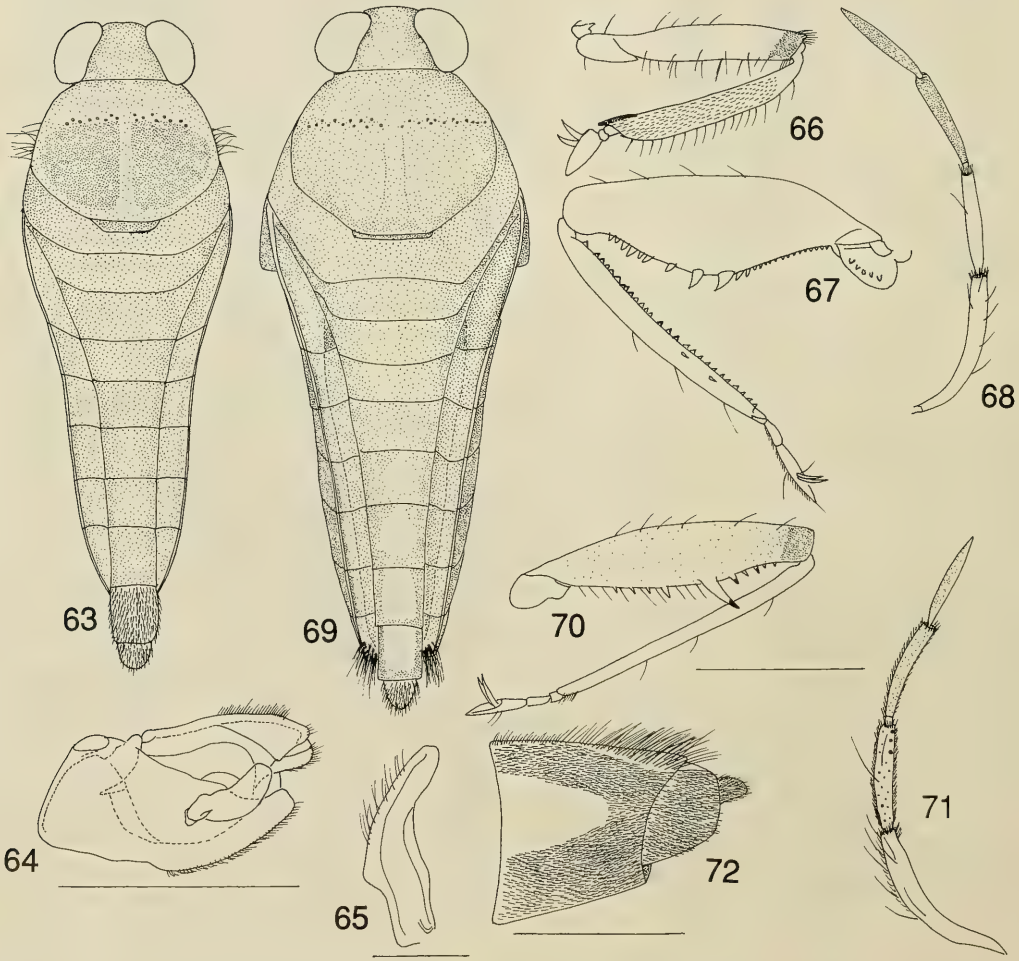
Remarks. – Comparing females of *R. browni* sp. n. it is rather similar to *Rhagovelia fulvus* sp. n., *browni* has a sinuate connexivum whereas the connexivum of *fulvus* is more or less straight. *Rhagovelia browni* is a much darker species; parameres elongate compared with the moderately reniform parameres of *fulvus*.

Rhagovelia fulvus sp. n.
(figs. 63-72, tabs. 11-12)

Type material. – Holotype ♂: Solomon Islands, Malaita, Fulisano-Maelegwasu, 26.v.1955. Small spring near its source, just west of main water-shed of island, E. S. Brown (BMNH). – Paratypes: same data as holotype, 7♂ 5♀ (BMNH, OXUM).

Description

Adult apterous. – Male (fig. 63) 3.64-3.8 mm long,



Figs. 63-72. *Rhagovelia fulvus* sp. n. – 63-68 male, 69-72 female. 63, 69, dorsal habitus apterous; 64, genital capsule; 65 paramere; 66, front leg; 67, 70, hind leg; 68, 71, antennae; 72, external genitalia. Figs. 63, 66-71 scale line 1 mm, fig. 64, 72, scale line 0.5 mm, fig. 65 scale line 0.1 mm.

Table 11. Proportions of antennal segments of *Rhagovelia fulvus* sp. n.

	I	II	III	IV
Apterous male	50	29.5	33	29
Apterous female	50	31	32.5	29

Table 12. Proportions of leg segments of *Rhagovelia fulvus* sp. n.

	Femur	Tibia	Tarsus I	Tarsus II	Tarsus III
Apterous					
♂ front leg	55	63	3	16	-
♀ front leg	55	58	3.5	15	-
♂ middle leg	94	70	5	26	39
♀ middle leg	90	64	5	26	40
♂ hind leg	92	85	3	8	19
♀ hind leg	79	86	3	9	16

maximum width 1.28-1.4 mm, female (fig. 69) 3.76-4.04 mm long, maximum width 1.36-1.44 mm.

Coloration. – Male (fig. 63): Head dorsally dark reddish brown. Pronotum either pale orange yellow or pinkish brown. Anterior lateral and medianly rather paler. Meso, metanotum and tergites 1-6 varying between dark yellowish and reddish brown. Connexivum and tergites 7-8 pale yellow. Propleura pale reddish brown, meso and metapleura slightly darker. Sternites dark reddish brown, 7th sternite faintly shining, 7th and 8th sternites pale yellowish brown. Coxae and trochanter pale yellow. Femur and tibia of all legs pale yellow, tarsi tending to be dark yellowish brown. First and 2nd antennal segments pale yellow, remainder brown.

Structure. – Male: Median pronotal length 2.56x eye length, covering almost all mesonotum. Pronotal width 1.46x median length. Anteriorly pronotum with a transverse row of punctures, lateral margins with a small field of black spicules, sometimes spicules much paler and difficult to see. Metanotum about 2x length of mesonotum. Tergites gradually increasing in length distally, 1-8 are 10 : 13 : 12 : 12 : 13 : 14 : 19 : 17. Connexivum more or less uniformly semi-erect. Lateral and posterior margins of pronotum with fine silvery adpressed hairs, remainder of pronotum covered with shorter hairs. Posterior margin of metanotum, tergites and lower margin of connexivum fringed long pale yellowish hairs. Lateral margin propleura, margins of jugum, proepisternum, meso and metasternum with fields of black spicules. Jugum barely separated from antenniferous tubercles. Sternites 2-6 with scattered black spicules and with long fine adpressed silvery hairs becoming denser on 7th sternite. Front leg (fig. 66) moderately finely spinose. Hind leg (fig. 67) femur incrassate, trochanter with a variable number of blunt nodules. Femur ventro-anteriorly with short regular setae, medially with 2 prominent spines, distally. Tibia either straight or slightly sinuate, inner margin armed with a regular row of triangular setae. Antennae (fig. 68). Genital capsule (fig. 64) paramere slightly reniform, paramere from different aspect (fig. 65).

Coloration. – Female (fig. 69): Very similar to male. Pronotum orange brown, anterior margin sometimes paler. Pleura with a pinkish tinge. Tergites dark yellowish brown with straggly yellow hairs, tergites 5-8 with shining areas increasing in size distally. Connexivum narrowly dark brown adjacent to tergites, upper margins paler. Sternites laterally dark brown, ventrally paler. Apices of femur narrowly annulated black. First antennal segment pale yellow, segments 2-4 pale brown.

Structure. – Female: Median prontal length 2.75x eye length, covering all but narrow strip of mesonotum. Connexivum reflexed outwards, distally not reaching distal margin of 8th tergite and densely pilose. Pleural and ventral black spicules similar to males second sternite with a denser field of black spicules. Proctiger slightly raised, gonocoxal plates large (fig. 72). Hind leg (fig. 70) femur not incrassate, ventral margin with a prominent distal spine, tibia straight, not armed along inner margin. Antennae (fig. 71) first segment sometimes infuscated pale brown, likewise segments 2-4.

Etymology. – Name refers to the tawny, reddish yellow coloration.

Remarks. – *Rhagovelia fulvus* sp. n. is a very pale species compared with *amnicus* and *browni*. The femurs are almost entirely pale. The connexivum of the female is shorter than in other species not reaching the end of tergite 8.

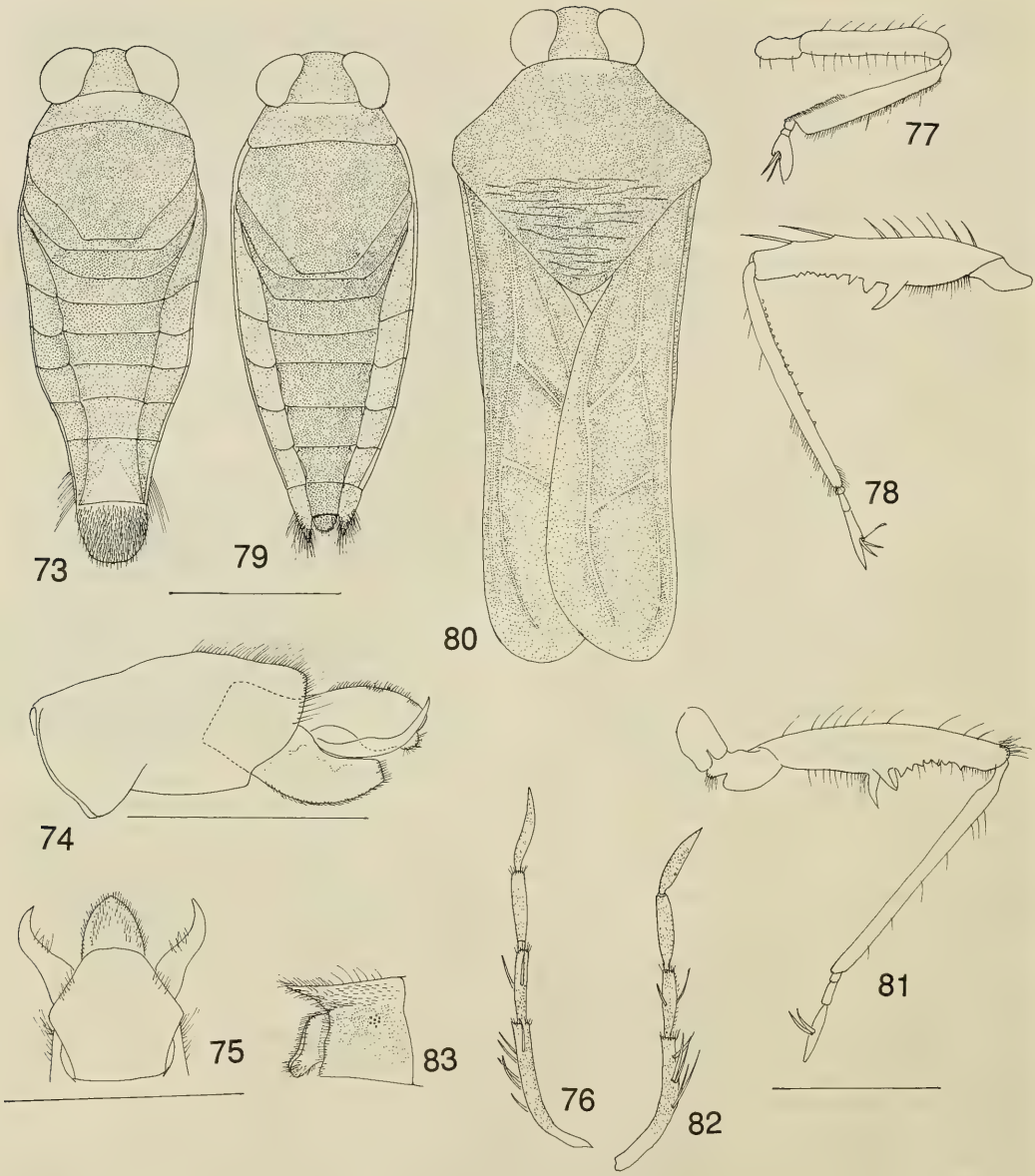
Rhagovelia biroi Lundblad
(figs. 73-83, tabs. 13-14)

Rhagovelia biroi Lundblad, 1936: 13-14; Polhemus & Polhemus 1988: 165.

Material. – Papua New Guinea: West Britain: Bialla, Balima River, 3.iii.1989, R. N. B. Prior, 5♂ 1♀ apterous; Bialla, River Inu, 10.ii.1989, R. N. B. P., 15♂ 17♀ apterous; Bialla, River Tiaru, 10.i.1989, R. N. B. P., 10♂ 7♀ apterous; same data, near log in river, 25.i.1989, 3♂ 1♀ apterous; Tamari Creek, 300 m., 14.vii.1989, R. N. B. P., 21♂ 15♀ apterous; Dami near Kimbe, vii.1989, R. N. B. P., 2♂ apterous; Bilomi River 9.iv.1989, R. N. B. P., 7♂ apterous; Von River, Banaule Village near Kimbe, 21.iii.1990, I. Lansbury, 17♂ 9♀ apterous, 1♀ macropterous (OXUM).

Redescription

Adult apterous. – Male (fig. 73) 3.2-3.48 mm long, maximum width 1.16-1.28 mm, female (fig. 79)



Figs. 73-83. *Rhagovelia biroi* Lundblad. – 73-78 male, 79-83 female. 73, 79, dorsal habitus apterous; 74, genital capsule; 75, ventral aspect genital plate; 76, 82, antennae; 77, front leg; 78, 81, hind leg; 80, dorsal habitus macropterous; 83, external genitalia. Figs. 73, 76-83 scale line 1 mm, figs. 74-75 scale line 0.5 mm.

3.24-3.48 mm long, maximum width 1.2-1.56 mm. Adult macropterous. Female (fig. 80) 3.92 mm long, maximum width 1.52 mm.

Coloration. – Male (fig. 73): Dorsum black, 7th tergite with a triangular iridescent greenish black patch. Pronotum anteriorly with an orange band not reaching inner margin of eyes. Venter greyish black. Coxal cavaties pale yellow. Antennae black other than basal third of 1st segment. Basal third of front femur pale yellow. Trochanters of front and hind legs pale yellow, remainder of all legs greenish black iridescent, most apparent on middle and hind femora.

Table 13. Proportions of antennal segments of *Rhagovelia biroi* sp. n.

	I	II	III	IV
Apterous male	43	19	21	23
Apterous female	42	22	20	22
Macropterous female	46	22	17	22

Table 14. Proportions of leg segments of *Rhagovelia biroi* sp. n.

	Femur	Tibia	Tarsus I	Tarsus II	Tarsus III
Apterous					
♂ front leg	48	53	4.5	13	-
♀ front leg	48	50	2.5	13	-
♂ middle leg	83	56	2	26	34
♀ middle leg	78	52	4	26	37
♂ hind leg	72	68	3	5	15
♀ hind leg	72	75	2	6	16
Macropterous					
♀ front leg	47	48	3	13	-
♀ middle leg	78	53	4	26	37
♀ hind leg	72	69	3	5	16

Structure. – Male: Median eye length 1.5x median prontal length. Pronotal width 4.8x median length. Mesonotum large, 4.3x pronotal length. Metanotum short, 0.3x pronotal length. Tergites 1-7 increasing in length distally, 8th shorter. Shining area of 7th and all of 8th with long brown hairs. 1-8 are 7 : 9 : 9 : 10.5 : 11 : 12 : 22 : 15. Dorsum clothed in fine pubescence. Pronotum, meso-metanotum and 1st tergite with short recumbent black setae. Remaining tergites with longer greyish hairs. Connexivum slightly reflexed outwards, upper margin narrowly shining brown. Jugum clearly distinct from antenniferous tubercles. Proepisternum with sparse minute black spicules difficult to see against background. Pro, meso and metasternum with scattered black spicules. Lateral margins of sternites 3-6 with two groups (1 + 1) of black spicules either side of midline. Second sternite with a dense area of black spicules. Venter clothed with long recumbent greyish hairs, 7th ventrite more pilose, medianly carinate with a fringe of semi-erect hairs. Front leg (fig. 77) tibia flattened. Legs with self coloured hairs and spines. Coxae with groups of curved hairs. Hind leg (fig. 78) femora with a prominent spine midway ventrad, further projections distally. Tibia slightly curved, inner margin armed with small setae. Antennae (fig. 76) 1st segment with many spines. Genital capsule (fig. 74) parameres elongate, apically acuminate, Lundblad (1936) figure shows apex more truncate. Ventral aspect of genital plate (fig. 75).

Coloration. – Female (fig. 79): Very much like the male. None of tergites shining. Connexivum, upper margin narrowly yellowish brown.

Structure. – Female: Median eye length 1.85x pronotal length. Pronotal width 5x median length. Mesonotum large, 4x pronotal length. Metanotum short 0.38x pronotal length. Tergites 1-7 increasing in length distally, 8th shorter, 1-8 are 7 : 9 : 10.5 : 11 : 11.5 : 14 : 18 : 10. Eighth tergite depressed, posterior margin of 7th with a cluster of hairs. Connexivum distally produced beyond 8th tergite and densely pilose. Mesonotum and metanotum with minute black shining spicules overlaid by long black hairs extending to 1st tergite along margins. Pro-meso and metasternum with scattered black spicules. Seventh sternite with dense areas of long golden hairs either side of midline. Hind leg (fig. 81) femora ventrad-distally with a bifurcate spinose projection, tibia straight, inner margin unarmed. Antennae (fig. 82). Gonocoxa and connexivum (fig. 83).

Macropterous female (fig. 80). – Coloration and structure similar to apterous form. Pronotal width subequal to median length, posteriorly slightly depressed and transversely rugose. Pronotal margins adjacent to prosternum narrowly yellow. Wings dark reddish brown, membrane clearly surpassing the proctiger. Veins not prominent reaching just beyond end of connexivum. Subcostal, medial and anal veins with minute black setae; basally with two closed cells extending onto distal half.

Remarks. – Described from Papua New Guinea, Astrolabe Bay, (Stephansort and Erima) and Raium in New Britain. Type series in HNHM. Both sexes of *biroi* are very similar, the hind femora are much alike. The projecting distal connexival segments of the female are distinctive. The male parameres are long and apically acuminate unlike other *Rhagovelia* so far recorded from 'New Guinea'. The greatly reduced pronotal length compared with the longer mesonotum distinguish *biroi* from species of the *papuensis* group (*priori*, *amnicus* and *browni* etc.).

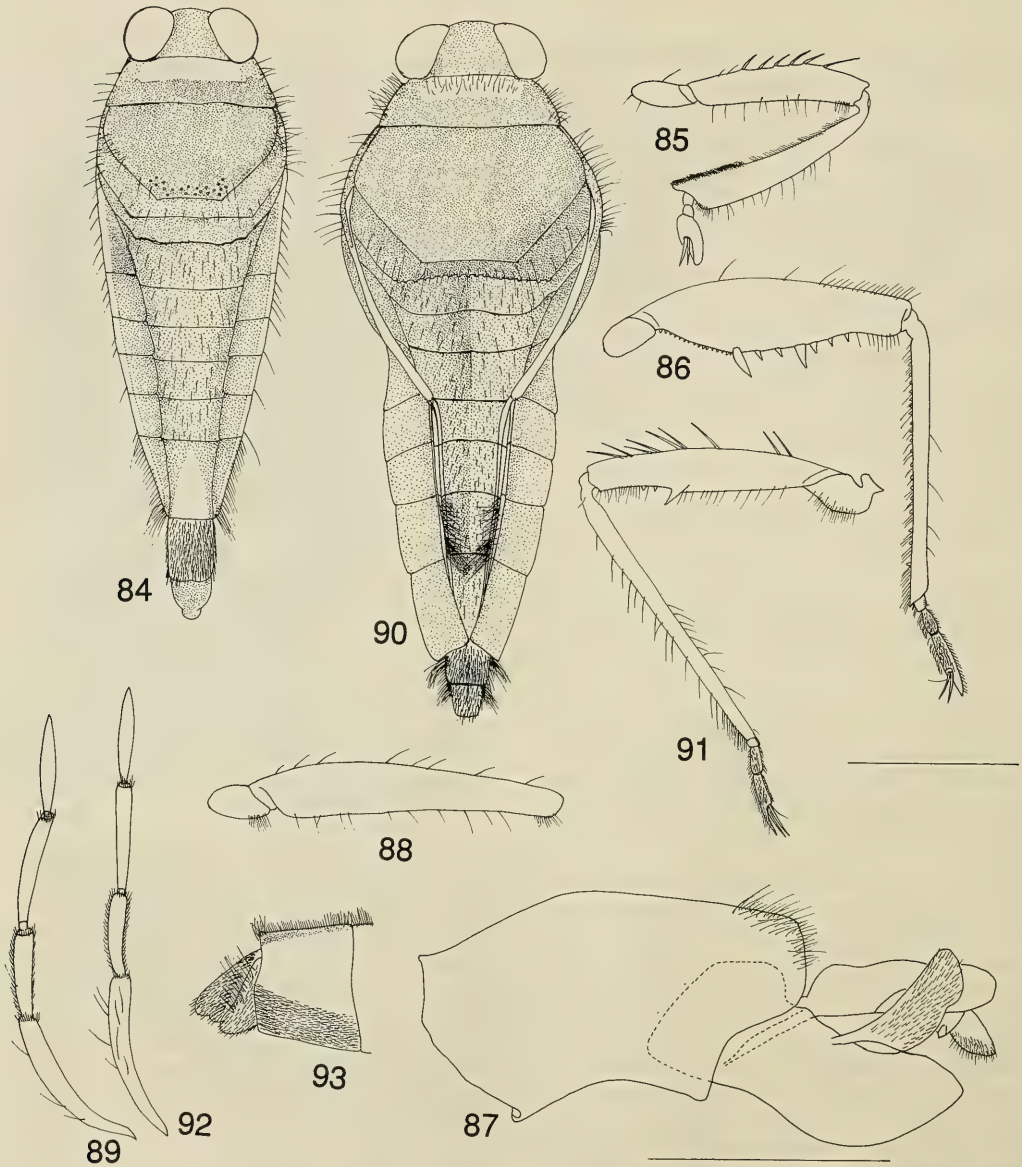
Rhagovelia hirsuta sp. n.
(figs. 84-93, tabs. 15-16)

Type material. – Holotype ♂: Papua New Guinea, Oro Province, Kokoda, Mambare River, Mambe Estate, 12.ix.1988, sheltered pools at side of river. R. N. B. Prior (OXUM). – Paratypes: Same data as holotype, 3♂ 5♀; East Highlands Province, Isodenu Yonki, 1700 m. 13.x.1989, Prior, 1♂ 1♀ (OXUM).

Additional material. – Papua New Guinea, Oro Province, Popondetta, Iseveni, small stream, 2.v.1989, Prior, 1♂ (OXUM); 'Papua, Mafulu, 4000 feet, December 1933, L.E. Cheesman', 3♂ 3♀ (BMNH).

Description

Adult apterous. – Male (fig. 84) 3.92-4.04 mm



Figs. 84-93. *Rhagovelia hirsuta* sp. n. – 84-89 male, 90-93 female. 84, 90, dorsal habitus apterous; 85, front leg; 86, 91, hind leg; 87, genital capsule; 88, mid-femora; 89, 92, antennae; 93, external genitalia. Figs. 84-86, 88-93 scale line 1 mm, fig. 87 scale line 0.5 mm.

long, maximum width 1.4-1.48 mm, female (fig. 90) 4-4.4 mm long, maximum width 1.52-1.64 mm.

Coloration. – Male (fig. 84): Dorsum generally black. Tergites and most of connexivum black, upper margins narrowly shining dark brown. Seventh tergite with an elongate triangular shining area. Anterior margin of pronotum orange brown. Lateral margins of pronotum, prosternum, mesosternum and sternites greyish blue tomentose. Proepisternum pale reddish brown, meso and metasternum dark grey margined reddish brown. Trochanters yellowish brown. Basal 0.2 of front femur pale yellow, remainder of front leg, middle and hind femora dark iridescent green, remainder of legs black. Antennae black, basal

Table 15. Proportions of antennal segments of *Rhagovelia hirsuta* sp. n.

	I	II	III	IV
Apterous male	48	27	32	29
Apterous female	49	25	34	28.5

Table 16. Proportions of leg segments of *Rhagovelia hirsuta* sp. n.

	Femur	Tibia	Tarsus I	Tarsus II	Tarsus III
♂ front leg	56	62	5	16	–
♀ front leg	57	62	5	17	–
♂ middle leg	95	73	6	32	40
♀ middle leg	92	72	5	32	41
♂ hind leg	85	84	5	8	19
♀ hind leg	75	88	4	7	19

0.2-0.3 of 1st pale yellow.

Structure. – Male: Maximum eye length clearly longer than pronotum (18: 16). Pronotal width 3.4-3.5x median length. Mesonotum 2.3x pronotal length, metanotum 0.3x length of pronotum. Tergites variable length, 1-8 are 12 : 12.5 : 10.5 : 10 : 10 : 11.5 : 22 : 21. Eighth tergite densely pilose. Pronotum laterally, meso and metaepimeron, lateral margins of metanotum, tergites and lower margins of connexivum with very long prominent semi-erect hairs. Proepisternum, prosternum and lateral margins of pronotum with fields of black spicules. Jugum almost touching the antenniferous tubercles. Second sternite bluntly keeled, 7th slightly flattened, covered with adpressed golden hairs. Eighth segment ventrally concave and distally reflexed downwards. Legs, all coxae with clusters of long golden hairs, hairs and spines of all legs self coloured. Front leg (fig. 85). Mid femora (fig. 88) slightly flattened and with fine hairs. Hind leg (fig. 86) trochanter unarmed. Femus moderately incrassate, antero-ventrad with a row of even-sized setae, medianly and posteriorly with larger irregular sized spines. Tibia straight armed with small setae along inner margin. Antennae (fig. 89) 1st segment not very spinose. Genital capsule (fig. 87) distally bluntly acuminate. Parameres large almost paddle-like.

Coloration. – Female (fig. 90): Vertex, posterior margin of pronotum, mesonotum, metanotum and most of 1st tergite black. Anterior margin of pronotum pale orange band reaching inner margin of eyes. Lateral margins of pronotum, visible tergites and lateral margins of visible sternites evanescent bluish grey. Connexivum apically narrowly dark brown margined narrowly pale yellow. Prosternum pale brown. Remainder of coloration similar to male.

Structure. – Female: Eye length subequal to median pronotal length (17:18). Pronotal width 3.22x median length. Mesonotum 2x median pronotal length, metanotum about 0.5x pronotal length. Tergites, 1-8 are 12.5 : 12 : 12 : 13 : 17 : 19 : 24 : 14. Eighth tergite and proctiger strongly reflexed downwards (fig. 93). Pronotum, lateral margins of meso and metanotum and posterior margin of 1st tergite, pro and mesosternum with scattered prominent black hairs. Posterior margin of pronotum, all of meso-metanotum and 1st tergite with adpressed short golden hairs. Tergites 3-6 bluntly raised medianly with discrete clusters of golden hairs increasing in length and density on 6th tergite. Connexivum anteriorly reflexed outwards, from 3rd tergite converging and meeting across 7th. Connexival margins of 6th with a cluster of long hairs. Lateral margins of 8th segment with two (1+1) clusters of curled hairs. Sternites covered with fine adpressed golden hairs, very dense on 7th sternite. Proctiger and ancilliary structures pilose. Hind femur with a single prominent spine ventrad, tibia straight, not armed along inner margin (fig. 91). Antennae (fig. 92).

Etymology. – *hirsuta* refers to the hairy appearance of this species.

Remarks. – This species tends to resemble *R. aureospicata* sp. n. The female *hirsuta* differs in having the connexivum converging posteriorly. The eye/pronotal ratio is subequal whereas the pronotum of *aureospicata* sp n. is longer than eye and the male middle femur has several stout setae proximo-ventrally whereas male middle femur of *hirsuta* sp. n. is fringed with fine hairs ventrally.

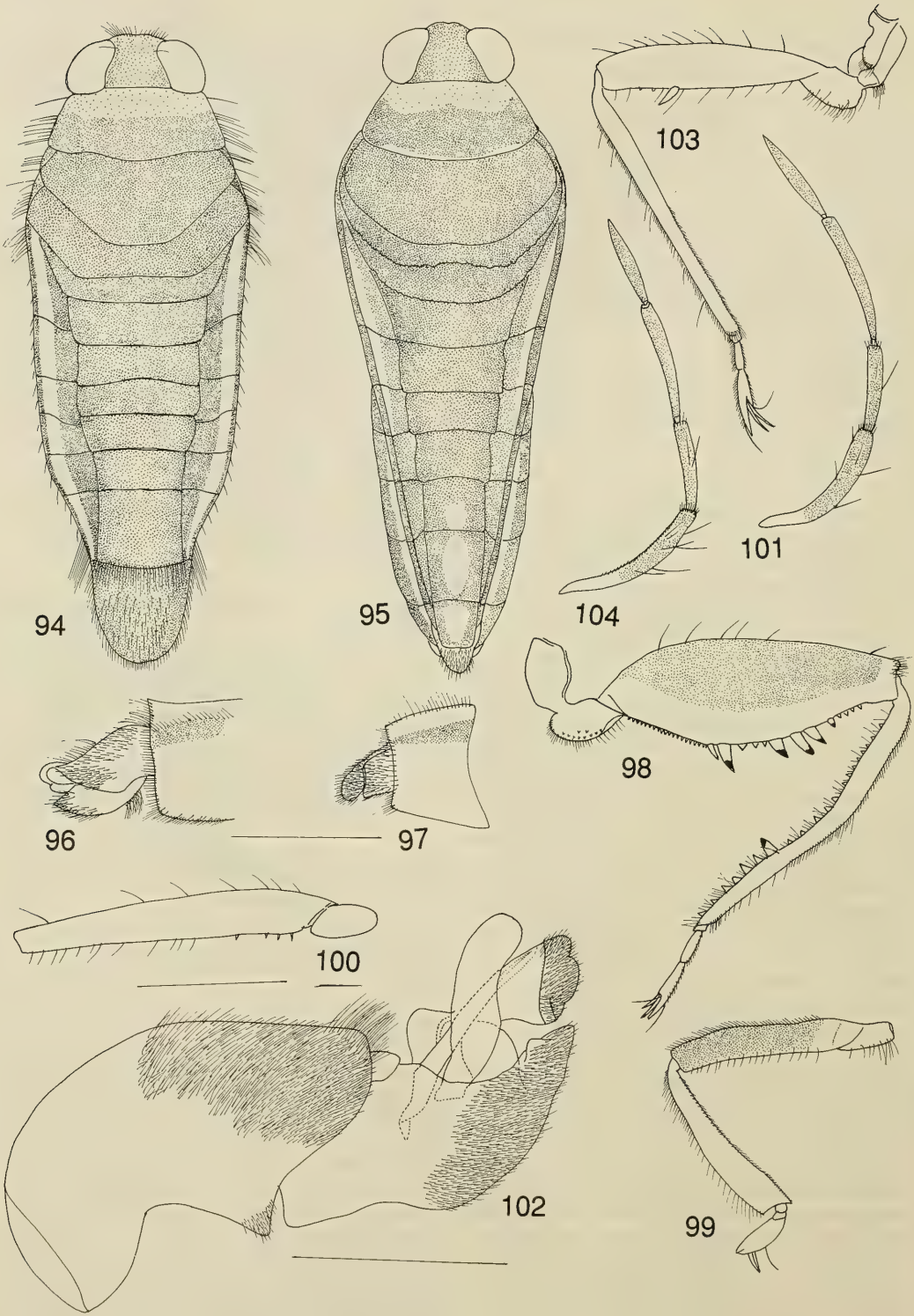
Rhagovelia aureospicata sp. n.
(figs. 94-104, tabs. 17-18)

Type material. – Holotype ♂: Papua New Guinea, Oro Province, Kokoda, Mambare river, 24.ix.1989, R. N. B. Prior (OXUM). – Paratypes, same data, 4♀ (OXUM).

Description

Adult apterous. – Male (fig. 94) 4.24 mm long, maximum width 1.56 mm, female (fig. 95) 4.40-4.44 mm long, maximum width 1.60-1.72 mm.

Coloration. – Male (fig. 94): Dorsal ground colour black. Anterior pronotal margin pale yellow. Connexivum dark brown with a pale brownish yellow band near upper margin. Prosternum pale yellow. Mesosternum upper margins evanescent blue remainder pale yellowish brown. Metasternum evanescent blue graduating into pale yellowish brown. Coxae and trochanters yellowish brown. Inner proximal half of front femur pale yellow, outer margin narrowly pale yellow. Front tibia and middle legs iridescent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greenish brown. Hind femur mostly pale brown, distal and dorsal surfaces and hind tibia and tarsi dark brown. Sternites 1-3 black, remainder yellowish brown tending to merge into black along connexival line. Antennae black, proximal third of 1st segment pale yellow graduating into black.

Structure. – Male: Pronotum longer than eye (25:18) pronotal width 2.44x median length. Mesonotum 1.2x length of pronotum and 4.2x length of metanotum. Lateral margins of prothorax fringed with long hairs. Tergites 1-6 subequal, 1-8 are 12 : 12 : 11.5 : 12 : 12 : 13 : 28 : 30. Black dorsal areas covered with fine golden spicules other than 7th tergite which is slightly flattened and dull shining, posterior margin fringed with long hairs. Distal connexival segment with very long black hairs which are carried round posterior margin of 7th sternite. Proepisternum without black spicules, pro-meso and metasternum with scattered black semi-erect hairs. Jugum broad almost touching antenniferous tubercles. Seventh sternite shallowly depressed, covered with fine brown hairs, ventrally segment depressed adjacent to 7th sternite, segment sharply reflexed downwards. Front leg (fig. 99) tibia slightly explanate distally. Middle femur (fig. 100) proximo-ventrad with four spines. Hind leg (fig. 98) femur moderately incrassate, proximo-ventrad with a row of seven even sized setae, medially with four large projections and a variable number of smaller iregular setae. Tibia sinuate, inner margin armed with stout projection distally and a row of small setae. Antennae (fig. 101) 1st and 2nd segments moderately hairy. Genital capsule (fig. 102), distal end of capsule curved upwards. Parameres elongate, distally rounded.

Coloration. – Female (fig. 95): Head and thorax similar to male. Tergites 5-7 with variable shining areas. Pale yellowish brown connexival band tending to be slightly wider than of male. Metasternum black, upper lateral margins of sternites black decreasing in area to 7th sternite. Basal half of front femur pale yellow. Ventrally front femur, middle and hind femura pale brown, dorsal surface of middle and hind femora iridescent green.

Structure. – Female: Pronotum longer than eye (25:18) pronotal width 2.6x median length. Mesonotum 1.2x length of pronotum and 6x length of metanotum. Tergites variable in length, 1-8 are 13 : 13 : 13 : 14.5 : 17.5 : 17.5 : 22 : 19. Structurally the thorax is same as male, the fringe of long hairs not present. The density of gold spicules on pronotum is not as dense as on mesonotum which has the spicules arranged in a semi circular pattern. The spicules on the metanotum and tergites 1-2 are denser than on male. Seventh tergite flattened and shining. Connexivum anteriorly reflexed outwards becoming more erect posteriorly. Proctiger and gonocoxal plates strongly reflexed downwards (fig. 97). Hind leg (fig. 103) femur with a prominent spine distad ventrally, tibia straight, inner margin unarmed. Antennae (fig. 104).

Tabel 17. Proportions of antennal segments of *Rhagovelia aureospicata* sp. n.

	I	II	III	IV
Apterous male	50	34	42	34
Apterous female	50	32	38	31

Tabel 18. Proportions of leg segments of *Rhagovelia aureospicata* sp. n.

	Femur	Tibia	Tarsus I	Tarsus II	Tarsus III
♂ front leg	63	64	5	17	-
♀ front leg	60	61	5	17	-
♂ middle leg	108	84	5	37	46
♀ middle leg	93	75	5	35	42
♂ hind leg	105	105	5	10	22
♀ hind leg	79	95	4	9	20

Etymology. – *Aureospicata* alludes to the golden spicules on the dorsum.

Remark. – This species belongs to the group which have the pronotum longer than the eye length, the former being shorter than the mesonotum. The prothorax is densely clothed with golden spicules and the male mid-femur with proximo-ventrad group of setae suggests a close relationship with *herzogensis* sp. n.

Rhagovelia herzogensis sp. n.
(figs. 105-116, tabs. 19-20)

Type material. – Holotype ♂ apterous: New Guinea, Morobe District, Herzog Mountains, Vagau c. 4000 feet, 4-17.i.1965, M. E. Bacchus (BMNH). – Paratypes, same data, 3♂ 3♀ apterous, 2♀ macropterous (BMNH, OXUM).

Description

Adult apterous. – Male (fig. 106) 4.08-4.2 mm long, maximum width 1.4-1.48 mm, female (fig. 107) 4 mm long, maximum width 1.56 mm. Adult macropterous. Female (fig. 105) 4.8 mm long, maximum width 1.72 mm.

Coloration. – Male (fig. 106): Head, thorax and abdomen dorsally black. Pronotum anteriorly broad-

Figs. 94-104. *Rhagovelia aureospicata* sp. n. – 94, dorsal habitus apterous male; 95, ibid female; 96, external genitalia male; 97, ibid female; 98-102 male, 103-104 female. 98, 103, hind leg; 99, front leg; 100, mid-femora; 101, 104, antennae; 102, genital capsule. Figs. 94-101, 103-104 scale line 1 mm, fig. 102 scale line 0.5 mm.

ly yellow. Inner lateral margins of connexivum with yellow stripe. Seventh tergite slightly shining. Anterior margin of mesonotum variably dark reddish brown. Pro and mesopleura pale yellow, upper lateral margins of metapleura black, remainder yellow. Jugum and prosternum pale yellow, meso and metasternum becoming progressively dark brown. Sternites 2-4 dark reddish brown, 5-8 pale yellowish brown. Lateral margins of sternites black, tapering distally to 7. Coxae and trochanters pale yellow. Front femur proximally yellowish brown, distally femur, tibia, middle and hind legs dorsally greenish black shining. Underside of front femur and hind femur yellowish brown, remainder of legs dark brown on ventral surfaces.

Structure. – Male: Median pronotal length longer than eye length (20 : 18). Pronotal width 3x median length. Mesonotum 1.6x median pronotal length and 6.4x length of metanotum. Tergites, 1-8 are 13 : 10 : 11 : 11 : 11 : 12 : 27 : 32. Upper margin of 7th tergite slightly shining, rugose, 8th very pilose. Lateral margins of pronotum, thorax, upper margins of connexivum and tergites with scattered long black hairs. Posterior margin of pronotum, meso and metanotum and tergites 1-6 covered with silvery short hairs. Connexivum reflexed slightly outwards with sparse silvery pubescense. Distal connexival segment with cluster of long curved hairs. Proepisternum without black spicules, pro-meso and metasternum with scattered brownish-black semi-erect spines. Jugum almost touching antenniferous tubercles. Second sternite obtusely carinate, 3rd less so fringed with two (1+1) rounded pilose elongated ridges. Eighth sternite sharply depressed adjacent to posterior margin of 7th sternite. Front leg (fig. 109). Middle femur (fig. 110) proximo-ventrad with several stout setae, tiba flattened. Hind leg (fig. 108) femur moderately incrassate, ventrally with two prominent projections and several smaller setae, tibia slightly sinuate, inner margin armed with setae. Antennae (fig. 111) segments 3-4 missing. Genital capsule (fig. 116) capsule distally acuminate, parameres elongate. External genitalia and abdomen (fig. 112).

Coloration. – Female (fig. 107): Similar in general appearance to male. Anterior yellow band on pronotum broader and tending to cover lateral margins posteriorly. Reddish brown area of mesonotum more prominent. Tergites 5-7 with shining areas. Front femur basal third pale yellow dorsally, ventrally pale colour extending along femur. Middle and hind legs dull greenish black ventrally pale yellowish brown. Abdominal coloration similar to male.

Table 19. Proportions of antennal segment of *Rhagovelia herzogensis* sp. n.

	I	II	III	IV
Apterous male	45	28	–	–
Apterous female	45	30	39	31
Macropterous female	45	31	39	32.5

Table 20. Proportions of leg segments of *Rhagovelia herzogensis* sp. n.

	Femur	Tibia	Tarsus I	Tarsus II	Tarsus III
Apterous					
♂ front leg	61	67	4	16	-
♀ front leg	60	60	5	16	-
♂ middle leg	100	78	6	33	41
♀ middle leg	94	68	5	32	42
♂ hind leg	89	95	4.5	9	19.5
♀ hind leg	74	88	3	7	20
Macropterous					
♀ front leg	55	60	4	15	-
♀ middle leg	91	69	5	34	43
♀ hind leg	77	92	3.5	8	20

Structure. – Female: Median pronotal length longer than eye length (23:19.5). Pronotal width almost 3x median length. Mesonotum 1.17x median pronotal length and 6.75x length of metanotum. Tergites 1-8 are 12.5 : 12.5 : 13 : 14 : 18 : 19 : 22 : 15. Tergites 1-2, sometimes 3 with a slight median ridge, distal shining tergites slightly flattened. Connexivum erect anteriorly, converging posteriorly, either reflexed inwards slightly or curved over and almost touching posteriorly obscuring shining area of 7th tergite. Posterior half of pronotum with scattered silvery hairs, mesonotum more densely pilose with hairs arranged in semi-circular pattern either side of midline. Lateral margins of metanotum and tergites 1-4 with decreasing areas of silvery hairs. Sternites medianly clothed with fine semi-erect golden hairs. Hind leg (fig. 113) femur slightly incrassate with a prominent projection distally, tibia straight, inner margin unarmed. Proctiger small and sharply reflexed downwards (fig. 114).

Macropterous female (fig. 105). – Similar to apterous form, except pronotum greatly lengthened caudad, anterior margin narrowly pale yellow, posterior margin reddish brown. Wings with four closed cells, wings brown, venation black. Wings extending well beyond end of abdomen.

Figs. 105-115. *Rhagovelia herzogensis* sp. n. – 105, dorsal habitus female macropterous; 106, dorsal habitus male apterous; 107, ibid female; 108-112 male, 113-115 female. 108, 113, hind leg; 109, front leg; 110, mid-femora; 111, 115, antennae; 112, 114, external genitalia. Scale line 1 mm for figs 105-107, and 108-115 respectively.

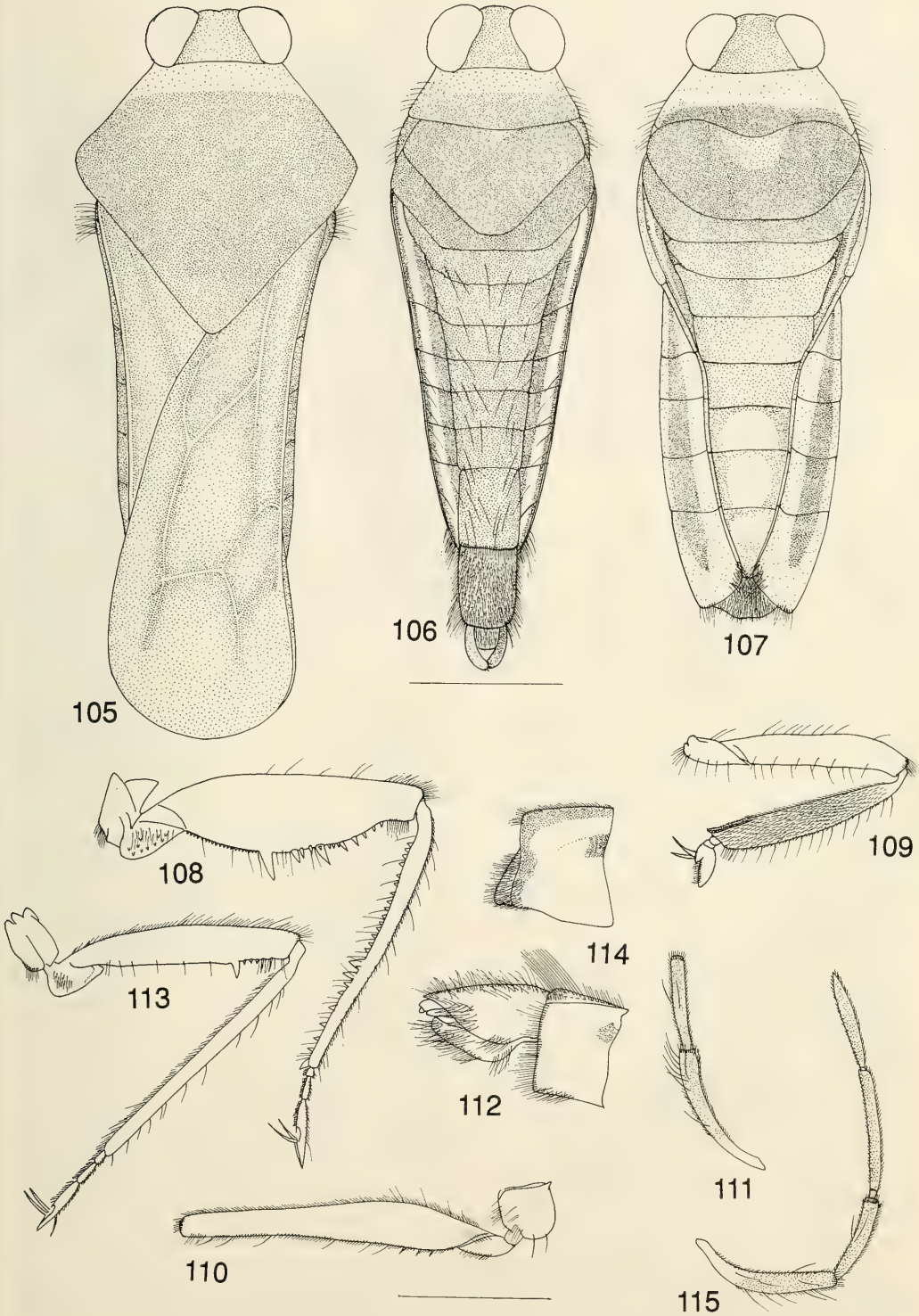
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Fig. 116. *Rhagovelia herzogensis* sp. n. – Male genital capsule. Scale line 0.5 mm.

Etymology. – Specific name alludes to the type locality Herzog Mountains.

Remarks. – This species is closely allied to *aureospicata* sp. n., male mid femura of both species bearing a short row of small spines proximo-ventrally. Male genital capsules similar. Lateral pilosity is much denser of *aureospicata* (fig. 94) compared with *herzogensis* (fig. 106). Female *herzogensis* has the connexivum converging posteriorly with clusters of long hairs (fig. 107), connexivum of female *aureospicata* not convergent distally and lacking the clusters of long hairs (fig. 95).

Rhagovelia crinita sp. n.
(figs. 117-125, tabs. 21-22)

Type material. – Holotype ♂ apterous: New Guinea, Madang District, Finisterre Mts., c. 5500 feet, 30.x.-15.xi.1964, M. E. Bacchus (BMNH). – Paratype: same data, 5♂ 11♀ (BMNH, OXUM).

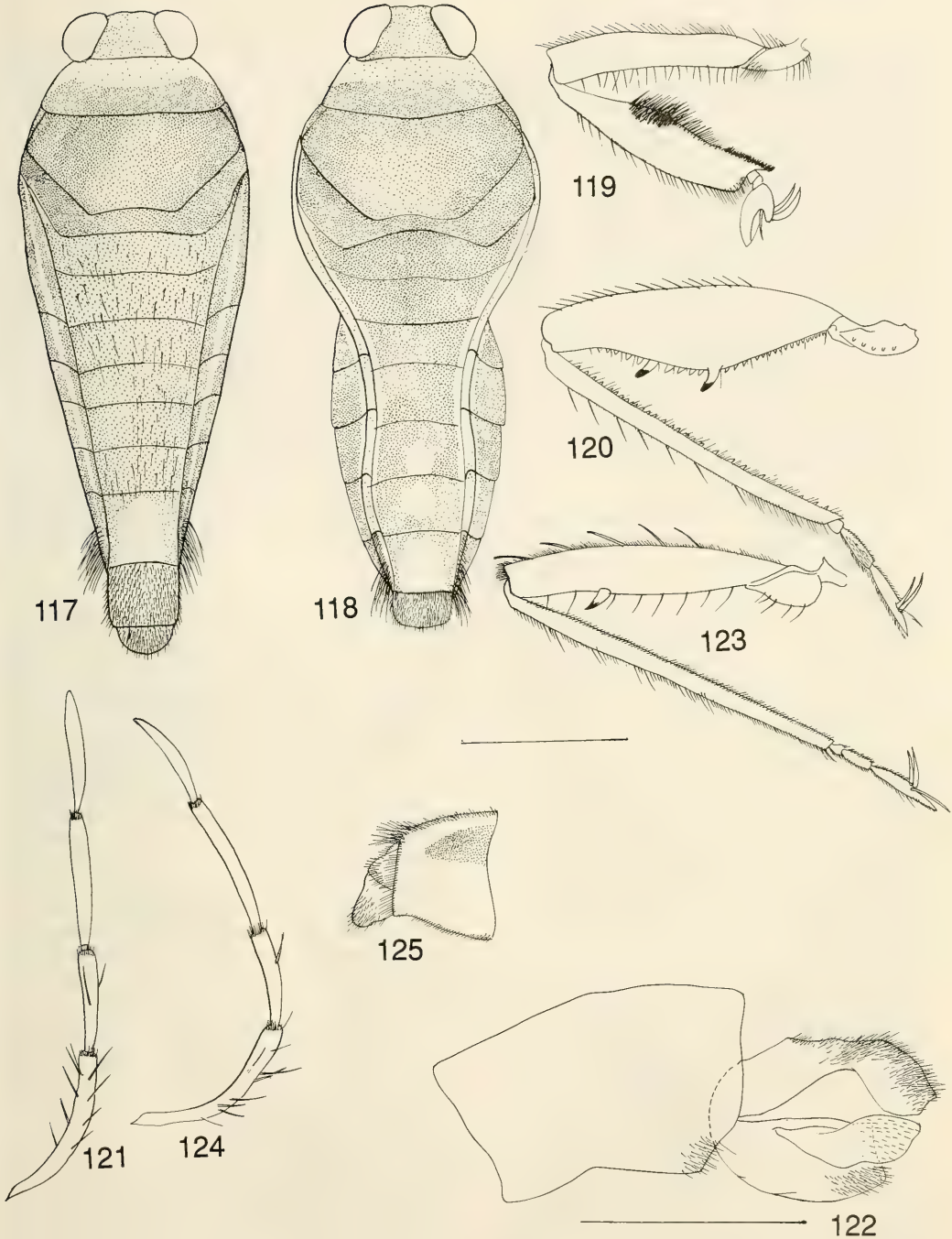
Additional material. – New Guinea: NE. Wau, Morobe District, Mt. Missim, 1200 m. 19.iv.1966, G. Lippert, 1♂ apterous (BPBM).

Description

Adult apterous. – Male (fig. 117) 3.92-4.32 mm long, maximum width 1.42-1.62 mm, female (fig. 118) 3.92-4.32 mm long, maximum width 1.42-1.66 mm.

Coloration. – Male (fig. 117): Head velvety black. Pronotum anteriorly bright yellowish orange, propleura, proepisternum and jugum pale yellow. Posterior half or more of pronotum, meso-metanotum, tergites 1-6 and inner lower margin of connexivum greyish black. Tergites anteriorly narrowly black. Dorsum covered with adpressed golden spicules which tend to be denser on median areas of tergites. Seventh tergite shining, 8th dark brown. Slightly teneral specimens tend to have anterior half of mesonotum reddish brown. Connexivum broadly yellowish orange, apically narrowly black. Meso and metaepimeron dark reddish brown. Sternites 2-5 reddish brown, black laterally, 6-8 tending to be pale yellow. Proximal antennal segment narrowly pale yellow, remainder of segments black. Coxae pale yellow. Inner margin front femur and tibia pale yellow, distal outer margins dark brown. Ventral margins of middle legs pale brown, dorsally brown-black. Hind femur pale yellow, dorsally dark brown, tibia and tarsi reddish brown.

Structure. – Male: Median pronotal length subequal to eye length (20:19). Pronotal width 3x median length. Mesonotum 1.6x pronotal length and 6.4x metanotum at midline. Tergites 1-8 are 13 : 13 : 13 : 12.5 : 14 : 16 : 25.5 : 20. Seventh tergite broadly faintly shining appearing slightly transversely rastrate, 8th tergite densely pilose. Connexivum almost erect, inner margins fringed with fine brown hairs, distal lateral margins fringed with very long hairs. Pronotum and propleura with scattered black hairs, posterior margin of propleura with a few dark brown pits. Jugum broad almost reaching antenniferous tubercles. Thorax ventrally without fields of black spicules. Meso and metapleura with scattered black hairs. Second sternite and part of 3rd moderately carinate, 2-5 with scattered adpressed yellow hairs, 6th densely hairy, 7th slightly flattened, laterally with two (1+1) rows of long yellow hairs, 8th proximally acutely depressed. Front leg (fig. 119) femur fringed with black hairs, tibia proximally narrow, medially explanate with a prominent fringe of stout setae/hairs decreasing in length distally, inner margin distally acuminate. Middle femur slightly flattened. Hind leg (fig. 120) femur moderately incrassate, ventral margin



Figs. 117-125. *Rhagovelia crinita* sp. n. – 117, 119-122 male, 118, 123-125 female. 117-118, dorsal habitus apterous; 119, front leg; 120, 123, hind leg; 121, 124, antennae; 122, genital capsule; 125, external genitalia. Figs. 117-121, 123-125 scale line 1 mm, fig. 122 scale line 0.5 mm.

proximally with a row of regular sized setae, distally with two prominent projections and several larger setae. Tibia almost straight, inner margin armed with a row of irregularly spaced setae. Antennae (fig. 121). Genital capsule (fig. 122) capsule distally truncate, parameres elongate, finely pilose.

Coloration. – Female (fig. 118): Broadly resembling male. Mesonotum tending to be more widely anteriorly dark reddish brown merging to black laterally and posteriorly. Tergites 3-8 becoming more yellowish brown medianly, 5-7 medianly pale brown and shining areas increasing in size distally. Some females have 3-8 becoming progressively more yellowish brown distally, 8 entirely yellowish brown. Connexivum and underside of thorax usually similar to male, metasternum sometimes very dark reddish brown. Sternite 2-7 reddish brown, distally tending to be pale brown. Black areas viewed from different angles appearing to bluish-black. Antennae and legs similar to male.

Structure. – Female: Pronotum slightly longer than eye (20:18). Pronotal width 3.7x median length. Mesonotum 1.57x median pronotal length and 5.7x metanotum at midline. Dark areas of pro-meso and metanotum with scattered long black hairs. Tergites 1-8 are 13 : 14 : 14.5 : 16 : 19 : 20 : 23 : 13. Tergites 1-2 raised above following tergites. Connexivum anteriorly erect, reflexed over lateral margins of 3-7, converging slightly posteriorly. Distally connexivum appearing acuminate with a tuft of black hairs. Sternites 1-6 evenly rounded. Distal margin of 7th transversely depressed (fig. 125). Eighth segment reflexed downwards, proctiger small. Antennae (fig. 124). Front femur densely pilose, tibia laterally with long hairs subequal to tibial width, distally with longitudinal depression. Middle femur slightly flattened. Hind leg (fig. 123) femur not incrassate, distally with a prominent projection, tibia straight, unarmed along inner margin.

Etymology. – *crinita* alludes to the fringe of stout hairs and spines along inner margin of male front tibia.

Remarks. – *Rhagovelia crinita* sp. n. and *thysanotos* sp. n. are superficially rather similar. The male front tibiae of both have a prominent fringe of stout hairs/-spines along inner margin (figs. 119, 129). Distal connexival segments of female *thysanotos* densely fringed with long hairs, *crinita* females have smaller tufts of hairs. The male genitalia of *crinita* differ from *thysanotos* being smaller, parameres of *crinita* distally bluntly acuminate (fig. 122) those of *thysanotos* are bent over apically.

Rhagovelia thysanotos sp n.
(figs. 126-135, tabs. 23-24)

Type material. – Holotype ♂ apterous: New Guinea, Torricelli Mts., 1700 feet, 11.ii.1939, G. P. Moore (BMNH). – Paratypes: same data, 2♂ 1♀ apterous, 1♂ macropterous (BMNH, OXUM).

Table 21. Proportions of antennal segments of *Rhagovelia crinita* sp. n.

	I	II	III	IV
Apterous male	50	33	48	38
Apterous female	50	31	48	38

Table 22. Proportions of leg segments of *Rhagovelia crinita* sp. n.

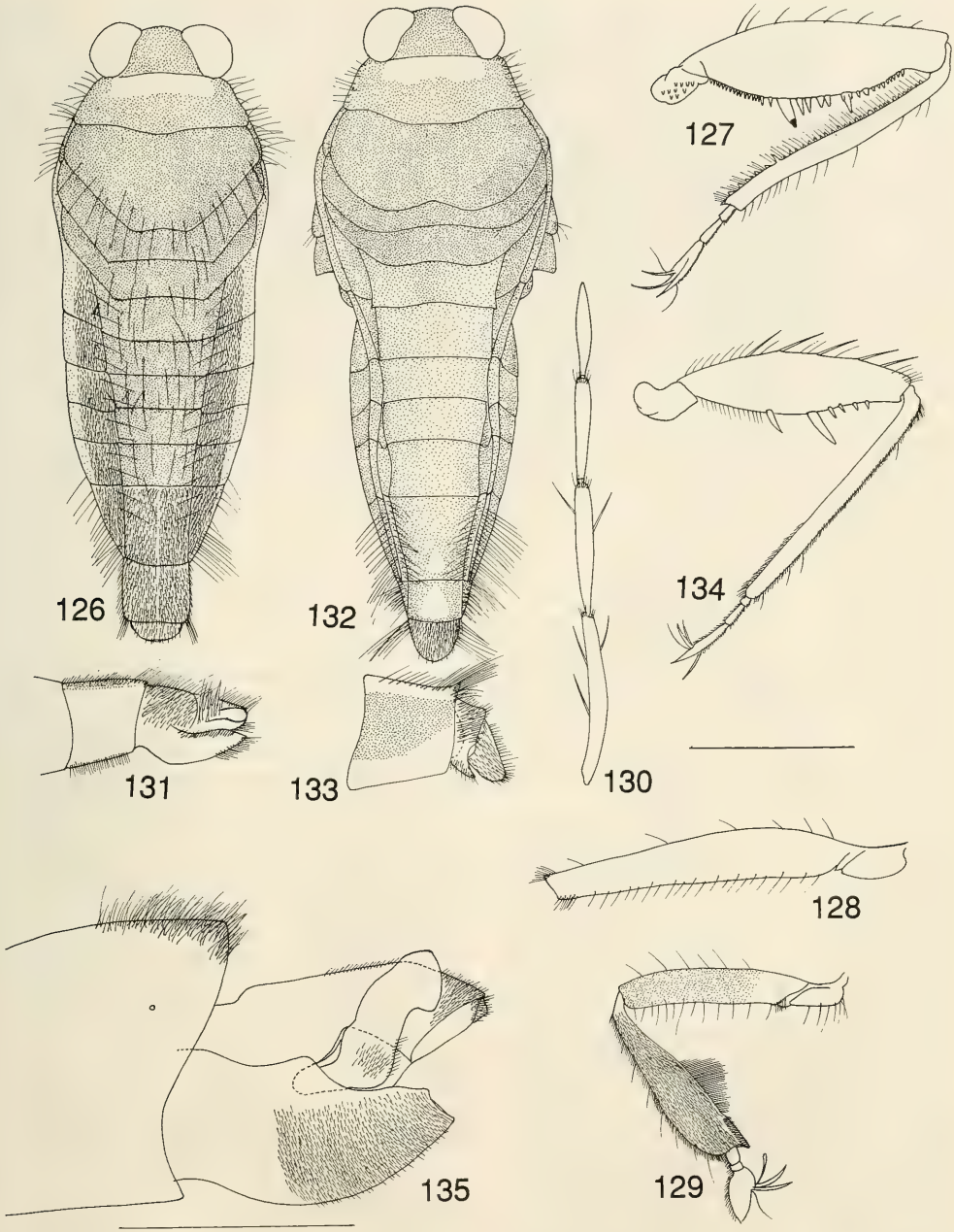
	Femur	Tibia	Tarsus I	Tarsus II	Tarsus III
♂ front leg	70	73	5	17	–
♀ front leg	67	68	6	17	–
♂ middle leg	110	83	5	41	43
♀ middle leg	105	82	3	40	41
♂ hind leg	100	110	5	14	26
♀ hind leg	90	110	3.5	13	24

Description

Adult apterous. – Male (fig. 126) 3.84-3.92 mm long, maximum width 1.4 mm. Female (fig. 132) 3.96 mm long, maximum width 1.52 mm. Adult macropterous. Male 4.08 mm long, maximum width 1.48 mm.

Coloration. – Male (fig. 126): Head velvety black. Pronotum anteriorly pale yellow reaching just beyond inner margin of eyes. Lateral margins, propleura and proepisternum bluish-black evanescent. Pronotum posteriorly, meso, metanotum, tergites and most of connexivum black. Upper margins of connexivum narrowly dark brown, apex narrowly blackish-brown. Seventh tergite faintly shining, 8th shining iridescent green. Jugum and coxae pale yellow. Underside of thorax and sternites greyish black, 6th sternite with lateral margins shining brown. Antennae black, proximal 0.2 of first segment pale yellow. Front leg, femora proximally pale yellow, remainder with tibia dark iridescent green. Middle femur iridescent green, tibia and tarsi rather darker. Hind femora dark brown with a faint green iridescent patch on outer margin, tibia and tarsi dark brown-black.

Structure. – Male: Eye length greater than median pronotal length (18:16). Pronotal width 3.43x median length. Mesonotum 1.9x pronotal length and 4.3x length of metanotum at midline. Lateral bluish margins of pronotum with scattered fields of minute black pits. Posterior margin of propleura with an almost continuous row of similar pits. Tergites 1-8 are 11.5 : 13 : 11.5 : 9.75 : 10 : 13 : 25 : 20. Thorax and tergites covered with short fine pale brown hairs. Overlying these long black hairs which are particularly dense along posterior margin of 7th tergite and



Figs. 126-135. *Rhagovelia thysanotos* sp. n. – 126-131 male, 132-134 female. 126, 132, dorsal habitus apterous; 127, 134, hind leg; 128, mid-femora; 129, front leg; 130, antenna; 131, 133, external genitalia; 135 male genital capsule. Figs. 126-134 scale line 1 mm, fig. 135 scale line 0.5 mm.

whole of 8th. Connexivum anteriorly slightly reflexed outwards, posteriorly erect, inner and outer margins pilose. Distal connexival segment fringed with very long hairs. Eighth tergite distally with two (1+1) clusters of shorter hairs. Pro and mesosternum with long black hairs. Jugum broad almost touching antenniferous tubercles. Second, 3rd and proximal part of 4th sternites bluntly carinate and with a field of short fine hairs. Fifth and 6th sternites laterally pilose, slightly flattened, 7th more pilose, transversely depressed. Front leg (fig. 129) femur moderately pilose. Tibia proximally narrow, medianly explanate with prominent fring of stout hairs decreasing in length distally, inner margin distally acuminate. Middle femur (fig. 128) very slightly flattened. Hind leg (fig. 127) femora moderately incrassate, medianly almost parallel sided. Ventral margin anteriorly and posteriorly with almost regular rows of triangular setae. Anteriorly with prominent projection, medianly with several smaller projections. Hind tiba slightly sinuate, inner margin armed with setae varying in size and density. Antennae (fig. 130). Genital capsule ventrally pilose, parameres elongate, distally slightly hooked (fig. 135). Entire genital segment very pilose (fig. 131).

Coloration. – Female (fig. 132): Broadly resembles male, anterior margin of pronotum more brightly coloured. Tergites appearing dull black with a faint bluish evanescence, 7-8 with small shining bluish-black discs, that of 8 covering most of segment. Connexivum apically broadly dark brown. Thorax ventrally and sternites bluish black. Legs and antennae similar to male.

Structure. – Female: Eye length less than median pronotal length (16:18). Median pronotal width 3.1x median length. Mesonotum 1.3x median pronotal length, posterior margin deeply emarginate, with a row of black pits along margin. Metanotum 0.24x length of mesonotum. Lateral margins of pronotum with scattered long black hairs. Tergites 1-8 are 13 : 13 : 12 : 12.5 : 14.5 : 17.5 : 22.5 : 15. Connexivum slightly reflexed outwards anteriorly, converging at 4th tergite erect, posteriorly slightly sinuate converging and erect distally, with prominent clusters of long dark brown-black hairs. External genitalia and proctiger sharply reflexed downwards, proctiger with lateral clusters of hairs (fig. 133). Hind leg (fig. 134) femur slightly incrassate, ventrally with two prominent projections and several smaller setae distally. Hind tibia straight, unarmed along inner margin.

Macropterous male. – Elytra damaged one missing, specimen in poor condition. Similar in coloration to apterous male. Pronotum lengthened caudad, anterior margin with transverse pale yellow band just reaching inner margin of eyes. Wing reaching beyond end of abdomen with four closed cells, basal two small, extending into distal part of wing. Elytra yellowish brown, veins black, R and Sc with many dark brown hairs. Hind leg similar to apterous male.

Table 23. Proportions of antennal segments of *Rhagovelia thysanotos* sp. n. * = missing.

	I	II	III	IV
Apterous male	49	27	32	30
Apterous female	47	22	*	*
Macropterous male	41	21	*	*

Table 24. Proportions of leg segments of *Rhagovelia thysanotos* sp. n.

	Femur	Tibia	Tarsus I	Tarsus II	Tarsus III
Apterous					
♂ front leg	59	60	4	16.5	-
♀ front leg	55	55	51	5	-
♂ middle leg	95	70	5	31	41
♀ middle leg	82	61	5	29	40
♂ hind leg	80	80	5	14	18
♀ hind leg	73	75	4	7	17
Macropterous					
♂ front leg	52	52	4	13.5	-
♂ middle leg	83	53	3	26.5	40
♂ hind leg	75	65	4	7	17

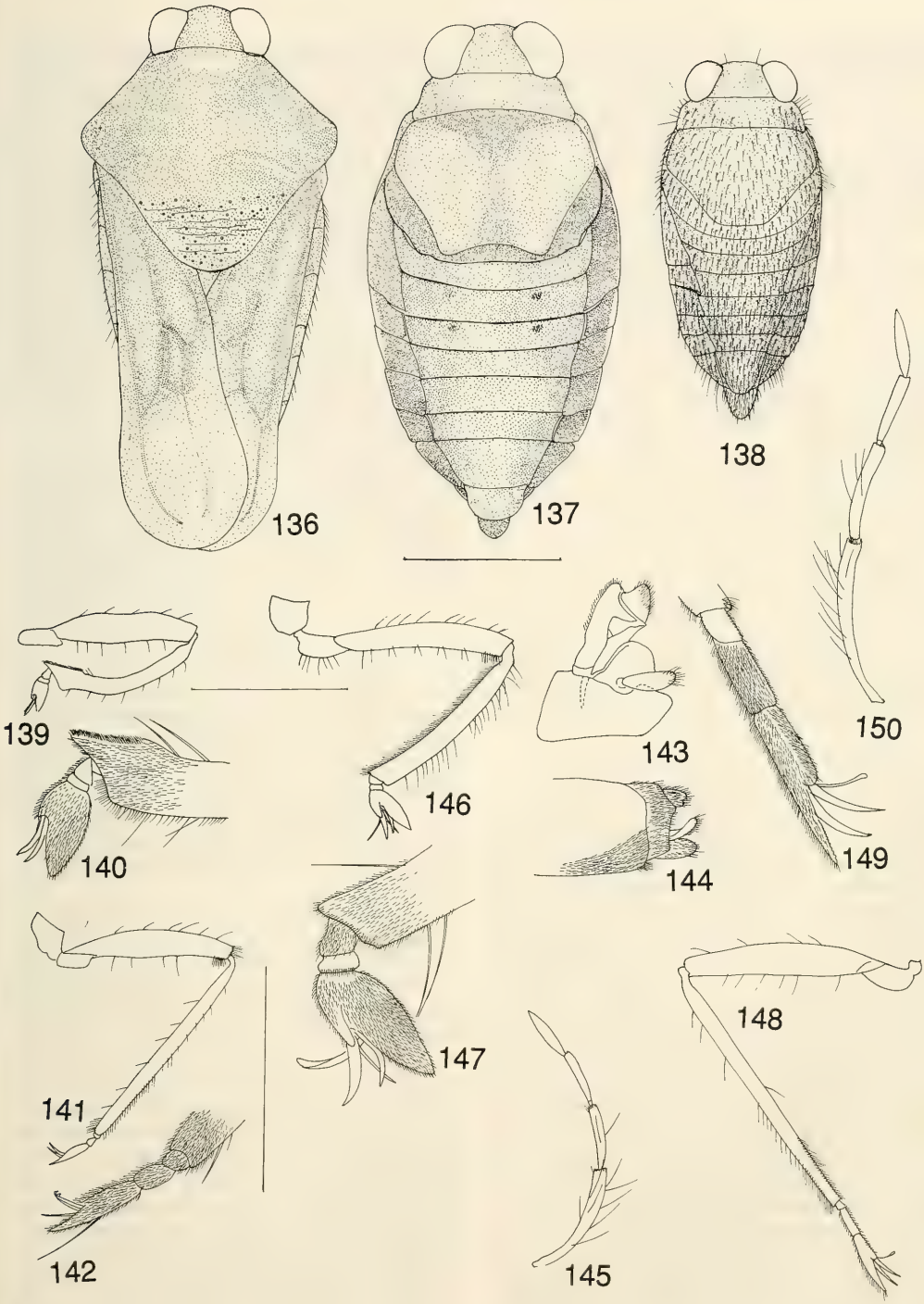
Etymology. – *Thysanotos* alludes to the fring of stout hairs along the inner median margin of the male front tibia.

Remarks. – *Rhagovelia thysanotos* sp. n. has features in common with *crinita* sp. n. Males of both species having a prominent fringe along inner margin of front tibia. The anterior pale band of *thysanotos* does not reach the lateral margins of pronotum and the shining areas of the distal tergites are much reduced compared with *crinita*. The male genital capsule of *thysanotos* is relatively much larger than of *crinita* and the parameres of the former are somewhat bent over distally, almost spatulate. The condition of the type series of *thysanotos* is very poor, only one male having complete antennae. All specimens covered with detritus/dust with signs of mite damage at some stage.

Rhagovelia caesius sp. n.
(figs. 136-150, tabs. 25-26)

Type material. – Holotype ♂ apterous: Papua New Guinea, Oro Province, Popondetta, Sambogo River, close to stones, 30.iv.1989, R. N. B. Prior (OXUM). – Paratypes: Same data, 64♂ 28♀ apterous, 1♂ 1♀ macropterous (OXUM); Papua New Guinea, Milne Bay Province, streams near Alotau, 27.iv.1989, Prior, 7♂ 6♀ apterous (OXUM).

Additional material. – Papua: Kokoda, 1200 feet, ix.1933, L. E. Cheesman, 7♂ 7♀ apterous; New Guinea,



Figs. 136-150. *Rhagovelia caesius* sp. n. – 136, dorsal habitus macropterous female; 137, dorsal habitus apterous female; 138, ibid male; 139-145 male, 146-150 female. 139, 146, front leg; 140, 147, distal end of tibia and tarsi of front leg; 141, 148, hind leg; 142, 149, distal end of tibia and tarsi of hind leg; 145, 150, antennae. Figs. 136-138 scale line 1 mm, figs. 139, 141, 144-146, 148, 150 scale line 1 mm, figs. 140, 142-143, 147, 149 scale line 0.5 mm.

Table 25. Proportions of antennal segments of *Rhagovelia caesius* sp. n.

	I	II	III	IV
Apterous male	38	19.5	17	19
Apterous female	48.5	30	23	23
Macropterous male	36	20	18	20

Table 26. Proportions of leg segments of *Rhagovelia caesius* sp. n.

	Femur	Tibia	Tarsus I	Tarsus II	Tarsus III
Apterous					
♂ front leg	45	46	3	14.5	-
♀ front leg	55	60	4.5	15	-
♂ middle leg	67	54	4	29	31
♀ middle leg	85	67	5	32	40
♂ hind leg	48	71	2	4	12
♀ hind leg	60	88	3	9	19
Macropterous					
♂ front leg	46	46	3	9	-
♂ middle leg	68	52	3	28	34
♂ hind leg	48	70	3	3	11

Morobe District, Lae-Bululo Road, 28.xii.1964, M.E. Bacchus, 1♂ 2♀ apterous; Papua New Guinea, Morobe Province, Buso, ix-xi.1979, J. Martin, 3♂ 3♀ apterous, 1♂ 1♀ macropterous (BMNH).

Description

Adult apterous. – Male (fig. 138) 2.32-2.52 mm long, maximum width 1-1.08 mm. Female (fig. 137) 3.28-3.36 mm long, maximum width 1.56-1.64 mm. Adult macropterous. Male 2.84-2.92 mm long, maximum width 1.24-1.28 mm. Female (fig. 136) 3.4 mm long, maximum width 1.64 mm.

Coloration. – Male (fig. 138): Head velvety black. General dorsal coloration appearing greyish black. Pronotum anteriorly with a rather indistinct orange brown transverse band not reaching the inner margin of eyes. Lateral margins of mesonotum sometimes faintly orange brown. Pro, meso and meta pleura tumescent black, viewed from various angles appearing dark evanescent blue. Antenniferous tubercles shining black. Jugum and rostrum shining iridescent greenish black. Median area of 7th sternite shining pale brown. Coxae and trochanters shining yellowish brown. Legs iridescent greenish black. Antennae black, basal third of proximal segment pale yellow.

Structure. – Male: Eye length greater than median pronotal length (13:9). Pronotal width 4.4x median length. Mesonotum 3.6x median pronotal length, lateral posterior margins emarginate. Metanotum about 0.12x length of mesonotum. Lateral margins of pronotum, all of mesonotum, metanotum, tergites and connexivum with long semi-erect black hairs overlying short greyish hairs. Tergites 1-8 are 5.5 : 5.75 : 5.9 : 6 : 6 : 6 : 12.5 : 9. Connexivum usually flattened, from side view tergites visible. Jugum clearly distinct from antenniferous tubercles, proepisternum lacking black spicules. Front coxae with clusters of short setae. Front leg (figs. 139-140) femur moderately finely spinose, tibia curved explanate distally with a prominent ridge of fine setae along inner distal margin (fig. 140). Middle and hind trochanters and coxae with stout short yellowish hairs. Hind leg similar to middle leg, not incrassate and spinose (figs. 141-142), middle and hind femora slightly flattened, hind tarsi pilose (fig. 142). Antennae (fig. 145) proximal segment with many long fine spines. Seventh abdominal segment rounded, genital segment cylindrical and pilose. Genital capsule (fig. 143) distally truncate, parameres elongate.

Coloration. – Female (fig. 137): Ground colour appearing blackish suffused with faint greenish black tumescence, pro-meso and metanotum sometimes suffused pale yellowish brown. Pronotum anteriorly with a faint transverse orange stripe merging into greenish tumescence almost reaching inner margin of eyes. Mesonotum and metanotum laterally pale greenish black, mesonotum and metanotum with field of minute black spicules. Connexivum and tergites uniform greenish black. Antenniferous tubercles, jugum and rostrum shining dark brown-black. Pro-meso and metaepisternum silvery grey tumescent. Venter greyish tumescent, 7th sternite shining dull black. Coxae and trochanters variably pale-dark yellow. Proximal margin of front femur narrowly pale yellow, remainder of all legs greenish black iridescent. Antennae black, proximal third of first segment pale yellow.

Structure. – Female: Eye length greater than median pronotal length (17:13). Pronotal width 4.1x median length. Mesonotum 3.3x pronotal length and 7.1x midline of metanotum. Posterior lateral margins of mesonotum slightly emarginate, posterior margin deeply emarginate. Tergites 1-8 are 6.5 : 11 : 10 : 8.5 : 9 : 10 : 11 : 10. Connexivum usually flattened, sometimes elevated reflexed outwards. Dorsally thorax, abdomen and connexivum not pilose as in males. Proepisternum without black spicules. Lateral margins of prothorax and abdomen with scattered erect black hairs. Lateral margins of sternites 2-6 with sparse golden short hairs. Seventh sternite black shining, laterally with fields of longer golden hairs increasing in density along distal margin. Jugum distinct from antenniferous tubercles. Front coxae and trochanters with pale yellow spine-like hairs. Front leg (fig. 146) femur and tibia curved with inner distal margin of tibia slightly expanded (fig. 147). Middle and hind legs similar, hind leg (fig. 148) tarsi elongate and pilose (fig. 149). Antennae (fig. 15) proximal seg-

ment with many long fine hairs, 2nd segment sparsely pilose.

Macropterous male. – Coloration not differing greatly from apterous form. Pronotum long (1.08 mm). Pronotum at its widest raised very prominently. Forewings more or less uniformly brown extending well beyond the end of abdomen. Venation with three closed cells proximally.

Macropterous female (fig. 136). – Coloration, resembles apterous form. Pronotum about 1.52 mm long, transverse orange band slightly more obvious than in apterous form, posterior lobe transversely striated and finely pitted. Forewings basally greenish grey, distally orange brown reaching just beyond end of abdomen. Three closed cells in basal dark area of wing.

Etymology. – *Caesius* alludes to the bluish grey appearance of the adult especially the female.

Remarks. – This species differs from others so far known from New Guinea and Solomon Islands by the absence of prominent spines/projections on the hind femora of either sex. The sexual dimorphic body size indicates phoretic behaviour. A pair from the Sambogo River were taken 'in cop', the curved male front femora fit in the lateral divergent margins of the female mesonotum and the curved male tibia encircle the pleural margins. The males also differ from the females in having the dorsum covered with long hairs, whereas the females lack the long hairs dorsally and their coloration is tomentose greyish blue. The females appear to be abnormally flattened compared to the males, this aspect is exagerated by the flat connexivum and broad prothorax in the majoriy of specimens.

Discussion

The *Rhagovelia* of the northern provinces of Papua New Guinea have a distinctive endemic fauna.The species so far recorded from the Oro Province (Popondetta region - Kokoda) see map in Cheesman (1943) includes *priori* sp. n.; *hirsuta* sp. n.; *aureospicata* sp. n. and *caesius* sp. n. representing three species groups, and does suggest that extensive sampling of rain forest creeks and rivers in 'limited areas' will greatly increase the *Rhagovelia* species known from Papua New Guinea.

Rhagovelia caesius sp. n. is the most aberrant species so far recorded from Papua New Guinea. The material included under this name has a distribution extending from Oro, Kokoda, 1200 feet to sealevel at Alotau, Milne Bay Province. Further studies may show that '*caesius*' is a group of closely allied species.

Polhemus & Polhemus (1988) discuss at length the zoogeography of *Rhagovelia*, commenting on the dearth of described species from the Philippines, New Guinea, Solomons and other zoogeographically important areas. The *Rhagovelia* of New Guinea are thought to have radiated extensively during the late Tertiary and the existing *Rhagovelia* fauna is stated to be endemic to New Guinea and to have originated primarily since the Oligocene. Sources of New Guinea *Rhagovelia* are thought to be New Caledonia and relict forms from northern australian refugia.

Kikkawa et al. (1981) postulate that the continental margin of Australia extended to southern New Guinea since the Lower Jurassic. Much of northern Australia and New Guinea were subsea suring the early Cretaceous. The northward movement of Australia continued and the collision of crustal plates in the mid Miocene created the present land mass of New Guinea. By the Pliocene, most of New Guinea had emerged from the sea. The major uplift of the present mountain ranges with major faulting accompanied by widespread volcanic activity in the late Miocene - early Pliocene (7 Ma) and continues today. Recent studies of the north coast of New Guinea show 32 terranes (micro-tectonic plates), each of which has 'docked' to the north coast over the past 20 million years, as the island was pushed northwards through a complex subduction zone. An earthquake on the 15th May, 1992 caused a 10 cm uplift near Sialum (Morobe Province), which was felt very strongly along the Madang coastline.

The total uplift may exceed 3000-4000 m. Smith & Briden (1977) commenting on the tectonic folding and uplift in central New Guinea and 'fragmented plates' suggest the fragmented plates created the 'Indonesian islands' and may have joined the continents of Asia and Australia allowing the first wave of Asian migrants to enter the Australian region.

The evidence of palaeogeography, climate and geology present a very confusing set of scenarios to account for the diversity of some groups of water-bugs in New Guinea. During the Pleistocene sea-level changes, New Guinea was linked to Australia until between 6500-8000 B. P. The aridity caused by the lowered sea-levels may have inhibited the movement of *Rhagovelia* between Australia and New Guinea and species on either land mass may have survived in refugic mesic habitats. The record of *R. australica* Kirkaldy from Mt. Lewis is of more than passing interest, as a number of relict forms have been recorded from Mt. Lewis. Other examples include the leafhopper *Myerslopia taylori* Evans, a primitive tribe hitherto known from Madagascar, New Zealand, Chile and Juan Fernandez, further *Ignambia*, a flightless genus of dung beetles (Coleoptera) also known from New Caledonia, and the stag beetle *Sphaenognathus* sp. (Coleoptera) unknown outside South America.

The formation of the mountain ranges with high rainfall has formed a wide variety of isolated lotic habitats, which over a long period may have enhanced the biodiversity of pleuston bugs in New Guinea.

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References

Andersen, N. M., 1982. The semiaquatic bugs (Hemiptera, Gerromorpha). Phylogeny, adaptations, biogeography and classification. – Entomonograph 3: 1-455.

Cheesman, L. E., 1943. Japanese Operations in New Guinea. – The Geographical Journal 101 (3); 98-110.

Hale, H. M., 1925. Results of Dr. E. Mjoberg's Swedish Scientific Expedition to Australia 1910-1913. The Aquatic and Semi-Aquatic Hemiptera. – Arkiv för Zoologi 17A (20): 1-19.

Hale, H. M., 1926. Studies in Australian Aquatic Hemiptera No. VII. – Records of the South Australian Museum 3: 195-217.

Kikkawa, J., Monteith, G. B. & G. Ingrams, 1981. Cape York Peninsula: Major region of faunal interchange. p. 1697-1736. – In: A. Keast (Ed.), Ecological biogeography of Australia. Junk, The Hague.

Kirkaldy, G. W., 1901. On some Rhynchota, principally from New Guinea, (Amphibicorisae and Notonectidae). – Annali del Museo Civico di Storia Naturale G. Doria 20: 804-810.

Kirkaldy, G. W., 1908. Memoir on a few heteropterous Hemiptera from eastern Australia. – Proceedings of the Linnean Society of New South Wales 32: 768-788.

Lundblad, O., 1933. Zur Kenntnis der aquatilien und semiaquatilen Hemipteren von Sumatra, Java und Bali. – Arkiv für Hydrobiologie, Supplement 12: 1-195, 263-489, pls. 1-21, figs. 142.

Lundblad, O., 1936. Die altweltichen Arten der Veliidengattungen *Rhagovelia* und *Tetraripis*. – Arkiv för Zoologi 28A: 1-63.

Polhemus, J. T. & D. A. Polhemus, 1988. Zoogeography, ecology, and systematics of the genus *Rhagovelia* Mayr (Heteroptera: Veliidae) in Borneo, Celebes, and the Moluccas. – Insecta Mundi 2: 161-230.

Smith, A. G. & J. C. Briden, 1977. Mesozoic and Cenozoic Palaeo-continental maps. – Cambridge University Press, Cambridge: 63 pp.

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REVISION OF THE SHORE-FLY GENUS *CHLORICHAETA* BECKER (DIPTERA: EPHYDRIDAE)

Mathis, W. N. & T. Zatwarnicki, 1993. Revision of the shore-fly genus *Chlorichaeta* Becker (Diptera: Ephydridae). – Tijdschrift voor Entomologie 136: 55-76, figs. 1-53. [ISSN 0040-7496]. Published 1 July 1993.
Chlorichaeta Becker, an Old-World genus of shore flies of the tribe Gymnomyzini, is revised. Included are seven species of which *C. africana* (Kenya: Lake Victoria), *C. mais* (Seychelles: Aldabra), and *C. orba* (Sri Lanka: Nilaveli) are newly described and *C. gioiellae* Canzoneri & Rampini is determined to be conspecific and the junior synonym of *C. villiersi* Canzoneri & Meneghini.
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Key words. – Diptera; Ephydridae; Gymnomyzinae; *Chlorichaeta*; revision; new species; Old World.

Shore flies of the genus *Chlorichaeta* Becker are known only from the Old World, mostly where warmer climates prevail, such as around the Mediterranean Sea or in tropical regions of Africa and the Orient. Only one species, *C. albipennis* (Loew), is known to occur in the more temperate regions of the Palearctic Region (Cogan 1984). The genus has never been treated on a worldwide basis, and that deficiency, in part, prompted the research that resulted in this revision.

There are few species in *Chlorichaeta,* and these are poorly known except to specialists. The history of previous work on the genus, as a consequence, is relatively brief and straightforward. Becker (1922) proposed *Chlorichaeta* towards the end of his career as a dipterist, and in the same paper, he described *C. tuberculosa,* which became the type species of the genus by monotypy. Becker's first and finest published work on shore flies was his monograph on Palearctic species (1896), which included *Gymnopa albipennis,* a species Loew (1848) described in his first paper on shore flies. This species remained in *Gymnopa* or its senior synonym, *Mosillus* Latreille, until Cresson (1925) transferred it to *Chlorichaeta.* The genus comprised only these two species until the 1940's when Duda (1942) described *Strandilus strandi* in a peculiar paper in which each new genus- or species-group name, which numbered five and 19 respectively, was named after Embrik Strand (1876-1947) except where a homonym would result. Papp (1979) studied Duda's collection, now mostly housed in Berlin (ZMHU), and found that the primary types of *S. strandi* (a lectotype was then designated) are conspecific with *Gymnopa albipennis* with the latter being the senior synonym. Cresson (1946), as part of a synopsis of Afrotropical shore flies, described *C. aerifer* from specimens collected in Angola. After another gap of two decades, Canzoneri & Meneghini (1969a) described *C. villiersi* from specimens collected in Senegal and published the first figures of male terminalia. In another publication, a well-illustrated faunal treatment of shore flies occurring in Italy, Canzoneri & Meneghini (1983) also provided a synopsis of *C. albipennis.* Finally, Canzoneri & Rampini (1990) described *C. gioiellae* from specimens collected in Sierra Leone. Nothing is known about the immature stages, and what little we know about the natural history comes from brief annotations that were included as part of taxonomic reviews or listings (Cresson 1946). Apart from entries in regional catalogues (Cogan 1980, 1984, Mathis 1989) little other work has been published on the genus.

In addition to revising the species of *Chlorichaeta,* we recharacterize the genus within the context of phylogenetic studies we are conducting on the tribe Gymnomyzini Latreille. Gymnomyzini include several genus-group taxa (Mathis et al. 1993), of which we have revised *Placopsidella* Kertész (Mathis 1986), the western Palaearctic species of *Athyroglossa* Becker (Mathis & Zatwarnicki 1990), and *Mosillus* Latreille (Mathis et al. 1993). Other species revisions of gymnomyzine genera are anticipated.

Methods

The methods used generally in this study were ex-

plained previously (Mathis 1986, Mathis & Zatwarnicki 1990). Because specimens are small, less than 3.50 mm, study and illustration of the male terminalia required use of a compound microscope.

Although we have followed the terminology for most structures of the male terminalia that other workers in Ephydridae have used (see references in Mathis 1986, and Mathis & Zatwarnicki 1990a, 1990b), Zatwarnicki (1992) advocated usage of the term dististylus rather than surstylus, largely based on an hypothesis advanced by Hennig (1936). The merits of Hennig's hypothesis are still being debated, and here we continue to use surstylus. In papers for which Zatwarnicki is first author, however, dististylus will be used.

Three ratios (two venational) are used commonly in the descriptions and are defined here for the convenience of the user (ratios are averages of three specimens):

1. Eye-to-cheek ratio: Genal height / eye height. Measurements are taken from the head in lateral view.

2. Costal vein ratio: the straight line distance between the apices of R_{2+3} and R_{4+5} / distance between the apices of R_1 and R_{2+3}.

3. M vein ratio: the straight line distance along M between crossveins (r-m and dm-cu) / distance apicad of crossvein dm-cu.

Although this study was based in large part on specimens in the U. S. National Museum of Natural History, numerous others were borrowed, particularly type specimens of the species previously described. To our colleagues and their institutions listed below who lent specimens, we express our sincere thanks. Without their cooperation this study could not have been completed.

ANSP – Academy of Natural Sciences of Philadelphia, Pennsylvania (J. K. Gelhaus and Donald Azuma); BMNH – British Museum (Natural History), London, England (Brian Pitkin); BBM – Bernice P. Bishop Museum, Honolulu, Hawaii (N. L. Evenhuis); CAS – California Academy of Sciences, San Francisco, California (P. H. Arnaud, Jr.); CANZ – Personal collection of Silvano Canzoneri, Venice, Italy; MNHN – Muséum National d'Histoire Naturelle, Paris, France (Loïc Matile); NMW – Naturhistorisches Museum, Vienna, Austria (Ruth Contreras-Lichtenberg); NMWL – National Museum of Wales, Cardiff, Wales, United Kingdom (J. C. Deeming); TAU – Tel Aviv University, Tel Aviv, Israel (A. Freidberg); USNM – former United States National Museum, collections in the National Museum of Natural History, Smithsonian Institution, Washington, D. C.; ZMHU – Zoologisches Museum, Humboldt Universität, Berlin, Germany (H. Schumann).

Systematic account

Genus *Chlorichaeta* Becker

Chlorichaeta Becker, 1922: 73. – Type species: *Chlorichaeta tuberculosa* Becker, 1922, monotypy; Cogan and Wirth 1977: 322 [Oriental catalogue], Cogan 1980: 656 [Afrotropical catalogue]; 1984: 127-128 [Palearctic catalogue], Canzoneri & Meneghini 1983: 227-229 [diagnosis].

Strandillus Duda, 1942: 10. – Type species: *Strandillus strandi* Duda, 1942 (= *Gymnopa albipennis* Loew, 1848), monotypy; Papp 1979: 98 [synonymy].

Diagnosis

Small to medium-sized shore flies, length 1.50-3.10 mm, mostly black, many surfaces subshiny to shiny; dorsum, especially of thorax, somewhat microtomentose, appearing subshiny to dull.

Head: Setation generally poorly developed; frontoorbital setae greatly reduced or lacking; ocellar setae short, inserted laterad of anterior ocellus and widely separated; both inner and outer vertical setae present, short. Frons generally smooth, shiny, ocellar triangle of mesofrons sometimes differentiated. Arista comparatively short, subequal to length of combined first 3 antennal segments, appearing bare or bearing several, very short hairs along dorsal surface, length of hairs subequal with basal aristal width. Face symmetrically pitted around midfacial protuberance, pits with silvery white microtomentum, making face appear spotted; midfacial conical protuberance not prominent; parafacials immediately adjacent to face with a vertical row of shallow, horizontal grooves; portion of parafacial near anteroventral margin of eye with some silvery white microtomentum; gena generally bare and high, height 2/3 to 3/4 eye height; posterior margin sharply angulate and marginate.

Thorax: Mesonotum mostly black, shiny, frequently with metallic luster, especially scutellum; mesonotal surface appearing granulose to various degrees. Notopleuron with 1 seta inserted near posteroventral angle; apical scutellar setae arising from tubercles; intra-alar seta 1; lacking row of prominent setae between postalar seta and base of scutellum; coloration of halter variable. Wing milky white; vein R_{2+3} long, with length of costal section II not quite twice section III; vein CuA_1 not reaching wing margin; alula wide alular marginal setulae much shorter than alular width. Fore femur much more swollen than mid or hind femora, produced ventrally to a somewhat pointed ridge near midlength, process bearing a row of 4-5 stout setae along anterior half of posteroventral margin, seta arising from ventral, midlength point conspicuously larger; mid tibia black, somewhat rounded (lacking conspicuously flattened surfaces), lacking silvery-white microto-

mentum on anterior surface. Basitarsomere colour variable, apical 2-3 tarsomeres usually blackish brown.

Abdomen: Dorsal surface of terga black, shiny, more finely granulose than mesonotum, lacking bands of microtomentum; terga well sclerotized, lateral margins continued laterally and ventrally; sterna of male relatively poorly developed, usually as small sclerotized rectangular plates, 1st sternum of male oriented perpendicular to plane of body, sterna 2-4 parallel to plane of body, 5th sternum as 2 sternites, these oriented to form a V, with vertex anteriad, sometimes fused at vertex; 5th tergum exposed but shorter than 4th, usually triangular or trapezoidal, with 2 dorsal pits toward posterior margin. Male terminalia: Epandrium in lateral view narrowed dorsally, expanded laterally, in posterior view widest at level of cerci; cerci oval, bearing short setae; hypandrium more or less U or V-shaped with posterolateral portion relatively long (representing fused distal portion of pregonite to hypandrium) and anteromedial portion forming vertex variously developed; surstyli generally elongate, subequal in length to that of cerci, broadly fused basally with ventral margin of epandrium, becoming tapered ventrally, pointed apically, ventral portion generally curved anteriorly to some degree; aedeagal apodeme more broadly developed in lateral view toward end that attaches to hypandrium; pregonite apparently fused with hypandrium; postgonite linear, rod-like, setulose; aedeagus with distinct basiphallus, distiphallus, and a sclerotized rod (ejaculatory apodeme) attached by a membranous duct to the base of the basiphallus; basiphallus well sclerotized, simple, tube-like; distiphallus more complex, with 2 sclerotized rods basally, apex membranous, in some species bearing 1-2 paired extended lateral processes and 1 unpaired ventral process, these sometimes sclerotized, all processes arising near base of distiphallus.

Distribution

Old World in tropical and warm temperate zones. Afrotropical, Australasian, Oceanian, Oriental and Palearctic (Japan, Lithuania, and Mediterranean) regions.

Natural history

Species of *Chlorichaeta* apparently feed as general scavengers in concentrated organic material, such as manure of terrestrial vertebrates. Cresson (1945: 53) reported that *C. tuberculosa* bred in rotten oil cake manure in Madras, India, and that the dissemination of the manure may account for the wide distribution of this species. On atolls of the Aldabra Group, *C. mais,* a new species described below, occurred in several habitats. We collected it most commonly on tortoise droppings but also found it around pig pens near the settlement (Picard Island) and occasionally on rotting seaweed that had accumulated at the strand line on beaches.

Adults are attracted to moisture on animals and are frequently associated with livestock (camels, cattle, donkeys, pigs). Suppurating sores on livestock are especially attractive (Cresson 1946: 244), and in the Negev Desert of Israel, Amnon Freidberg and W. N. Mathis observed that adults of *C. tuberculosa* were attracted to moisture, especially perspiration on bare legs. Cresson (1946) also noted that a specimen was found on a coccid (Homoptera) on the trunk of a China-tree in Angola (this occurrence may be incidental and of little significance).

Diagnosis and discussion of phylogenetic relationships

Chlorichaeta is similar and closely related to *Mosillus* Latreille and a group of species related to '*Gymnopa beckeri* Cresson'. The genus is more distantly related to *Placopsidella* and possibly to *Chaetomosillus.* The monophyly of *Chlorichaeta, Mosillus,* and the species related to '*Gymnopa beckeri*' (hereafter called the *Mosillus* clade) is established by the following synapomorphies:

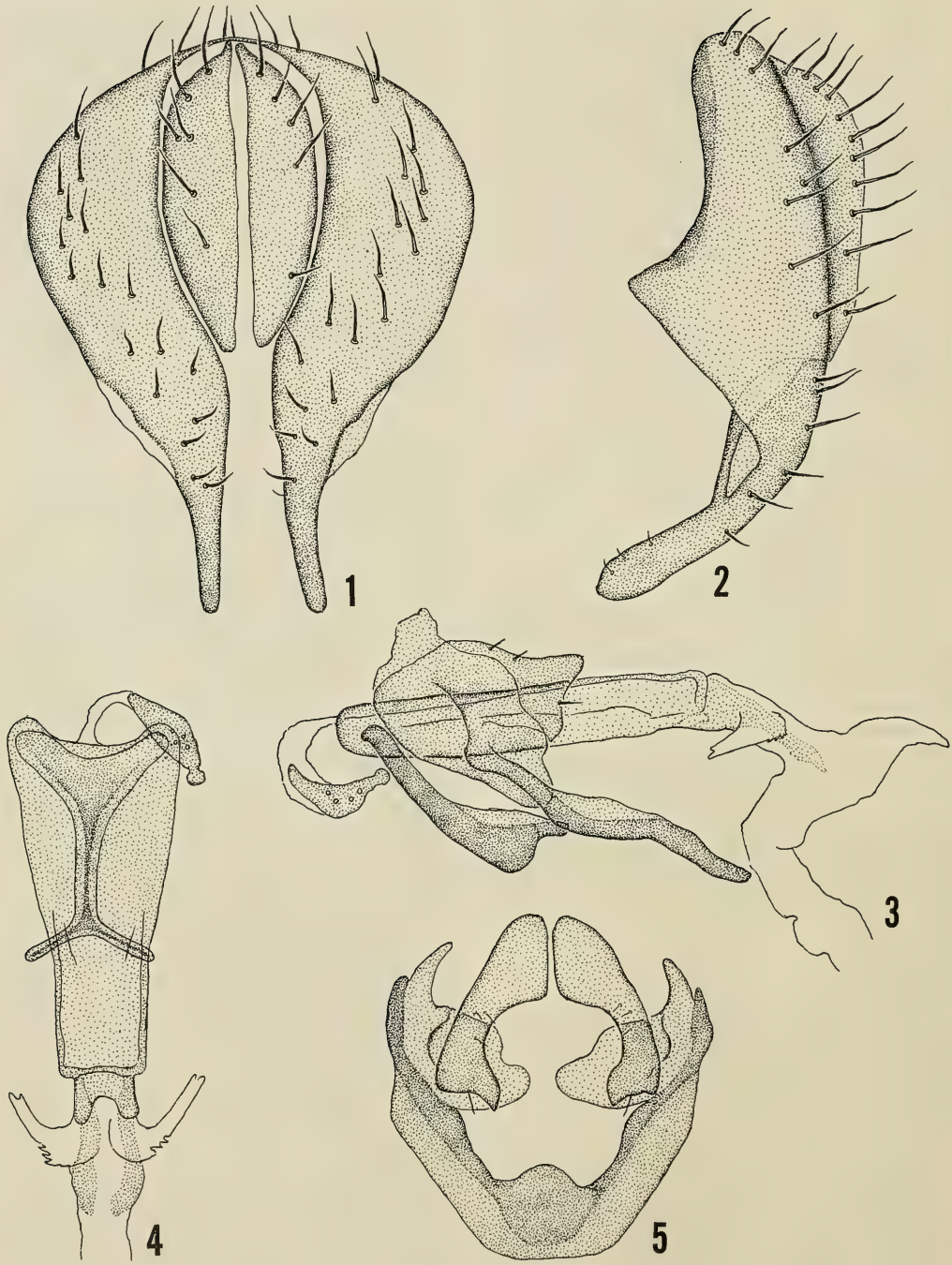
1. The hypandrium, especially the lateral arms, is fused with the pregonites, a character unique to this clade.

2. The fore femur bears 5-8 stout setae, with the first one or two being the largest. In most genera of Gymnomyzini the fore femur is either unarmed or in a few genera the fore femur is produced posteroventrally, usually forming a pointed, narrow ridge (*Chaetomosillus* and *Stratiothyrea*) or there is 1-2 stout setae (*Athyroglossa*).

3. The anterior margin of the hypandrium is produced anteriorly to form a Y-shaped sternite with the two lateral arms. In other genera the hypandrium is truncate to broadly rounded, but not produced anteriorly.

4. The ocellar setae are reduced or lacking. In other genera of Gymnomyzini the ocellar setae are distinct even though varying in size from small to well developed.

Chlorichaeta is distinguished from related genera of the tribe Gymnomyzini by the synapomorphies noted for the clade and the following characters: body mostly shiny black with reduced setation; face pitted, appearing spotted, and with silvery white microtomentum in pits; mid facial conical protuberance small; parafacials with a vertical row of furrows; apical scutellar setae usually arising from basal tubercles; wing lacteous; alula of wing broad, auriculate along



Figs. 1-5. Male genitalia of *Chlorichaeta aerifer*. – 1, epandrium and cerci, posterior view; 2, idem, lateral view; 3, internal male genitalia, lateral view; 4, idem, ventral view; 5, hypandrium and postgonites, ventral view.

inferior margin, strongly convex; fore femur bearing a large ventral seta at ventral prominence near midlength and with 5-6 short but stout setae between largest seta and apex along posteroventral margin; fifth tergum of male and to a lesser degree in female with 2 small, dorsal depressions towards posterior margin.

Key to species groups and species of *Chlorichaeta*

1. Scutellum with brilliant, golden-bronze luster, distinctly contrasted with blackish scutum; distiphallus short, angulate, lacking long, paired processes at base (the *aerifer* group) 2
– Scutellum and scutum either essentially concolorous, mostly blackish, or scutum slightly golden bronze and scutellum blackish; distiphallus elongate, mostly straight or gently curved, bearing 2, paired, basal processes (the *albipennis* group) ...3
2. Parafacials with 3rd silvery-white area narrowly linear (sometimes narrowly connected dorsally with 2nd spot) at anteroventral margin of eye; posteroventral process of postgonite elongate, finger-like, long (fig. 9) ....*C. villiersi* Canzoneri & Meneghini
– Parafacials with 3rd silvery-white area elongate, lunate or shallowly triangular along anteroventral margin of eye; posteroventral process of postgonite relatively short (fig. 3) .....*C. aerifer* Cresson
3. Hind basitarsomere yellow, sometimes slightly darker basally, mostly concolorous with tarsomeres 2 and 3 4
– Hind basitarsomere almost entirely dark coloured, blackish brown to brown 5
4. Extended ocellar triangle granulose, contrasted with shiny and smooth parafrons; silvery-white microtomentum on parafacials as 3 patches: 2 spots near level of antenna (dorsal spot at level of ventral margin of pedicel, ventral spot at level of midheight of 1st flagellomere) and a more linear patch at anteroventral margin of eye; mesonotum distinctly microsculptured, appearing granulose, with some metallic bronzish-gold luster ....*C. mais* sp. n.
– Extended ocellar triangle shiny and smooth, similar to parafrons; silvery-white microtomentum on parafacials as 2 patches: 1 spot at level of pedicel and a long linear patch at anteroventral margin of eye; scutum very lightly microsculptured, scutellum more so, appearing granulose; mesonotum with some metallic bluish luster ....*C. orba* sp. n.
5. Scutellum bearing 3-5 large, marginal setae on each side that arise from distinct tubercles; disc of scutellum distinctly more microsculptured than scutum, appearing granulose ....*C. albipennis* (Loew)
– Scutellum bearing 2 large, marginal setae on each side that arise from tubercles (1-2 smaller setae usually between larger setae); scutum and scutellum about equally microsculptured 6
6. Surstyli in lateral view distinctly and more or less evenly curved anteroventrally, tapered gradually and evenly to acutely pointed apex..... .....*C. tuberculosa* Becker
– Surstyli in lateral view more shallowly curved anteroventrally and with apex slightly recurved and somewhat spatulate .....*C. africana* sp. n.

The *aerifer* group

Diagnosis

This species group is distinguished from other taxa of *Chlorichaeta* by the following combination of characters (synapomorphies, which provide evidence of the group's monophyly, are indicated by an asterisk): mesonotum appearing granulose, microsculptured, shiny; *scutellum except along base with brilliant, golden-bronze luster, distinctly contrasted with blackish scutum, disc of scutellum distinctly rugose, with rugae aligned longitudinally; larger 4-5 setae along each side scutellum arising from tubercles; *distiphallus short and lacking long, paired processes at base.

Both species of this group occur in the Afrotropical Region, principally in countries along the west coast.

Chlorichaeta aerifer Cresson
(figs. 1-6)

Chlorichaeta aerifer Cresson, 1946: 245. Holotype ♀, Angola: Makussi, July 23, 1931, J. Ogilvie (Cresson stated that the holotype is deposited in the BMNH, but on visits there, the holotype was not found, nor did we find it at the ANSP); Cogan 1980: 656 [Afrotropical catalogue].

Diagnosis

This species and *C. villiersi* are sister species, as established by the synapomorphies noted for the species group (see characters noted above and in key). It is distinguished from *C. villiersi* by the short projection of the postgonite and the more flared apex of the surstylus. In specimens of *C. villiersi* the postgonal projection is long, finger-like, and the apices of the surstyli are parallel.

Description

Small to medium-sized shore flies, length 1.85 to 3.10 mm.

Head: Mesofrons, especially extended ocellar triangle, entirely smooth, shiny, similar to parafrons; para-

Fig. 6. Distribution map for *Chlorichaeta aerifer* (dots) and *C. villiersi* (diamonds).

facials with silvery-white to white microtomentum arranged as 3 spots, 1st at level of pedicel, 2nd at level of first flagellomere, 3rd along anteroventral margin of eye, distinctly wider at middle, lunate or sometime shallowly triangular. Gena very high, eye-to-cheek ratio averaging 0.75.

Thorax: Mesonotum finely microsculptured, appearing granulose, scutellum more so; scutum black with faint metallic bluish reflections; scutellum with base 1/8 black, remainder brownish gold with metallic reflections; marginal scutellar setae 4-6 on each side that arise from tubercles. Halter white. Costal vein ratio averaging 0.50; vein M ratio averaging 0.48. Fore basitarsomere reddish orange, other fore tarsomeres becoming darker, apical 2 black; hind basitarsomere black.

Abdomen: Male terminalia (figs. 1-5): Length of epandrium+surstyli in posterior view 1.3 X width; lateral margins of surstyli in posterior view distinctly concave ventrally (fig. 1); surstylus in lateral view digitiform, moderately rounded apically, distinctly curved anteroventrally at basal merger with ventral margin of epandrium (fig. 2); hypandrium in lateral view sinuous basally, in posterior view broadly V-shaped, emarginate ventrally; aedeagal apodeme only slightly enlarged toward end that attaches to hypandrium (fig. 3); postgonite with a posteroventral, short process (fig. 3), in posterior view becoming broader toward apex, and apex concave; distiphallus distinctly angulate, dorsal angle acutely produced, pointed; bearing 1 short, lateral process that is broadly attached toward base (figs. 3, 4), basoventral margin of process irregularly serrate (figs. 3, 4).

Other specimens examined

Afrotropical: Angola. Luanda, 22 Aug 1949, Malkin (1♂, 3♀; USNM). Cameroon. Kribi (beach), 28-29 Nov 1987, F. Kaplan (4♂, 4♀; USNM); Kribi, Rt. N7 (beach), 28-29 Nov 1987, A. Freidberg (1♂, 2♀; USNM). Nigeria. Lagos (shore), 15 Dec 1987, A. Freidberg (2♂; USNM); Lagos, Victoria Island (shore), 15 Dec 1987, F. Kaplan (3♂, 2♀; USNM). Sã Tomé and Principe. São Tomé (sandy beach), G.R. Gradwell, D. Snow (6♂, 12♀; BMNH).

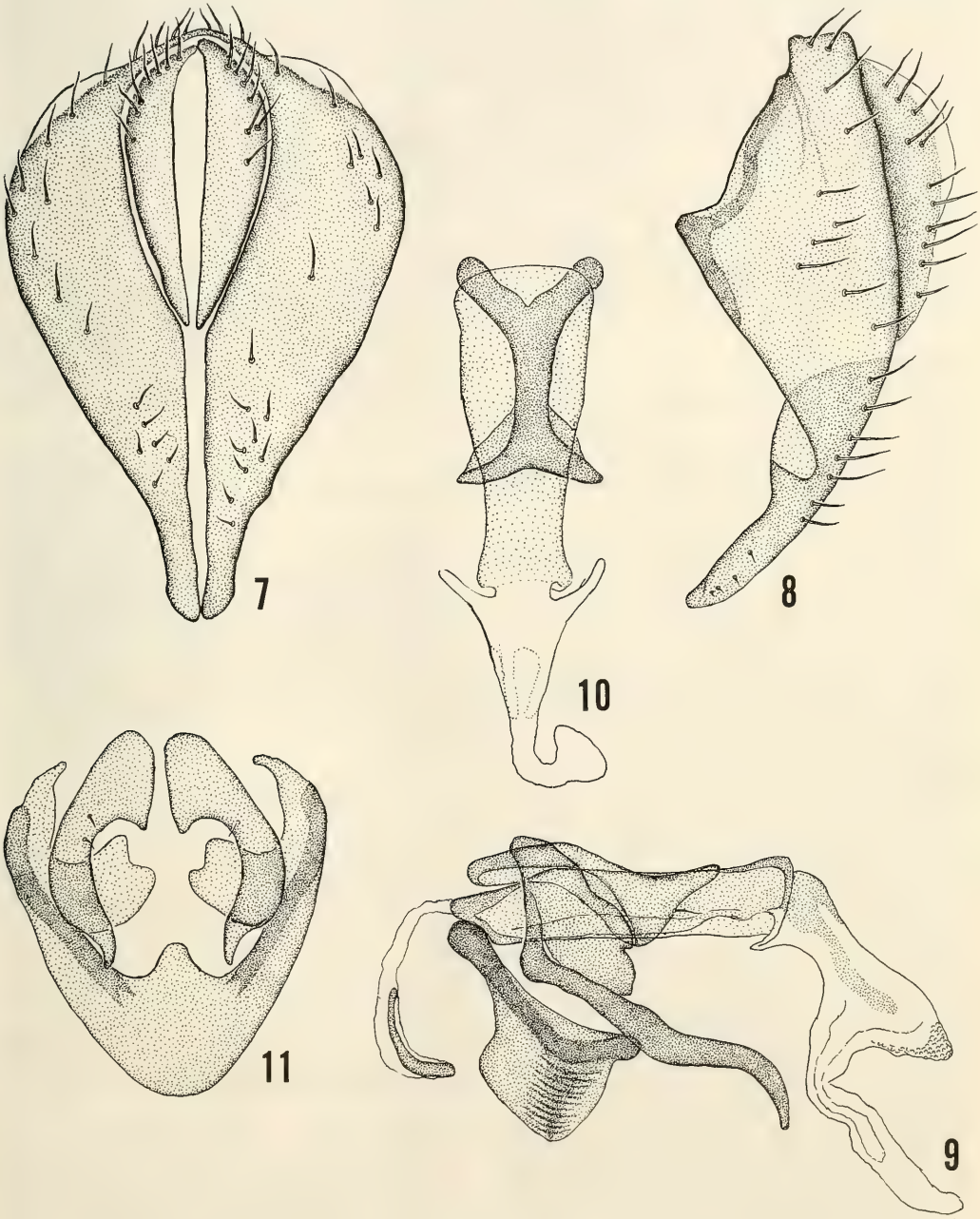
Distribution (fig. 6)

Afrotropical. Angola (Luanda, Makussi), Cameroon, Nigeria, and Sao Tomé and Principe.

Chlorichaeta villiersi Canzoneri & Meneghini (figs. 6-11)

Chlorichaeta villiersi Canzoneri & Meneghini, 1969a: 1481.

Holotype ♂: 'Sénégal Kayar ['Kayar' handwritten]/-MUSÉUM PARIS 2-X-61 [2 Oct 1961] A. Villiers [date and collector handwritten, blue]/sur Alternanthera [handwritten]/HOLOTYPUS ♂ *Chlorichaeta villiersi* sp. n. [gender, name, and 'sp. n.' handwritten, red]'. The holotype is glued to a card, is in very poor condition (specimen



Figs. 7-11. Male genitalia of *Chlorichaeta villiersi*. – 7, epandrium and cerci, posterior view; 8, idem, lateral view; 9, internal male genitalia, lateral view; 10, idem, ventral view; 11, hypandrium and postgonites, ventral view.

glued upside down, obscuring dorsum of head and thorax; left wing, forelegs, and abdomen missing), and is deposited in the MNHN; Cogan 1980: 656 [Afrotropical catalogue], Canzoneri 1981: 203 [list, Senegal]; 1982: 57 [list, Sierra Leone].

Chlorichaeta gioiellae Canzoneri & Rampini, 1990: 112. – Holotype ♂: 'Sierra Leone[,] W.Area-Spiaggia[,] Sussex - 9.XI.87 [9 Nov 1987] Leg. Rossi/ HOLOTYPUS ♂ *Chlorichaeta gioiellae* nov. det. Canzoneri S. [gender, species name, and 'nov.' handwritten, red]'. The holotype is double mounted (minuten in a rectangular block of plastic foam), is in fair condition (left mid leg missing), and is deposited in CANZ. **Syn. n.**

Diagnosis

This species and *C. aerifer* are closely related and very similar but the former is distinguished by the longer, finger-like projection of the postgonite.

Description

Moderately small to medium-sized shore flies, length 2.10 to 3.00 mm.

Head: Mesofrons, especially extended ocellar triangle, entirely smooth, shiny, similar to parafrons; parafacials with silvery-white to white microtomentum arranged as 3 spots, 1st at level of pedicel, 2nd at level of first flagellomere, 3rd along anteroventral margin of eye, distinctly wider at middle, lunate or sometime shallowly triangular. Gena very high, eye-to-cheek ratio averaging 0.65.

Thorax: Mesonotum finely microsculptured, appearing granulose, scutellum more so; scutum black with faint metallic bluish reflections; scutellum with base 1/8 black, remainder brownish gold with metallic reflections; marginal scutellar setae 4-6 on each side that arise from tubercles. Halter white. Costal vein ratio averaging 0.49; vein M ratio averaging 0.47. Fore basitarsomere reddish orange, other fore tarsomeres becoming darker, apical 2 black; hind basitarsomere black.

Abdomen: Male terminalia (figs. 7-11): Length of epandrium+surstyli in posterior view 1.5 X width; lateral margins of surstyli only slightly concave ventrally (fig. 7), in lateral view digitiform, narrowly rounded apically, curved anteroventrally but at same curvature of epandrium (fig. 8); hypandrium in lateral view sinuous basally, in posterior view broadly V-shaped, rounded ventrally; aedeagal apodeme distinctly enlarged on 2/3 portion toward attachment with hypandrium (fig. 9); postgonite with a posteroventral, relatively long, narrow, somewhat finger-like process (fig. 9), in posterior view curved medially toward apex, and apex acutely pointed; distiphallus distinctly angulate, dorsal angle acutely produced, rounded (fig. 9), produced dorsolaterally at base, appearing wing-like in posterior view (fig. 10).

Other specimens examined

Afrotropical: Gambia. Bakau at tropic bungalow, (meadow rich in flowers at beach), 16-18 Nov 1977, L. Cederholm, R. Danielsson, Hammarstedt, Hedqvist, Samuelsson (29♂, 47♀; BMNH, ZIL, USNM). Senegal. Dakar N'Gor, sabbia nuda e talitr., 24 Jun 1973, A.G. Soika (3♂, 1♀; USNM); Dakar N'Gor, spiaggia sabb.-limo, 24 Jun 1973, A.G. Soika (1♀; USNM). Somone, spiaggia terr. crabs, 6 Jul 1973, A.G. Soika (4♂, 1♀; USNM).

Distribution (fig. 6)

Afrotropical. West Africa: Gambia, Senegal, Sierra Leone.

Remarks

We directly compared the primary types of *C. villiersi* and *C. gioiellae* and are of the opinion that they are conspecific. The structures of the male terminalia are virtually identical, and we are thus proposing the synonymy noted above, with *C. villiersi* as the senior synonym.

The *albipennis* group

Diagnosis

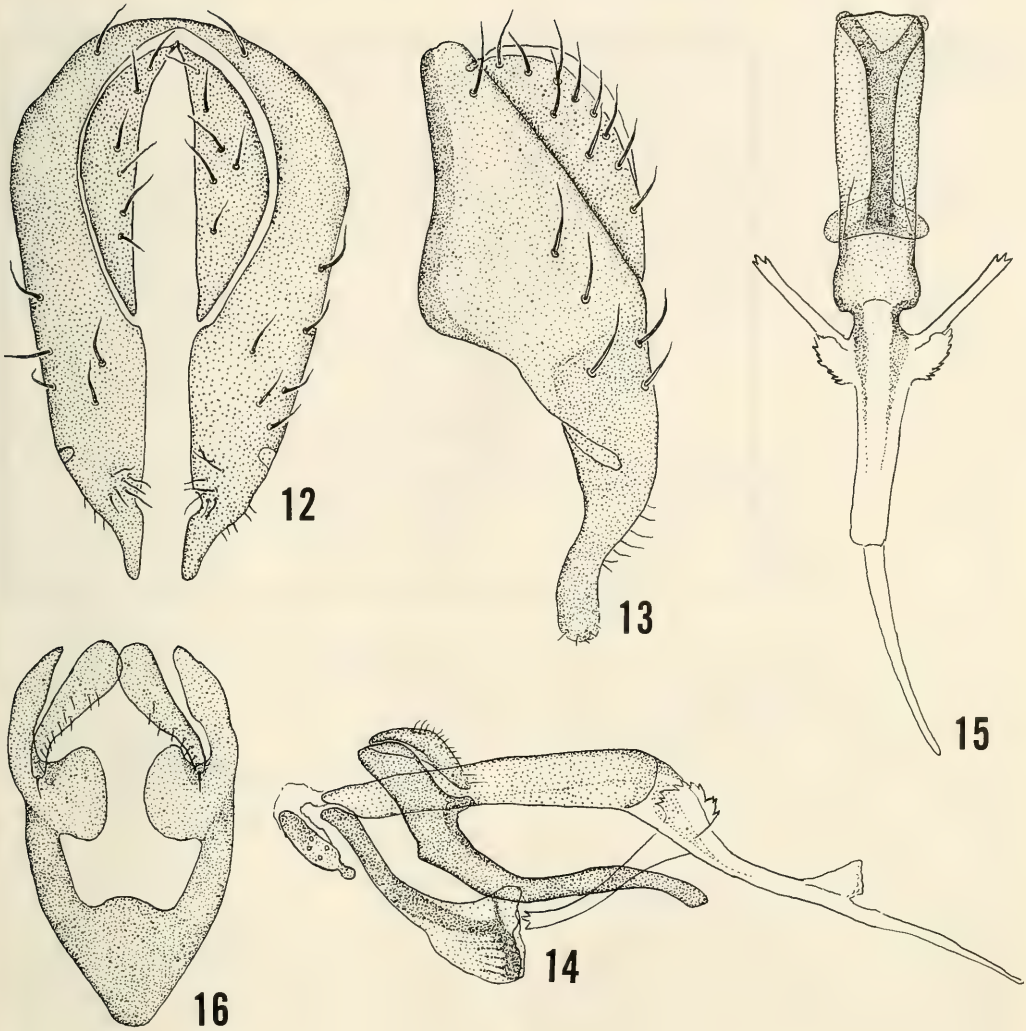
This species group is distinguished from other taxa of *Chlorichaeta* by the following combination of characters (synapomorphies, which provide evidence of the group's monophyly, are indicated by an asterisk): mesonotum appearing granulose, microsculptured, shiny; *distiphallus long and bearing long, paired processes at base.

Chlorichaeta africana sp. n.
(figs. 12-17)

Type material. – Holotype ♂: "KENYA Lake Victoria 10km S Kisumu 19.XI.1986 [19 Nov 1986] A. Freidberg'; 13 paratypes (7♂, 6♀; TAU, USNM) bear the same label data as the holotype. Other paratypes are as follows: Cameroon. Kribi (beach), 28-29 Nov 1987, F. Kaplan (2♂, 7♀; TAU, USNM); Kribi, Rt. N7 (beach), 28-29 Nov 1987, A. Freidberg (1♂, 4♀; USNM). Ghana. Kedzi-Keta (on coconut), 29 Jul 1959 (Min. Agric. C.I.E. Coll. 16732 8377; 4♂, 6♀; BMNH). Nigeria. Lagos, Victoria Island (shore), 15 Dec 1987, F. Kaplan (1♂; USNM). The holotype is double mounted (minuten in a block of polyporus), is in excellent condition, and is deposited in the USNM.

Diagnosis

This species is very similar to *C. tuberculosa* in having a black hind basitarsomere but is distinguished from the latter by characters of the male terminalia, especially the shape of the surstylus, which, in lateral view, is shallowly recurved apically and



Figs. 12-16. Male genitalia of *Chlorichaeta africana*. – 12, epandrium and cerci, posterior view; 13, idem, lateral view; 14, internal male genitalia, lateral view; 15, idem, ventral view; 16, hypandrium and postgonites, ventral view.

has a bluntly rounded apex.

Description

Small to moderately small shore flies, length 1.60-2.60 mm.

Head: Mesofrons, especially extended ocellar triangle, smooth, shiny, very similar to parafrons; parafacials with silvery-white to white microtomentum arranged as 2 patches, dorsal patch much smaller, a spot laterad of pedicel, ventral patch long, linear, length equal to combined length of pedicel and flagellomere 1. Gena high, eye-to-cheek ratio averaging 0.60.

Thorax: Mesonotum microgranulose, scutum with some faint metallic golden luster; scutellum with similar microsurface as scutum, black, lacking metallic luster, bearing 2 pairs of marginal setae that arise from tubercles. Halter pale, whitish yellow to yellow. Costal vein ratio averaging 0.71; vein M ratio averaging 0.58. Fore tarsi black; hind basitarsomere entirely dark coloured, blackish brown to brown.

Abdomen: Male terminalia (figs. 12-16): Length of epandrium+surstyli in posterior view 1.65 X width; lateral margins of surstylus in posterior view distinctly though shallowly concave ventrally (fig. 12), base of surstylus wide then distinctly narrowed at apical

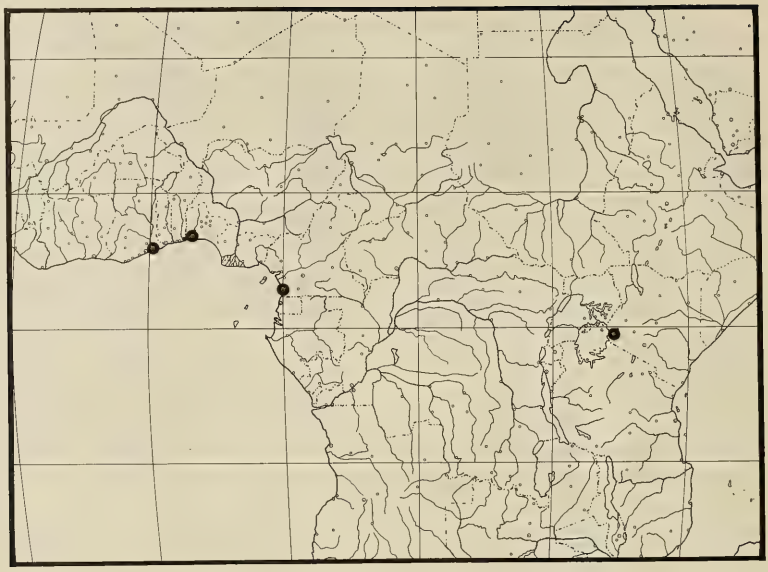


Fig. 17. Distribution map for *Chlorichaeta africana.*

1/3, apex less than greatest width of cercus; surstylus in lateral view digitiform, base in same curvature as epandrium, apex slightly recurved, narrowly spatulate (fig. 13); hypandrium short, L-shaped in lateral view with longer arm slender and more or less parallel with basiphallus, lateral portion (= fused pregonite) more or less as a parallelogram, more than twice width of longer arm (fig. 14); aedeagal apodeme moderately enlarged toward attachment with hypandrium (fig. 14); postgonite evenly lunate in lateral view (fig. 14); distiphallus moderately long, slightly longer than basiphallus, gently angulate in lateral view, lateral projections at base of distiphallus long, length equal to narrowed portion of aedeagal apodeme (fig. 15), basoventral margin of process distinctly and irregularly serrate (figs. 14, 15).

Distribution (fig. 17)

Afrotropical. Cameroon, Ghana, Kenya, and Nigeria.

Etymology

The species epithet, *africana,* refers to the continent on which this species was collected.

Chlorichaeta albipennis **Loew**
(figs. 18-23)

Gymnopa albipennis Loew, 1848: 14. Syntypes from Italy. Sicily: Messina [ZMHU, apparently lost].

Mosillus albipennis; Schiner 1864: 235 [generic combination].

Chlorichaeta albipennis; Cresson 1925: 235 [generic combination, review]; 1946: 244 [review], Cogan and Wirth 1977: 322 [Oriental catalogue], Cogan 1980: 656 [Afrotropical catalogue]; 1984: 128 [Palearctic catalogue], Canzoneri & Meneghini 1983: 229-230 [review, Italy], Mathis 1989: 640 [Australasian/Oceanian catalogue].

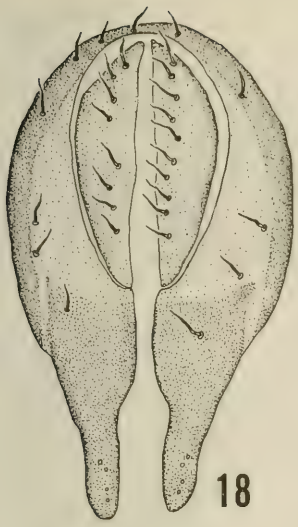
Strandillus strandi Duda, 1942: 10. Lectotype ♂ (designated by Papp 1979: 97): '*M. strandi* D. d. Duda/[Lithuania] Nidden [= Nida on Kurskaya Kosa Peninsula] 4. 8. 40 [4 Aug 1940]/Lectotypus [red]'. The abdomen of the lectotype has been removed, dissected and is in a plastic microvial attached to the specimen pin. The lectotype is deposited in the ZMHU. – Papp 1979: 97 [synonymy].

Mosillus subsultans of authors, not Fabricius (misidentification); Miyagi 1977: 27.

Diagnosis

The species is similar to congeners of the *albipennis* group but may be distinguished from them by the following combination of characters: scutellum bearing 3-5 large, marginal setae on each side that arise from distinct tubercles; disc of scutellum distinctly more microsculptured than scutum, appearing more granulose; hind basitarsus black; characters of the male genitalia (see description below and figs. 18-22).

Figs. 18-22. Male genitalia of *Chlorichaeta albipennis.* – 18, epandrium and cerci, posterior view; 19, idem, lateral view; 20, internal male genitalia, lateral view; 21, idem, ventral view; 22, hypandrium and postgonites, ventral view; 23, Distribution map for *Chlorichaeta albipennis.*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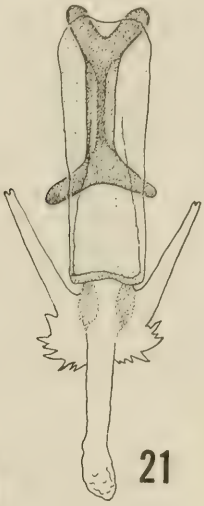
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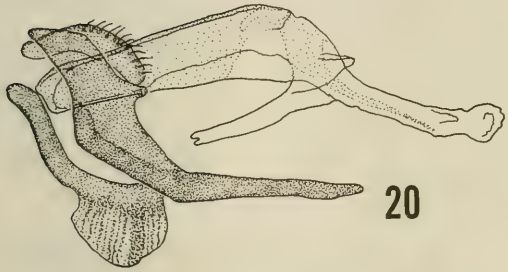
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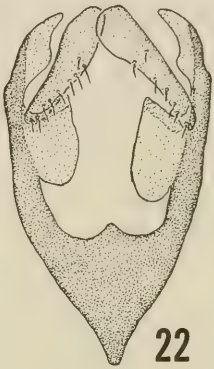
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Description

Small to moderately small shore flies, length 1.50 to 2.85 mm.

Head: Mesofrons, especially extended ocellar triangle, shiny and smooth, similar to parafrons; silvery-white microtomentum of parafacials as 2 patches: dorsal spot much smaller, placed at level of pedicel and a long linear patch at anteroventral margin of eye. Gena high, eye-to-cheek ratio averaging 0.70.

Thorax: Mesonotum (colour and texture of scutum and scutellum; scutellum distinctly granulose, bearing 3-5 pairs of marginal setae that arise from tubercles. Halter dark, brown to blackish brown (pale coloured in specimens from Sri Lanka and Japan). Costal vein ratio averaging 0.60; vein M ratio averaging 0.58. Fore tarsi entirely black; hind basitarsomere entirely dark coloured, blackish brown to brown.

Abdomen: Male terminalia (figs. 18-22): Length of epandrium+surstyli in posterior view 1.6 X width; lateral margins of surstylus in posterior view only slightly concave ventrally (fig. 18), surstylus narrow, apical 1/3 less than greatest width of cercus; surstylus in lateral view digitiform, bluntly rounded apically, curved anteroventrally but at about same curvature of epandrium (fig. 19); hypandrium in lateral view L-shaped with longer arm slender and more or less parallel with basiphallus, lateral portion (= fused pregonite) more or less as a parallelogram, more than twice width of longer arm (fig. 20); aedeagal apodeme distinctly enlarged toward attachment with hypandrium (fig. 20); postgonite evenly lunate in lateral view (fig. 20); distiphallus short, less than length of basiphallus, gently curved in lateral view, lateral projections at base long, length equal to narrowed portion of aedeagal apodeme (fig. 20), basoventral margin of process distinctly and irregularly serrate (fig. 21).

Other specimens examined

Oriental: India. Bombay, Juhu Beach, 7 Mar 1985, K.A. Spencer (1♀; NMWL). Laos. Vientiane, 28 May 1965, P. D. Ashlock (1♂; BBM). Sri Lanka. Colombo: Colombo, 14 Apr 1980, W. N. Mathis (1♀; USNM); Colpetty (103 Galle Road), 3 Apr 1968, T. F. Halstead (13♂, 17♀; CAS); Negombo (6 km S), 7 May 1980, L. Jayawickrema, W. N. Mathis, T. Wijesinhe (3♂, 5♀; USNM). Mannar: Mannar, 13 Apr 1968, T. F. Halstead (1♂, 3♀; CAS). Tricomalee: Mutur, 2 May 1980, L. Jayawickrema, W. N. Mathis, T. Wijesinhe (1♂; USNM); Nilaveli (5 km N), 3 May 1980, L. Jayawickrema, W. N. Mathis, T. Wijesinhe (34♂, 19♀; USNM). Vietnam. Nha Trang, 17-26 Nov 1960, C.M. Yoshimoto (1♂; BBM). Palearctic: France. Herault: Étang de Canet, stessa Straz., 27 Jul 1954, A. Giordani Soika (2♂; BMNH). Italy. Sicily: Capo San Vito, 29 Aug 1982, A. Freidberg (1♀; USNM). Veneto: Lido Alberoni (Laguna di Venezia), sentiero dune gulf, 21 Apr-4 Oct 1958, 1961, A. Giordani Soika, Levrini (2♂, 2♀; USNM). Japan. Honshu: Osaka, 29 Aug 1954, P. H. Arnaud, Jr. (22♂, 22♀; CAS, USNM). Okitsu (in cage), 27 Oct 1914, F. Muir (1♂; BBM). Russia. Primorski Krai (Maritime Territory): Glazkovka (20 km SW Valentin), 1-2 Sep 1986, A. Ozerov (3♂, 2♀; ZMMU). Ukraine. Charkov: Charkov vicinity, 14 Sep 1883, Jaroshevski (2♀; ZISP).

Distribution (fig. 23)

Oriental. India, Laos, Sri Lanka, Vietnam. Palearctic. France, Italy, Japan (Hokkaido, Honshu, Kyushu), Lithuania, Russia (Far East), Ukraine.

Remarks

Specimens of this species were frequently misidentified as *C. tuberculosa,* and the two species are apparently sympatric over some of their range (see records from Italy, Canzoneri & Meneghini 1983).

The specimens from Sri Lanka and Japan have pale coloured halteres but are otherwise similar, especially characters of the male terminalia. Thus we attribute the variation to be intraspecific.

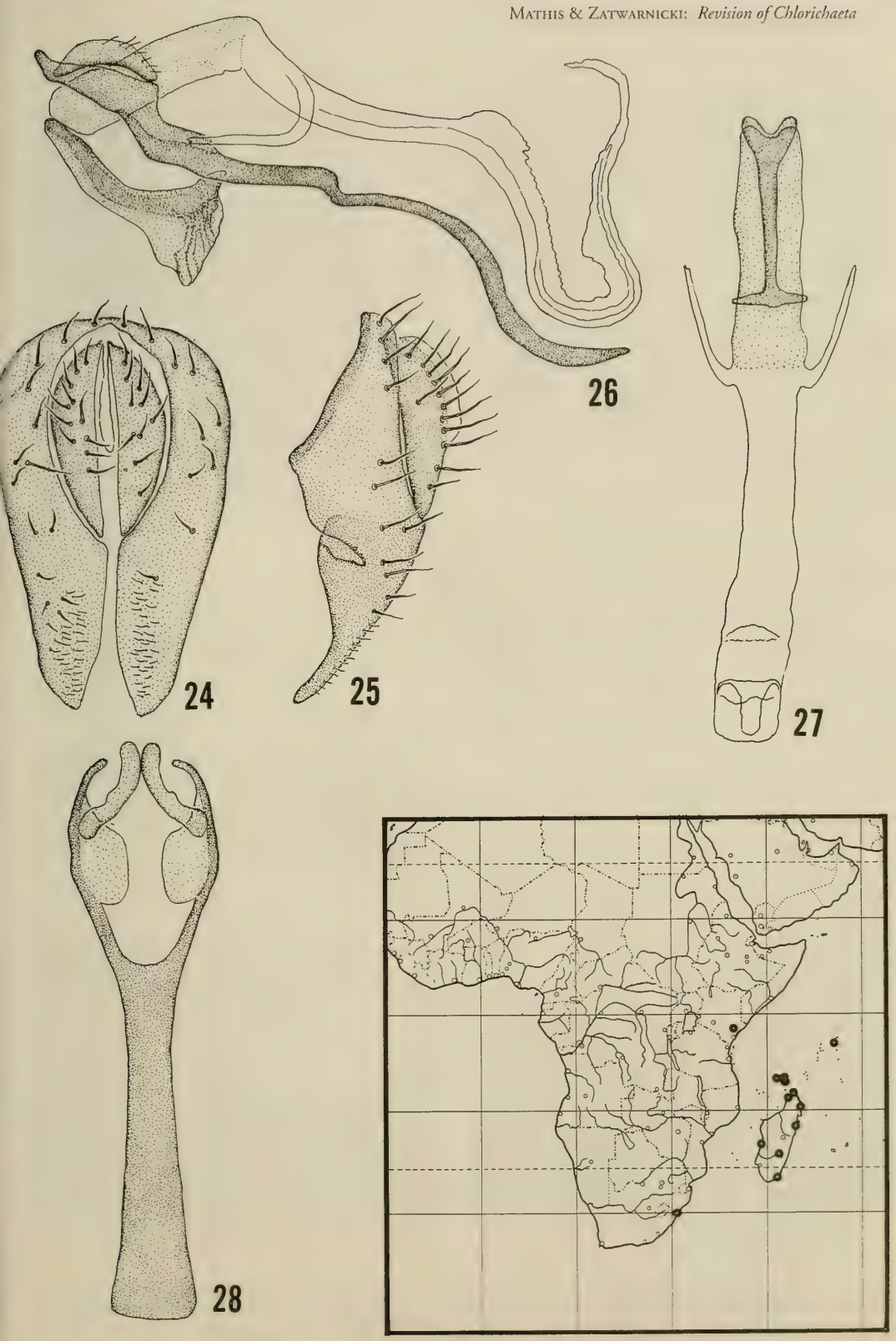
Chlorichaeta mais sp. n.
(figs. 24-29)

Mosillus albipennis; Lamb 1912: 319 [misidentification, Seychelles (Mahé)].

Type material. – Holotype ♂: 'ALDABRA. Grande Terre: Anse Mais[,] 17 March 1986[,] Wayne N. Mathis'. The holotype is double mounted (minuten in a block of plastic), is in good condition, and is deposited in the USNM; 36 paratypes (12♂, 25♀) bear the same locality label as the holotype. – Other paratypes are as follows: Aldabra. Grande Terre: Cinq Cases, 12-13 Mar 1986, W. N. Mathis (16♂, 14♀; USNM). Malabar: Passe Houareau, 14-18 Mar 1986, W. N. Mathis (2♂, 1♀; USNM). Picard: La Gigi,19-20 Mar 1986, W. N. Mathis (1♂, 1♀; USNM); Settlement, 15-21 Mar 1986, W. N. Mathis (7♂, 21♀; USNM); trail to Jellyfish Pool, 22 Mar 1986, W. N. Mathis (9♂, 11♀; USNM).

Additional specimens. – Cosmoledo. Menai Island: Station, 26 Mar 1986, W. N. Mathis (1♀; USNM). Wizard Island: 6 Mar 1968, B. H. Cogan, A. M. Hutson (ex; BMNH). Astove. around coconut plantation, 5 Mar 1968, B. H. Cogan, A. M. Hutson (4♂, 37♀; BMNH). Kenya. Mombasa (150 km N), 4 Dec 1989, A. Freidberg, F. Kaplan (1♂; USNM). Madagascar. Antseranana: Nosy Bé, Ambatoloaka (beach), 4-7 Apr 1991, A. Freidberg, F. Kaplan (5♂, 4♀; TAU, USNM); Nosy Tanikely, 6 Apr 1991,

Figs. 24-28. Male genitalia of *Chlorichaeta mais.* – 24, epandrium and cerci, posterior view; 25, idem, lateral view; 26, internal male genitalia, lateral view; 27, idem, ventral view; 28, hypandrium and postgonites, ventral view; 29. Distribution map for *Chlorichaeta mais.*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A. Freidberg, F. Kaplan (1♀; USNM); Nosy Komba, 6 Apr 1991, A. Freidberg, F. Kaplan (9♂, 4♀; TAU, USNM); Ramena, 10 Apr 1991, A. Freidberg, F. Kaplan (1♀; USNM); Sambava Beach, 14 Apr 1991, A. Freidberg, F. Kaplan (4♀; USNM). Fianarantsoa: Mananjary, 26 Oct 1988, R. Van Epps (1♀; USNM). Toamasina: Fénérive (on beach), Dec 1955, B. Stuckenberg (1♀; USNM). Toliara: Berenty, 20 Apr 1991, A. Freidberg, F. Kaplan (1♀; USNM); Fort Dauphin (-beach), 18 Apr 1991, A. Freidberg, F. Kaplan (4♂, 8♀; TAU, USNM); Fort Dauphin (50 km W, river), 20 Apr 1991, A. Freidberg, F. Kaplan (1♂, 1♀; USNM); Morondava (20°17'S, 44°16'E; sea level), 20 Jan 1985, F. M. Harrington, J. D. Weintraub (4♀; USNM); Sud-Est Sainte-Luce (10 m), Fort Dauphin, 22-24 Feb 1958, B. Stuckenberg (1♂; USNM). Seychelles. Mahé (1♀; BMNH). South Africa. Natal: St. Lucia Park, 7-8 Oct 1983, A. Freidberg (1♀; USNM); Umkomaas (beach), 11 Oct-9 Dec 1954, 1983, A. Freidberg, B. Stuckenberg (6♂, 3♀; USNM); Umhlanga Rocks, 4 Jan 1955, E. Callan (1♀; USNM); Umhloti (mouth), 19 Jun 1962, B. & P. Stuckenberg (1♀; USNM); Durban, The Bluff, Oct 1931, A. MacKie (1♂; ANSP).

Diagnosis

This species is closely related to *C. orba* but is distinguished from that species by the granulose extended ocellar triangle and three versus two parafacial microtomentose, silvery spots.

Description

Small to moderately small shore flies, length 1.60-2.65 mm.

Head: Mesofrons, especially extended ocellar triangle, granulose, contrasted with shiny, smooth parafrons; silvery-white microtomentum of parafacials as 3 patches: 2 spots near level of antenna (dorsal spot at level of ventral margin of pedicel, ventral spot at level of midheight of 1st flagellomere) and a more linear patch at anteroventral margin of eye (sometimes 2nd spot and ventral, linear patch narrowly connected). Gena high, eye-to-cheek ratio averaging 0.50.

Thorax: Mesonotum with faint to conspicuous metallic bronzish-gold reflections; 2 marginal scutellar setae on each side that arise from tubercles, several smaller setulae between. Halter white. Costal vein ratio averaging 0.63; vein M ratio averaging 0.45. Basitarsomere of foreleg variable in colour, usually dark, mostly blackish, at most very slightly lighter in colour than other tarsomeres of foreleg, sometimes yellowish; hind basitarsomere yellow, sometimes slightly darker basally, mostly concolorous with tarsomeres 2 and 3.

Abdomen: Male terminalia (figs. 24-28): Length of epandrium+surstyli in posterior view 1.65-1.70 X width; lateral margins of surstylus in posterior view convex ventrally (fig. 24), broad, apical 1/3 wider than cercus; surstylus in lateral view narrowly digitiform, narrowly rounded apically, shallowly curved anteroventrally at about same curvature of epandrium (fig. 25); hypandrium in lateral view very long and sinuous, more or less in same conformation of basiphallus, lateral portion (= fused pregonite) more or less as a parallelogram, only slightly wider than long arm (fig. 26); aedeagal apodeme distinctly enlarged toward attachment with hypandrium (fig. 26); postgonite evenly lunate in lateral view (fig. 26); distiphallus long, more than twice length of basiphallus, sinuous in lateral view, apex recurved posterodorsally, lateral projections at base of distiphallus long, length equal to narrowed portion of aedeagal apodeme (figs. 26, 27), basoventral margin of process not serrate (fig. 27).

Distribution (fig. 29)

Afrotropical. Aldabra Group (Aldabra, Astove, Cosmoledo), Kenya, Madagascar, Seychelles (Mahé), South Africa (Natal).

Natural history

This species occurs in several habitats on atolls of the Aldabra Group. We collected it most commonly on tortoise droppings but also found it around pig pens near the settlement (Picard Island) and occasionally on rotting seaweed that had accumulated at the high tide mark on the beach.

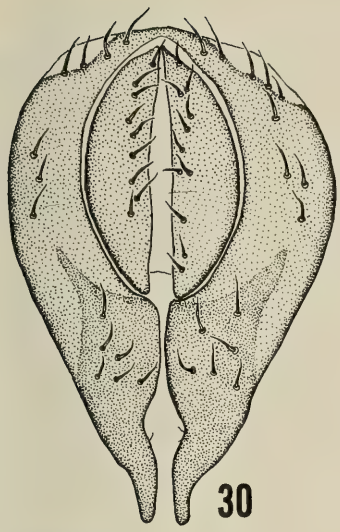
Etymology

The specific epithet, *mais*, alludes to the type locality of this species, Anse Mais, on the atoll of Aldabra (Grande Terre). The species name is a noun in apposition.

Remarks

The specimens from Aldabra, including the holotype, all have the fore basitarsomere mostly blackish, similar in colour to the other tarsomeres of the foreleg. The states for this character are variable in specimens from Madagascar and South Africa, however. Some specimens have a pale, mostly yellowish basitar-

Figs. 30-34. Male genitalia of *Chlorichaeta orba*. – 30, epandrium and cerci, posterior view; 31, idem, lateral view; 32, internal male genitalia, lateral view; 33, idem, ventral view; 34, hypandrium and postgonites, ventral view; 35. Distribution map for *Chlorichaeta orba*. The locality in Australia (Northern Territory) could not be precisely located.



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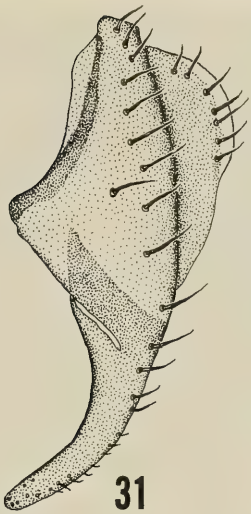

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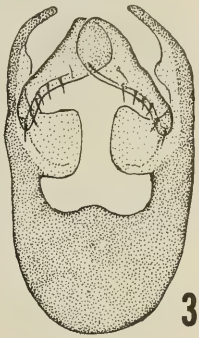

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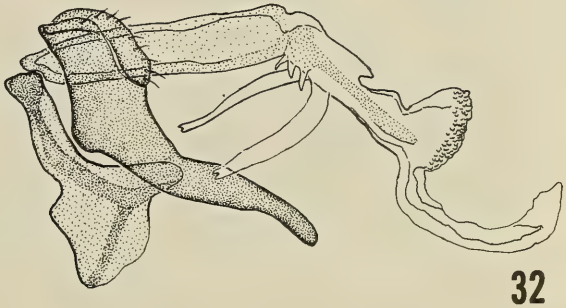

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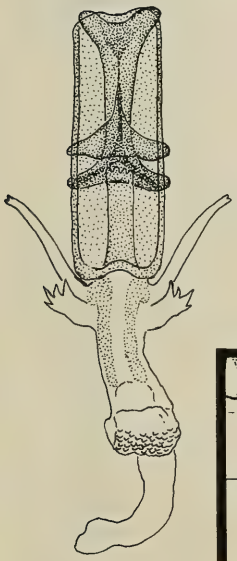

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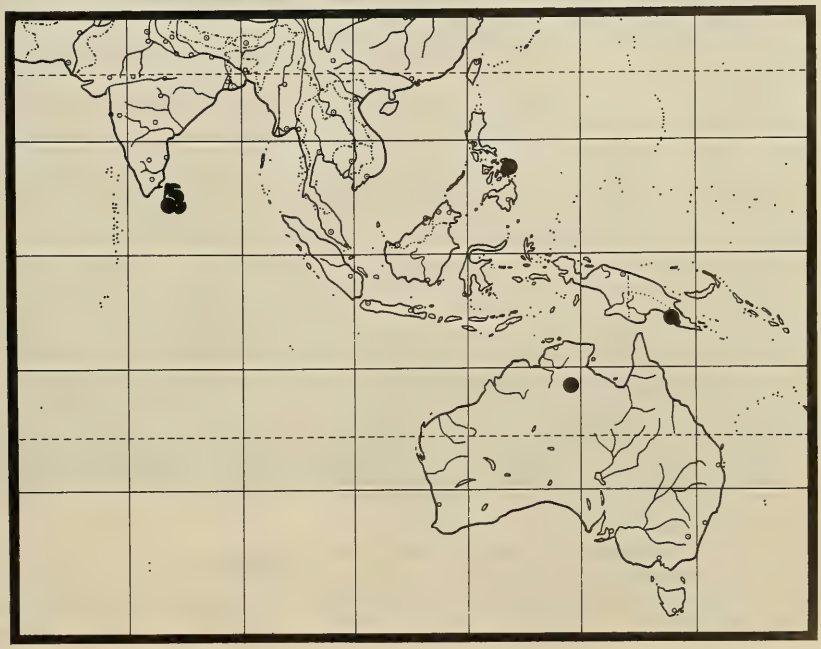


somere, but in others from the same series this structure is dark coloured, as in specimens from Aldabra. We have dissected the male terminalia of the variable series and see no differences and are thus of the opinion that this variation is intraspecific.

Chlorichaeta orba sp. n.
(figs. 30-35)

Type material. – Holotype ♂: 'SRI LANKA: TRI[NCOMALEE]. Dist[rict]. Nilaveli (5 km N) 3 May 1980/Collectors: W. N. Mathis[,] T. Wijesinhe[,] L. Jayawickrema'. Six paratypes (2♂, 4♀) bear the same label data as the holotype. – Other paratypes are as follows: Sri Lanka. Colombo: Ratmalana, Colombo (9 mi S), 7-13 Jan 1962, H. Andersson, P. Brink, L. Cederholm (2♀; ZIL); Kalutara, Colombo (25 mi SSE), 25 Jan 1962, H. Andersson, P. Brinck, L. Cederholm (1♀; ZIL). Hambantota: Kirinda, 25 Apr 1980, W. N. Mathis (2♀; USNM). Uva: Heda Oya, Bibile (29 mi SE), 7 Mar 1962, H. Andersson, P. Brinck, L. Cederholm (1♂; ZIL).

Additional specimens. – Australasian Region: Australia. Northern Territory: Wurruwardumanja, 15 Jan 1980, T. Donovan (1♂; ANIC). Papua New Guinea. Central Province: Laloki (muddy river bank), 2 Jul 1984, J. W. Ismay (1♂; USNM). Oriental Region: Philippines. Calicoan (from dead land crab; sand near tent), 27 Jul 1945, F. F. Bibby (8♂, 7♀; USNM).

Diagnosis

This species is similar to *C. mais* in having the hind basitarsomere yellow but differs from the latter in the following characters: extended ocellar triangle smooth and shiny, similar to parafrons; parafacial with 2 patches of silvery microtomentum; scutum very lightly microsculptured, scutellum slightly more so, appearing granulose; and mesonotum with some metallic bluish luster.

Description

Small to moderately small shore flies, length 1.80-2.60 mm.

Head: Mesofrons, especially extended ocellar triangle, shiny and smooth, similar to parafrons; silvery-white microtomentum of parafacials as 2 patches: dorsal spot much smaller, placed at level of pedicel and a long linear patch at anteroventral margin of eye. Gena high, eye-to-cheek ratio averaging 0.47.

Thorax: Mesonotum with some metallic bluish reflections; scutum very lightly microsculptured, scutellum more so, appearing granulose, bearing 2 pairs of marginal setae that arise from tubercles. Halter yellow to yellowish white. Costal vein ratio averaging 0.60; vein M ratio averaging 0.55. Tarsi of foreleg with basal 2 tarsomeres yellow, apical 3 black; basitarsomere of foreleg yellowish, contrasted with blackish apical tarsomeres of foreleg; hind basitarsomere yellow, sometimes slightly darker basally, mostly concolorous with tarsomeres 2 and 3.

Abdomen: Male terminalia (figs. 30-34): Length of epandrium+surstyli in posterior view 1.55 X width, lateral margins irregularly tapered toward pointed apex (fig. 30); surstylus in lateral view digitiform, narrowly rounded apically, curved anteroventrally but only slightly more curvature of epandrium (fig. 31); hypandrium U-shaped in posterior view (fig. 34), in lateral view L-shaped with anteromedial portion slender, more or less parallel with basiphallus, tapered toward apex, posterolateral portion (= fused pregonite) as a parallelogram, more than twice width of anteromedial portion (fig. 32); aedeagal apodeme distinctly enlarged toward attachment with hypandrium (fig. 32); postgonite linear, lacking a process (fig. 32); distiphallus slightly longer than basiphallus, distinctly angulate, dorsal angle acutely produced, rounded (fig. 32), bearing 1 paired slender, lateral processes at base with anterodorsal orientation (fig. 33) and a single medial process (fig. 32).

Distribution (fig. 35)

Australasian: Australia (NT), Papua New Guinea. Oriental: Philippines, Sri Lanka.

Etymology

The specific epithet, *orba,* is derived from Latin and means bereft of parents or an orphan.

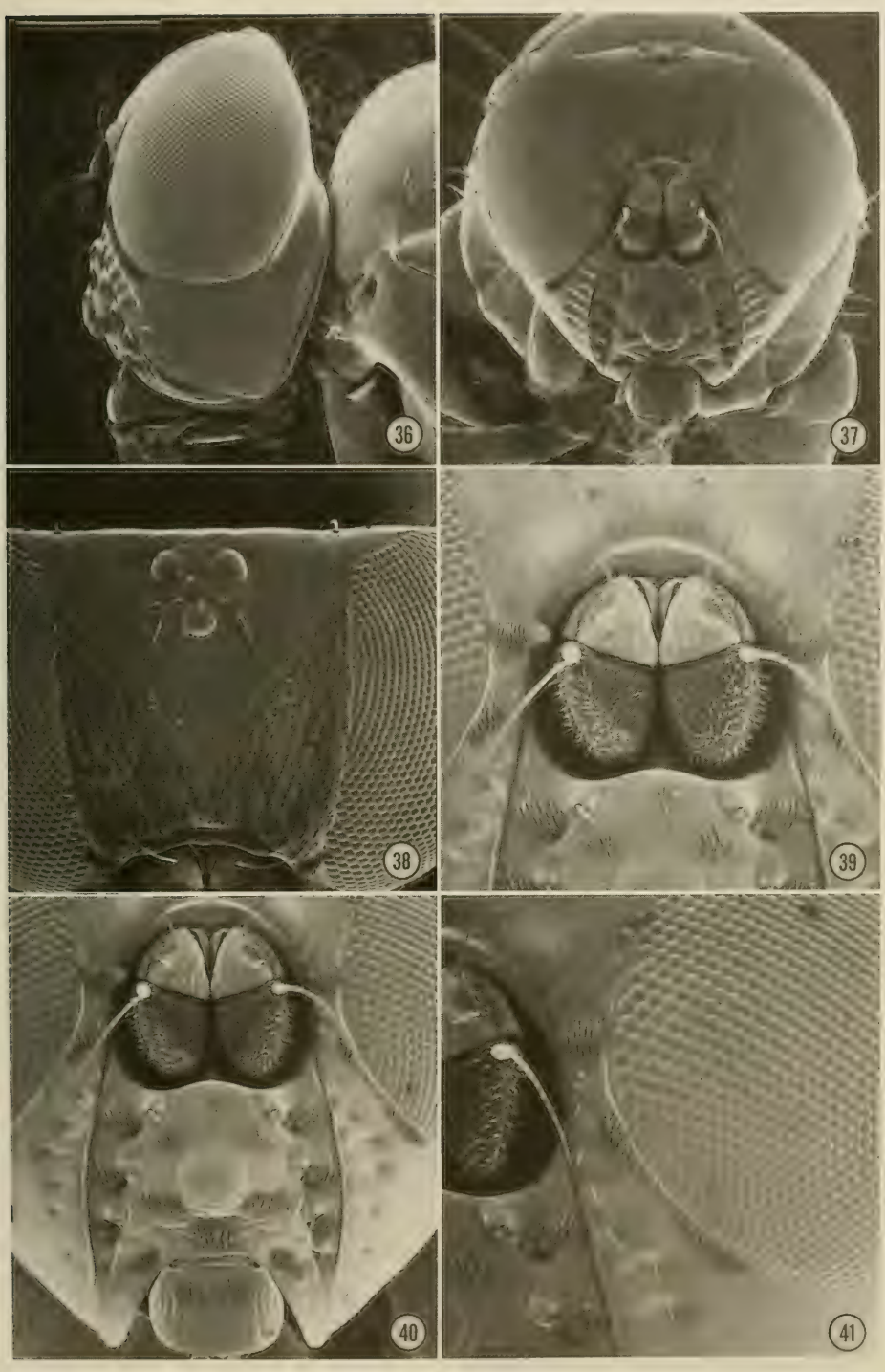
Chlorichaeta tuberculosa Becker
(figs. 36-48)

Chlorichaeta tuberculosa Becker, 1922: 74. Lectotype ♀ (designated by Cresson 1925: 234): '[Sudan. Khartoum region] Sennar 18.-24.II. [handwritten] / Aegypt. Sudan Ebner.1914/TYPE [red] / *Ch. tuberculosa* Beck. [handwritten] det. Becker'. The lectotype is double mounted (minute nadel in plastic foam block), is in poor condition (mesonotum damaged, right mid leg and 1st flagellomeres missing), and is deposited in the NMW. – Cresson 1925: 234 [review]; 1945: 53 [review]; 1946: 245 [review], Wirth 1955: 49 [list, Tanzania. Mugango (on Lake Victoria)], Canzoneri & Meneghini 1969a: 1481 [list, Senegal, figures of ♂ genitalia]; 1969b: 167 [list, Zaire], Cogan and Wirth 1977: 322 [Oriental catalogue], Cogan 1980: 656 [Afrotropical catalogue], Mathis 1989: 640 [Australasian/Oceanian catalogue].

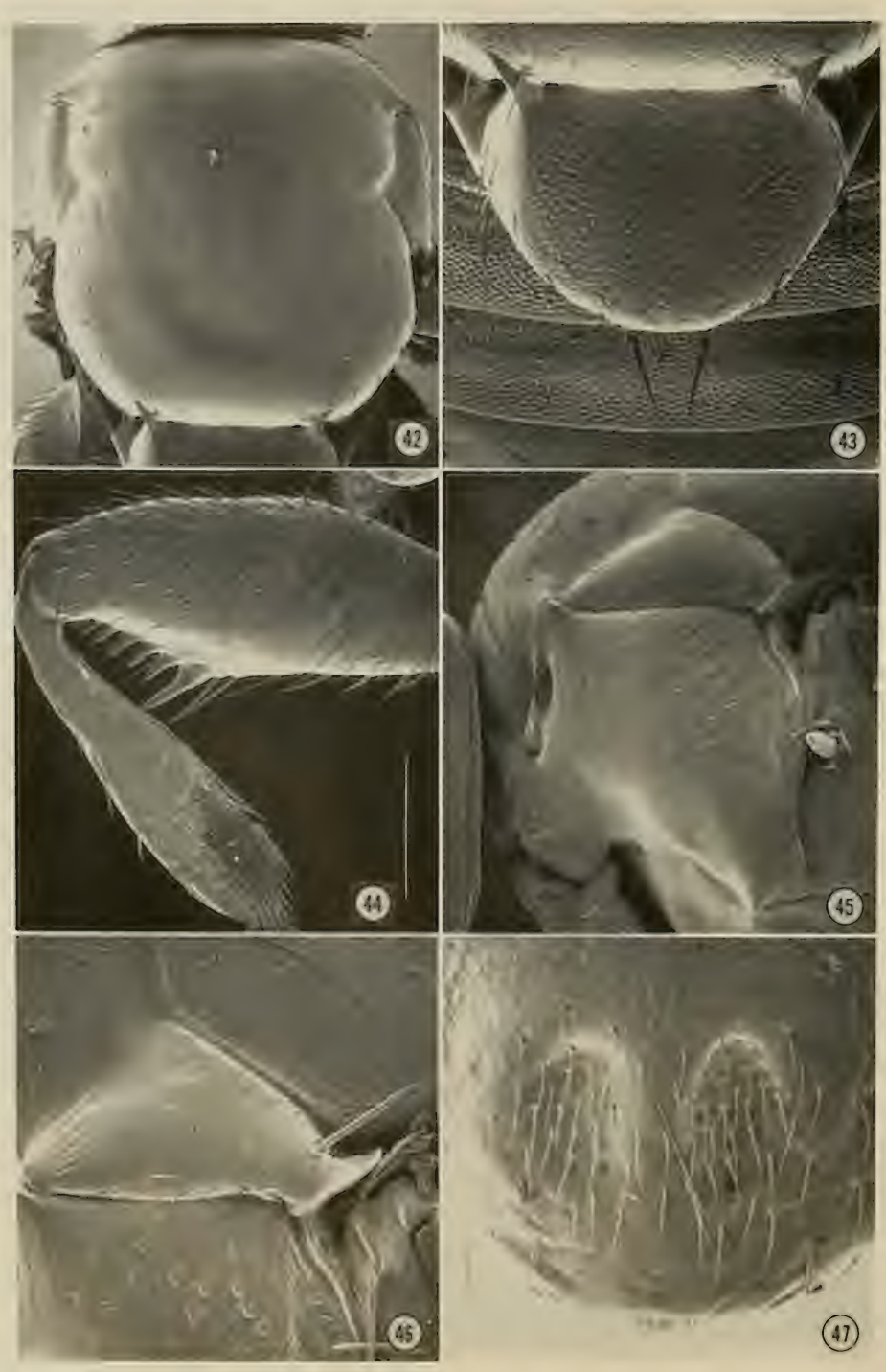
Chlorichaeta albipennis of authors, not Loew (misidentification). – Collin 1949: 202 [list, Egypt, Siwa], Tenorio 1980: 267-268 [list, Hawaii].

Diagnosis

This species is very similar to *C. africana* but is distinguished from the latter and other congeners of the



Figs. 36-41. Scanning electron micrographs of *Chloriohaeta tuberculosa* (Israel; scale length in parenthesis; bar scale for all photographs = fig. 36). 36, head, lateral view (0.27 mm); 37, idem, anterior view (0.30 mm); 38, frons, anterodorsal view (176 µm); 39, antennae, anterior view (136 µm): 40, face, anterior view (176 µm); 41, parafacial, anterior view (120 µm).



Figs. 42-47. Scanning electron micrographs of *Chlorichaeta tuberculosa* (Israel; scale length in parenthesis; bar scale for all photographs = fig. 44). 42, mesonotum, dorsal view (0.40 mm); 43, scutellum, dorsal view (176 µm); 44, left foreleg, anterior view (150 µm); 45, pleuron, lateral view (176 µm); 46, notopleuron, lateral view (136 µm); 47, 5th tergum of abdomen, dorsal view (75 µm).

albipennis group by the following combination of characters: scutellum bearing 2 large, marginal setae on each side that arise from tubercles; scutum and scutellum about equally microsculptured and coloured; hind basitarsomere almostly entirely brownish black to black; and surstylus in lateral view distinctly and more or less evenly curved anteroventrally, tapered gradually and evenly to acutely pointed apex.

Description

Small to moderately small shore flies, length 1.65-2.70 mm.

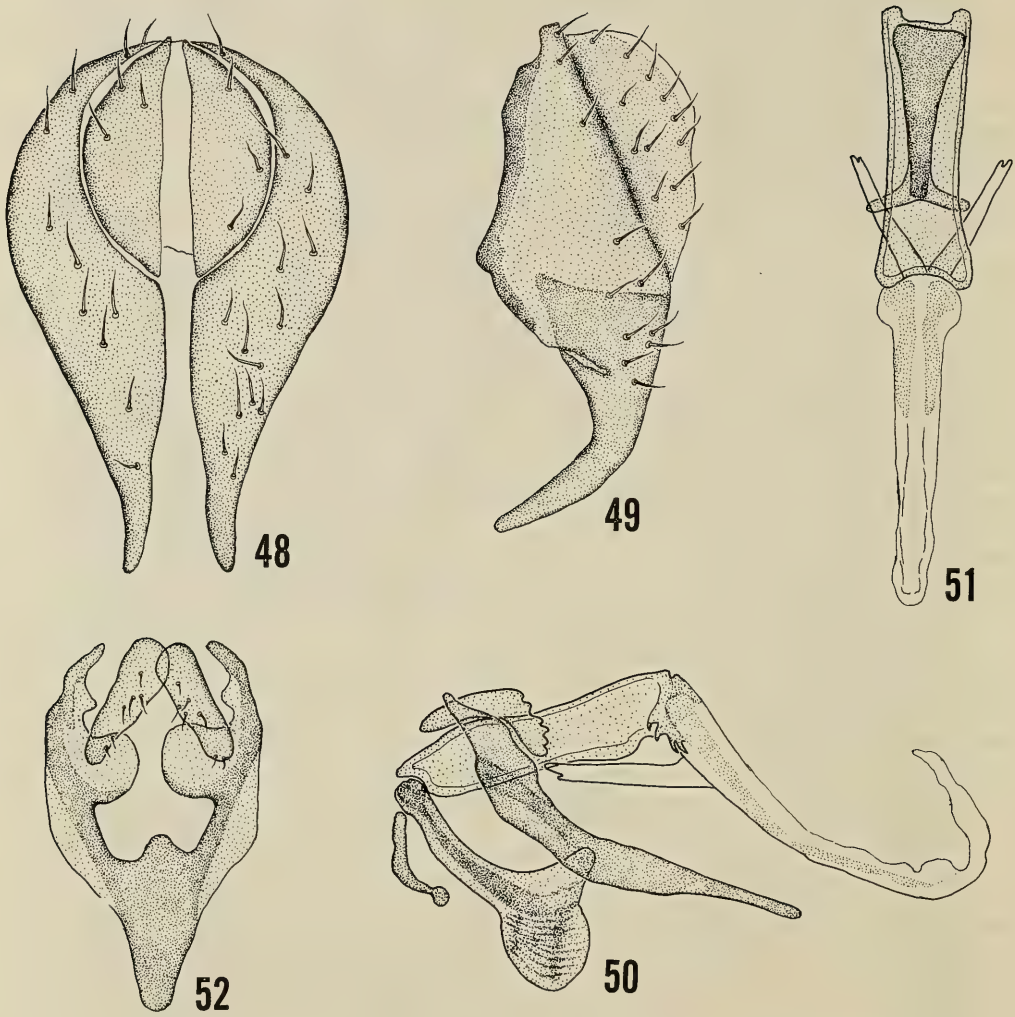
Head (figs. 36-41): Mesofrons, especially extended ocellar triangle, smooth, shiny, very similar to parafrons; parafacials with silvery-white to white microtomentum arranged as 2 patches, dorsal patch much smaller, a spot laterad of pedicel, ventral patch long, linear, length equal to combined length of pedicel and flagellomere 1. Gena high, eye-to-cheek ratio averaging 0.52.

Thorax (figs. 42-46): Mesonotum mostly black, shiny, some specimens with faint, bronzish luster on scutum; scutum and scutellum with similar texture, both at most lightly granulose, bearing 2 pairs of marginal setae that arise from tubercles. Halter pale, whitish yellow to yellow. Costal vein ratio averaging 0.64; vein M ratio averaging 0.58. Fore tarsi black; hind basitarsomere entirely dark coloured, blackish brown to brown.

Abdomen (fig. 47): Male terminalia (figs. 48-52): Length of epandrium+surstyli in posterior view 1.5 X width; lateral margins of surstylus straight to concave towards apex in posterior view (fig. 48), in lateral view distinctly and evenly tapered to narrowly rounded apex, curvature in lateral view anteroventrad, distinctly more so than curvature of epandrium (fig. 49); hypandrium short, curved in lateral view with anteromedial portion more or less parallel with basiphallus and tapered toward apex, dorsal portion (= fused pregonite) as a parallelogram, more than twice width of anteromedial portion (figs. 50, 52); aedeagal apodeme distinctly enlarged toward attachment with hypandrium (fig. 50); postgonite evenly lunate in lateral view (fig. 50); distiphallus longer than basiphallus, gently curved along basal 2/3 in lateral view, recurved apically, lateral projections from base long, length equal to narrowed portion of aedeagal apodeme (figs. 50, 51), at base of process with a short membranous lobe that bears a few finger-like serrations.

Other specimens examined

Afrotropical: Angola. Lobito Bay (on trunk of *Melia azedarach*), 19 Jul-10 Aug 1931, T. D. A. Cockerall, J. Ogilvie (1♀, 1ex; ANSP). Ethiopia. Lake Langano (7°27'N, 39°11'E), 8 Feb-13 Dec 1973, 1989, R. Baker, A. Freidberg, F. Kaplan (2♂; BMNH, USNM). Ghana. Cape St. Paul, 22 May 1958 (1♀; BMNH). Kenya. Tsavo National Park, 4-7 Apr 1968, B. Cogan, A. Hutson (1♂; BMNH). Malawi. Ruo ChiKonje (on cattle), 16 Dec 1915, R. C. Wood (13♂, 6♀; BMNH, ANSP). Mozambique. Pafuri (hippo carcass), 21 May 1983, L. Braack (2♂, 4♀; USNM). Nigeria. Cotonon, in Dahomey (70 mi W Lagos), 5 Jun 1914, W. A. Lamborn (1♀; ANSP). South Africa. Kruger National Park (22°27'S, 31°17'E, across river from Pafuri, on impala carcass), L. Braack (2♂, 1♀; USNM). Sudan. Erkowit, 17 May 1943, D.J. Lewis (1♂, 1♀; BMNH). Khartoum (sores on the backs of camels), 21 Feb-1 Mar 1932, 1933, H. W. Bedford (2♂, 5♀; BMNH, ANSP). Tuti Island (attracted to human sweat), 20 Mar 1932, H. W. Bedford (1♂, 4♀; BMNH). Wad Medani (on dead goat), 27 Mar 1940, D. J. Lewis (1♀; BMNH). Yemen. Aden, 3 Dec 1951 (1♂; USNM); Kirsh, Wadi 'Aqqan (3000 ft), 17 Mar 1940, P. W. R. Petrie (1♂; BMNH). Socotra Island: Rás Shóab, Feb 1899, O. Simony (1♂; ANSP). Australasian/Oceanian: Guam. Agana (sea cucumber), 3 Aug 1945, G. E. Bohart, J.L. Gressitt (1♀; ANSP); Antigua, 2 Aug 1945, G. E. Bohart, J. L. Gressitt (1♀; USNM); SE coast, 9 May 1945, G. E. Bohart, J. L. Gressitt (1♂, 1♀; USNM); Pt Oca, May 1945, G. E. Bohart, J. L. Gressitt (1♀; USNM). Hawaii. Hawaii: N Kona, Makalawena Tract, 12 Feb 1970, D. E. Hardy (1♂, 1♀; USNM). Maui: Lahaina (2 km S; on herbs and grass along sea shore), 23 Oct 1981, L. & I. Cederholm (2♂, 3♀; BMNH). Oahu: Fort Kam, 4 Jul 1944, D. G. Hall (2♀; USNM). Oriental: India. Madras, Sidhout (bred in rotting oilcake manure), 9 Mar 1934, C. S. B (3♀; BMNH, ANSP). Sri Lanka. W. Province: Ratmalana, Colombo (9 mi S), swept on dry grassland, or on herbs on sandy beach, 7-13 Jan 1962, H. Andersson, P. Brinck, L. Cederholm (6♂, 8♀; ZIL); Kalutara, Colombo (25 mi SSE), swept on dry grass on sandy beach, 25 Jan 1962, H. Andersson, P. Brinck, L. Cederholm (1♂, 2♀; ZIL); Beruwala, Colombo (34 mi SSE), 25 Jan 1962, H. Andersson, P. Brinck, L. Cederholm (1♂; ZIL). Thailand. Thonburi Province: Mueng District, Manop, 7 May 1959 (1♀; USNM). Rajburi, Banpongnoung, 29 Jun-3 Jul 1952, R. E. Elbel (1♀; USNM). Vietnam. Saigon, Cho Binh Tay, 15 May 1973, R.E. Parsons (1♂, 1♀; USNM). Palearctic: Afghanistan. Khourmalik (between Farah and Dilaram, 800 m, under stones), 6 Sep 1957, K. Lindberg (2♂; USNM). Algeria. Kairouan, 7 Aug, F. Santchi (1♂; ANSP). Egypt. Egypt (1♂; ANSP). Giza Province: Manshiet Radwan, 28 Apr 1965, K.V. Krombein (1♂; USNM); Siwa, 15 Jul 1935, J. Omer-Cooper (7♂, 9♀; BMNH); Wadi el Natrun (N Cairo; sores on donkey), 20 Jul 1950, C. W. Sabrosky (3♂, 5♀; USNM); Wadi Ghoderat Kosaima (tamarix), 1934, Priesner (1♂; USNM). Saqqra, 10 May 1966, P. M. Marsh (1♂, 2♀; USNM). Sinai: Bir Tmade, 8 Sep 1977, D. Simon (2♂; TAU); Dahab, 7 Apr-23 May 1973, 1981, A. Freidberg, M. Kaplan, W. N. Mathis (2♂, 3♀; TAU, USNM); 'En Qsaib, 15 Mar 1982, I. Yarom (1♀; TAU); Wadi Firan (oasis), 9 Apr-29 July 1950, 1971, 1973, A. Freidberg, C. W. Sabrosky (1♂, 4♀; TAU, USNM); 1950, C. W. Sabrosky (1♀; USNM); Mt. Abas, 14 Aug 1971, J. Kugler (1♂, 1♀; TAU); Muyat-Hara, 12 Aug 1971, J. Kugler (1♂, 2♀; TAU); Ofira (sewage area), 22 Mar-21 May 1981, A. Freidberg, W. N. Mathis (49♂, 16♀; TAU, USNM); Neviot, 14 May 1981, T. Furman (1♂; TAU); Ras Burka, 20 May-5 Sep 1976, 1981, A. Freidberg (1♂, 1♀; TAU); Sinai Mountains, St. Katharina, 18 Jul 1974, F. Kaplan (1♀; TAU); Sinai Mountains, Wadi Tlach (1500 m), 15 Jul 1974,



Figs. 48-52. Male genitalia of *Chlorichaeta tuberculosa*. – 48, epandrium and cerci, posterior view; 49, idem, lateral view; 50, internal male genitalia, lateral view; 51, idem, ventral view; 52, hypandrium and postgonites, ventral view.

A. Freidberg, F. Kaplan (2♀; TAU); Wadi Mesech, 14 Apr 1981, T. Furman (2♂; TAU); Wadi Watir, 6 Apr-5 Aug 1973, 1975, A. Freidberg, M. Kaplan (15♂, 12♀; TAU). Khor Gwob, 25 Nov 1930, R. C. M. Darling (1♂, 2♀; BMNH). Greece. Macedonia, 1933, R. C. Shannon (1♀; USNM); Larissa, Platamon, 5-9 Sep 1965, B. H. Cogan (4♂, 1♀; BMNH). Israel. Arad, 21 Apr 1981, F. Kaplan, A. Freidberg (3♂, 1♀; TAU); Dead Sea, 11-18 Oct 1939, E. Rivnay (5♂, 3♀; ANSP, TAU); 'En 'Avedat, 16-29 Mar 1980, 1988, A. Freidberg, W. N. Mathis (6♂, 9♀; TAU, USNM); 'En Boqéq, 30 Jul-20 Sep 1971, 1977, A. Freidberg, J. Kugler (1♂, 1♀; TAU); 'Ein Fashkha (Dead Sea at 'Enot Zuqim), 2 Jul 1946, O. Theodor (5♂, 2♀; TAU); 'En Gedi, 21 Mar 1980, A. Freidberg, W. N. Mathis (8♀; USNM); 'En Mor, 31 Mar-30 Oct 1981, 1984, 1986, A. Freidberg (7♂, 5♀; TAU); Hameshar, 16 Mar 1988, A. Freidberg (2♂; TAU); Hazeva, 21 Apr 1981, A. Freidberg (1♂; TAU); Jerusalem (Mt. Scopus), 9 Sep 1935, O. Theodor (2♂; TAU); Kefar Yeroham, 22 Jul 1962, J. Kugler (3♂, 1♀; TAU); Mikhmoret, 28 Aug 1980, C. Nagy (1♀; TAU); Nahal 'Iddan, 22 Mar 1980, A. Freidberg, W. N. Mathis (2♂, 1♀; USNM); Nahal Ramon, 15-30 Oct 1975, 1984, A. Freidberg (4♂, 6♀; TAU); Nahal Zibor, 17 Mar 1988, A. Freidberg, F. Kaplan (4♂, 3♀; TAU); Ne'ot ha'Kikkar, 21 Mar 1980, A. Freidberg, W. N. Mathis (1♂; USNM); Nizzanim, 4-12 Oct 1983, I. Nussbaum (4♂; TAU); Qalya, 8 Mar 1976, A. Freidberg (1♀; TAU); Taba, 28 Apr 1974, A. Freidberg (1♀; TAU); Wadi Yamin, 19 Oct 1983, I. Nussbaum (1♀; TAU). Italy. Sardinia: Rio Geremeas, 23 Jul 1952, Th.G. Aitken (9♂, 7♀; USNM). Oman. Al Khoudh, 11 Nov 1988, M. J.

Fig. 53. Distribution map for *Chlorichaeta tuberculosa.*

Ebejer (1♂, 1♀; NMWL); Al Seefa, 4 Dec 1987, M. J. Ebejer (1♀; NMWL); Ghuzayn, date culture, 10 Apr 1985, P. Ardö (1♂; ZIL); Nizwa-Tanuf road, 12 Apr 1985, P. Ardö (1♀; ZIL); Wadi Daigah, 23°06'N, 58°52'E, 27 Jan 1989, M. J. Ebejer (2♀; NMWL).

Distribution (fig. 53)

Afrotropical. Angola, Cape Verde Islands, Ethiopia, Ghana, Kenya, Malawi, Mozambique, Nigeria, South Africa, Sudan, Tanzania (no specimens seen), Yemen (including Socotra). Australasian/Oceanian. Guam, Hawaiian Islands. Oriental. India, Sri Lanka, Thailand, Vietnam. Palearctic. Afghanistan, Algeria, Bulgaria (no specimens seen), Canary Islands (no specimens seen), Egypt, Greece, Israel, Italy, Oman.

Acknowledgements

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References

Becker, T. 1896. Dipterologische Studien IV. Ephydridae. – Berliner Entomologische Zeitschrift 41(2): 91-276.

Becker, T. 1922. Wissenschaftliche Ergebnisse der mit Unterstützung der Akademie der Wissenschaften in Wien aus der Erbschaft Treitl von F. Werner unternommenen Zoologischen Expedition nach dem Anglo-Ägyptischen Sudan (Kordofan) 1914. VI. Diptera. – Denkschriften der Akademie der Wissenschaften in Wien (mathematisch-naturwissenschaftliche Klasse) 98 (1923): 57-82.

Canzoneri, S. 1981. Ricerche condotte dal Prof. A. Giordani Soika nel Senegal ed in Gambia (Diptera: Ephydridae e Canaceidae). – Bollettino del Museo civico di Storia Naturale di Venezia 31: 201-221.

Canzoneri, S. 1982. Ephydridae e Canaceidae della Sierra Leone (Diptera). –Accademia nazionale dei Lincei 1982 (255): 53-62.

Canzoneri, S. & D. Meneghini. 1969a. Ephydridae [Dipt.] raccolti dal Dr. A. Villiers nell'Africa occidentale. – Bulletin de l'Institut Francais Afrique Noire 30(4): 1480-1485.

Canzoneri, S. & D. Meneghini. 1969b. Sugli Ephydridae e Canaceidae della fauna etiopica. – Bollettino del Museo civico di Storia Naturale di Venezia 19: 101-185.

Canzoneri, S. & D. Meneghini. 1983. Ephydridae e Canaceidae. – Fauna d'Italia 20, 337 pp. Bologna.

Canzoneri, S. & L. Rampini. 1990. Appunti sugli Ephydridae e Canaceidae della Sierra Leone (Diptera, Brachycera). – Accademia Nazionale dei Lincei, Problemi Attuali di Scienza e di Cultura, Sezione: Missioni ed Esplorazioni - XII 265: 107-120.

Cogan, B. H. 1980. 71. Family Ephydridae. Pp. 655-669. –

In: R. W. Crosskey, ed., Catalogue of the Diptera of the Afrotropical Region. British Museum (Natural History), 1437 pp. London.

Cogan, B. H. 1984. Family Ephydridae. Pp. 126-176. – In, A. Soós & L. Papp, eds., Catalogue of Palearctic Diptera. Vol. 10, 402 pp. Budapest.

Cogan, B. H. & W. W. Wirth. 1977. Family Ephydridae. Pp. 321-339. – In: M. D. Delfinado & D. E. Hardy, eds., A Catalogue of the Diptera of the Oriental Region. Suborder Cyclorrhapha (Excluding Division Aschiza). Univ. Press Hawaii, Vol. 3, 854 pp. Honolulu.

Collin, J. E. 1949. Results of the Armstrong College Expedition to Siwa Oasis (Libyan Desert), 1935, under the leadership of Prof. J. Omer-Cooper. Diptera Empididae, Dolichopodidae, Aschiza and Acalypterae. – Bulletin de la Société Foudad ler d'Entomologie 33: 175-225.

Cresson, E. T., Jr. 1925. Studies in the dipterous family Ephydridae, excluding the North and South American Faunas. – Transactions of the American Entomological Society 51: 227-258.

Cresson, E. T., Jr. 1945. A systematic and annotated arrangement of the genera and species of the Indoaustralian Ephydridae (Diptera). I. The subfamily Psilopinae. – Transactions of the American Entomological Society 71: 47-75.

Cresson, E. T., Jr. 1946. A systematic and annotated arrangement of the genera and species of the Ethiopian Ephydridae (Diptera). I. The subfamily Psilopinae. – Transactions of the American Entomological Society 72: 241-264.

Duda, O. 1942. Neue oder ungenügend bekannte Zweiflügler der paläarktischen Region aus meiner Sammlung. 2. Fortsetzung. – Deutsche Entomologische Zeitschrift 1942(1-4): 1-39.

Lamb, C. G. 1912. The Percy Sladen Trust Expedition to the Indian Ocean in 1905, under the leadership of Mr. J. Stanley Gardiner, M. A. Volume IV. Number XIX. Diptera: Lonchaeidae, Sapromyzidae, Ephydridae, Chloropidae, Agromyzidae. – Transactions of the Linnean Society of London (series 2) 15: 303-348.

Loew, H. 1848. Ueber die Arten der Gattung *Gymnopa*. – Berliner Entomologische Zeitschrift 1848: 13-15.

Mathis, W. N. 1986. Studies of Psilopinae (Diptera: Ephydridae), I: A revision of the shore fly genus *Placopsidella* Kertész. – Smithsonian Contributions to Zoology 430: 1-30.

Mathis, W. N. 1989. 99. Family Ephydridae. Pp. 639-649. – In: N. Evenhuis, ed., Catalog of the Diptera of the Australasian and Oceanian Regions. 1155 pp. Bishop Museum Press and E.J. Brill.

Mathis, W. N. & T. Zatwarnicki. 1990a. A revision of the western palearctic species of *Athyroglossa* (Diptera: Ephydridae). – Transactions of the American Entomological Society 116 (1): 103-133.

Mathis, W. N. & T. Zatwarnicki. 1990b. Taxonomic notes on Ephydridae (Diptera). – Proceedings of the Biological Society of Washington 103 (4): 891-906.

Mathis, W. N., Tadeusz Zatwarnicki, & M. G. Krivosheina. 1993. Studies of Gymnomyzinae (Diptera: Ephydridae), V: A revision of the shore-fly genus *Mosillus* Latreille. – Smithsonian Contributions to Zoology, number 548, in press.

Miyagi, I. 1977. Ephydridae (Insecta: Diptera). Fauna Japonica, 113 pp.

Papp, L. 1979. A contribution to the revision of the Palaearctic Ephydridae (Diptera). – Folia Entomologica Hungarica 32(1): 97-104.

Schiner, J. R. 1863. Die Fliegen (Diptera). Fauna Austriaca 2 (9-10): 81-288. Wien.

Tenorio, J. 1980. Ephydridae. Pp. 251-351. – In: D. E. Hardy & M. D. Delfinado, eds., Insects of Hawaii. Diptera: Cyclorrhapha III. Univ. Press Hawaii. Vol 13, 451 pp.

Wirth, W. W. 1955. East African Ephydridae (Ins., Diptera). – Mitteilungen aus dem Zoologischen Museum in Berlin 31(1-2): 48-58.

Zatwarnicki, T. 1992. A new classification of Ephydridae based on phylogenetic reconstruction (Diptera: Cyclorrhapha). – Genus 3 (2): 65-119.

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A NEW GENUS OF TACHINIDAE FROM THE PHILIPPINES (DIPTERA)

Pape, T. & H. Shima, 1993. A new genus of Tachinidae from the Philippines (Diptera). – Tijdschrift voor Entomologie 136: 77-81, figs. 1-5. [ISSN 0040-7496]. Published 1 July 1993.
A new genus of Tachinidae, *Aporeomyia* gen. n., including only the type species *Aporeomyia antennalis* sp. n., is described from the Philippines. It is placed in the subfamily Tachininae, and possible phylogenetic relationships to other tachinine genera are discussed.
Correspondence: Dr. T. Pape, Zoological Museum, Universitetsparken 15, DK - 2100 Copenhagen, Denmark.
Key words. – Tachinidae, Philippines, new genus, new species.

The present study deals with two male specimens belonging to the Tachinidae family-group and showing a tripartition of the first flagellomere. Although possibly sexually dimorphic with the female first flagellomere unpartitioned, this feature makes the species easily recognizable (fig. 3). Tripartition of the first flagellomere occurs within the Tachinidae family-group in the family Tachinidae and in some undescribed Australian–New Guinean taxa of uncertain familial affiliation (see discussion below). However, the configuration of the tripartition is never fully identical to that seen in the present species. We take this opportunity to describe and name the taxon, and as is discussed in detail below the species does not fit very well into any of the named genera, for which reason a new genus is described.

Taxonomic part

Aporeomyia gen. n.

Type species: *Aporeomyia antennalis* sp. n.

Etymology. – Gender: Feminine. Composed from the type locality, Mt. Apo of Mindanao, and the Greek, *oreos, oros* = mountain, and *myia* = fly.

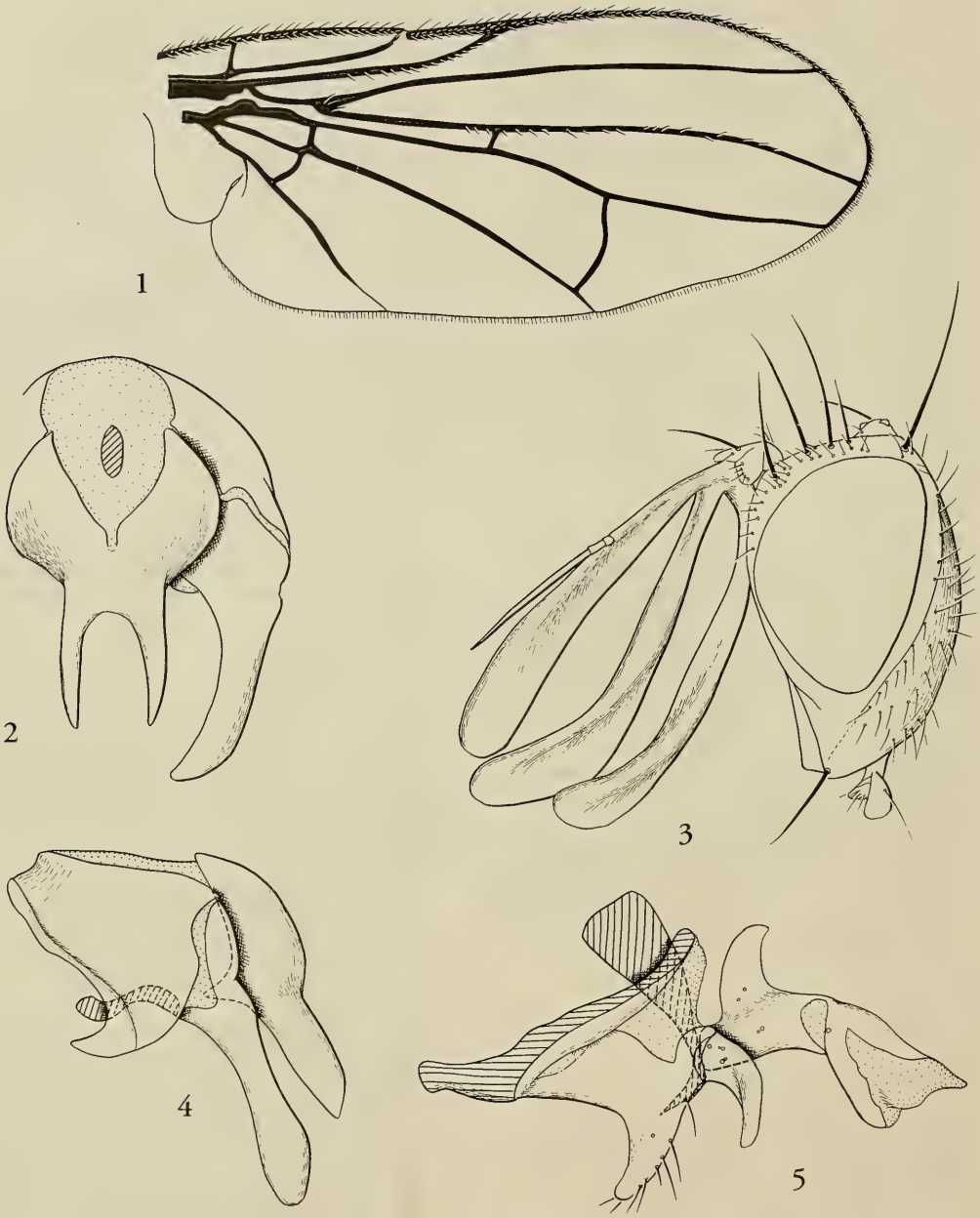
Diagnosis. – Male: Head profile narrowed ventrally. Proboscis and palpus short. Antenna very large and with first flagellomere tripartite from base. Arista inserted on upper lobe at a point about 0.3 from base to tip. Antennal scape and pedicel raised above level of lunule. Prosternum bare. Subscutellum slightly swollen. Wing vein R_1 setulose in distal part, vein M almost straight and without a bend distal to cross-vein dm-cu, and vein $Cu+A_1$ extended to wing margin. Lower calypter narrow and with median margin diverging from scutellum. Hind tibia with postero-ventral apical seta.

Aporeomyia antennalis sp. n.
(figs. 1-5).

Type material. – Holotype ♂: PHILIPPINES, Mindanao, Mt. Apo, Agko - Lake Binado, 1,350-2,300 m, 5.viii.1978, A. Nakanishi & O. Yata. – Paratype ♂, data as holotype, terminalia dissected and stored in a microvial pinned with the specimen. Both types are deposited in the Biological Laboratory, Kyushu University, Fukuoka, Japan.

Etymology. – From the Latin, *antenna* = feeler, *-is* = adjectival suffix meaning with or having. The name refers to the first flagellomere, the peculiar shape of which makes the species easily recognizable.

Description. – Male. Head brown in ground colour, without pollinosity; frontal vitta dark brown; face pale yellowish; scape and pedicel reddish, first flagellomere brown; palpus pale yellowish. Head profile short and high, strongly narrowed ventrally; frons about 0.4x as long as height of face profile; vertex wide, 0.47-0.50x head width; frontal vitta weakly widened anteriorly, about 3x as wide as fronto-orbital plate at middle; parafacial in profile very narrow; gena slightly less than 0.5x eye height, genal dilation obliquely occupying about lower 0.3 of gena; mouth opening reduced, about 0.75x as long as wide. Inner vertical seta strong, slightly less than eye height; 2 fine divergent postocellar setae; ocellar seta fine, proclinate, subequal in length to postocellar seta; no reclinate and proclinate orbital setae; 3-4 frontal setae, lowest seta nearly level with base of pedicel; 2-3 irregular rows of short fine hairs on anterior portion of



Figs. 1-5. *Aporeomyia antennalis.* – 1, right wing, dorsal view; 2, epandrium (in part), cerci and right surstylus; posterior view; 3, male head; 4, epandrium, surstylus and cercus, lateral view; 5, hypandrium, pre- and postgonite and aedeagus, lateral view.

fronto-orbital plate descending to upper 0.25 of parafacial; vibrissa fine and short, slightly more than 0.3x length of face; facial ridge with several fine short hairs just above vibrissa; occiput with short black hairs. Antenna long, distinctly longer than face; first flagellomere tripartite, each lobe weakly widened apically, middle lobe slightly longer than others. Arista short, about 0.4x as long as upper lobe of first flagellomere,

inserted on basal 0.3 of upper lobe of first flagellomere; second aristomere about 2x as long as wide. Mouthparts strongly reduced; proboscis very short; labella small; palpus short, subequal in length to pedicel.

Thorax brown on dorsum except for pale brownish postpronotal lobe, pale brownish on pleura except for brownish posterior 0.5 of anepisternum and anterior 0.3 of katepisternum, without pollinosity. Dorsum with rather sparse short fine hairs except for bare area between rows of dorsocentral and intra-alar setae of postsutural scutum, pleura without hairs other than strong setae; 1 postpronotal seta; 2 notopleural setae; no acr seta; 1-2 + 2-3 dc setae; 0 + 1 ia seta; 1 supraalar seta; proepisternum bare, with 1 fine proepisternal seta; 1 fine proepimeral seta; 2 + 2-1 katepisternal setae; katepimeron and katatergite bare; scutellum with 2 pairs of marginal setae, strong subapicals and short apicals; discal scutellar setae absent. Metathoracic spiracle rather small, anterior and posterior fringes subequal and not standing out from spiracular rim.

Wing hyaline, evenly tinged with pale brown; tegula and basicosta dark brown; lower calypter pale brownish yellow. Vein R_{2+3} joins costa near wing apex, giving a long third costal sector slightly more than 4x length of second; vein R_{4+5} joins costa slightly beyond wing apex; vein M straight from crossvein dm-cu to wing margin; last section of vein CuA_1 short, slightly more than 0.25 of crossvein dm-cu. Costa setulose dorsally and ventrally; vein R_1 setulose dorsally on distal half; vein R_{4+5} ventrally with 1-2 setulae at base, dorsally with several setulae at base as well as setulae from just proximal to crossvein r-m and almost to wing margin. Halter large, about 0.7x as long as lower calypter.

Legs pale brownish yellow; pulvilli whitish. Fore tibia with 1 fine p seta; mid tibia with 0 ad, 2 pd and 1 v setae. Claws and pulvilli very short.

Abdomen brownish in ground colour, without pollinosity; anterior 0.4 of syntergum 1+2, anterior 0.3 of terga 3-4 and anterior 0.25 of tergum 5 pale brownish; mid dorsal stripe dark and narrow; syntergum 1+2 rather long, only faintly excavated at base; sterna 2-3 exposed. Hairs short, fine, dense and recumbent on dorsum, longer and sparser on venter; tergum 2 with 2-3 lateral discal, 2 lateral marginal and 2 median marginal setae, all setae strong; tergum 3 with 2 rather fine lateral discal, 2 strong median and lateral discal setae; terga 4-5 each with 1-2 fine lateral discal setae and a row of strong marginal setae; sterna without strong setae.

Male genitalia. Cercal bases fused medially, apical prongs well separated and pointed; surstylus narrow and longer than cerci; epiphallus present; distiphallus rather short, with tapering unpaired dorsomedian process.

Length. Body, 3.7-4.5 mm; wing, 3.4-4.3 mm.

Female. – Unknown.

Biology. – Unknown.

Distribution. – Oriental Region: Philippines (Mindanao).

Systematic discussion

Aporeomyia antennalis is unquestionably a member of the Tachinidae family-group or Oestroidea, the monophyly of which is discussed at length elsewhere (Griffiths 1972, McAlpine 1989, Pape 1992). Families of the Tachinidae family-group are in the main well defined, but many genera showing a combination of a slightly swollen subscutellum, oval or tongue-shaped lower calypteres, small metathoracic spiracles, and an obtuse (or missing) bend of vein M have been, and are still being, shuffled around amongst the tachinoid families, e. g., *Mimodexia* Rohdendorf (currently Rhinophoridae, Tschorsnig 1985a), *Bezzimyia* Townsend and *Malayia* Malloch (Tachinidae or Rhinophoridae, Pape 1992), and *Morinia* Robineau-Desvoidy (currently Calliphoridae, Rognes 1991). *Aporeomyia antennalis* possesses these four character states, which may be apomorphic groundplan states of the Rhinophoridae, and it has accordingly a rhinophorid appearance. The structure of the aedeagus, however, provides no support for a rhinophorid affiliation. In the Rhinophoridae, the aedeagus is generally slender, always equipped with a long epiphallus, and usually with paired dorsolateral processes. In *Aporeomyia* the aedeagus is rather short with a short and compact epiphallus, and with an unpaired, tapering dorsomedian process ('Fortsatz des Dorsalsklerits' of Tschorsnig [1985a, b]). Pape (1986: 27) recognized a single monophyletic group within the Rhinophoridae, defined by an unpaired dorsomedian process, but this group is part of a more inclusive group sharing a tripartite (and apomorphic) acrophallus not found in *Aporeomyia*. The groundplan of the possibly monophyletic Sarcophagidae + Tachinidae is characterized by an unpaired dorsomedian process (Pape 1992), but *Aporeomyia* does not share any synapomorphies with any of the sarcophagid subfamilies and cannot be included in this family. It is our experience that the male terminalia in general provide much more substantial evidence of phylogenetic relationships than the above-mentioned rhinophorid-like features. Thus, we consider an assignment to the Tachinidae as most probable, even though we have no clearcut evidence in support of this.

Fitting *Aporeomyia antennalis* into the subfamilial classification of the Tachinidae with no information on the structure of female terminalia, female reproductive system, and immatures (egg, first instar larva)

has to be preliminary. Of the four subfamilies generally applied, e. g. by Tschorsnig (1985b) and Wood (1987), perhaps only the Dexiinae and the Phasiinae are monophyletic taxa. Indeed, it has been stressed that at least the subfamily Tachininae very probably is not monophyletic ('sehr wahrscheinlich nicht monophyletisch'; Tschorsnig [1985b: 119]) or even 'almost certainly polyphyletic' (Crosskey 1980: 822-823).

Aporeomyia antennalis does not possess the aedeagal hinge characterizing the groundplan of the Dexiinae, nor any of the derived character states listed for the Phasiinae by Tschorsnig (1985b: 121). Also, it does not possess a setose prosternum as found in many (but not all) Exoristinae. *Aporeomyia antennalis* will key out to subfamily Tachininae in Crosskey's (1976: 11) comprehensive (given as 'alternative') key to subfamilies of Oriental Tachinidae, but mainly because it repeatedly fits the entry: 'Forms without such combination of characters present simultaneously'. Note that Pape (1992) used a broad concept of the Tachininae, including all species which embryonate their eggs in the uterus. With only males of *Aporeomyia* available, nothing can be deduced on female reproductive biology. We have chosen to place *Aporeomyia* in the Tachininae as this does not conflict with the general morphology of this subfamily (whether in the traditional sense or the broader sense used by Pape [1992]).

Assigning *antennalis* to a genus of its own deserves an explanation as monotypy in itself conveys little, if any, information. Often - as here - monotypic genera are erected to accommodate aberrant species which present insufficient and conflicting evidence for inclusion within already named genera.

The tripartite first flagellomere – in so far as this is of very rare occurrence in the Tachinidae – may be taken as evidence of phylogenetic relationship. *Trischidocera sauteri* Villeneuve is the only other Oriental species with a tripartite first flagellomere, and the head profile of *Aporeomyia antennalis* moreover resembles that of *T. sauteri* to the extent that both have the antennal insertion at or slightly above the level of upper eye margin, an almost horizontal frons, a short lower head margin and very short mouthparts (compare Crosskey 1976: fig. 50 with the present fig. 3). Many of these features, however, may be considered constraints imposed by the very long and tripartite first flagellomere. It is important to note that the first flagellomere of *A. antennalis* and *T. sauteri* reveals some structural differences: Firstly, *T. sauteri* has the first flagellomere basally bipartite with the lower lobe (i. e., that closest to the facial plate) further bipartitioned at a point about one fifth from its base, while in *A. antennalis* the three lobes of the first flagellomere all originate from a common point at the base – or perhaps with the middle and upper lobes sharing a *very* short common base. Secondly, the arista is terminal in *T. sauteri* but inserted at 0.3 from the base in *A. antennalis*. Thus, for the tripartition to be homologous, i.e., for the two configurations to be connected in a transformation series, it is necessary to assume some fairly dramatic reorganizations of the first flagellomere. It may thus be at least as parsimonious to put up a transformation series between the bipartite first flagellomere of *Diglossocera bifida* Wulp (Crosskey 1976: fig. 51) and the tripartite flagellomere of *A. antennalis*. This is not to say that dramatic reorganizations are impossible; only that tripartition *per se* is difficult to use as a character (state) and consequently as an argument for phylogenetic relationship.

Whether or not *Trischidocera sauteri* and *T. atratula* (Malloch) are distinct species (see note by Crosskey 1976: 210) has no relevance for the present discussion, but when Chao & Zhou (1987) described *T. yunnanensis*, which has a markedly different head profile and a simple, and much shorter, first flagellomere, the genus seems defined mainly by the unique position of the arista apically on the first flagellomere. The displacement of the arista towards the distal part of the first flagellomere in *A. antennalis* is in itself evidence of phylogenetic relationship with *Trischidocera*, but a similar, although less pronounced, displacement occurs in the Oriental genera *Germariochaeta* Villeneuve (Crosskey 1976: fig. 39) and *Lophosiosoma* Mesnil, which constitute the tribe Germariochaetini. This tribe is interesting as the lower calypteres of its members are narrow and diverging, as is shown by Villeneuve (1937: fig. 1) for *Germariochaeta clavata* Villeneuve, and thus represent a possible synapomorphy with *Aporeomyia antennalis*. No further evidence, however, corroborates a sister-group relationship between *Aporeomyia antennalis* and the morphologically very different Germariochaetini, and the latter taxon is often considered closely related to *Triarthria* Stephens and its relatives, or to the Minthoini (Crosskey 1976).

A slightly swollen subscutellum, the small metathoracic spiracle, the narrow, diverging lower calypteres, the reduced bend of vein M, and the extension of the first anal vein towards the wing margin are character states shared with the Oriental *Malayia*. This genus was listed by Crosskey (1976: 163) as a tribally unplaced genus within the Tachininae together with *Trischidocera*. At least one of the two species included in *Malayia* possesses an aedeagus with separate dorsolateral processes, which have the extreme tip free of the aedeagal wall (the only male specimen of *Malayia* known is the single *M. fuscinervis* Malloch reported by Dear & Crosskey [1982: 134]; examined by TP). The aedeagus of *Malayia* thus pro-

vides a character state that, in combination with the rhinophorid-like structure of metathoracic spiracle, subscutellum, wing venation, and lower calypteres, actually is strong indication that *Malayia* should be transferred to the Rhinophoridae. Similarities also exist between *Aporeomyia antennalis* and the Australian-New Guinean taxon containing a dozen undescribed species and tentatively put in a separate (unnamed) tachinoid family by Colless & McAlpine (1991). Apart from possessing all the rhinophorid-like features mentioned above, these undescribed species have the antennal arista displaced towards apex, sometimes inserted very close to the tip (Colless & McAlpine 1991, fig. 39.38: c, d). Bi- and tripartition occurs in some of the undescribed species but is here of a very different appearance. Also, as in *Malayia*, the aedeagus has paired dorsolateral processes, which here is considered evidence that these species may possibly not belong to the Tachinidae.

In conclusion, we have not been able to find evidence in the morphology of *Aporeomyia antennalis* for a reliable inclusion within any named genus. Tripartition of the first flagellomere gives the species a superficial resemblance to the similarly equipped *Trischidocera sauteri*, but differences in configuration of the lobes weakens a hypothesis of homology. Other character states suggest a hypothesis of a sister-group relationship to the Germariochaetini, but several of the characters discussed are notoriously much prone to evolutionary homoplasy.

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References

Chao, C.- M. & S. Zhou, 1987. New species of tachinid flies from Hengduan Mountains of China (Diptera: Tachinidae). – Sinozoologia 5: 207-215. [In Chinese with English summary].

Colless, D. H. & D. K. McAlpine, 1991. Diptera (Flies). – Pp. 717-786 in Naumann, I. E. et al. (eds.), The insects of Australia. Vol. 2. Melbourne University Press, vi + 543-1137.

Crosskey, R. W., 1976. A taxonomic conspectus of the Tachinidae (Diptera) of the Oriental Region. – Bulletin of the British Museum (Natural History) Entomology Supplements 26: 1-357.

Crosskey, R. W., 1980. Family Tachinidae. – Pp. 822-882 in R. W. Crosskey (ed.), Catalogue of the Diptera of the Afrotropical Region. British Museum (Natural History), London. 1437 pp.

Dear, J. & R. W. Crosskey, 1982. A taxonomic review of the Tachinidae (Insecta, Diptera) of the Philippines. – Steenstrupia 8: 105-155.

Griffiths, G. C. D., 1972. The phylogenetic classification of Diptera Cyclorrhapha with special reference to the structure of the male postabdomen. – Junk Publ., The Hague. 340 pp.

McAlpine, J. F., 1989. Phylogeny and classification of the Muscomorpha. – Pp. 1397-1505 in J.F. McAlpine (ed.), Manual of Nearctic Diptera. Vol. 3. Research Branch, Agriculture Canada, Monograph No. 32, vi + 1333-1581.

Pape, T., 1986. A phylogenetic analysis of the woodlouse-flies (Diptera, Rhinophoridae). – Tijdschrift voor Entomologie 129: 15-34.

Pape, T., 1992. Phylogeny of the Tachinidae family-group (Diptera: Calyptratae). – Tijdschrift voor Entomologie 135: 43-86.

Rognes, K., 1991. Blowflies (Diptera, Calliphoridae) of Fennoscandia and Denmark. – Fauna Entomologica Scandinavica 24: 1-272.

Tschorsnig, H.-P., 1985a. Die Struktur des männlichen Postabdomens der Rhinophoridae (Diptera). – Stuttgarter Beiträge für Naturkunde (A) 375: 1-18.

Tschorsnig, H.-P., 1985b. Taxonomie forstlich wichtiger Parasiten: Untersuchungen zur Struktur des männlichen Postabdomens der Raupenfliegen (Diptera, Tachinidae.). – Stuttgarter Beiträge für Naturkunde (A) 383: 1-137.

Villeneuve, J., 1937. Myodaires supérieurs de Chine. – Bulletin de la Musée Royal d'Histoire Naturelle Belgique 13(34): 1-16.

Wood, D. M., 1987. Tachinidae. – Pp. 1193-1269 in J. F. McAlpine (ed.), Manual of Nearctic Diptera. Vol. 2. Research Branch, Agriculture Canada, Monograph No. 28, vi + 675-1332.

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BOOK REVIEWS

Scoble, Malcolm J., 1992. The Lepidoptera: Form, function and diversity. – Natural History Museum Publications, Oxford University Press. 404 pp., 321 figs., 4 colour plates. [ISBN 0 19 854031 0]. Price £ 45.

This book is the third volume in a series, issued by the Natural History Museum of London, the former British Museum (Natural History), providing overviews of the insect orders. Unlike the two previous volumes (on Hymenoptera and on Hemiptera), which are primarily based on the British fauna, 'The Lepidoptera' treats the order on a global scale.

More than half the book is devoted to general chapters, dealing extensively with morphology, immature stages, hearing sound and scent and the ecological importance of Lepidoptera. The remaining part of the book deals with the lepidopteran superfamilies and families. For all families a short description of adult and immature stages is given and biology, phylogenetic relationships and classification are briefly discussed. For some larger families, the subfamilies are treated separately. An extensive list of references and an index conclude the book.

The four colour plates show adults in resting posture, various types of larvae, larval habits and eggs. An adult example of most families is shown in 17 black and white plates, with photos of mounted specimens.

Scoble has succeeded in bringing together a wealth of information on the whole order, including much recent work, yet the texts remain concise and clear. Especially the general chapters give much detailed information on lepidopteran structure and function. The family treatments differ considerably, undoubtedly because for some families much more data is available than for others. What is missing compared to the earlier volumes are references to identification guides. However, this is quite understandable on the global scale, because the number of references would have been endless. A slightly weak point is the lack of illustration of the diversity of Lepidoptera: the systematic chapters are completely without line drawings and some of the black and white photos of adults are of insuficient quality, hardly giving an impression of the enormous diversity. A few more colourplates would have helped a lot.

It is tempting to compare this volume to two other recent treatments of the order, both centered on the Australian fauna: I. F. B. Common's Moths of Australia (1990) and Nielsen and Common's chapter on Lepidoptera in the new edition of 'The insects of Australia'. Undoubtedly both are far better illustrated than the present volume, especially Common's book with its many colour plates, and in general the family descriptions have more detail. On the other hand, dealing particularly with the australian fauna, these treatments miss some information on non-australian families, and Scoble's general chapters have much detail not found in the other books. One could wonder if it is wise to produce such similar treatments within this short period, with the inevitable amount of overlap.

One final point is purely esthetical: I personally do not like the rather coarse design of the cover (a black zygaenid on red), nor the graphic design (typeset in palatino with a slightly too narrow spacing).

In conclusion: a valuable overview of Lepidoptera, especially recommended for general and applied entomologists, teachers and students. The specialist can find an easy entry into the literature of a specific family or subject, in addition to the other recent treatments of the group. The general chapters give the most extensive recent review of Lepidoptera form and function.

[E. J. van Nieukerken]

Fibiger, Michael, 1993. Noctuidae Europaeae. Volume 2, Noctuinae II. – Entomological Press, Sorø. 230 pp., 11 colour plates, textfigs, many maps. [ISBN 87-89439-02-6]. Price DKK 680 excl postage; subscribers to volumes 1-12 receive 10% discount. Distributed by Apollo Books, Kirkeby Sand 19, DK-7771 Stenstrup, Denmark. Fax + 4562263780.

This is the second volume of this series, which started in 1990, and concludes the treatment of the subfamily Noctuinae.

The series Noctuidae Europaeae will provide in 12 volumes a monograph which will enable an accurate identification of all European species of Noctuidae and supply information on bionomics and distribution. Each volume will treat one or more subfamilies, each with their own authorships. The text is in english and french, printed alongside.

In this volume 116 species are dealt with. For each species a short diagnosis is given, together with notes on bionomics, distribution and taxonomy. An area map gives a general impression of the distribution. The adults are superbly illustrated in the colour plates, which were prepared by the well known photographer David Wilson. Usually both sexes, and some variation is shown. It should be mentioned that the genitalia of the species from the volumes 1 and 2 will be shown in volume 3.

Again, Fibiger has prepared a wonderful piece of work: thorough texts, much new information, which is all brought together in an attractive book. We should admire an amateur with a full time job who produces such a fine piece of scientific work. We must hope that the author and his coworkers find time to continue at least with the same speed: if volumes will come out with the same interval of time as between volume one and two, the whole series will be completed in 33 years!

[E. J. van Nieukerken]

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REVISION OF THE COCKROACH GENUS *CTENONEURA* HANITSCH (BLATTARIA, POLYPHAGIDAE).

Roth, L. M., 1993. Revision of the cockroach genus *Ctenoneura* Hanitsch (Blattaria, Polyphagidae). – Tijdschrift voor Entomologie 136: 83-109, figs. 1-21. [ISSN 0040-7496]. Published 1 July 1993.
Most of the 15 known species of *Ctenoneura* are redescribed and 12 new taxa are described. The genus is principally Malaysian, Indonesian, and Asian. A key is given to distinguish the adults.
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Key words. – *Ctenoneura*; Blattaria, Polyphagidae; cockroaches; taxonomy; new species.

There are 15 described species of *Ctenoneura* (Princis 1963: 101, 1971: 1138). I have seen the types of ten. I have not examined Bey-Bienko's species but have included his references and diagnostic features and included them in my key. Twelve new species are described.

The following museums and their curators or collection managers kindly loaned me specimens, or house types which I have not examined:
EASC - Institute of Entomology, Academy of Science, China.
HDEO - Hope Department of Entomology, University Museum, Oxford, England; Dr. George C. McGavin & Mr. I. Lansbury.
MCZ - Museum of Comparative Zoology, Harvard University, Cambridge, MA, U.S.A.
NRSS - Naturhistoriska Riksmuseet, Stockholm, Sweden; Dr. P. Inge Persson.
RMNH - National Museum of Natural History (Rijksmuseum van Natuurlijke Historie), Leiden, The Netherlands; Mr. J. van Tol.
ZILS - Zoological Institute, Lund, Sweden; Dr. Roy Danielsson.
ZINR - Institute of Zoology, Academy of Science, Russia.

Systematic part

Genus *Ctenoneura* Hanitsch

Ctenoneura Hanitsch, 1925: 100; Princis (1953) 1954: 207-208 (key to species); 1963:101. – Type species: *Ctenoneura major* Hanitsch, selected by Princis 1950: 204.

Etymology. – The name refers to the comb-like arrangement of the cubitus branches on the hind wing (Hanitsch 1925: 100).

Diagnosis. – Head, pronotum and tegmina not pubescent. Tegmina and wings fully developed extending well beyond the end of the abdomen, the former horny, venation clearly defined, discoidal sectors usually oblique (fig. 4C), rarely longitudinal or curved anteriorly (figs. 1F, 2B). Hind wings completely overlapping each other; usually with (fig. 9c) an intercalary vein (rarely absent; fig. 1E) between the radial and branched media rami; cubitus vein with three to eight parallel, curved, comb-like branches (some of which may be forked) (figs. 1E, 9C), the anal area folded over the rest of the wing, but not fan-like. Anteroventral margin of front femur with a row of minute piliform spinules, terminating with a single large spine (Type C_1); pulvilli absent, tarsal claws symmetrical, usually simple, rarely serrated, arolia, if present, minute, fleshy, unsclerotized. Supraanal plate of both sexes transverse, short. Male: Abdominal terga appear to be unspecialized, but many species have a white, membranous area which could be a tergal gland on the supraanal plate (slides of the terminalia were not prepared). Subgenital plate usually strongly asymmetrical with modified hind margin (e.g., fig. 6B), rarely symmetrical, unmodified (fig. 1B); usually with only one style on the left side (e.g., fig. 5B), rarely with two (fig. 1B), or styles absent (fig. 14E). Female: subgenital plate valvular.

I did not study the male genitalia because for most of the species there were very few duplicate specimens to prepare slides. One of the most diagnostic characters is the shape of the male's subgenital plate and this structure is so convex that it is greatly distorted when flattened on a slide. Polyphagid genitalia are much more complex structures than those of Blattellidae and Blaberidae, and possibly might not show specific

differences. I did not think it worth mutilating unique specimens for this purpose.

Distribution checklist by species of *Ctenoneura*

aberrans Hanitsch: Mentawai; Sumatra 86
acuticerca Bey-Bienko: China 87
annulicornis Princis: Borneo 88
biguttata Hanitsch: Sumatra 90
birmanica Princis: Burma 91
brunnea Hanitsch: Sumatra 92
crassistyla sp. n.: Pahang 107
fulva Hanitsch: Sarawak 94
gigantea sp. n.: Perak ... .87
hanitschi Princis: Sumatra 96
kemneri Princis: Java ... .92
kinabaluana sp. n.: Sabah 104
luma sp. n.: Perak 101
major Hanitsch: Sarawak 96
misera Bey-Bienko: China 92
mjoebergi Princis: Kalimantan; Sarawak 97
murudensis sp. n.: Sarawak 106
parascutica sp. n.: Sabah 103
poringa sp. n.: Sabah.....100
propannulicornis sp. n.: Sabah 89
scutica sp. n.: Sabah 102
simulans Bey-Bienko: China 107
sp.: South Vietnam 107
spinastyla sp. n.: Sumatra 98
triprocessa sp. n.: Sabah 106
tuberculata Princis: Sumatra 97
uncata sp. n.: Sabah 99
yunnanea Bey-Bienko: China 94

Geographical distribution checklist of *Ctenoneura* species

Borneo (Kalimantan; Sabah; Sarawak): *annulicornis*; *fulva*; *kinabaluana*; *major*; *mjoebergi*; *murudensis*; *parascutica*; *poringa*; *propannulicornis*; *scutica*; *triprocessa; uncata*

Burma: *birmanica*

China: *acuticerca*; *misera*; *simulans*; *yunnanea*

Java: *kemneri*

Malay Peninsula (Pahang; Perak): *crassistyla*; *gigantea*; *luma*; *spinastyla*

Mentawai I.: *aberrans*

Sumatra: *aberrans*; *biguttata*; *brunnea*; *hanitschi*; *tuberculata*

South Vietnam: sp.

Key to species of *Ctenoneura*

1. Hind wing without a intercalary vein (figs. 1E, 2C). Arolia absent 2
– Hind wing with an intercalary vein (fig. 9C). Arolia minute or absent. Male subgenital plate asymmetrical 4

2(1). Tarsal claws serrated. Cubitus vein of hind wing with three branches (fig. 1E). (male & female). Male subgenital plate symmetrical with two similar styles (fig. 1B) .....*aberrans*
– Tarsal claws simple. Cubitus vein of hind wing with four to six branches (figs. 2C, 2D) 3

3(2). Pronotal disk reddish brown, lateral zones darker brown, the edges yellow (fig. 2A). (sex unknown) .....*gigantea*
– Pronotal disk yellowish brown, lateral regions yellow-hyaline. (male) .....*acuticerca*

4(1). Subgenital plate with a setal tuft on the left posterolateral corner (figs. 3A, 3C) 5
– Subgenital plate without a setal tuft on the left posterolateral corner 6

5(4). Hind margin of subgenital plate with two U-shaped excavations on the right side (fig. 3A). Antennae with first four segments brown, succeeded by three whitish antennomeres, remaining segments brown. (male) ... .*annulicornis*
– Hind margin of subgenital plate unmodified on the right side (fig. 3C). Antennae dark brown, distal end with three white antennomeres succeeded by four dark terminal segments. (male) .....*propannulicornis*

6(4). Subgenital plate hind margin deeply excised, with a large, round swelling on the left side (figs. 12A, 12B; 13A, 13D) 7
– Subgenital plate hind margin excised or not, without a round swelling on the left side ..8

7(6). Left style small, arising near the apex of the left lobe of the subgenital plate, apexes of both lobes not setose (fig. 12B). (male) ....*tuberculata*
– Left style elongate, spine-like, arising near the base of the left lobe of the subgenital plate, apexes of both lobes setose (figs. 13A-D). (male) .....*spinastyla*

8(6) Pronotum shining black medially, dark reddish brown laterally, and with a pair of orangish maculae on either side of the anterior margin (fig. 4A). Right of subgenital plate with a pair of curved, spine-like processes directed towards the left (figs. 4B, 4E). (male) .....*biguttata*
– Pronotum and subgenital plate not as above. 9

9(8). Hind margin of subgenital plate not excavated, with an elongate process on the right side; style, if present, not visible from below or the rear (figs. 21E, 21F). (male) ....*simulans*

– Hind margin of subgenital plate excavated, left style, if present, visibile from below or the rear 10

10(9). Left side of subgenital plate with a hook-like structure, style absent (figs. 14C-14E). Antennae with four brown basal segments succeeded by yellowish antennomeres to about the middle, those on the distal half brown with some white terminal or preterminal ones. (male) .....*uncata*

– Subgenital plate without a hook-like structure on the left side, style present. Antennae not as above 11

11 (10). Subgenital plate with a long, slender process on the left side, its apex directed towards the right, bearing a small cylindrical style near its middle (figs. 11B-11D). (male) .....*mjoebergi*

– Subgenital plate not as above 12

12 (11). Hind margin of subgenital plate widely excavated, with a colourless, membranous area bearing a small, cylindrical style on its basal end (figs. 15A-15C). (male) .....*poringa*

– Hind margin of subgenital plate not as above 13

13 (12). Hind margin of the subgenital plate divided principally into two or three, dissimilar lobes, with a small cylindrical style arising on the left lobe near its middle, or posterolateral corner, or on the inner margin of the excavation 14

– Hind margin of the subgenital plate not as above 22

14 (13). Hind margin of subgenital plate with a deep V-shaped excavation, with a slender style on the left side; a slender, thorn-like filament is located on the dorsal surface of the plate, protrudes beyond the apical margin of the right lobe (figs. 15E-15G). Supraanal plate trigonal (fig. 15D). (male) .....*luma*

– Subgenital and supraanal plates not as above 15

15 (14). Subgenital plate with two overlapping lobes on the right side, the dorsal one upturned and partially covering the right side of the supraanal plate, the ventral lobe with minute spicules near its distal margin (figs. 5B, 5C). (male) .....*birmanica*

– Subgenital plate not as above 16

16 (15). Left lobe of the subgenital plate much narrower than the right one, the style originating on the posterolateral corner (fig. 5E). (male) .....*misera*

– Hind margin of subgenital plate not as above 17

17 (16). Hind margin of subgenital plate with a pair of narrowly separated lobes directed posteriorly, a style originating near the middle of the left one (figs. 8B-8D). Arolia absent. (male) .....*fulva*

– Hind margin of subgenital plate not as above. Arolia minute 18

18 (17). Style on the left lobe of the subgenital plate originating along the inner margin of the excavation (fig. 6B). (male) .....*brunnea*

– Style originating near the posterolateral corner of the left lobe 19

19 (18). Hind margin of the subgenital plate with a small process that curves dorso-sinistrad (fig. 10B-10D). Pronotum subrectangular, the disk with a sublozenge-shaped reddish brown macula narrowly margined with yellow, broad lateral zones yellow-hyaline (fig. 10A). (male). .....*hanitschi*

– Subgenital plate and pronotum not as above 20

20 (19). Right lobe of subgenital plate narrow, elongate, extending well beyond hind margin of the shorter, wider left lobe (figs. 9D, 9E). Pronotum suborbicular, reddish brown (fig. 9A). Cubitus of hind wing with eight branches (fig. 9C) .....*major*

– Right and left lobes of subgenital plate not as above (figs. 7C, 7F) 21

21(20). Pronotal edging yellow, disk reddish brown, lateral regions brown-hyaline. Cerci brown. (male) .....*kemneri*

– Pronotal disk brownish black, lateral regions yellow. Cerci yellow. (male) .....*yunnanea*

22(13). Subgenital plate trigonal, hind margin with three slender processes that are curved dorsad, and a long tapering filament that protrudes between the left and middle processes; style absent (figs. 19A-19E). Cubitus vein of hind wing with three branches (fig. 19F) ....*triprocessa*

– Subgenital plate not as above. Style present. Cubitus vein of hind wing with more than three branches. Style present 23

23(22). Subgenital plate with a broad plate whose distal margin is excavated and upturned; left style is located in a pale, membranous area (figs. 20A-20E). Cubitus vein of hind wing with eight branches. (male) .....*murudensis*

– Subgenital plate not as above. Cubitus vein of hind wing with less than eight branches 24

24 (23). Hind margin of subgenital plate deeply excavated with a very large, stout style in the left corner (figs. 21A-21C). (male) .....*crassistyla*

– Subgenital plate and left style not as above 25

25 (24). Subgenital plate broadly excavated, with a short, broad, process without close lobes on either side, that extends dorsad, its distal end curving anteriorly towards the supraanal plate (figs. 18A-18D). (male) .....*kinabaluana*

– Subgenital plate narrowly divided medially, with a dark spine-like process that curves dorsad between the two lobes 26

26 (25). Margins of the excision smooth, practically touching the spine-like process (figs. 16A-16C). (male) .....*scutica*

– Margins of the excision are irregular and on the left side the region is unsclerotized (fig. 17B). (male).....*parascutica*

REDESCRIPTIONS, AND DESCRIPTIONS OF NEW SPECIES

Ctenoneura aberrans Hanitsch
(fig. 1)

Ctenoneura aberrans Hanitsch, 1928: 37, pl. 2 figs. 8,9 (♀); 1929a: 294, Bruijning 1948: 41, 148, fig. 54; Princis, 1963: 101.

Material examined. – Holotype, (♀), Mentawe[a]i, Siberut, no. 91, 23.ix.1924, H. H. Karny; Type Orth. 342$^{1}/_{2}$, in HDEO. – Paratype. Mentawai. HDEO: same locality and collection data as holotype, 1♂ (reported as 'sex ?'), no. 80, 22.ix.1924, Type Orth. 342$^{2}/_{2}$. – SUMATRA. HDEO: Wai Lima, 1♂, 1♀, 2 (abdomens missing).

Redescription. – Female: Head covered, interocular space distinctly wider than the distance between antennal sockets. Pronotum with lateral and anterior margins convex, hind margin straight (fig. 1A). Tegmina and wings extending beyond end of abdomen, the former with a few well marked raised veins, few almost longitudinal veins in discoidal sector (fig. 1F). Hind wings broad, mediastinal vein straight, simple, radial vein slightly sinuous, costals not distinguishable; media vein, simple, cubitus vein with three curved parallel branches; intercalary vein (between the radial and media veins) absent (fig. 1E). Front femur Type C_1; pulvilli and arolia absent, tarsal claws symmetrical, distinctly serrated. Supraanal plate trigonal, apex broadly rounded (fig. 1D). Subgenital plate trigonal, valvular, completely hidden under the supraanal plate.

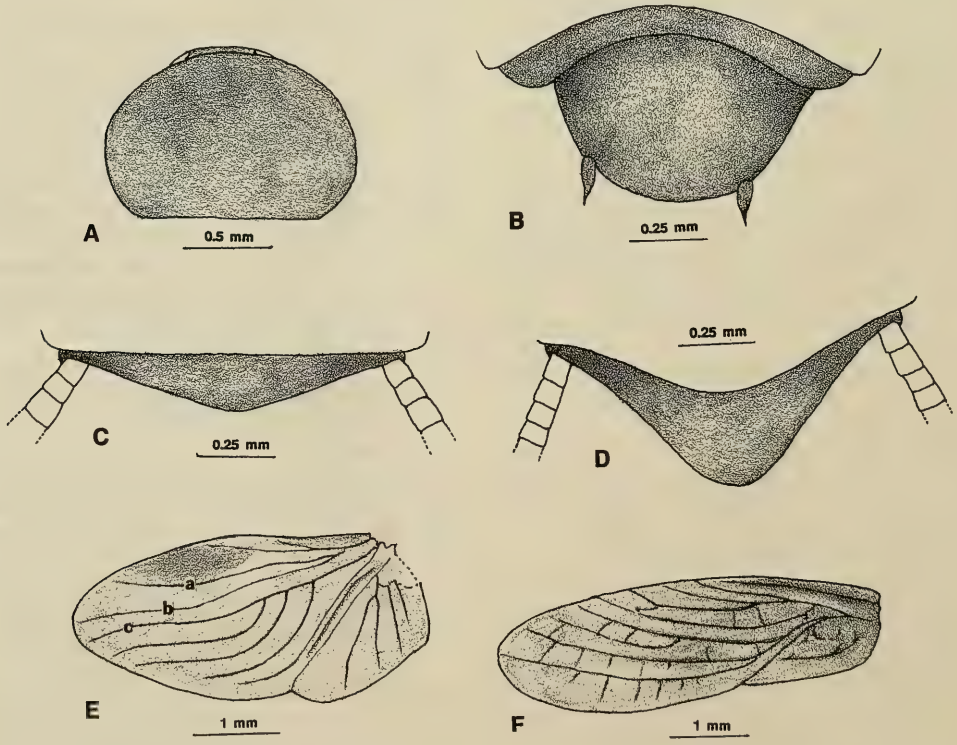

Fig. 1. *Ctenoneura aberrans* Hanitsch. – A. female (holotype) pronotum; B, C. male (paratype) subgenital (ventral) and supraanal (dorsal) plates, respectively; D-F. female holotype: D. supraanal plate (dorsal); E, F. hind wing and tegmen respectively (a = radius; b = media; c = cubitus).

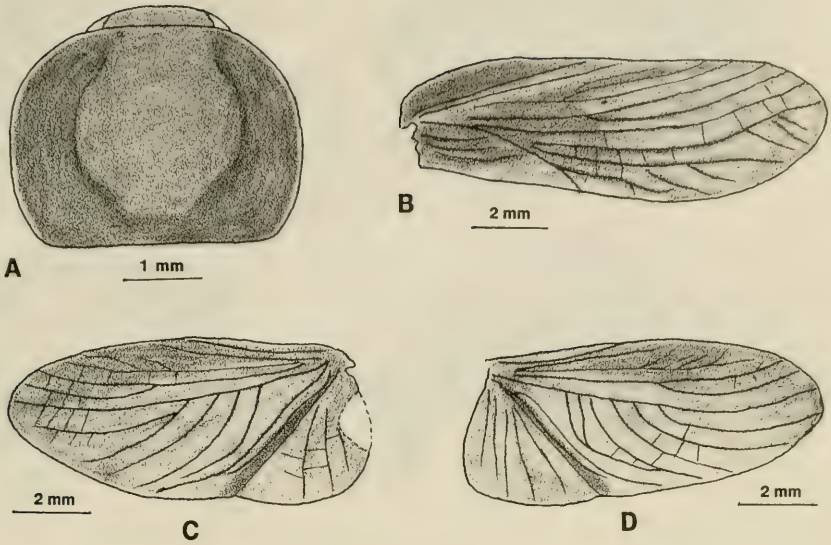

Fig. 2. *Ctenoneura gigantea* sp. n., holotype. – A. pronotum; B. right tegmen; C, D. left and right wings.

Male (previously undescribed): Differs from the female as follows: Supraanal plate transverse, very short, shallowly trigonal, apex rounded (fig. 1C). Subgenital plate essentially symmetrical, with two widely separated, similar styles, interstylar margin unmodified, convexly rounded (fig. 1B).

Colour. – Head dark chestnut brown, shiny; antennae relatively pale with yellowish tinge. Pronotum reddish brown throughout (fig. 1A). Tegmina hyaline amber, humeral and part of costal vein regions darker (fig. 1F). Wings with a dark blotch in the costal vein region (fig. 1E). Abdomen dark brown. Cerci brown. Legs pale testaceous.

Measurements (mm) (♀ in parentheses). – Length, 3.8-4.3 (3.6-4.0); pronotum length x width,, 1.1-1.3 x 1.5-1.8 (1.1-1.3 x 1.7-1.8); tegmen length, 4.0-4.5 (4.2-4.6); interocular space, 0.8 (0.8).

Comments. – This is the smallest species in the genus and is also unique in having a symmetrical subgenital plate with two styles, and serrated tarsal claws.

Ctenoneura acuticerca Bey-Bienko

Ctenoneura acuticerca Bey-Bienko, 1957: 896, 903, 912 (type ♀, Mt. Santaishan, Yunnan, China; in EASC) [not examined] (Russian, English summary); Princis 1963: 101.

Description (from Bey-Bienko). – Female: Pronotum smooth. Tegmina with five oblique branches of the radius which run into the median third of the costal margin, anal veins not quite distinct. Radius of hind wings with three slightly pronounced oblique branches, intercalary vein absent between radius and media, cubitus divided into six branches. Arolia absent. Supraanal plate large, triangular, apex emarginate. Subgenital plate with valvular part lozenge shaped. Apex of cerci with a large spine.

Colour. – Brownish yellow, pronotal disk yellowish brown, lateral parts yellow, transparant. Wings with distal part yellowish. Legs yellow. Cerci brownish yellow.

Male: Unknown.

Measurements (mm). – Body length, 8.5-8.7; pronotum length, 2.7; tegmen length, 10.2-10.5.

Comments. – According to Bey-Bienko, this species is related to *aberrans* (probably because of the absence of an intercalary vein, and arolia).

Ctenoneura gigantea sp. n.
(fig. 2)

Type material. – Holotype, sex unknown (abdomen missing), Gunung Kledang, Perak, 2646', xi.1916 (with a handwritten label, *C. pauciramosa*..., ms. name); in RMNH.

Description. – Sex unknown: Head exposed, interocular space greater than the distance between ocellar spots and antennal sockets. Pronotum parabolic (fig. 2A). Tegmina and wings fully developed, the former with raised veins, and longitudinal discoidal sectors (fig. 2B). Hind wing with about three poorly defined costal veins, intercalary vein absent, media vein with one branch, cubitus vein with four branches (one forked near the base on the left wing), and six branches (two of them joined distad on the right wing) (figs.

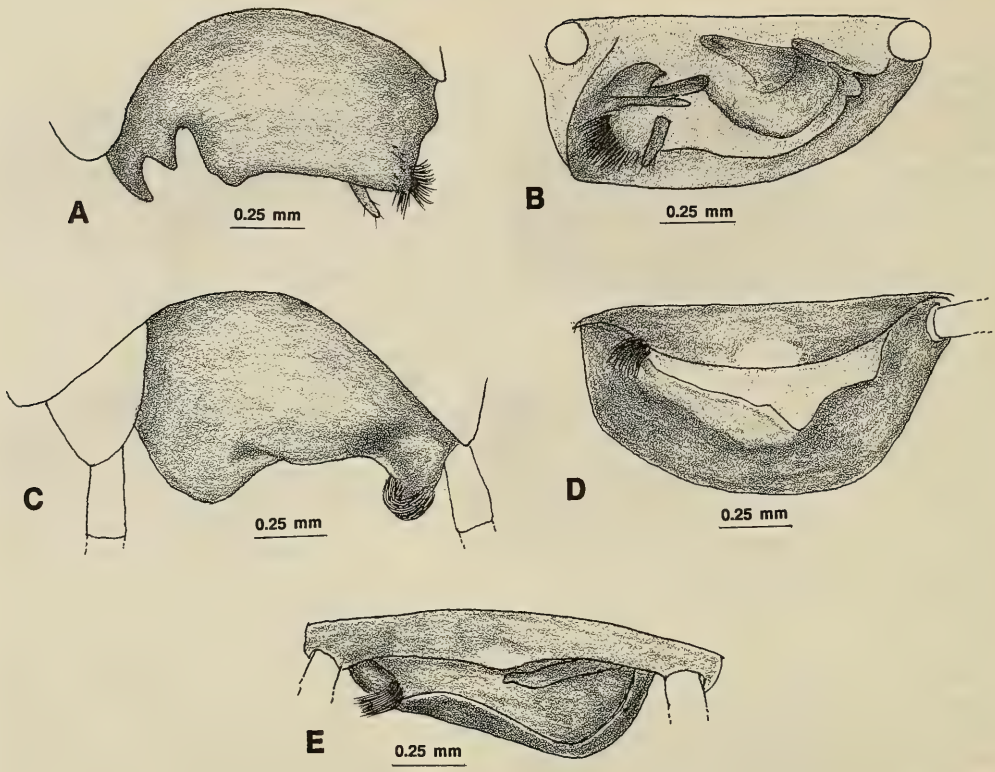

Fig. 3. *Ctenoneura* spp. – A-B, *C. annulicornis* Princis, male holotype, A. subgenital plate (ventral); B. subgenital plate (rear view); C-E. *C. propannulicornis* sp. n., male holotype: C. subgenital plate (ventral); D. supraanal and subgenital plates (rear view); E. supraanal and subgenital plates (dorsal; the distal region of the supraanal plate is deflexed and the margin is distorted)

2C, D). Front femur Type C_1; pulvilli absent, tarsal claws very long, simple symmetrical, arolia absent. Abdomen missing.

Colour. Head reddish brown, the region from the occiput to ocellar spots darker; antennae blackish. Pronotal disk reddish brown, lateral zones darker brown, lateral edges yellowish (fig. 2A).

Measurements (mm). – Length, ?; pronotum length x width, 2.9 x 3.7; tegmen length, 10.4; interocular space, 1.3.

Etymology. – The specific name refers to the large size of the species.

Comments. – I am describing this species even though its abdomen is missing, because its size is so much greater than any of the known species. Also the parabolic shape of the pronotum, the absence of an intercalary vein on the hind wing (known only in *aberrans* and *acuticerca*), and the complete absence of arolia, are good distinctive characters when coupled with its size.

Ctenoneura annulicornis Princis
(figs. 3A-B)

Ctenoneura annulicornis Princis, (1953) 1954; 206, fig. 3. Holotype, ♂, Borneo, Long Navang, Mjöberg (NRSS) [examined]; Princis 1963: 102.

Ctenoneura fulva (nec Hanitsch, 1925); Hanitsch 1933: 235 [in part; only the Long Navang ♂]; Princis 1963:102.

Redescription. – Male: Head hidden, interocular space greater than the distance between ocellar spots and antennal sockets. Pronotum suboval. Tegmina and wings extending well beyond end of abdomen. Tegminal veins not raised. Hind wing with intercalary vein, media vein with one forked branch, cubitus with six branches. Front femur Type C_1; pulvilli and arolia absent, tarsal claws symmetrical, simple. Abdominal terga unspecialized. Supraanal plate transverse, narrow, symmetrical. Subgenital plate asymmetrical with a setal tuft on the left posterolateral corner, and with three sclerotized structures and a

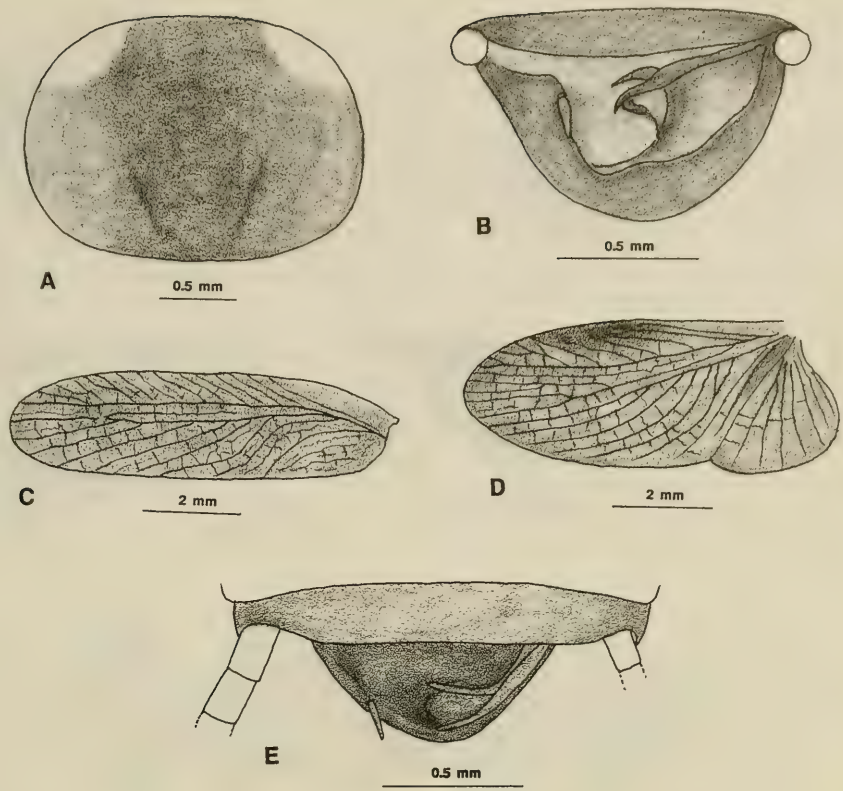

Fig. 4. *Ctenoneura biguttata* Hanitsch, male holotype. – A. pronotum; B. supraanal and subgenital plates (rear view); C, D. left tegmen and hind wing; E. supraanal and subgenital plates (dorsal).

well developed cylindrical style, also on the left side, the right side with a pair of U-shaped excavations (figs. 3A, B).

Colour. – Head dark reddish brown; antennae with first four segments brown, succeeded by three whitish antennomeres, remaining segments brown. Pronotal disk dark reddish brown, lateral zones hyaline. Tegmina hyaline light brown. Adomen brown, broad lateral zones on the sterna pale. Legs light brown.

Female: Unknown.

Measurements (mm). – Length, 5.7; pronotum length x width, 1.7 x 2.2; tegmen length, 6.3; interocular space, 0.6.

Ctenoneura propannulicornis sp. n.
(figs. 3C-E)

Type material. – Holotype, ♂, Malaysia, Sabah, Ulu Rurun, 115°40'30"E 4°22'N, 1500 m, 21-22.xii.1986, J. Huisman (RMNH). – Paratype. Sabah, same locality and collector as the holotype, ML, 1♂, 20.xii.1986 (RMNH).

Description. – Male: Head hidden, interocular space greater than the distance between the antennal sockets. Pronotum subelliptical. Tegmina and wings fully developed extending well beyond the end of the abdomen, discoidal sectors of the former oblique. Hind wing with distinct costal veins, the proximal ones thickened distad, intercalary vein present, media vein with one branch, cubitus vein with five branches (one of them may be forked). Front femur Type C_1; pulvilli absent, tarsal claws simple, symmetrical, arolia minute. Abdominal terga unspecialized. Supraanal plate transverse, hind margin broadly, shallowly excavated, with a large, dense group of curved setae on the left corner, style absent, right side of plate unmodified (figs. 3C-E).

Colour. – Head dark brown; antennae dark brown, the distal end with three white antennomeres, succeeded by four dark terminal segments. Pronotal disk dark brown, the lateral regions infuscated-hyaline. Tegmina dark brown-hyaline, humeral region yellowish. Hind wing infuscated, darkest in the costal vein and apical regions, lightest in the mid portion. Abdominal terga brown, lateral edges darker, supraanal plate with a white macula anteromedially. Abdominal sterna light brown, subgenital plate darker. Cerci brown, apical segment lighter. Coxae, femora, and tibiae brown, tarsi lighter.

Female: Unknown.

Measurements (mm). – Length, 5.8-6.3; prono-

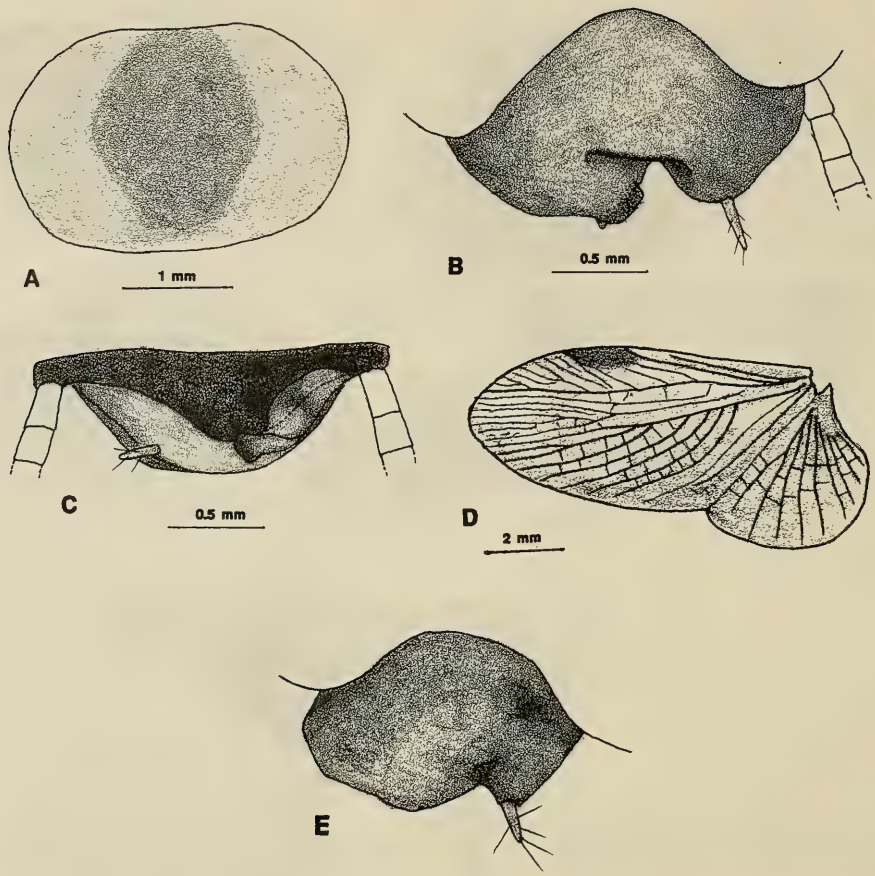

Fig. 5. *Ctenoneura* spp. – A-D, *C. birmanica* Princis, males: A. pronotum (holotype); B-D. paratype: B. subgenital plate (ventral); C, supraanal and subgenital plates (dorsal; the dotted line indicates the margin of the supraanal plate that is hidden by one of the lobes of the subgenital plate); D. hind wing. – E, *C. misera* Bey-Bienko, male holotype, subgenital plate (ventral) (redrawn from Bey-Bienko, 1970).

tum length x width, 1.9 x 2.3-2.4; tegmen length, 7.1-8.3; interocular space, 0.6.

Comments. – I place this species near *annulicornis* (hence the specific name), because both taxa have a dense tuft of setae in the left corner of the subgenital plate. Differences in the shape of the right side of the plate, absence of the left style (in *propannulicornis*), and antennal colouration, separate the two species.

Ctenoneura biguttata Hanitsch
(fig. 4)

Ctenoneura biguttata Hanitsch, 1932a: 6. Holotype, ♂, Sumatra, Deli, Fulmek, 1921-26, Brastagi, Urwald, viii.1924, R. Ebner; Type Orth. 375 (HDEO), [examined]; Bruijning 1948: 41, 149; Princis (1953) 1954: 207 (footnote), 1963: 103.

Redescription. – Male: Head exposed, eyes wide apart, interocular space greater than distance between antennal sockets. Pronotum subcircular (fig. 4A). Tegmina and wings extending beyond end of abdomen, veins and cross veins of both distinct, discoidal sectors of the former oblique (fig. 4C). Wing with six costals, the first four with distal ends merging into a marginal dark patch; intercalaray vein present between the radial and median; media vein branched, cubitus with five branches (fig. 4D). Front femur Type C_1; pulvilli and arolia absent, tarsal claws symmetrical, simple (not serrated). Abdominal terga unspecialized. Supraanal plate transverse, very narrow, hind margin entire (fig. 4E). Subgenital plate asymmetrical, with a small cylindrical style on the left side, (Hanitsch stated, 'styles not observed'), right side with a pair of curved spinelike processes directed towards the left (figs. 4B, E).

Colour. – Head shining black; antennae pale yel-

lowish with darker terminal segments. Pronotum shiny black medially, dark reddish brown laterally, and with a pair of orangish maculae on either side of the anterior margin (fig. 4A). Tegmina uniformly dark brown (fig. 4C). Wings hyaline, brown, with a dark patch along the anterior costal region (fig. 4D). Abdominal terga light brown, sterna dark brown, subgenital plate with an orangish area distad. Legs with coxae and femora dark brown, tibiae and tarsi yellowish. Cerci with brown basal segments, remaining cercomeres yellowish.

Female: Unknown.

Measurements (mm). – Length, 5.7; pronotum length x width, 1.7 x 2.2; tegmen length, 7.3; interocular space, 0.8.

Ctenoneura birmanica Princis
(figs. 5A-D)

Ctenoneura birmanica Princis, (1953) 1954: 206, fig. 5. Holotype, ♂, Kambaiti, N. E. Burma, 7000 ft., 25.v.1934, R. Malaise (NRSS) [examined]; Princis 1963: 102.

Ctenoneura major (nec Hanitsch, 1925); Princis 1950: 203, 204 (♂), 1963: 102.

Material examined. – Holotype, and paratypes. Burma. NRSS: 1 ♂, same locality and collector as holotype, 2000 m, 28.v.1934. ZILS: 1 ♂, same data as holotype; 1 ♂, same locality and collector as holotype. 2000 m, 29.v.1934.

Redescription. – Male: Head hidden or slightly exposed; interocular space greater than distance between ocellar spots and antennal sockets. Pronotum subelliptical (fig. 5A). Tegmina and wings fully developed extending well beyond end of abdomen, discoidal sectors of former oblique. Hind wing with the distal ends of the proximal costal veins reaching only to the dense spot near the costal margin; intercalary vein present, media vein with two branches (one forked), cubitus vein with six branches (one forked) (fig. 5D). Front femur Type C_1; pulvilli ab-

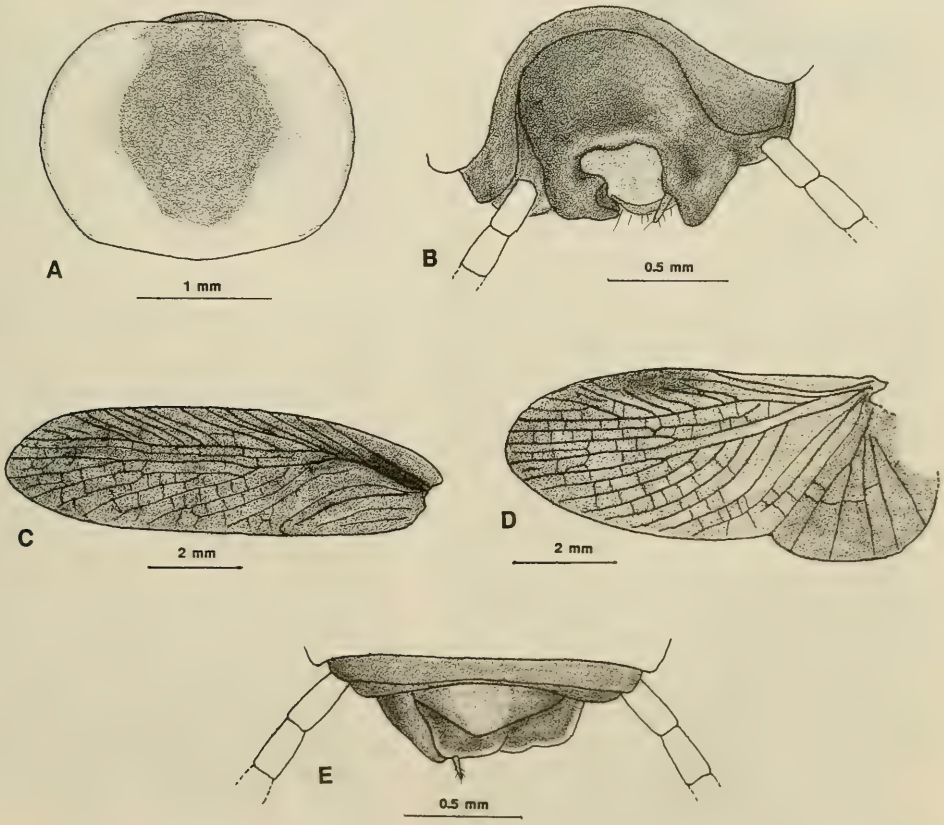

Fig. 6. *Ctenoneura brunnea* Hanitsch, male holotype. – A. pronotum; B. subgenital plate (ventral); C, D. left tegmen and hind wing; E. supraanal and subgenital plates (dorsal).

sent, tarsal claws symmetrical, simple, arolia minute. Supraanal plate transverse, hind margin convexly rounded, symmetrical, entire (fig. 5C). Subgenital plate asymmetrical, divided by a medial excavation, one lobe on the left side bearing a cylindrical style, two overlapping lobes on the right side, the dorsal one upturned (in the holotype only it partly covers the right side of the supraanal plate), the ventral lobe with minute spicules near its distal margin (figs. 5B, C).

Colour. – Antennae dark brown with pale junctions between individual segments. Head reddish brown. Pronotal disk reddish brown, lateral areas dark-hyaline (fig. 5A). Tegmina brownish, hyaline. Hind wings weakly infuscated. Abdomen dark brown, supraanal plate black. Legs brown. Cerci brown, proximal cercomeres darker on both surfaces.

Female: Unknown.

Measurements (mm). – Body length, 7.7-8.1; pronotum length x width, 2.1-2.2 x 3.0; tegmen length, 10.0-10.4; interocular space, 0.8-0.9.

Ctenoneura misera Bey-Bienko
(fig. 5E)

Ctenoneura misera Bey-Bienko, 1969: 832, fig. 1 (Russian). Holotype ♂, S. China, Yunnan, Tapa-shan Mountains, near Pin P'ien, 1300 m, 23.vi.1956, Huen K'e-yen; in ZINR. [not examined]; 1970: 528 (English translation).

Description (after Bey-Bienko). – Male: Small. Head with flat vertex, almost pendent (overhanging), forming an obtuse angle with the frons; interocular space slightly more than double the distance between antennal sockets. Pronotum one and one half times as wide as long, with broad transparent lateral parts, hind margin with a narrower hyaline border. Hind wings with oblique branches of the radius distinct, vein between radius and media arched backwards; cubitus vein with seven branches. Subgenital plate as in fig. 5E [style in the left posterior corner]. Cerci long, thickened towards the bases, terminal segment not spine-like.

Colour. – Rusty yellow. Head chestnut brown, antennae brownish yellow. Hind wing just visibly infuscate, yellowish along costal margin.

Female: Unknown.

Measurements (mm). – Body length, 6.8; pronotum length x width, 2.0 x 3.0; tegmen length, 8.0; overall length, 10.0.

Comments. – According to Bey-Bienko, this species is similar to *yunnanea* from China and *kemneri* from Java, but clearly distinguished by the colour of head and pronotum, small body, and structural details of the subgenital plate. The subgenital plate (fig. 5E) of *misera* more closely resembles that of *birmanica* (fig. 5B) than it does *yunnanea* (fig. 7F) or *kemneri* (fig. 7C).

Ctenoneura brunnea Hanitsch
(fig. 6)

Ctenoneura brunnea Hanitsch, 1929a: 266, 292, fig. 5; 1932b: 52, 81. Holotype, ♂ [Hanitsch did not indicate the sex], Gunung Singgalong (Sumatra, Westkust), 1800 m, 1925, E. Jacobson; Type Orth. 362, in HDEO [examined]; Bruijning 1948: 41, 148: Princis (1953) 1954: 208, fig. 8 (♂) Princis 1963: 102.

Additional material. – Sumatra. RMNH: N. Sumatra, Bivouac One, Mt. Bandahara, 3°43'N 97°41'E, ca. 810 m, 1 ♂, 25.vi. –5.vii.1972, J. Krikken.

Redescription. – Male (Hanitsch did not determine the sex of the type): Head covered, interocular space less than distance between antennal sockets. Pronotum subcircular (fig. 6A). Tegmina and wings fully developed extending beyond end of abdomen, veins of the former distinct, not raised, discoidal sectors oblique (fig. 6C). Hind wing with a forked media vein, intercalary vein present, cubitus with six branches (fig. 6D). Front femur Type C_1; pulvilli absent, tarsal claws symmetrical, simple, arolia subobsolete. Abdominal terga unspecialized. Supraanal plate strongly transverse, shallowly trigonal (fig. 6E). Subgenital plate asymmetrical, hind margin deeply, widely excavated, with a small cylindrical style on the left side along the inner margin of the excavation (fig. 6B).

Colour. – Head shiny dark reddish brown; antennae dark brownish black. Pronotal disk dark reddish brown, lateral borders broad, hyaline, partially yellowish (fig. 6A). Tegmina shining brown. Wings brownish, darker along the distal half of the costal margin and apically (fig. 6D). Abdomen yellowish to reddish brown, lateral borders darker. Cerci dark brown to black. Coxae, femora, and tibiae reddish brown, tarsi yellowish.

Female: Unknown.

Measurements (mm). – Length, 5.6-6.5; pronotum length x width, 1.6-1.8 x 2.1-2.3; tegmen length, 7.1-8.5.; interocular space, 0.5-0.7.

Ctenoneura kemneri Princis
(figs. 7A-E)

Ctenoneura kemneri Princis, 1967: 146, fig. 1. Holotype ♂, Tjitjoroeng, Java, 23.i.1921, N. A. Kemner (ZILS) [examined] ; Princis 1971: 1138.

Redescription. – Male: Head hidden, interocular space wrinkled, slightly less than the distance between the antennal sockets. Pronotum strongly transverse,

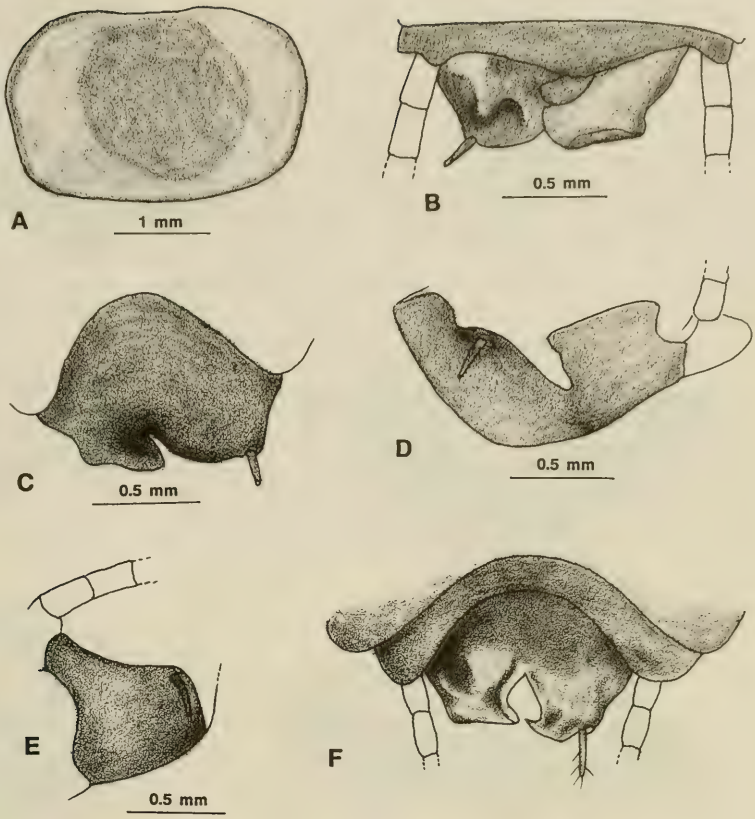

Fig. 7. *Ctenoneura* spp. A-E. – *C. kemneri* Princis, male holotype: A. pronotum; B. supraanal and subgenital plates (dorsal); C. subgenital plate (ventral); D. subgenital plate (rear view); E. subgenital plate (left lateral). – F. *C. yunnanea* Bey-Bienko, male holotype, subgenital plate (ventral) (redrawn from Bey-Bienko, 1957).

its greatest width before the middle, anterior margin cucullate above the head (fig. 7A). Tegmina extending well beyond end of abdomen, discoidal sectors of the former oblique. Hind wing with distinct costal veins, not thickened distad; intercalary vein present, media vein with one branch, cubitus vein with six or seven branches (one of the branches may be forked). Front femur Type C_1, terminal spine very small; pulvilli absent, tarsal claws symmetrical, simple, arolia minute. (Princis claimed that only the fourth segment of the basitarsus had a pulvillus. However this 'pulvillus' is spined and is no different from the pulvillar region on the other tarsomeres. Pulvilli normally are fleshy and lack spines and I consider the basitarsus in this species as lacking a pulvillus). Abdominal terga unspecialized; supraanal plate short, transverse, hind margin convexly rounded (fig. 7B). Subgenital plate divided into two dissimilar lobes, the left one bearing a cyclindrical style in the posterolateral corner (figs. 7B-D).

Colour. – Head dark brown with lighter mouthparts; antennae brown. Pronotum with yellow edging (wider laterally than on the anterior and posterior margins, disk bright red brown, the lateral parts hyaline brown. Tegmina uniformly reddish brown, veins yellowish. Hind wings darkly infuscated, part of costal vein area with a yellowish patch. Abdomen brown. Cerci brown, darker ventrally. Coxae, femora, and tibiae reddish brown, tarsi yellowish.

Female: Unknown.

Measuremnts (mm). Body length, 6.5; pronotum length x width, 2.0 x 3.2; tegmen length, 8.2; interocular space, 0.6.

Comments. – Princis stated that *kemneri* to some degree resembled *major*, chiefly because its subgenital plate is of the same type. However their lobes differ in shape. Actually Princis's drawing of the subgenital plate of *kemneri* (Princis, 1967: fig. 1) resembles that of *yunnanea* (fig. 7F), more closely than it does that of *major* (fig. 9E). My camera lucida drawing of the subgenital plate of *kemneri* differs from Princis's but slight differences in the angle from which the specimen is drawn can make a marked difference in the shape of the structure. The shapes of the subgenital plate lobes of *kemneri* (fig. 7C) show some resemblance to those of *birmanica* (fig. 5B).

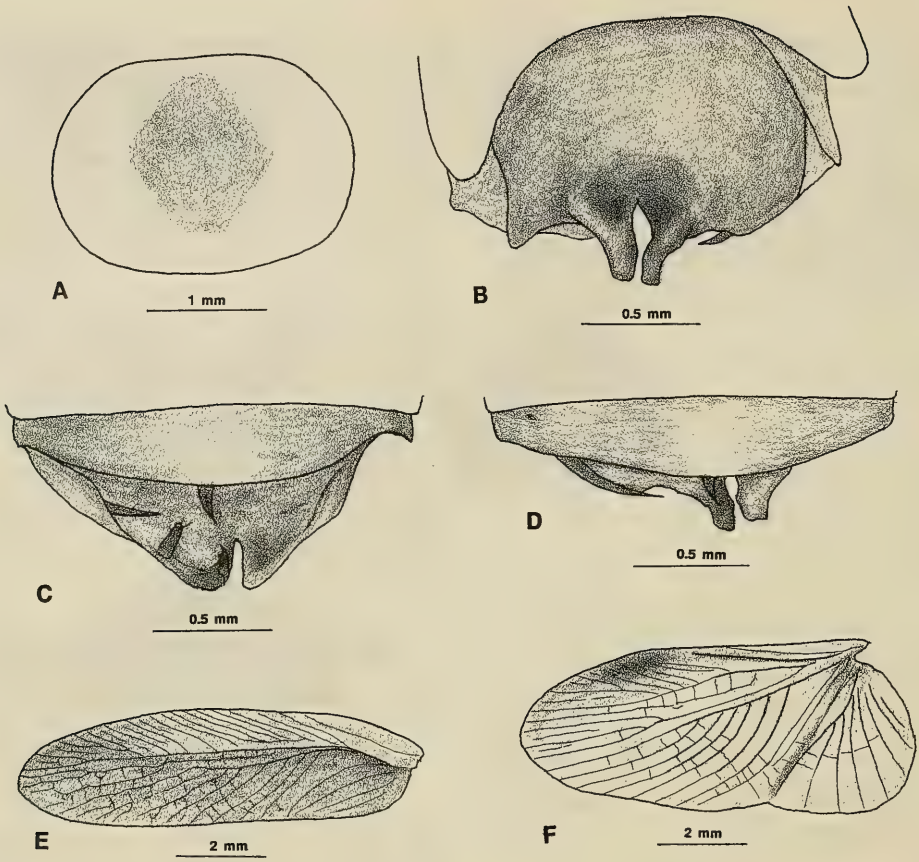

Fig. 8. *Ctenoneura fulva* Hanitsch, male holotype. – A. pronotum; B. subgenital plate (ventral); C. supraanal and subgenital plates (rear view); D. supraanal and subgenital plates (dorsal); E, F. left tegmen and hind wing.

Ctenoneura yunnanea Bey-Bienko
(fig. 7F)

Ctenoneura yunnanea Bey-Bienko, 1957: 896, 902, 912, fig. 1. Holotype ♂, Mt. Santaishan, Yunnan, China (EASC) [not examined] (Russian, English summary); Princis 1963:102.

Description (from Bey-Bienko). – Male: Pronotum transverse. Tegmina and wings with typical venation; wings with distinct oblique branches of the radius, intercalary vein between radius and media present, cubitus vein with seven branches. Supraanal plate very short. Subgenital plate with a deep round emargination, right margin thickened, style long, thin, placed on the upper left margin of the plate (fig. 7F). Cerci moniliform.

Colour. – Brownish yellow. Vertex distinctly bordered above antennal sockets. Pronotal disk brownish black, lateral parts yellow. Cerci yellow.

Female: Unknown.

Measurements (mm). – Body length, 7.0; pronotum length, 2.0; tegmen length, 8.5.

Comments. – Bey-Bienko stated that this species strongly resembles *hanitschi*. However, its subgenital plate is similar to that of *brunnea* and *kemneri*.

Ctenoneura fulva Hanitsch
(fig. 8)

Ctenoneura fulva Hanitsch, 1925: 78, 101, figs. 13-14 (♂ & ♀). Lectotype (here designated) ♂, Mt. Murud, Sarawak, 6000 ft., Dr. E. Mjöberg, Sarawak Mus. dd 1925; Type Orth. 300[1]/[3], in HDEO [examined]. [Hanitsch listed six specimens in his original description, three ♂♂ from Mt. Murud, and one ♂ and two ♀♀ from Mt. Dulit; there are only two paralectotypes in the HDEO, and neither one is *fulva*; see comments, below]; Princis 1933: 303, 329; Bruijning 1948: 41, 148; Princis (1953) 1954: 207, fig. 6 (♂); Princis 1963: 101.

Redescription. – Male: Head covered by pronotum, interocular space greater than distance between antennal sockets. Pronotum subelliptical (fig. 8A). Tegmina and wings extending well beyond end of body, the former with proximal costal veins arising from a common trunk, the distal ones singly, discoidal sectors oblique (fig. 8E). Hind wing with intercalary vein, media vein with two branches, cubitus with six simple branches (fig. 8F). Front femur Type C_1; pulvilli and arolia absent, tarsal claws symmetrical, simple. Abdominal terga unspecialized. Supraanal plate short transverse, hind margin shallowly convex (figs. 8C, D). Subgenital plate asymmetrical, hind margin with a pair of weakly dissimilar lobes, and a small cylindrical style on the left side adpressed to the surface, its apex directed anteriorly. The style is hidden in ventral view but can be seen in end view. The tips of two apically acute structures, probably genital phallomeres, protrude laterally, and dorsally from beneath the supraanal plate (figs. B-D).

Colour. – Head dark reddish brown, shiny, antennae dark brown. Pronotal disk reddish brown, surrounding area broad, hyaline (fig. 8A). Tegmina brownish yellow, humeral and costal area lighter (fig. 8E). Wings pale hyaline with a yellowish tinge, anterior portion with a dark area along the anterior margin where the ends of the proximal costals merge (fig. 8F). Abdominal terga brown, terminal segments darker, supraanal plate with a pale medial zone. Abdominal sterna light brown, margins darker. Legs brown.

Female: Not seen.

Measurements (mm). – Length, 6.6; pronotum length x width, 1.9 x 2.7; tegmen length, 9.5; interocular space, 0.7.

Comments. – Two of Hanitsch's paralectotypes are not *fulva*. One from Mt. Murud (Type Orth. $300^3/_3$) is a new species, *murudensis*, described below. The other paralectotype, from Mt. Dulit (Type Orth. $300^2/_3$), is possibly new but I am not describing it because its subgenital plate is distorted and it is difficult to see the shape of the hind margin.

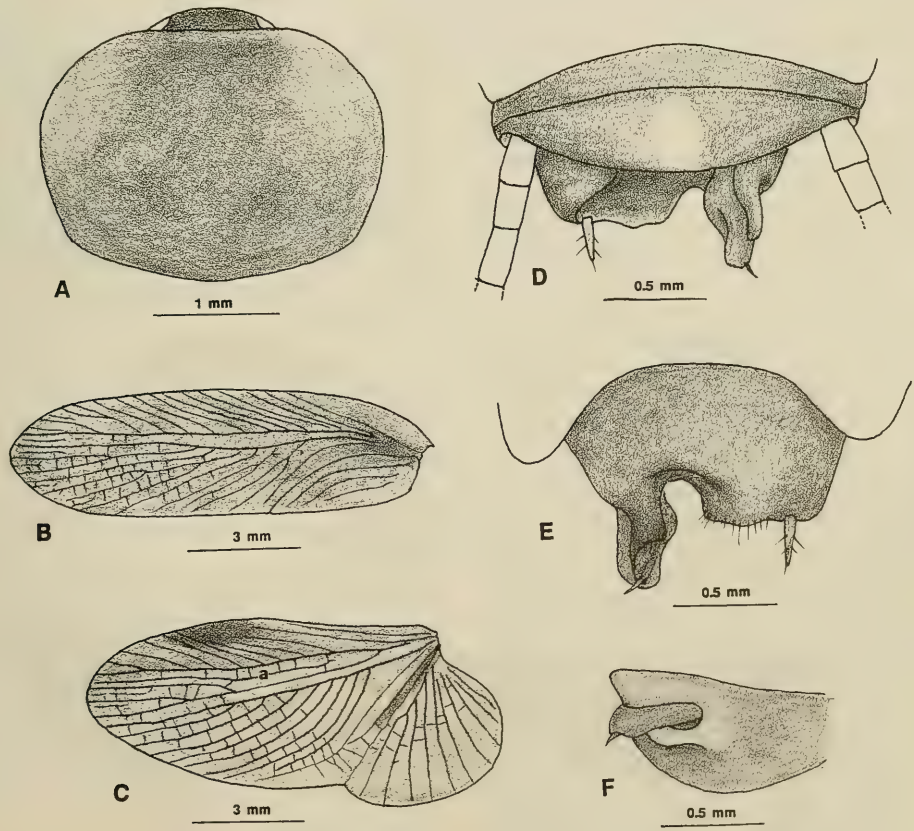

Fig. 9. *Ctenoneura major* Hanitsch, male holotype. A. pronotum; B, C. left tegmen and hind wing; a = intercalary vein. D. supraanal and subgenital plates (dorsal); E. subgenital plate (ventral); F. subgenital plate (right lateral).

Ctenoneura major Hanitsch
(fig. 9)

Ctenoneura major Hanitsch, 1925: 78, 102 (♂ & ♀). Holotype ♂, Mt. Murud, Sarawak, 6500 ft., x.1922-i.1923, Dr. E. Mjöberg, Sarawak Mus., dd 1925; Type Orth. 301, in HDEO [Hanitsch listed a ♂ and ♀ from Mt. Murud, but according to the number 301, there is only one type specimen in HDEO] [examined]; Hanitsch 1927: 9, 26, 42 (in part?); Bruijning 1948: 41, 148; Princis (1953) 1954: 207, fig. 7 (♂); Princis 1963: 101.

Redescription (Hanitsch described both ♂ & ♀ in the same paragraph. His description can not be used to distinguish between the sexes). – Male: Head slightly exposed, interocular space less than the distance between ocellar spots and antennal sockets. Pronotum suborbicular (fig. 9A). Tegmina and wings extending beyond end of abdomen, the former with distinct, but not thickened veins, discoidal sectors oblique (fig. 9B). Hind wing with eight costals, the distal ends of the first three merging into a thickening, intercalary vein present, media with two branches, cubitus vein with eight rami (fig. 9C). Front femur Type C_1; pulvilli absent, tarsal claws simple, symmetrical, arolia minute. Abdominal terga unspecialized. Supraanal plate transverse, very narrow, hind margin convex, entire (fig. 9D). Subgenital plate asymmetrical, a small cylindrical style on the left side near the posterior corner, right side produced, the process directed posteriorly (figs. 9D-F).

Colour. – Head reddish and dark brown, shining, ocelli pale, antennae dark brown. Pronotal disk dark reddish brown (fig. 9A). Tegmina brown (fig. 9B). Wings brown, thickened costal vein region darker (fig. 9C). Abdomen brownish yellow, hind margin of subgenital plate in part yellowish. Cerci fuscous brown. Legs dull brownish yellow.

Female. Not seen.

Measurements (mm). – Length, 9.7; pronotum length x width, 2.2 x 3.0; tegmen length, 11.1; interocular space, 0.7.

Ctenoneura hanitschi Princis
(fig. 10)

Ctenoneura hanitschi Princis, (1953) 1954: 204, fig. 1 (♂. Holotype, ♂, Sibajak, Sumatra, 1600 m, Mjöberg; (NRSS) [examined]; 1963: 102.
Ctenoneura major (nec Hanitsch, 1925); Hanitsch 1929b: 3, 18 (in part, ♂).

Redescription. – Male: Head hidden, interocular space greater than the distance between antennal sockets. Pronotum subrectangular (fig. 10A). Tegmina and wings fully developed extending well beyond end of abdomen, the former with oblique discoidal veins. Hind wing with an intercalary vein. Front femur Type C_1; pulvilli absent, tarsal claws symmetrical, simple, arolia minute. Abdominal terga unspecialized. Supraanal plate transverse, very short, hind margin shallowly convex, entire (fig. 10C). Subgenital plate asymmetrical, with a cylindrical style on the left side; the right side has a process that is

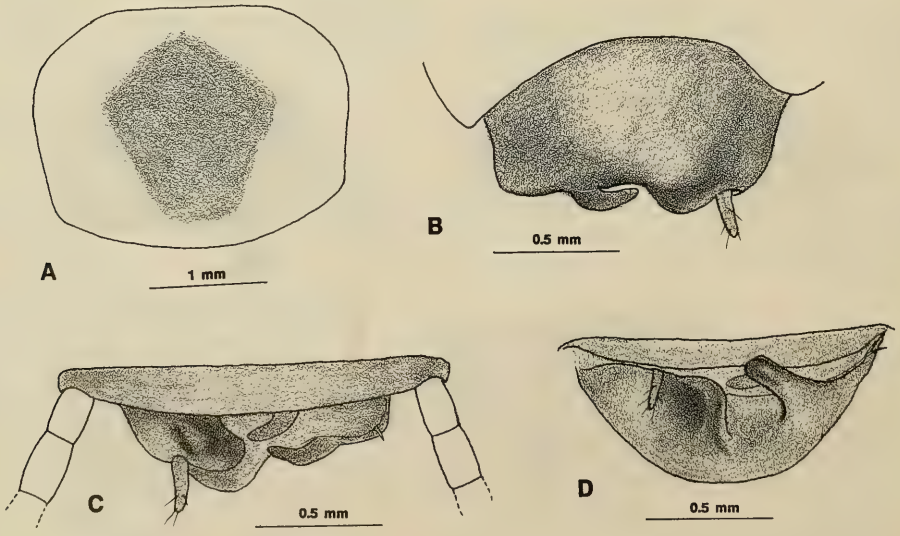

Fig. 10. *Ctenoneura hanitschi* Princis, male holotype. – A. pronotum; B. subgenital plate (ventral); C. supraanal and subgenital plates (dorsal); D. supraanal and subgenital plates (rear view).

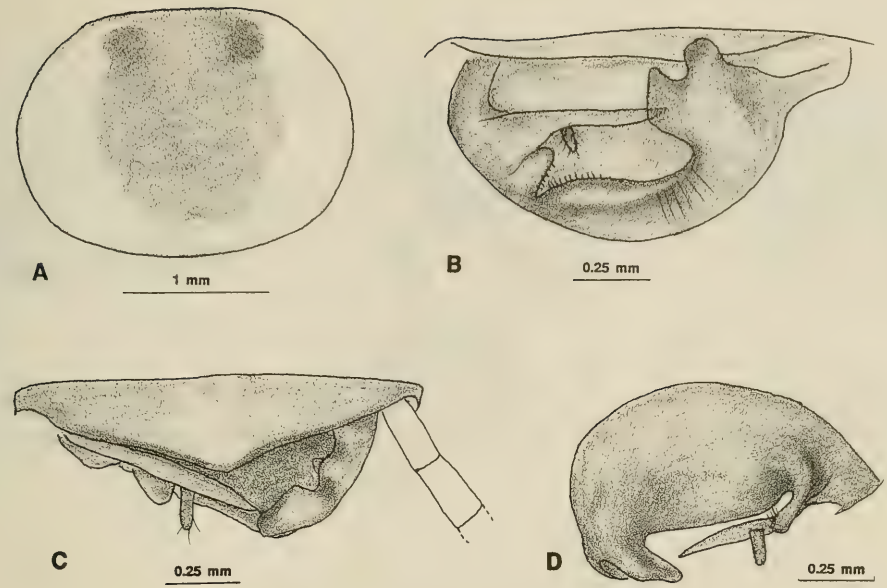

Fig. 11. *Ctenoneura mjoebergi* Princis, male holotype. – A. pronotum; B. supraanal and subgenital plates (rear view); C. supraanal and subgenital plates (dorsal); D. subgenital plate (ventral).

curved dorsad towards the left (figs. B-D).

Colour. – Head dark reddish brown; antennae dark brown, monochromatic. Pronotal disk with a sublozenge-shaped reddish brown macula narrowly margined with yellow, broad lateral zones yellowish-hyaline (fig. 10A). Tegmina brownish. Hind wing weakly infuscated. Abdomen brown. Legs dark to yellowish brown.

Female: Unknown.

Measurements (mm). – Body length, 7.3; pronotum length x width, 2.2 x 2.5; tegmen length, 9.4; interocular space, 0.6.

Ctenoneura mjoebergi Princis
(fig. 11)

Ctenoneura mjoebergi Princis, (1953) 1954: 206, fig. 4 (♂). Holotype, ♂, O. Borneo, Pajau River, [Kalimantan], Mjöberg; in (NRSS) [examined].
Ctenoneura fulva (nec Hanitsch, 1925). – Hanitsch 1933: 235 (in part; Mt. Tibang and Pajau River material); Princis 1963: 102.

Material examined. – Holotype, and paratype: Kalimantan. 1♂, same data as holotype (NRSS). Sarawak. Mt. Tibang, 1400 m, 1 ♂, Mjöberg (NRSS).

Redescription. – Male: Head concealed, interocular space greater than distance between antennal sockets. Pronotum subelliptical (fig. 11A). Tegmina and wings fully developed extending well beyond end of abdomen, the former with oblique discoidal sectors. Hind wing with an intercalary vein, media vein with a forked branch, cubitus with five branches (one forked). Front femur Type C_1; pulvilli absent, tarsal claws simple, symmetrical, arolia minute. Supraanal plate symmetrical, transverse, shallowly trigonal, hind margin entire (fig. 11C). Subgenital plate asymmetrical with several processes, one of which on the left side is elongated and bears a single style (figs. 11B-D).

Colour. Head reddish brown; antennae with segments on proximal half yellow (except for the first two brown antennomeres), distal half brownish. Pronotal disk reddish brown with a pair of dark spots on anterior margin, lateral zones hyaline (fig. 11A). Tegmina brownish, subcostal vein yellow. Hind wing lightly infuscated. Abdomen brown, the sterna lighter medially and laterally. Legs and cerci brown.

Female: Unknown.

Measurements (mm). – Length, 5.5-5.8; pronotum length x width, 1.5-1.7 x 2.1-2.3; tegmen length, 6.6-6.8; interocular space, 0.6.

Ctenoneura tuberculata Princis
(fig. 12)

Ctenoneura tuberculata Princis, (1953) 1954: 205, fig. 2 (♂). Holotype, ♂, Sumatra, Sibajak, Mjoeberg (NRSS) [examined]; Princis 1963: 101.

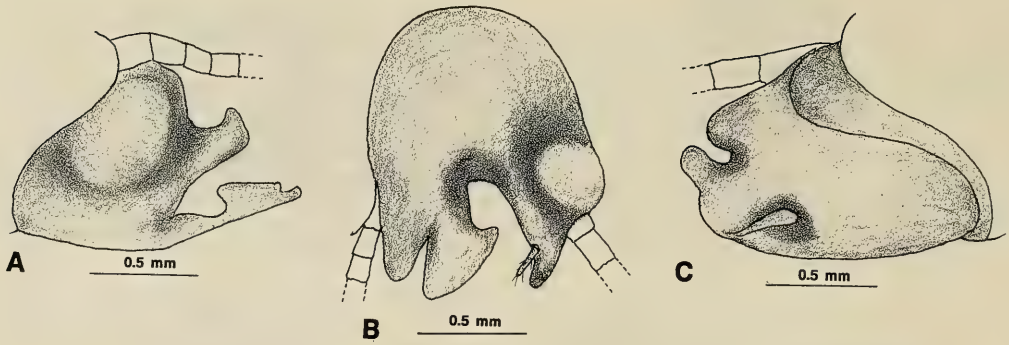

Fig. 12. *Ctenoneura tuberculata* Princis, male from Mt. Bandahara. A. subgenital plate (left lateral); B. subgenital plate (ventral); C. subgenital plate (right lateral).

Ctenoneura major (nec Hanitsch, 1925); Hanitsch 1929b: 3, 18 (♂, in part); Princis 1963: 101.

Additional material. – Sumatra. N. Sumatra, Bivouac One, Mt. Bandahara, 3°43'N 97°41'E, ca. 810 m, 1♂, 25.vi. –5.vii.1972, J. Krikken (RMNH).

Redescription. – Male: Head hidden, interocular space greater than the distance between antennal sockets. Pronotum subelliptical. Tegmina and wings fully developed extending beyond end of abdomen, the former with oblique discoidal sectors. Hind wing with intercalary vein, media vein with one branch, cubitus vein with six branches. Front femur Type C_1; pulvilli absent, tarsal claws symmetrical, simple, arolia minute. Abdominal terga unspecialized. Supraanal plate shallowly trigonal, apex rounded and medially incised. Subgenital plate strongly asymmetrical, hind margin deeply divided forming two asymmetrical lobes, the one on the left bearing a small cylindrical style below its apex on the inner margin of the excision; the lobe on the right deeply excised; a large round swelling is located along the margin distad on the left side (figs. 12A-C).

Colour. – Head reddish brown; antennae dark brown. Pronotal disk reddish brown the surrounding area hyaline and partly yellowish. Tegmina with humeral and costal vein areas yellowish, remainder brown. Hind wing with yellowish tinge. Abdomen brown, subgenital plate reddish brown (holotype), or partly yellowish. Legs light brown. Cerci light brown dorsally, darker brown ventrally.

Female: Unknown.

Measurements (mm). – Body length, 6.0; pronotum length x width, 1.7-1.8 x 2.3-2.5; tegmen length, 7.2-9.0; interocular space, 0.5-0.6.

***Ctenoneura spinastyla* sp. n.**
(fig. 13)

Type material. – Holotype, ♂, Pahang, F.M.S., 'Cameron's Highlands', No. 4 Camp, 4800 ft., 14.-viii.1923, H.M., Pendlebury (incorrectly labelled by Hanitsch, *Ctenoneura major* Hanitsch); in HDEO.

Description. – Male: Head hidden, interocular space greater than the distance between ocellar spots and antennal sockets. Pronotum suboval. Tegmina and wings extending well beyond end of abdomen, discoidal sectors of the former oblique. Hind wing with distinct costal veins, intercalary vein present, media vein forked beyond the middle, each branch again dividing (left wing, fig. 13E), or with two branches (one of them forked, right wing); cubitus vein with five or six branches (two of them branching once or twice) (fig. 13E). Front femur Type C_1; pulvilli absent, tarsal claws symmetrical, simple, arolia minute. Abdominal terga unspecialized. Supraanal plate strongly transverse, very short, hind margin almost truncate (fig. 13A). Subgenital plate asymmetrical with a pair of large dissimilar processes, the left one with a bulbous swelling near the apex, both lobes setose apically, those on the right much longer; on the left margin near the base of the plate is a long, slender, spine-like style (figs. 13A-D).

Colour. – Head reddish brown; antennal segments black (most of the antennae are missing). Pronotal disk reddish brown, becoming yellowish in the posterior region, lateral zones yellowish-hyaline. Tegmina with humeral zone yellowish, remainder brownish-hyaline, mediastine vein very dark. Abdomen, cerci, and legs brown.

Female: Unknown.

Measurements (mm). – Length, 8.2; pronotum

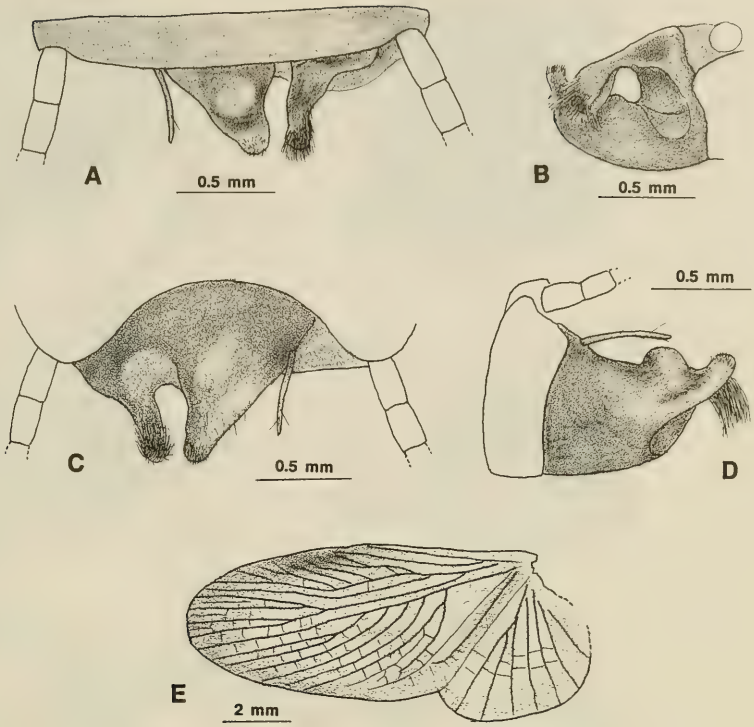

Fig. 13. *Ctenoneura spinastyla* sp. n., male holotype. – A. supraanal and subgenital plates (dorsal); B. subgenital plate (right lateral); C. subgenital plate (ventral); D. subgenital plate (left lateral); E. left hind wing.

length x width, 2.3 x 2.9; tegmen length, 11.1; interocular space, 0.8.

Etymology. – The specific name refers to the slender, greatly elongated left style.

Comments. – The two setose processes, and the spine-like style on the subgenital plate are unique and readily identifies this species.

Ctenoneura uncata sp. n.
(fig. 14)

Type material. – Holotype, ♂, Malaysia, S.W. Sabah, nr. Long Pa Sia (East), c. 1000 m, Mal. trap 5, 1-13.iv.1987, C. v. Achterberg; in RMNH . – Paratypes: Sabah. RMNH: The following were collected by C. v. Achterberg: S.W. Sabah, nr. Long Pa Sia (West), c. 1050 m, Mal. trap 3, 1 ♂, 1-14.iv.1987; same data as holotype, 1 ♂, 25.xi. –7.xii.1987; nr. Long Pa Sia (West), 1010 m, Mal. trap 1b, 1 ♂, Mal. trap 2, 1020 m, 2 ♂♂, 25.xi. –8.xii.1987. The following were collected by J. Huisman: Sg. Malabit, Rd. Long Sia-L Semado, 115°41'E 4°21'N, 1175 m, 1 ♂, 8.xii.1986; Long Pa Sia, confl. S. Maga and S. Pa Sia, 4°26'30"N 115°40'E, high moist forest, sandsoil, 1350 m, 2 ♂♂, 16-19.x.1986. One ♂ retained in MCZ.

Description. – Male: Head hidden, interocular space greater than the distance between the ocellar spots and antennal sockets. Pronotum suboval (fig. 14A). Tegmina and wings fully developed extending beyond end of abdomen. Hind wing with intercalary vein, media vein with one branch, cubitus vein with five or six branches (some may be forked). Front femur Type C_1; pulvilli absent, tarsal claws symmetrical, simple, arolia minute. Abdominal terga unspecialized. Supraanal plate transverse, subtrigonal (fig. 14E). Subgenital plate strongly asymmetrical, the right side with a broad, elongated lobe that curves towards the left where there is a broad, apically curved, hook-like process; style absent (figs. 14B-E).

Colour. – Head dark reddish brown; basal four antennal segments brown, succeeded by pale (yellowish) antennomeres to about the middle, those on the distal half brown, with as many as six terminal (or preterminal) white antennomeres (some lacked, or had only two or three white segments, but these may have been damaged specimens). Pronotal disk with a broad, dark reddish brown macula that extends to both the anterior and posterior margins, lateral areas usually hyaline (fig. 14A), sometimes partly opaque yellowish. Tegmina with humeral and proximal half of the costal vein region yellowish-hyaline, the remainder dark hyaline-brown. Hind wing with yellowish tinge in the costal vein region. Abdomen brown, supraanal plate with a white area, subgenital plate may be a lighter brown and sometimes partly yellow.

Female: Unknown.

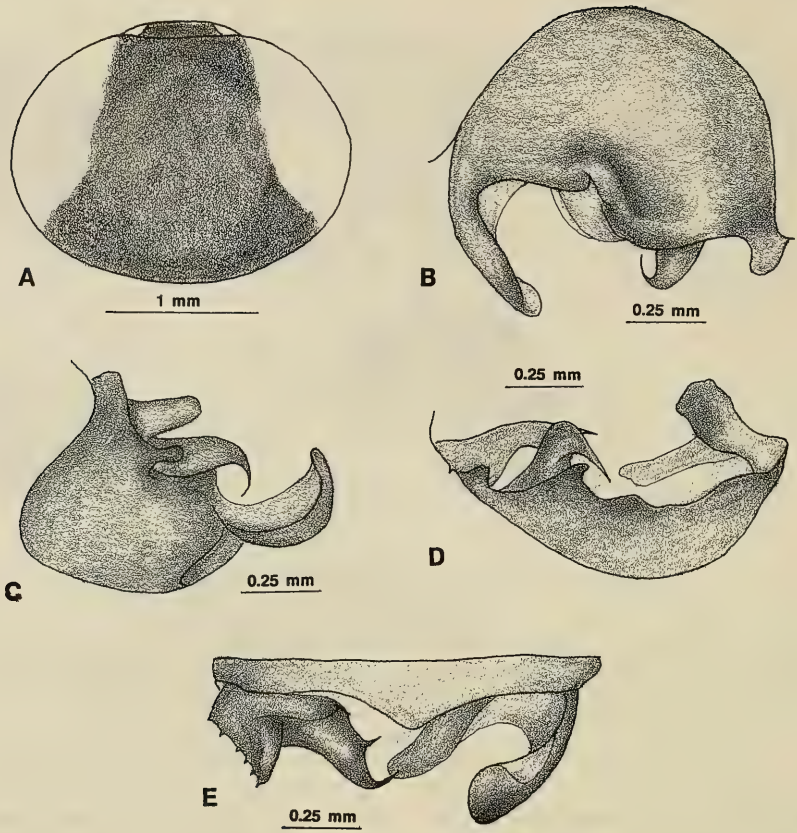

Fig. 14. *Ctenoneura uncata* sp. n., male paratype from near Long Pa Sia. – A. pronotum; B. subgenital plate (ventral); C. subgenital plate (left lateral); D. subgenital plate (rear view); E. supraanal and subgenital plates (dorsal).

Measurements (mm). – Length, 5.0-5.8; pronotum length x width, 1.6-1.7 x 2.1-2.3; tegmen length, 7.0-7.7; interocular space, 0.6.

Etymology. – The specific name refers to the hook-shaped structure on the left side of the subgenital plate.

Ctenoneura poringa sp. n.
(figs. 15A-C)

Type material. – Holotype, ♂, Malaysia, Sabah, Poring hot spring, Sg. Kepungit, E. of park boundary, c. 116°42'E 6°03'N, 480 m, ML, 26.xi.1986, J. Huisman; in RMNH.

Description. – Male: Head hidden under pronotum, interocular space greater than distance between ocellar spots and antennal sockets. Pronotum subovoal. Tegmina and wings fully developed extending beyond end of abdomen, the former with oblique discoidal sectors. Hind wing intercalary vein present, media vein with one branch, cubitus vein with six rami (one may be branched). Front femur Type C_1; pulvilli absent, tarsal claws symmetrical, simple, arolia minute. Abdominal terga unspecialized. Supraanal plate transverse. Subgenital plate asymmetrical, hind margin deeply, widely excavated, with a large whitish, membranous area bearing a cylindrical style at its basal end (figs. 15A-C).

Colour. – Head dark brown; two basal antennal segments dark brown succeeded by about 25 yellowish antennomeres, then three or four brown and three or four white segments, terminating in one or two brown ones (some terminal segments may have been missing). Pronotal disk dark reddish brown, anterior and posterior areas darker, lateral regions hyaline. Tegmina with humeral region yellow-hyaline, remainder brown-hyaline. Hind wing infuscated, darker along the costal vein area. Abdominal terga brown, supraanal plate with a white medial zone. Abdominal sterna light brown, subgenital plate darker. Cerci with four basal segments brown, distal three segments yellowish. Coxae and femora brown, tibiae and tarsi pale.

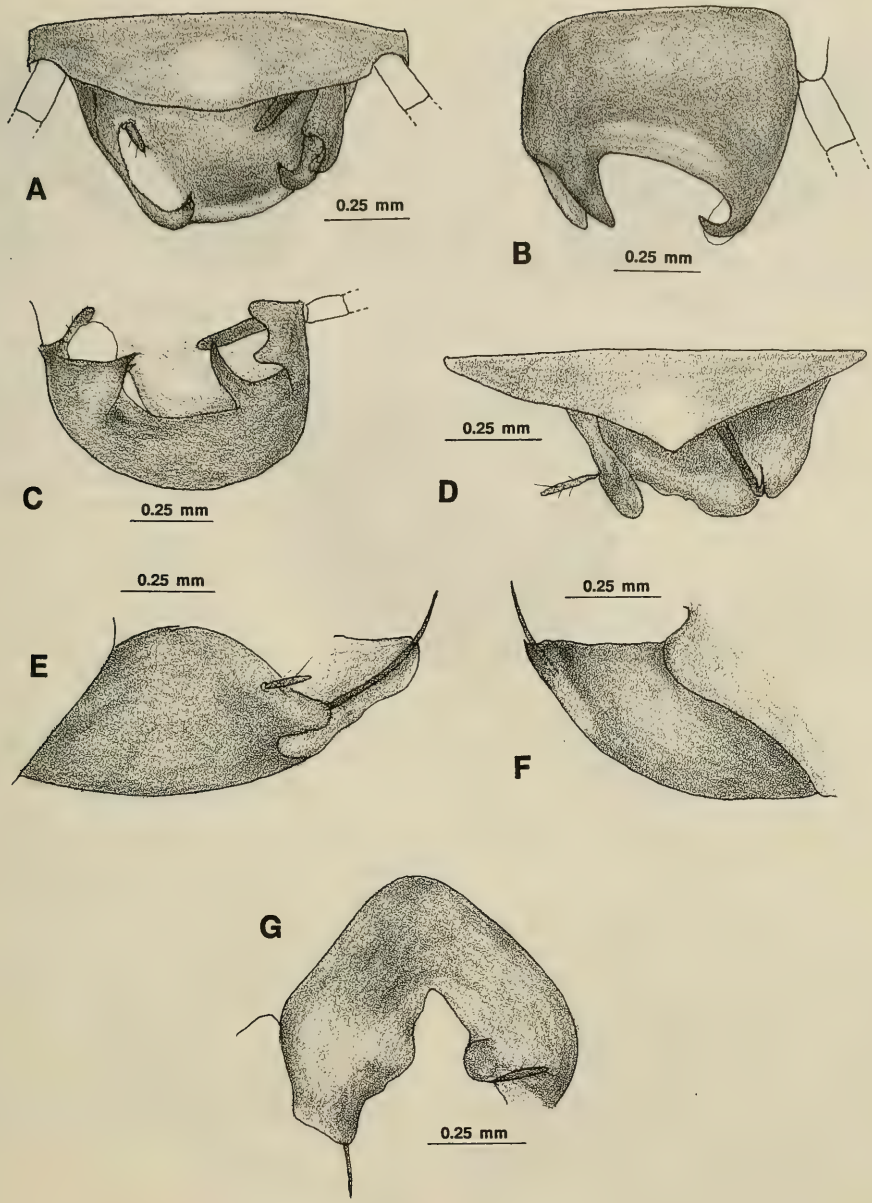

Fig. 15. *Ctenoneura* spp. A-C. *C. poringa* sp. n., male holotype. A. supraanal and subgenital plates (dorsal); B. subgenital plate (ventral); C. subgenital plate (rear view). – D-G. *C. luma* Sp. n., male holotype. D. supraanal and subgenital plates (dorsal); E. subgenital plate (left lateral); F. subgenital plate (right lateral); G. subgenital plate (ventral).

Female: Unknown.

Measurements (mm). – Length, 5.0; pronotum length x width, 1.6 x 2.0; tegmen length, 6.3; interocular space, 0.5.

Etymology. – The species is named for Poring hot spring.

Ctenoneura luma sp. n.
(figs. 15D-G)

Type material. – Holotype, ♂, Malay Penin., Perak, Larut Hills, 4000-4500 ft., ii. –iii.1905, R. Shelford (incorrectly labelled *C. fulva*, by Hanitsch); in HDEO. – Paratype. Perak. HDEO: Perak, F.M.S., Jor Camp, 2000 ft., 1♂,

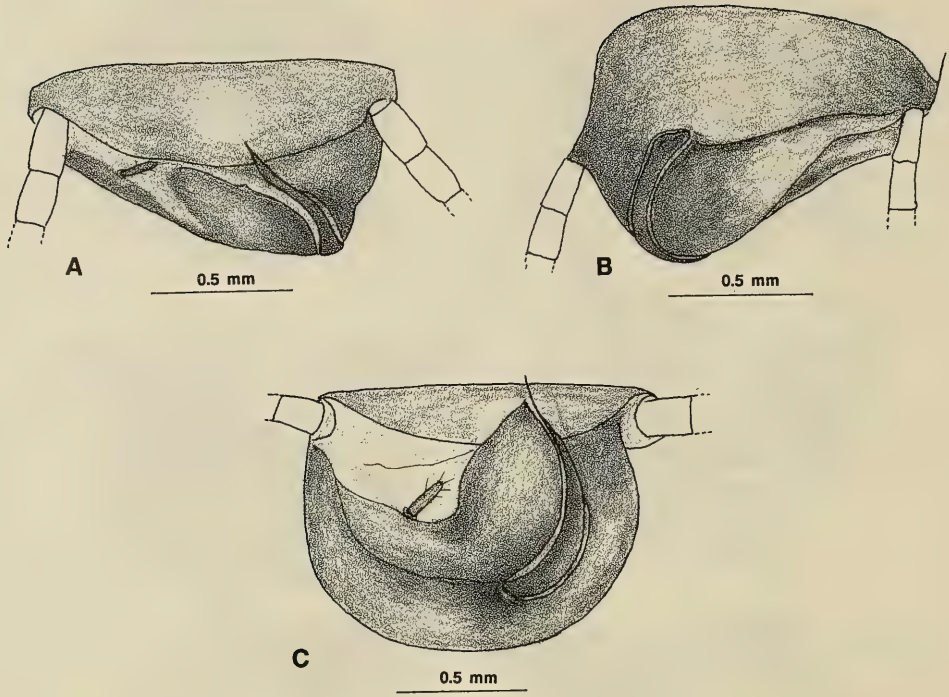

Fig. 16. *Ctenoneura scutica* sp. n., male holotype. A. supraanal and subgenital plates (dorsal); B. subgenital plate (ventral); C. subgenital plate (rear view).

6.ix.1922, 2♂, at light, 27.viii.1922, E. Sumiind (labelled *C. pumosa*, mss name, by Hanitsch).

Description. – Male: Head barely exposed, interocular space greater than the distance between ocellar spots and antennal sockets. Pronotum suboval. Tegmina and wings fully developed, the former with oblique discoidal sectors. Hind wing with distinct costal veins, the proximal ones thickened distad, intercalary vein present, media vein bifurcate (one of the rami also branched), cubitus vein with six branches. Front femur Type C_1; pulvilli absent, tarsal claws symmetrical, simple, arolia minute. abdominal terga unspecialized. Supraanal plate trigonal, entire (fig. 15D). Subgenital plate asymmetrical, deeply excavated medially forming two dissimilar lobes, with a slender style on the left side (the style was accidentally broken off and lost after the drawings were made); on the right side, a slender, thorn-like structure appears to arise from the margin of the plate but actually lies pressed tightly against the dorsal surface, and its apex protrudes beyond the the right lobe margin (figs. 15E-G).

Colour. Head reddish brown. Pronotal disk reddish brown, the macula narrowly margined with yellow, lateral portions hyaline. Tegmina and wings pale hyaline. Abdominal terga light brown, supraanal plate with a white macula medially near the hind margin, subgenital plate darker except for a pale zone around the medial excavation. Cerci pale. Legs light brown.

Female: Unknown.

Measurements (mm). – Length, 5.5; pronotum length x width, 1.5 x 1.8; tegmen length, 6.3; interocular space, 0.6.

Etymology. – The specific name refers to the thorn-like structure that arises on the dorsal surface of the subgenital plate and protrudes beyond the right lobe.

Ctenoneura scutica sp. n.
(fig. 16)

Type material. – Holotype ♂, Malaysia, Sabah, one half way Rd. Melligan, Long Pa Sia, 115°42'E 4°35'N, 1200 m, ML, 15.xii.1986, J. Huisman; in RMNH.

Description. – Male: Head hidden, interocular space greater than the distance between ocellar spots or antennal sockets. Pronotum suboval. Tegmina and wings extending well beyond end of abdomen, the former with oblique discoidal sectors. Hind wing with intercalary vein, media vein with one bifurcated branch, cubitus with five branches. Front femur Type

C_1; pulvilli absent, tarsal claws symmetrical, simple, arolia minute. Abdominal terga unspecialized. Supraanal plate symmetrical, transverse, short, hind margin entire. Subgenital plate asymmetrical, the left side concavely excavated bearing a small cylindrical style in a white membranous area; near the mid region of the plate is a deep, narrow, oblique (towards the left) excision with a long, stout, tapering whip-like process that curves upwards and anteriorly between the smooth walls of the excision (figs. 16A-C).

Colour. – Head dark reddish brown; antennae brown, monochromatic. Pronotal disk reddish brown, darker near the anterior and posterior margins. Tegmina with humeral and proximal part of the costal vein area yellowish-hyaline, remainder slightly darker. Hind wing with a yellowish tinge, costal vein region darker. Abdominal terga brown, lateral edges and terminal segments darker, supraanal plate with a white medial zone. Abdominal sterna light brown, lateral edges darker, distal part of subgenital plate yellowish. Cerci brown, terminal segment lighter. Legs light brown.

Female: Unknown.

Measurements (mm). – Length, 5.6; pronotum length x width, 1.8 x 2.2; tegmen length, 7.6; interocular space 0.6.

Etymology. – The specific name refers to the whip-like process between the narrow incision on the subgenital plate.

Ctenoneura parascutica sp. n.
(fig. 17)

Type material. – Holotype, ♂, Malaysia, Sabah, base of S. Nologana, 1010 m, Crocker range, 115°55'E 5°10'N, UV, 10-11.x. 1986, J. Huisman (RMNH).

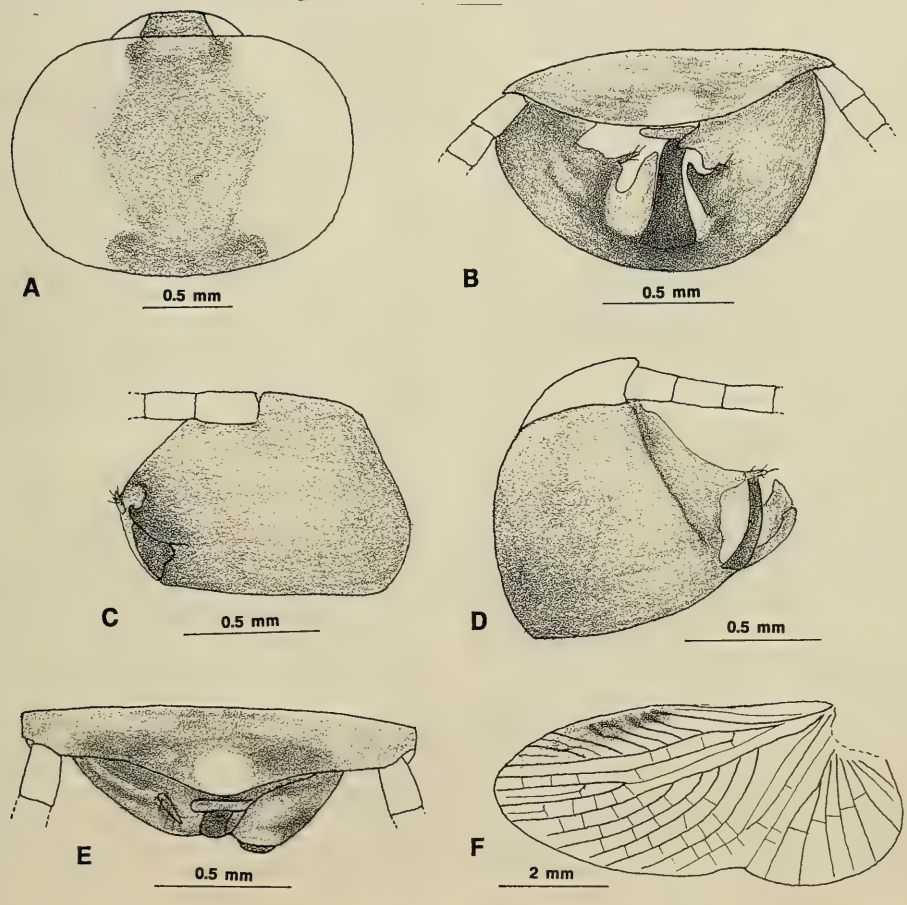

Fig. 17. *Ctenoneura parascutica* sp. n., male holotype. A. pronotum; B. Supraanal and subgenital plates (rear view); C. subgenital plate (right lateral); D. subgenital plate (left lateral); E. supraanal and subgenital plates (dorsal); F. left hind wing.

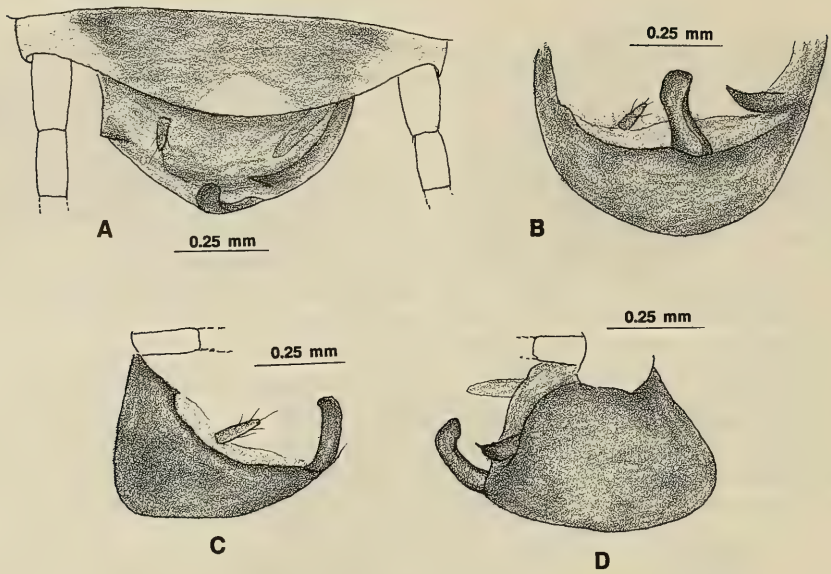

Fig. 18. *Ctenoneura kinabaluana* sp. n., male paratype from Kiau, Mt. Kinabalu. A. supraanal and subgenital plates (dorsal); B. subgenital plate (rear view); C. subgenital plate (left lateral); D. subgenital plate (right lateral).

Description. – Male: Head exposed, interocular space greater than the distance between ocellar spots and antennal sockets. Pronotum subelliptical (fig. 17A). Tegmina and wings fully developed extending beyond end of abdomen, the former with oblique discoidal sectors. Hind wing with the proximal three or four costal veins clubbed, intercalary vein present, media vein with one branch, cubitus vein with five branches (the right wing has one of the branches forked) (fig. 17F). Front femur Type C_1; pulvilli absent, tarsal claws symmetrical, simple, arolia minute. Abdominal terga unspecialized. Supraanal plate transverse, hind margin entire (figs. 17B, E). Subgenital plate asymmetrical, hind margin excised, with a large dark, spine-like process that curves dorsad, its apex hidden under the supraanal plate; the margins of the excision on either side of the spine-like process are irregular, and on the left side the region is unsclerotized; a small cylindrical style is on the left side (figs. 17B-E).

Colour. – Head reddish brown; antennae brown (distal halves missing). Pronotal disk reddish brown, anterior and posterior border regions darker, a small yellowish area anteriorly on each side along the edges of the macula, lateral regions hyaline (fig. 17A). Tegmina with humeral and proximal costal vein regions yellowish-hyaline, remainder darker. Hind wing with a yellowish tinge in the costal vein region (fig. 17F). Abdominal terga brown, supraanal plate with a white macula posteromedially (fig. 17E). Abdominal sterna brown, subgenital plate darker. Cerci brown, segments on distal half lighter. Legs pale.

Female: Unknown.

Measurements (mm). – Length, 5.2; pronotum length x width, 1.7 x 2.3; tegmen length, 7.3; interocular space, 0.6.

Comments. – I place *parascutica* close to *scutica* because both have a large, darkly sclerotized, curved, spine-like process on the hind margin of the subgenital plate.

Ctenoneura kinabaluana sp. n.
(fig. 18)

Material. – Holotype, ♂, B.N. Borneo [Sabah], Mt. Kinabalu, Lumu Luma, 3500 ft., 16.iv.1929 [labelled *C. fulva*, by Hanitsch] (HDEO). – Paratypes. Sabah. Same locality and date as holotype, 3500 ft., 1♂; Mt. Kinabalu, Kamboranga, 7000 ft., 2♂, 30.iii.1929 (HDEO); Malaysia, Sabah, Mt. Kinabalu Kg. Kiau, S. Kadamaian, 116°31'E 6°02'N, 720 m, UV, 1♂ 26.viii.1986, J. Huisman (RMNH).

Description. – Male: Head hidden, interocular space greater than the distance between ocellar spots and antennal sockets. Pronotum suboval. Tegmina and wings fully developed extending well beyond end of abdomen, discoidal sectors of the former oblique. Hind wing with distinct costal veins, intercalary vein present, media vein with one branch (the branch may be bifurcate), cubitus vein with six branches (some may be forked; also one of the wings has two veins fused a short distance from their bases and then sep-

arate). Front femur Type C_1; pulvilli absent, tarsal claws symmetrical, simple, arolia minute. Abdominal terga unspecialized. Supraanal plate transverse, hind margin convex, entire (fig. 18A). Subgenital plate asymmetrical, with a short, median process that extends postero-obliquely, or dorsad, its distal end curving anteriorly towards the supraanal plate; a cylindrical style is located on the left side and the margin to the right of the process is prolonged (figs. 18A-D). The length of the median process varies and is longest in the specimen from Kiau.

Colour. – Head reddish brown; antennae brown. Pronotal disk reddish brown, lateral zones hyaline. Tegmina with humeral and costal vein zones yellow-hyaline, remainder brown-hyaline. Hind wing infuscated, darkest in the costal vein zone. Abdominal terga brown, supraanal plate with a white macula anteromedially. Abdominal sterna brown, distal margin of subgenital plate yellowish. Cerci and legs brown. The specimen from Kiau is smaller and darker than the others: head dark brown, basal three antennomeres brown, remainder yellowish (distal segments of the antennae missing); supraanal plate yellow laterally, and with a white area posteromedially (fig. 18A). Cerci with basal segments brown, distal cercomeres yellowish. Coxae, femora, and tibiae brown, tarsi lighter.

Female: Unknown.

Measurements (mm) (male from Kiau in parentheses). – Length, 6.5-6.6 (5.3); pronotum length x width, 1.8-1.9 (1.5 x 2.1); tegmen length, 9.0 (6.7); interocular space, 0.6-0.7 (0.6).

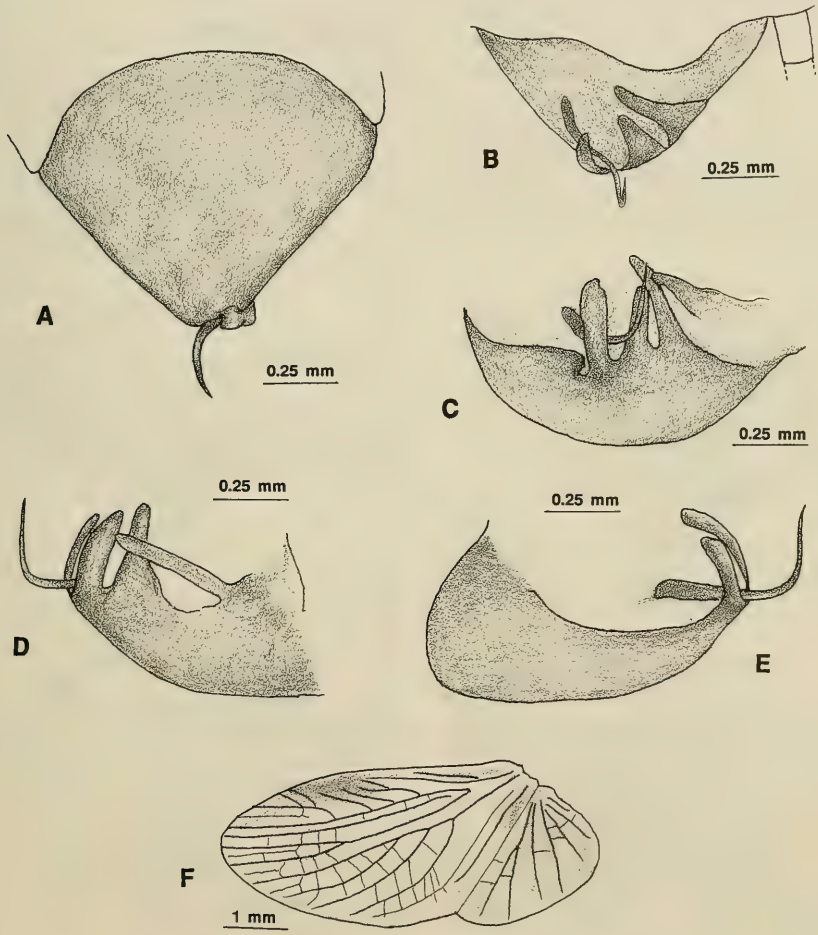

Fig. 19. *Ctenoneura triprocessa* sp. n., male holotype. A. subgenital plate (ventral); B. subgenital plate (dorsal); C. subgenital plate (rear view); D. subgenital plate (right lateral); E. subgenital plate (left lateral); F. left hind wing.

Ctenoneura triprocessa sp. n.
(fig. 19)

Type material. – Holotype ♂, Malaysia, SE. Sabah, Danum Valley Field C., c. 150 m, W.O., Mal. trap 5, 22.xi.-4.xii.1987, C. v. Achterberg & D. Kennedy (RMNH) [The type is fragmented, head and thorax, tegmina and wings, and terminal abdominal segments are mounted on cards].

Description. – Male: Head hidden, interocular space greater than the distance between ocellar spots and antennal sockets. Pronotum suboval. Tegmina and wings fully developed extending beyond end of abdomen, discoidal sectors of former oblique. Hind wing with a intercalary vein, media vein with one branch, cubitus vein with three branches (one of which may or may not be branched near its base) (fig. 19F). Front femora missing; other legs lack pulvilli, tarsal claws symmetrical, simple, arolia minute. Abdominal terga unspecialized. Supraanal plate transverse, hind margin convexly rounded, entire. Subgenital plate asymmetrical, trigonal (fig. 19A), hind margin with three long processes that curve dorsad; arising on the dorsal surface of the plate near the left process is a long filament that protrudes between the left and middle processes; style absent (figs. 19B-E).

Colour. – Head dark reddish brown; antennae with pale yellowish segments (about half the segments are missing). Pronotal disk reddish brown, slightly lighter on the anterior and posterior regions, lateral areas clear hyaline. Tegmina with humeral and proximal half of the costal vein area yellowish-hyaline, remainder light brown-hyaline. Hind wing with yellowish tinge mostly in the costal vein zone (fig. 19F). Abdomen brown, distal part of supraanal plate white, subgenital plate yellowish brown.

Female: Unknown.

Measurements (mm). – Pronotum length x width, 1.5 x 1.8; tegmen length, 5.7; interocular space, 0.5.

Etymology. – The specific name refers to the three prominent processes or prolongations on the hind margin of the subgenital plate.

Ctenoneura murudensis sp. n.
(fig. 20)

Ctenoneura fulva; Hanitsch (in part, ♂ paralectotype) 1925: 101.

Type material. – Holotype, ♂ paralectotype (Type Orth. 300 $^{3}/_{3}$) of *Ctenoneura fulva* Hanitsch, Mt. Murud [Sarawak], 6500 ft. (HDEO).

Description. – Male: Head hidden, interocular

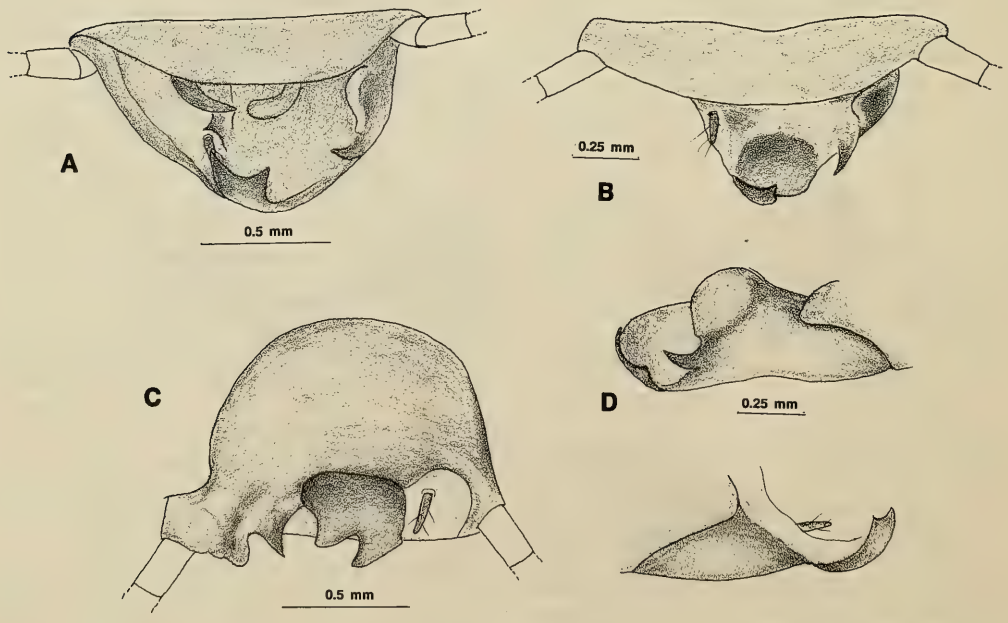

Fig. 20. *Ctenoneura murudensis* sp. n., male holotype. A. supraanal and subgenital plates (rear view); B. supraanal and subgenital plates (dorsal); C. subgenital plate (ventral); D. subgenital plate (right lateral); E. subgenital plate (left lateral).

space greater than the distance between ocellar spots and antennal sockets. Pronotum suboval. Tegmina and wings fully developed extending beyond end of abdomen, the former with oblique discoidal sectors. Hind wing with distinct costal veins, the proximal ones clubbed distally, intercalary vein present, media vein forked about at the middle, cubitus with eight unbranched rami. Front femur Type C_1; pulvilli absent, claws simple, symmetrical, arolia small. Abdominal terga unspecialized. Supraanal plate transverse, deflexed, hind margin convex, entire (figs. 20A-B). Subgenital plate asymmetrical with a small, dark, cylindrical style located in a membranous area on the left side; a darkly sclerotized lobe with a U-shaped excavation on its apical margin arises medially, and on the right side is a small acute prolongation (figs. 20A-E).

Colour. – Head light reddish brown; antennae dark brown, monochromatic. Pronotal disk light reddish brown, surrounding areas hyaline. Tegmina with humeral and proximal half of the costal vein zone yellowish-hyaline, remainder darker, hyaline. Wings pale, with a yellowish tinge, darker in the clubbed costal vein region. Abdominal terga uniformly light brown, supraanal plate without a medial white spot. Abdominal sterna yellowish-brown, distal part of subgenital plate yellow. Cerci light brown dorsad, darker ventrally. Legs light brown.

Female: Unknown.

Measurements (mm). – Length, 6.7; pronotum length x width, 1.8 x 2.3; tegmen length, 8.5; interocular space, 0.7.

Comments. – Hanitsch incorrectly considered this as *fulva*, but the subgenital plate of that species (fig. 8B) is distinctly different from *murudensis* (fig. 20C).

Ctenoneura crassistyla sp. n.
(figs. 21A-D)

Type material. – Holotype, ♂, Pahang, F. M. S., Cameron's Highlands, Tanak...., 4800 ft., 22.v.1931, H. M. Pendlebury (HDEO).

Description. – Male: Head hidden, interocular space greater than the distance between ocellar spots and antennal sockets; antennae missing. Pronotum suboval. Tegmina and wings fully developed extending beyond end of abdomen, the former with oblique discoidal sectors. Hind wings with distinct costal veins, media vein bifurcate, cubitus vein with six branches. Front femur Type C_1; pulvilli absent, tarsal claws symmetrical, simple, arolia minute. Abdominal terga unspecialized, supraanal plate strongly transverse, very short, hind margin almost truncate, entire (fig. 21A). Subgenital plate asymmetrical, hind margin deeply, unevenly excavated, with a large, stout style on the basal corner of the left side of the excavation; the apex of the style is split and a small piece of 'fleshy' tissue protrudes between the ends; right side with distal region concavely depressed (figs. 21B-D).

Colour. – Head reddish brown. Pronotum with narrow yellow edging, disk reddish brown, lateral regions hyaline. Tegmina hyaline yellow, darker on the anal field region. Hind wings pale with yellowish mostly in the costal vein region and apical part of the anterior field. Abdominal terga light brown, supraanal plate yellowish with a medial white area near the hind margin (fig. 21A). Abdominal sterna brown, subgenital plate darker. Cerci pale dorsally. Legs light brown.

Female: Unknown.

Measurements (mm). – Length, 6.4; pronotum length x width, 1.9 x 2.5; tegmen length, 8.3; interocular space, 0.7.

Etymology. – The specific name refers to the large, stout, left style.

Ctenoneura sp.

Material. – South Vietnam. HDEO: 1♂, S. Annam, Longbian Peaks, 5500-7500 ft., iv.–v.1918, C. B. Kloss (labelled *Ctenoneura major* Hanitsch, by Hanitsch).

Comments. – This species has a subgenital plate similar to that of *crassistyla*, with a large, stout, style on the basal corner of the left side (the style is not split at the apex). The media vein of the hind wing has two branches, and the cubitus vein has seven branches, one or two of which may be branched. The tarsal claws are long, simple, symmetrical, arolia absent. The supraanal plate is transverse, hind margin weakly convex. This is the only species recorded from Vietnam.

Measurements (mm). – Length, 7.8; pronotum length x width, 2.3 x 3.1; tegmen length, 10.2; interocular space, 0.8.

Ctenoneura simulans Bey-Bienko
(figs. 21E-F)

Ctenoneura simulans Bey-Bienko, 1969: 833, figs. 2,3, (♂) (Russian). Holotype ♂, S. China, Yunnan: Hsiamonyang vicinity, 900-1100 m, 6.v.1957, Hung Kuang-ti (ZINR) [not examined]; 1970: 528 (English translation).

Description (from Bey-Bienko). – Male: Small. Vertex passing roundly into frons, interocular space two and one half times wider than distance between antennal sockets. Pronotum somewhat less than one and one half times as wide as long. Hind wings with cross branches of the radius vein distinct, intercalary vein between the radius and media, almost straight;

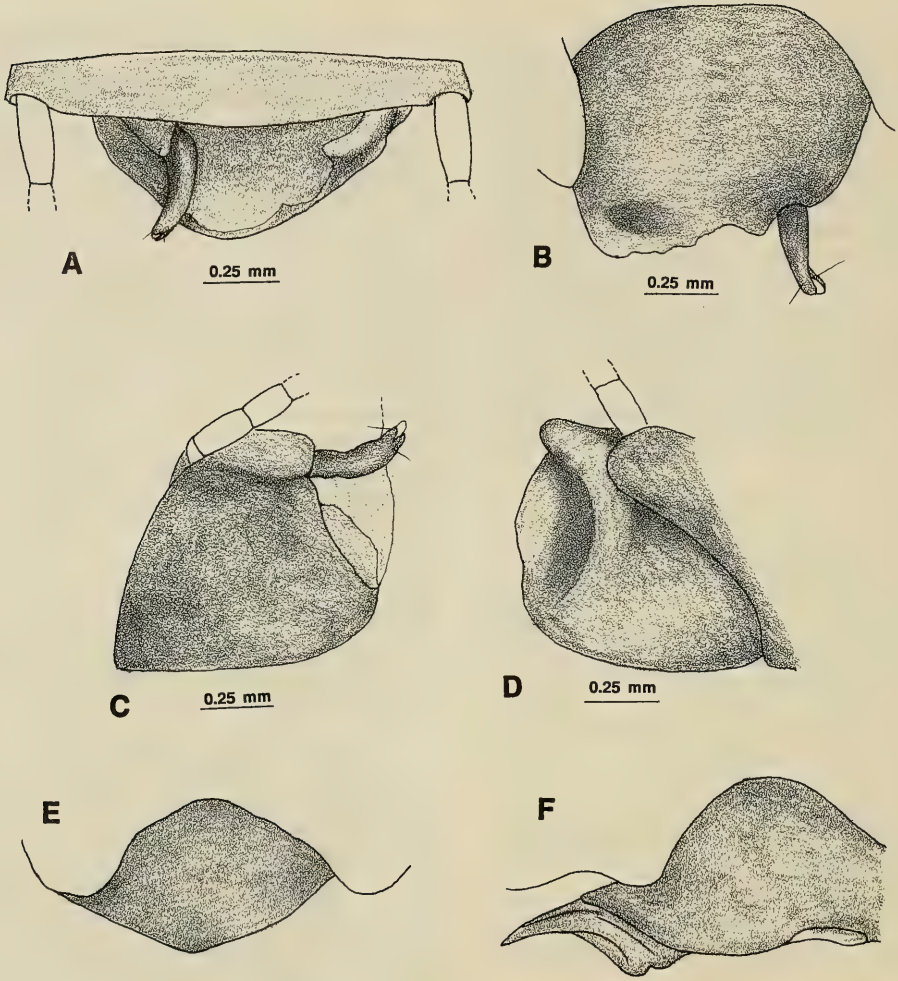

Fig. 21. *Ctenoneura* spp. – A-D, *C. crassistyla* sp. n., male holotype. A, supraanal and subgenital plates (dorsal); B. subgenital plate (ventral); C. subgenital plate (left lateral); D. subgenital plate (right lateral). – E, F. *C. simulans* Bey-Bienko; E. subgenital plate (ventral); F. subgenital plate (rear view) (redrawn from Bey-Bienko, 1969).

cubitus vein with six branches, the first one from the wing base bifurcate. Subgenital plate when viewed from below as in fig. 21E; when viewed from behind it has an irregular appendage on the right (fig. 21F). Cerci moderately long, fourth to sixth segments oval, tip of apical segment blunt, rounded.

Colour. – Brownish yellow. Head dark chestnut. Pronotum chestnut brown with broad, hyaline lateral parts. Wings just perceptably infuscated.

Female. Unknown.

Measurements (mm). – Body length, 8.0; pronotum length x width, 2.2 x 3.0; tegmen length, 9.0; overall length, 11.5.

Comments. – According to Bey-Bienko, outwardly this species resembles *misera*, but is clearly distinguished from all known species in the genus by the structure of the subgenital plate. Bey-Bienko does not mention whether or not there is a style (which could be small on the dorsal surface of the plate, and not visible in ventral or rear views).

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REFERENCES

Bey-Bienko, G. Ya., 1957. Blattoidea. I. The results of the Chinese-Soviet zoologico-botanical expeditions to southwestern China 1955-1956 . – Entomologicheskoe Obozrenie, Moskva 36: 895-915. (Russian; English summary).

Bey-Bienko, G. Ya., 1969. New genera and species of cockroaches (Blattoptera) from tropical and subtropical Asia. – Entomologicheskoe Obozrenie, Moskva 48: 831-862. (Russian). (English translation of this article: Entomological Review, Washington 48 (1970): 528-548).

Bruijning, C. F. A., 1948. Studies on Malayan Blattidae. – Zoologische Mededelingen Leiden, 29: 1-174.

Hanitsch, R., 1925. On a collection of Blattidae from northern Sarawak, chiefly Mt. Murud and Mt. Dulit. – Sarawak Museum Journal 3 (1): 75-106.

Hanitsch, R., 1927. On a collection of Blattidae from southern Annam. – Journal of the Siam Society, Natural History Supplement 7(1): 7-48.

Hanitsch, R., 1928. Spolia Mentawiensia: Blattidae. – Bulletin Raffles Museum 1: 1-44.

Hanitsch, R., 1929a. Fauna Sumatrensis. Blattidae. – Tijdschrift voor Entomologie 72: 263-302.

Hanitsch, R., 1929b. Dr. E. Mjöberg's zoological collections from Sumatra. 11. Blattidae. – Arkiv for Zoologi 21A (2): 1-20.

Hanitsch, R., 1932a. On a collection of blattids from the east coast of Sumatra. – Miscellanea Zoologica Sumatrana 62: 1-8.

Hanitsch, R., 1932b. Beccari and Modigliani's collection of Sumatran Blattidae in the Museo Civico, Genoa. – Annali del Museo civico di Storia naturale di Genova 56: 48-92.

Hanitsch, R., 1933. On a collection of Bornean and other oriental Blattidae from the Stockholm Museum. – Entomologisk Tidskrift 54: 230-245.

Princis, K., 1950. Entomological results from the Swedish expedition 1934 to Burma and British India. – Arkiv for Zoologi 1: 203-222.

Princis, K., 1954. Kleine Beiträge zur Kenntnis der Blattarien und ihrer Verbreitung. VI. – Entomologisk Tidskrift 74 (1953): 203-213.

Princis, K., 1963. Blattariae: Subordo: Polyphagoidea, Fam. Polyphagidae. *In* Beier (ed.): Orthopterorum Catalogus 4: 77-172. 's-Gravenhage.

Princis, K., 1967. Kleine Beiträge zur Kenntnis der Blattarien und ihrer Verbreitung. X. – Opuscula Entomologica 32: 141-151.

Princis, K., 1971. Blattariae: Subordo Epilamproidea, Fam.: Ectobiidae. *In* Beier (ed.): Orthopterorum Catalogus. 14: 1039-1224. 's-Gravenhage.

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A NEW SPECIES OF *EXTATOSOMA* GRAY (PHASMATODEA: PHASMATIDAE) FROM PAPUA NEW GUINEA, WITH REMARKS ON THE SPECIES IN THE GENUS

Beccaloni, G. W., 1993. A new species of *Extatosoma* Gray (Phasmatodea: Phasmatidae) from Papua New Guinea, with remarks on the species in the genus. – Tijdschrift voor Entomologie 136: 113-123, figs. 1-16, tabs. 1-2. [ISSN 0040-7496]. Published 10 December 1993.
Extatosoma carlbergi sp. n. (Phasmatidae), is described from Papua New Guinea. The biology, ecology and distribution of this and the three other species of *Extatosoma* Gray is discussed and a hypothesis is advanced to explain the discrete altitudinal ranges of the two New Guinean species. The phylogenetic relationships of the species are considered and a key to the adult females is presented.
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Key words. – Phasmatodea, Phasmida, *Extatosoma*, New Guinea, Australia, biology, ecology, distribution, phylogeny.

The genus *Extatosoma* is widely known due to familiarity with an Australian species, *E. tiaratum* (MacLeay 1826). This is one of the stick-insects most commonly cultured by amateur enthusiasts (Bragg 1991) and it is also a popular laboratory animal on which many physiological, behavioural and morphological studies have been conducted (for references see Carlberg 1983, 1987a).

Two other species are currently recognised as belonging to the genus : *E. bufonium* Westwood, 1874 from Australia and *E. popa* Stål, 1875 from New Guinea. Another nominal species, *E. elongatum* Froggatt, 1922, was synonomised with *E. bufonium* by Vickery (1983). The holotype of *E. bufonium* (in the Hope Entomological Collection, Oxford, UK) is a penultimate (?) instar female nymph, not a male as stated by Vickery (1983), and Froggatt (1922) based *E. elongatum* on the adult female of this species. A third, as yet undescribed, species may exist in the vicinity of Brisbane, Queensland, Australia (P. D. Brock, in prep.). The adult female of this taxon (fig. in Wilson 1991) is superficially similar to *E. tiaratum* in appearance, while the egg resembles that of *E. bufonium.*

Both *E. popa* and *E. bufonium* are poorly known and only the former species has been cultured in captivity (Harman 1985). The males of these two species have not been figured or formally described, although Harman briefly noted that the male of *E. popa* can be distinguished from that of *E. tiaratum* by its clear wings and a white dot behind its head. From personal observation of a series of preserved adult male *E. popa* cultured by Harman and deposited in the BMNH, it is evident that the 'white dot' referred to is in fact a pale v-shaped marking on the mesonotum, similar to that possessed by the adult female of this species.

The existence of a second New Guinean species of *Extatosoma* was first suggested in print by Harman (1985) who stated that there is '....another species [of *Extatosoma*] which occurs in the mountainous regions of Papua New Guinea. I have seen a number of specimens in the collection at the Wau Ecology Institute Museum'. During July and August of 1990 the author led an Imperial College (University of London) expedition to Papua New Guinea (PNG). For the first four weeks we were based at the Wau Ecology Institute (WEIC) and the author took the opportunity to investigate Harman's claim. Three adult females of an undescribed *Extatosoma* were present in the WEIC collection, together with a note stating that the taxon was new.

A reward was offered to two Papuan youths to collect living specimens of this species and one day later an adult female (fig. 1) was received. This individual was placed in a cylindrical net cage on cut foodplant standing in water and was kept alive for twelve days for observation.

Despite further requests and a search of the locality

Fig. 1. *Extatosoma carlbergi* sp. n. – Holotype ♀ resting on twig of *Calliandra surinamensis* Benth.

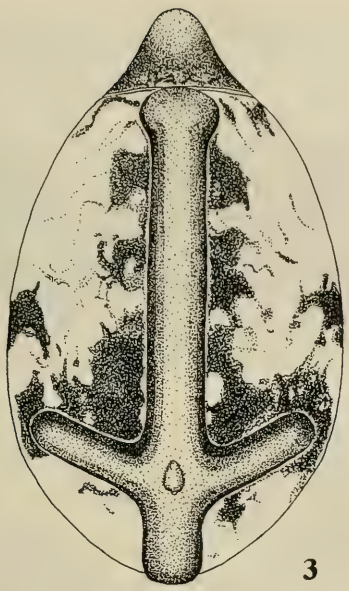
from which the specimen had been collected, no other individuals were obtained. Several local Papuans who were interviewed stated that they were familiar with this species but that it was only rarely seen (more rarely than *E. popa*).

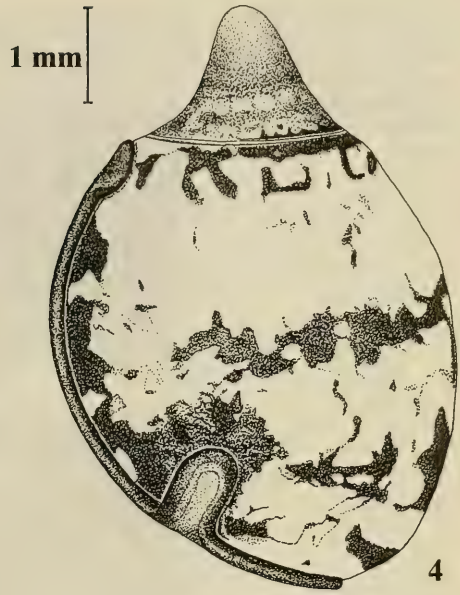
Materials and methods

The terminology used to describe eggs is after Clark (1976a), with the following additions and modifications : 'total egg length' is the length of the egg capsule plus the length of the operculum ; 'length of operculum' is the maximum length of the operculum from its base to its summit ; 'diameter of operculum' is the maximum diameter across the base of the operculum ; 'micropylar arm' is a new term given to the lateral extensions of the micropylar plate located on either side of the micropylar cup region ; 'length of micropylar arm' is the length of one micropylar arm measured from the centre of the micropylar cup to the apex of the arm; 'distance across micropylar arms' is the maximum distance between the tips of the micropylar arms ; 'height of micropylar mound' is the height with which the micropylar plate is raised above the surface of the egg capsule and is measured midway along the plate's length; 'chorionic membrane' is a new term given to the membrane or layer which covers the entire outer surface of the egg. This membrane expands and detaches from the egg surface if the egg is immersed in alkali (e.g. sodium hydroxide solution). The membrane is thinner and weaker around the base of the operculum and the portion of membrane covering the operculum remains attached to it when it detaches on hatching of the egg. The eggs of all four *Extatosoma* are covered by a chorionic membrane, but it appears to be absent from the eggs of other stick-insect species (Clark 1976b); 'capitulum', in light of the recent discovery that this structure has a function analogous to the elaiosome of certain plant seeds, and acts as a handle which enables ants to carry stick-insect eggs back to their nests (Compton & Ware 1991, Hughes & Westoby 1992), the author proposes to restrict Clark's (1976a) definition to structures attached to and protruding from the surface of the operculum.

The coloration of *E. carlbergi* is described from slides of the living holotype taken on 'Kodachrome 64' slide film under natural lighting conditions. Specimens of *E. carlbergi* and *E. popa* collected by the author were killed by freezing and preserved by injection of embalming fluid (formula in Cogan & Smith 1974). Eggs (fully developed) were removed from the

Fig. 2. *Extatosoma carlbergi* sp. n. – Holotype ♀, dorsal habitus.





Figs. 3-4. Egg of *Extatosoma carlbergi* sp. n. taken from ovipositor of holotype. – 3, dorsal view; 4, lateral view.

abdomen of the *E. carlbergi* holotype by first relaxing the specimen (in a sealed plastic box with damp tissue paper in the base) and then by softening a section of intersegmental membrane between tergites and sternites with 10% aqueous ammonia solution, so that an incision could easily be made and the eggs removed with forceps. The chorionic membrane was removed from eggs for study, by placing the eggs for c. 5 minutes in a 5% aqueous solution of sodium hydroxide at room temperature. Drawings were produced using a drawing tube on a Wild M5 stereomicroscope. All measurements are given in millimetres. Measurements of eggs (accurate to 0.01 mm) were made using an ocular micrometer, except for micropylar plate length, which because of the plate's curvature, was first drawn using a drawing tube and then measured using inelastic fishing line and a ruler. All other measurements (accurate to 1 mm) were taken from specimens using a pair of dividers and a ruler.

Abbreviations of depositories

BMNH: The Natural History Museum, London, England; BPBM: Bishop Museum, Hawai'i; TPNG: Central Reference Insect Collection, Department of Agriculture and Livestock, Port Moresby, Papua New Guinea; FICB: National Forest Insect Collection, Forest Research Institute, Lae, Papua New Guinea; NHMN: Nottingham Natural History Museum, Nottingham, England; UPNG: University of Papua New Guinea, Port Moresby, Papua New Guinea; WEIC: Wau Ecology Institute, Wau, Papua New Guinea.

TAXONOMY

Extatosoma carlbergi sp. n.
(figs. 1-5, 8, 12-14)

Type material. – Holotype ♀: Papua New Guinea, Morobe Province, Wau, golf course, c. 1150 m, ex *Calliandra surinamensis* Benth., 14.vii.1990, G. W. Beccaloni (BMNH). – Paratypes: PAPUA NEW GUINEA: 2♀, Southern Highlands Province, Tari, 1600 m, ex *Casuarina*, 4.x.1963, R. Straatman (BPBM); 1♀ (fragmented), Chimbu Province, Karimui, 4.vi.1961, Gressitt (BPBM); 1♀, Morobe Province, Wantoat, feeds on *Casuarina*, 1.xii.1957, R. W. Paine (BMNH).

Additional material examined. – NEW GUINEA: 1♀, no other data (NHMN); PAPUA NEW GUINEA: 2♀, Southern Highlands Province, Pangia, defoliating *Casuarina oligodon*, 1.vi.1971, J. Lowien (FICB); 1♀, Southern Highlands Province, Pangia, found on *Casuarina* trees, 30.iv.1971, J. Wallis (TPNG); 2♀, no data (WEIC); 1♀ (nymph, penultimate ? instar), Morobe Province, Wau, 1200 m, 14.x.1966, G. A. Samuelson (BPBM); 1♀, Morobe Province, Wau, 1100 m, collected on *Casuarina* sp., 10.xii.1974, A. D. Hart (WEIC); 1♀, Morobe Province, Wau, Wau Ecology Institute Office, 1150 m, 27.xi.1986, J. Somp (UPNG).

Description

Based on adult female holotype and four adult female paratypes. Measurements of selected structures given in table 1. Male unknown.

Female (adult) . – Head typical for the genus; hypognathous with conical occiput. Occipital medial spines large and robust; four pairs anterior to crest and two pairs posterior to crest. A large lamellate compound spine present on either side of occipital

Figs. 5-6. Lateral views of abdomens of adult ♀ *Extatosoma* spp., showing spination on tergites 3-10. – 5, *Extatosoma carlbergi* sp. n. (holotype); 6, *Extatosoma tiaratum*.

crest. Eyes small and globular, situated anterolaterally. Ocelli indicated by slight swellings covered by integument. Antennae simple, with 25 segments (n=2). A large spine present between eyes and antennal sockets.

Pronotum elongate-rectangular, slightly rounded posteriorly. Spines around margin variable in size and number; a pair of large medial lamellate spines usually present on posterior third of segment.

Mesonotum with a well developed pair of pre-median spines and a large pair of compound lamellate spines situated between tegminal bases. Lateral borders with 3-6 large spines, the two directly above the tegminal bases often confluent basally. Tegmina reduced, lobose, extending to posterior margin of metanotum.

Metanotum with a pair of well developed lamellae above posterior margin. Wings rudimentary, extending into anterior third of first tergite.

Tergites one to nine bearing a pair of medial compound lamellate spines on the posterior third, with a well developed simple spine posterior and to either side of these. The lamellate spines on tergites five and six especially well developed (fig. 5) ; those on tergites seven to nine are sometimes simple. The posterolateral margins of tergites two to nine expanded laterally and strongly serrated or spined. The anterolateral margin of the tenth tergite is similarly produced. Lateral expansions of tergites five to seven are c. twice the size of those on the other tergites. Tenth tergite usually with a pair of medial spines on posterior half and the hind margin has large posteriorly directed spines (fig. 5).

Supra-anal plate with large pair of posteriorly directed medial spines. Cercus 2.6 mm in length, bilobed, setose (fig. 14). Both structures concealed beneath tenth tergite.

Operculum keel-shaped, the anterior third ventrally expanded with a serrated edge (fig. 5). Sternites two to seven with many long to short irregularly arranged robust spines. A pair of double weakly confluent medial spines may be present posteriorly. Spination of sternites four to six reduced in comparison with that of sternites two to three. Meso- and metathoracic basisterna with few irregular short robust spines. Ventral margins of meso- and metathoracic episterna with long to short laterally or ventrally directed spines.

Fore femur with strongly serrated dorsal and lateral expansions. Fore tibia with dorsal expansion arcuate and ventral expansion denticulate (fig. 8). Proximal tarsomere of fore leg expanded into lobe

Table 1. Measurements of selected structures of type specimens and female (? penultimate instar) nymph of *E. carlbergi*. All measurements in mm (accurate to 1 mm). [1] excluding occipital spines; [2] n = 1.

Structures measured (Lengths)	Holotype	Paratypes (n=4)		Nymph
		x̄ ± SD	Range	
Body	128	129 ± 9.9	116 - 140	70
Antenna	27	27[2]	–	11
Head [1]	19	19.5 ± 1.3	18 - 21	11
Pronotum	9	10.5 ± 1.3	9 - 12	5
Mesonotum	15	16.0 ± 0.8	15 - 17	10
Metanotum	12	11.5 ± 0.6	11 - 12	5
Fore femur	25	22.5 ± 1.3	24 - 27	15
Median femur	20	20.3 ± 1.0	19 - 21	11
Hind femur	30	28.8 ± 1.0	28 - 30	15
Fore tibia	23	23.5 ± 0.6	23 - 24	13
Median tibia	21	21.0 ± 1.2	20 - 22	12
Hind tibia	32	32.8 ± 1.7	31 - 35	16
Operculum	26	24.3 ± 0.5	24 - 25	7

dorsally towards distal end. Dorsal surfaces of median and hind femora (figs. 12-13) with serrated expansion distally. Outer ventral margin serrated and expanded ventrally. Inner ventral margin spined and expanded distally. Dorsal expansions of hind tibia usually strongly arcuate (fig. 12), rarely weakly so (fig. 13); median tibia likewise. Inner and outer ventral margins of median and hind tibiae with large ventrally directed spines. Legs and body densely setose.

Coloration in life: Mesonotum with conspicuous v-shaped marking which is paler than rest of segment (this marking is usually white or cream in preserved specimens). Arms of 'v' extend from anterolateral corners of segment, with base of 'v' below middle of segment. Area between arms usually black or dark brown. Dorsal and ventral surfaces of body (including spines, tegmina and wings) pale green with darker green, white and black mottling; mirrored on each side of body. Intersegmental membranes cream to light brown. Legs with similar coloration to rest of body; dorsal surfaces with a higher incidence of larger black and dark green marks often arranged as transverse stripes; ventral surfaces (less so of fore legs) aposematically patterned with thick irregular black, ochreous and white transverse bands. Median and hind tibiae often with black predominating.

Nymph (female, penultimate ? instar). – Measurements given in table 1. Morphology similar to that of adult, except that wings not developed (small, c. 1.5 mm long wing buds present) and operculum is relatively shorter; not extending beyond posterior margin of ninth tergite and not covering the supra-anal plate or cerci. Coloration in life presumed similar to that of adult, as coloration is similar to that of the preserved adult specimens examined (i.e. with light to dark brown replacing pale green ground colour).

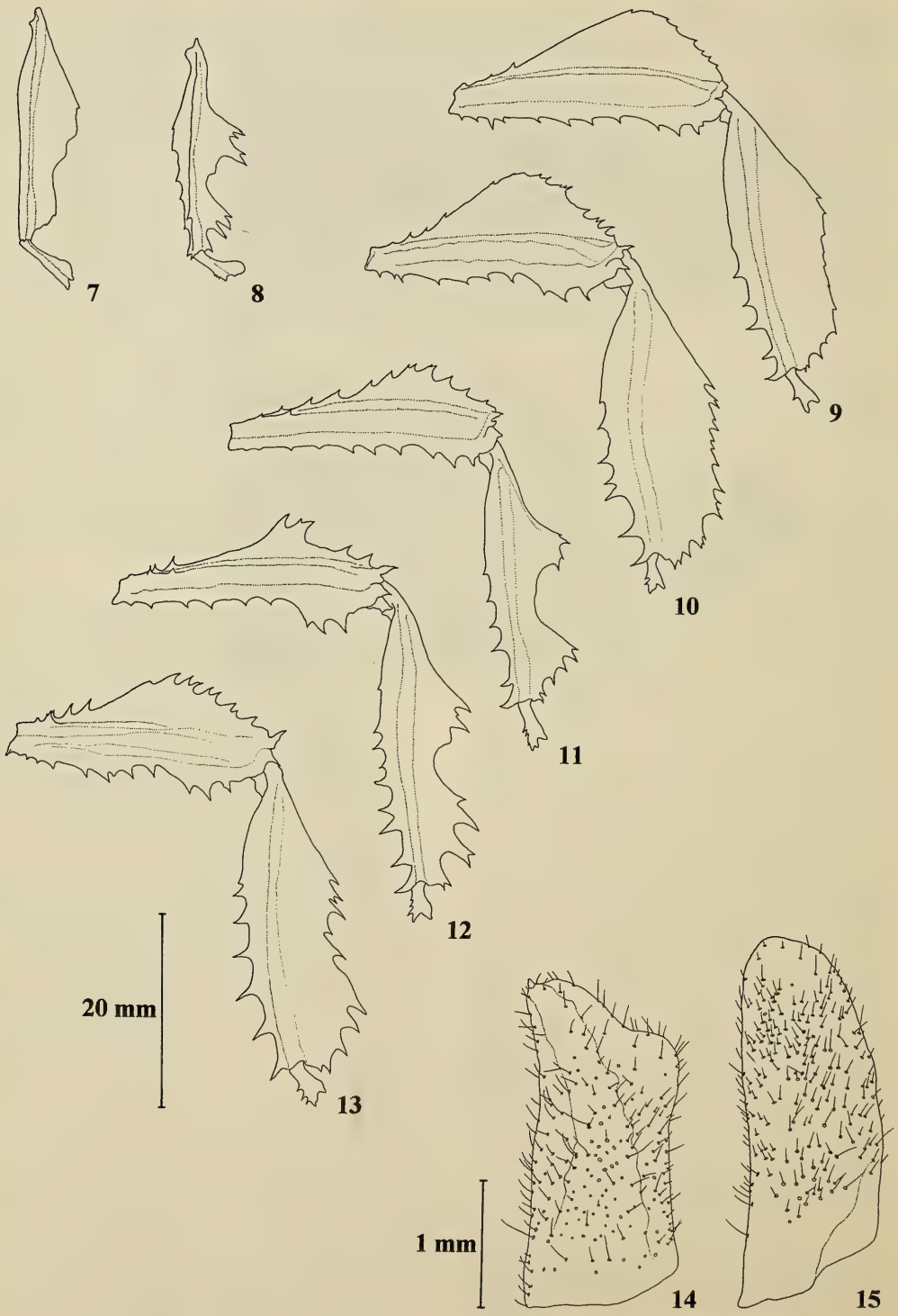
Egg (figs. 3-4). – Measurements given in table 2. Operculum conical. Chorionic membrane transparent, not thickened and modified into a capitulum on the operculum (see below). Capsule smooth and glossy, marked with mottled pattern of black and grey on cream. Micropylar plate cream, slightly raised above surface of capsule on micropylar mound, with lateral arm on either side of the micropylar cup region.

Etymology

This species is named in honour of Dr. Ulf

Table 2. Means, sample standard deviations and ranges of dimensions of 17 eggs from *E. carlbergi* holotype (1 egg taken from ovipositor, 16 extracted from abdomen). All measurements in mm (accurate to 0.01 mm).

Egg dimensions	x̄ ± SD	Range
Total egg length	6.54 ± 0.12	6.40 - 6.85
Capsule length	5.17 ± 0.07	5.06 - 5.31
Capsule height	4.49 ± 0.03	4.42 - 4.56
Capsule width (maximum)	3.79 ± 0.05	3.71 - 3.84
Length of operculum	1.37 ± 0.12	1.22 - 1.54
Diameter of operculum (maximum)	2.32 ± 0.07	2.20 - 2.43
Micropylar plate length	6.09 ± 0.28	5.70 - 6.73
Micropylar plate width (at middle)	0.67 ± 0.03	0.61 - 0.70
Length of micropylar arm	1.74 ± 0.06	1.60 - 1.79
Distance across micropylar arms	3.00 ± 0.07	2.88 - 3.07
Height of micropylar mound	0.15 ± 0.03	0.13 - 0.19


7
8
9
10
11
12
13
20 mm
1 mm
14
15

Carlberg, in recognition of his work on and passion for *Extatosoma.*

Biology and behaviour

In common with the other members of the genus, *E. carlbergi* is arboreal and when not feeding hangs motionless upside down under thin branches of the host tree (fig. 1). The holotype was collected on *Calliandra surinamensis* (Leguminosae), an introduction from South America commonly grown in PNG gardens (Verdcourt 1979). In captivity the specimen accepted *Leucaena* sp. (Leguminosae) and guava, *Psidium* sp. (Myrtaceae). Both originate from the Neotropics and the former is cultivated in Wau as a shade tree for coffee, while the latter is grown for its fruit. J. Somp (pers. comm.) informed the author that he has collected *E. carlbergi* on *Sterculia* sp. (Sterculiaceae), and *Casuarina* sp. (Casuarinaceae) is the only foodplant recorded on the data labels of this taxon examined during the course of this study.

Both *E. tiaratum* and *E. popa* are also polyphagous. The latter has been collected on *Casuarina*, *Diospyros ferrea* (Ebenaceae), *C. surinamensis* and *Hibiscus* sp. (Malvaceae) (taken from data labels listed in Appendix) and it will also feed on *Leucaena* and *Psidium* in captivity (pers. observation). For a list of the foodplants of *E. tiaratum* see Carlberg (1987b). The only foodplant known for *E. bufonium* is Japanese plum, ? *Prunus cerasifera* (Rosaceae) (from data label of adult female in Queensland Museum, Brisbane, Australia; collected at Mt. Tamborine, near Brisbane, December 1924).

When disturbed the *E. carlbergi* holotype was observed to exhibit a defensive behaviour similar to that shown by adult females of *E. tiaratum* (Carlberg, 1981) and *E. popa* (pers. observation). The abdomen is curled over the body, presenting the dense spination on the sternites towards the potential predator. The hind legs are raised and extended to reveal the aposematic pattern of black, white and ochreous bands on the ventral surfaces of the femur and tibia. This threat posture is maintained until any possible danger has passed. Should a predator approach too close, the insect will attempt to grasp it between the femur and tibia of the hind legs; retracting and extending the legs with a rapid, synchronous scissor-like action. The ventral margins of these appendages are furnished with sharp downwardly directed spines, which are capable of inflicting injury to human skin if caught between them.

The egg of *E. carlbergi* (figs. 3-4), which resembles a seed, is held in the ovipositor for several hours and is then catapulted to the ground with a vigorous flick of the abdomen. Eggs of *E. popa* (A. J. E. Harman, pers. comm.) and *E. tiaratum* (Carlberg, 1984) are deposited in a similar manner.

ECOLOGY AND DISTRIBUTION OF THE EXTATOSOMA SPECIES

The known distributions of the two New Guinean *Extatosoma* species is shown in fig. 16. The locality records plotted on this map were taken from data labels of specimens examined by the author or from the literature. Records for *E. popa* are listed in the Appendix while those for *E. carlbergi* are listed under the species description. Dubious records or possible misidentifications have been omitted.

From fig. 16 it can be seen that *E. popa* has a wider recorded geographical distribution than *E. carlbergi*, ranging from Jayapura in Irian Jaya to Mt. Obree in the Owen Stanley Range, PNG. Altitude appears to be the most important factor in determining the distributions of these two species. Günther (1929) placed *E. popa* in an altitude band of 600-1500 m above sea level. However, the highest that this species has been recorded is c. 1200 m at Budemu, PNG. In contrast, all known specimens of *E. carlbergi* have been collected in the range 1100 m (Wau, PNG) to 1600 m (Tari, PNG). Wau (1100-1200 m) and Wantoat, PNG, (1200 m), where the species are sympatric, are located within the c. 100 m altitudinal overlap of the two species ranges.

The altitudinal ranges of *E. popa* and *E. carlbergi* match the distributions of two discrete vegetation belts, lower montane rain forest and mid-montane rain forest respectively, which differ from each other both in terms of species composition and in the structure and physiognomy of the vegetation. Lower montane rain forest has a mean canopy height of 30-40 m and is distinctly drier in aspect than the mid-montane, with few species of ferns and mosses. In contrast, the mid-montane rain forest has a mean canopy height of 20-30 m and its main characteristic is the abundance and high species diversity of terrestrial and epiphytic ferns, mosses and lichens (Johns 1982).

It is proposed that the gross differences in colour pattern and morphology seen between *E. popa* and *E. carlbergi* (nymphs and adult females only; adult males of *Extatosoma* are macropterous and differ from nymphs and adult females in both body form and behaviour) are the result of these species evolving cryp-

Figs. 7-15. *Extatosoma* spp. adult ♀ appendages. – 7-8, lateral views of left fore tibia and proximal tarsomere: 7, *tiaratum*; 8, *carlbergi* sp. n. (holotype). 9-13, lateral views of left hind femur, tibia and proximal tarsomere: 9, *tiaratum*; 10, *popa*; 11, *bufonium*; 12, *carlbergi* sp. n. (holotype); 13, *carlbergi* sp. n. (paratype from Tari, PNG). 14 - 15, ventral views of left cercus: 14, *carlbergi* sp. n. (holotype); 15, *tiaratum*.

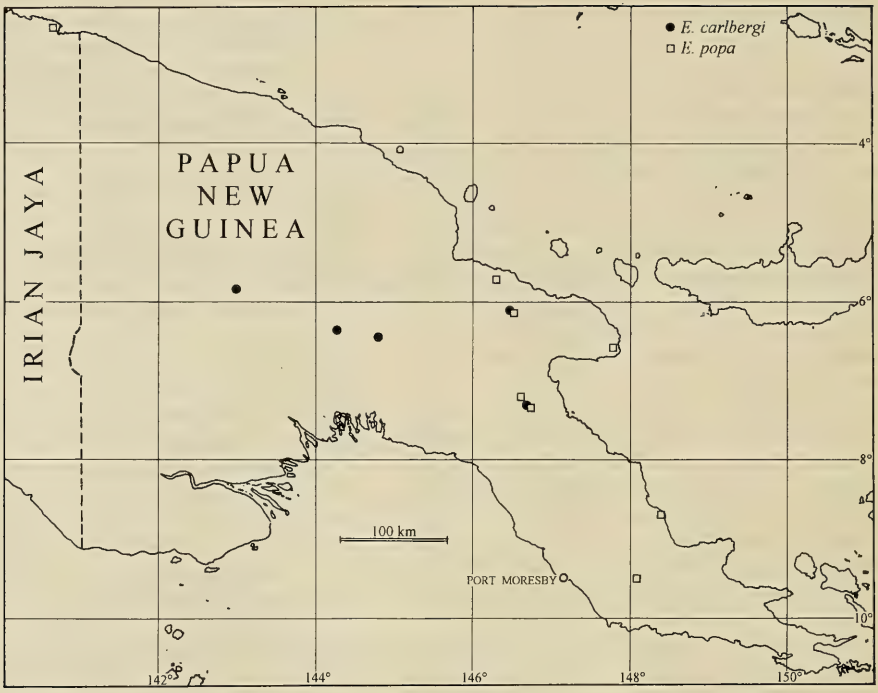


Fig. 16. Sketch map of Papua New Guinea and eastern Irian Jaya, showing known distributions of *E. popa* (13 records) and *E. carlbergi* (11 records).

sis adapted to different habitat types. Once evolved this would tend to restrict the species to the habitat in which it is best concealed from predators.

The body coloration of *E. popa* is primarily brown and when the insect is hanging under a branch at rest the foliose expansions of the legs (fig. 10) and abdomen give it a resemblance to a bunch of dried leaves. In the lower montane rain forests, where this species is found, dry brown leaves are presumably more common than in the wetter mid-montane forests occupied by *E. carlbergi*. In these latter forests, the bark of trees and other plants is covered by dense growths of lichens, and mosses are three times as abundant as in the lower montane (Johns 1982). Thus the dark green, white and black mottling of *E. carlbergi*, together with the arcuate flanges of the tibiae (figs. 8, 12) and small lateral expansions of the tergites (fig. 2), are probably adaptations for resembling foliose epiphytic lichens, such as the abundant *Usnea*, or leaves covered with epiphyllous growth.

The crypsis of the Australian *Extatosoma* mirrors that of the New Guinean species, with one, *E. tiaratum*, a leaf mimic (Brock 1992) and the other, *E. bufonium*, a probable lichen mimic. Both taxa are restricted to the coastal forests of eastern Queensland and New South Wales (NSW), although the former species has doubtfully been recorded from Lord Howe Island (Redtenbacher 1908, Günther 1931). *E. tiaratum* is distributed from Daintree in north-east Queensland (data from a final instar female nymph in BMNH) to Kiama, near Sydney, NSW (Froggatt 1922) and appears to range further inland than *E. bufonium* (Beccaloni, unpublished). It is possible that literature records of '*E. tiaratum*' from Brisbane southward represent the undescribed taxon referred to earlier. *E. bufonium* ranges from Moreton Bay, near Brisbane, south-east Queensland (data from a female nymph in BMNH) to Camden, near Sydney, NSW (Froggatt, loc. cit.). This species may also occur in north-east Queensland, as a female nymph probably belonging to this taxon was collected in Atherton in 1989 (P. D. Brock, pers. comm.). A patchwork of different forest types (ranging from rain forest to dry eucalypt woodland) is found in eastern Queensland and NSW and without further detailed study it is not possible to determine in which habitats the Australian *Extatosoma* live. However, considering the types of crypsis exhibited by these species, it is hypothesised that *E. bufonium* will be found to inhabit a habitat type with a higher representation of lichens and other epiphytes than that in which *E. tiaratum* occurs.

COMPARATIVE MORPHOLOGY AND PHYLOGENETIC RELATIONSHIPS

The characters discussed below are taken from adult females and eggs, as only males of *E. popa* and *E. tiaratum* are known and they do not exhibit suffi-

cient characters to make comparisons worthwhile.

Both *E. popa* and *E. tiaratum* range from light to dark brown in colour, although the latter species is known to have a green form which is not uncommon. The dorsal foliose expansions of the femur and tibia of the legs (figs. 7, 9-10) are broad and well developed in both species, as are the lateral expansions of the fifth to seventh tergites (as in fig. 6). The lateral expansions of tergites two to four and eight to nine are reduced (*E. popa*) or obsolete (*E. tiaratum*).

The coloration of *E. carlbergi* and *E. bufonium* is again similar: both are green, with white and black mottling in varying proportions. The dorsal expansions of the tibiae (figs. 8, 11-13) are arcuate in both taxa and the lateral expansions of the fifth to seventh tergites (as in figs. 2, 5) are much reduced relative to those of *E. popa* and *E. tiaratum*. Lateral expansions of tergites two to four and eight to nine are relatively well developed.

The superficial similarities in coloration and body form (listed above) between *E. popa* and *E. tiaratum* and between *E. carlbergi* and *E. bufonium*, are probably due to convergence upon analogous cryptic morphologies and thus do not reflect the phylogenetic relationships of the group. Characters not obviously related to crypsis (see below) are incongruent with those characters involved in crypsis and suggest a grouping reflecting the biogeographical division of the taxa (New Guinea / Australia).

The New Guinean taxa share a number of features not possessed by the Australian taxa. Both are larger than the Australian species and the body spination is relatively longer and more robust. Both possess a distinctive pale v-shaped marking on the mesonotum, and the pair of medial lamellate spines on the posterior third of the meso- and metanotum are large and well developed. The paired medial lamellae of the fifth and sixth terga each occupy about one-third of the length of the segment and their basal width is less than their height (as in fig. 5). The posterior margin of the tenth tergite has large posteriorly directed spines (as in fig. 5) and the apex of the cercus is bilobed (as in fig. 14). The ventral expansion of the fore tibia has a denticulate margin (as in fig. 8) and the inner ventral margin of the median and hind femur is expanded ventrally towards its distal end (figs. 10, 12-13). The egg of *E. popa* (fig. 100 in Sellick, 1980) is virtually identical in appearance and dimensions to that of *E. carlbergi* (figs. 3-4).

The Australian taxa share the following characters: the pale mesonotal v-shaped marking (of *E. popa* and *E. carlbergi*) is absent in the adults (although present in newly hatched nymphs of *E. tiaratum*) and the pair of medial spines on the posterior third of the meso- and metanotum are poorly developed and, if double, are only weakly confluent basally. The paired medial lamellae of the fifth and sixth tergites each occupy about one half of the segment and their basal width is greater than their height (as in fig. 6). The posterior margin of the tenth tergite has small posteriorly directed spines (as in fig. 6), which may be subobsolete, and the cercus is tapered towards its apex (as in fig. 15). The margin of the ventral expansion of the fore tibia is entire (as in fig. 7) and the inner ventral margin of the median and hind femur is only weakly (or not) expanded ventrally towards its distal end (figs. 9, 11). The eggs of *E. tiaratum* (fig. 8 in Clark, 1976a) and *E. bufonium* (pers. observation) share a number of characters not possessed by eggs of the New Guinean taxa. Eggs of both species lack micropylar arms and the opercula are only c. half the length (corrected for differences in egg size) of *E. popa* / *E. carlbergi* eggs. In addition, the chorionic membrane on the opercula of eggs of the Australian species is thickened and modified into an opaque hollow dome or capitulum. The chorionic membrane on the opercula of eggs of the New Guinean species is not modified into a capitulum, and instead is transparent and lies in contact with the surface of the operculum. (Note that the capitulum of *E. tiaratum* is relatively much larger than that of *E. bufonium*. Also note that the egg of *E. bufonium* is c. half the size of that of *E. tiaratum*, the capitulum is dark brown in colour and the egg capsule has a pitted and irregular surface. The capitulum of *E. tiaratum* is cream in colour and the egg capsule is smooth and glossy like the capsules of the New Guinean taxa).

It has not been possible to determine the polarity of the above characters, as appropriate outgroups to *Extatosoma* have not been identified. The other genera (e.g. *Podacanthus* Gray, *Tropidoderus* Gray, *Didymuria* Kirby) placed with *Extatosoma* in the tribe Tropidoderini, differ greatly from *Extatosoma* in both adult and egg morphology preventing useful comparison. However, the non-polar characters described above imply that either the two New Guinean species are sister taxa and/or the Australian species are sister taxa. This ambiguity can only be resolved through polarity determination.

Key to the adult females of *Extatosoma*

1. Mesonotum with conspicuous pale v-shaped marking; ventral expansion of fore tibia with denticulate margin (as in fig. 8) 2
– Mesonotum lacking a pale v-shaped marking; ventral expansion of fore tibia with entire margin (as in fig. 7) 3
2. Lateral expansions of tergites 5-7 small, non-overlapping (fig. 2); dorsal expansions of median and hind femur arcuate (figs. 12-13); body coloration pale green, with white and black mottling

.....*carlbergi* Beccaloni

– Lateral expansions of tergites 5-7 large and overlapping; dorsal expansions of median and hind femur broad, not arcuate (fig. 10); body coloration light to dark brown .....*popa* Stål

3. Tergites 2-4 and 8-10 bearing lateral expansions; dorsal expansions of median and hind femur arcuate (fig. 11); body coloration green, with darker green, white and black mottling.....
.....*bufonium* Westwood

– Tergites 2-4 and 8-10 without lateral expansions; dorsal expansions of median and hind femur broad, not arcuate (fig. 9); body coloration brown or green, not mottled .....
.....*tiaratum* (MacLeay)

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The author's thanks also go to Mr P. D. Brock and Mr A. J. E. Harman (UK) for providing useful information, to Dr U. Carlberg (Sweden) for his enthusiasm and help, and to Jerry and Willie of Wau (PNG) for collecting the holotype of *E. carlbergi*.

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References

Bragg, P., 1991. Species census returns 1991. – Phasmid Study Group Newsletter 46: 6.

Brock, P. D., 1992. Rearing and studying stick and leaf insects. – The Amateur Entomologists' Society, Handbook 22: i-v, 1-73.

Carlberg, U., 1981. Defensive behaviour in adult female *Extatosoma tiaratum* (MacLeay) (Phasmida). – Entomologist's Monthly Magazine 116: 133-138.

Carlberg, U., 1983. Bibliography of Phasmida (Insecta) I. 1970-1979. – Spixiana 6: 27-43.

Carlberg, U., 1984. Oviposition behaviour in the Australian stick insect *Extatosoma tiaratum*. –Experientia 40: 888-889.

Carlberg, U., 1987a. Bibliography of Phasmida (Insecta) VI. 1980-1984. – Spixiana 10: 147-156.

Carlberg, U., 1987b. Culturing stick- and leaf-insects (Phasmida)-A review. – Zeitschrift Versuchstierkunde 29: 39-63.

Clark, J. T., 1976a. The eggs of stick insects (Phasmida): a review with descriptions of the eggs of eleven species. – Systematic Entomology 1: 95-105.

Clark, J. T., 1976b. The capitulum of phasmid eggs (Insecta: Phasmida). – Zoological Journal of the Linnean Society 59: 365-375.

Cogan, B. H. & K. G. V. Smith, 1974. Insects. – Instructions for Collectors 4a, 5th Edition, British Museum (Natural History), London, 169 pp.

Compton, S. G. & A. B. Ware, 1991. Ants disperse the elaiosome-bearing eggs of an African stick insect. – Psyche 98: 207-213.

Froggatt, W. W., 1922. Description of a new phasma belonging to the genus *Extatosoma*. – Proceedings of the Linnean Society of New South Wales 47: 344-345.

Günther, K., 1929. Die Phasmoïden der deutschen Kaiserin Augusta-Fluss-Expedition 1912-13. – Mitteilung aus dem Zoologisches Museum in Berlin 14: 597-746.

Günther, K., 1931. Beiträge zur Systematik und Geschichte der Phasmoïdenfauna Ozeaniens. – Mitteilung aus dem Zoologisches Museum in Berlin 17: 753-835.

Gurney, A. B., 1947. Notes on some remarkable Australasian walkingsticks, including a synopsis of the genus *Extatosoma* (Orthoptera: Phasmatidae). – Annals of the Entomological Society of America 40: 373-396.

Harman, A., 1985. The genus *Extatosoma* Gray. – Phasmid Study Group Newsletter 25: 5.

Hughes, L. & M. Westoby, 1992. Capitula on stick insect eggs and elaiosomes on seeds: convergent adaptations for burial by ants. – Functional Ecology 6: 642-648.

Johns, R. J., 1982. Plant zonation. p. 309-330. – In: J. L. Gressitt (Ed.), Biogeography and Ecology of New Guinea. Junk, The Hague.

Redtenbacher, J., 1908. p. 380-381. – Die Insektenfamilie der Phasmiden 3. Verlag Von Wilhelm Engelmann, Leipzig.

Sellick, J. T. C., 1980. A study of the eggs of the insect order Phasmida with particular reference to the taxonomic value of egg structure in this group. – Unpublished Ph. D. thesis, University of London, England.

Verdcourt, B., 1979. – A manual of New Guinea Legumes. Kristen Press Inc., Madang, PNG, 645 pp.

Vickery, V. R., 1983. Catalogue of Australian stick insects (Phasmida, Phasmatodea, Phasmatoptera, or Cheleutoptera). – CSIRO Australia, Division of Entomology Technical Paper 20: 1-19.

Wilson, S. K., 1991. Throwing your babies at the enemy. – GEO Australasia's Geographical Magazine 12: 106-113.

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Appendix

The following records of *Extatosoma popa* were used to plot fig. 16. The data have been taken from material examined by the author, unless stated otherwise. IRIAN JAYA: 1♂, Hollandia, 3°10'S 140°E, 300-600 m, i.1937-8, W. Stüber (BMNH). Papua New Guinea: Madang Prov.: 1♀, Finisterre Mts., Damanti, 1065 m, 2-11.x.1964, M. E. Bacchus (BMNH); 1♀, Finisterre Mts., Budemu, c. 1200 m, 15-24.x.1964, M. E. Bacchus (BMNH); Morobe Prov.: 2♀, Wantoat, 1200 m , *Casuarina*, x.1957, R. W. Paine (BMNH); 2♀, Wau, golf course, 1150 m, ex *Calliandra surinamensis* Benth., 13.vii.1990, G. W. Beccaloni (BMNH); 1♀ (nymph), Wau, c. 1200 m, ex *Hibiscus*, 1.vii.1990, G. W. Beccaloni (BMNH); 1♀ (nymph), Wau, 1150 m, 24.vi.1974, Gewise Otaweto (WEIC); 1♂, Wau, 1180 m, 18.x.1974, A. D. Hart (WEIC); 1♂, Wau, 1150 m, coll'd on *Diospyros ferrea*, 6.xii.1975 (WEIC); 1♀, Bulolo, v.1990 (BMNH); Northern Prov.: 1♀, Mt. Obree, 1.x.1921, R. Neill (BMNH).

The following records were taken from Gurney (1947): Papua New Guinea: Morobe Prov.: Sattelberg, vic. Finschafen; Northern Prov.: Buna.

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see page 288

THOMAS W. DONNELLY

Binghamton, N. Y., U. S. A.

TWO NEW GENERA OF ISOSTICTID DAMSELFLIES FROM NEW BRITAIN, BOUGAINVILLE, AND THE SOLOMON ISLANDS (ODONATA: ZYGOPTERA)

Donnelly, T. W., 1993. Two new genera of isostictid damselflies from New Britain, Bougainville, and the Solomon Islands (Odonata: Zygoptera). – Tijdschrift voor Entomologie 136: 125-132, figs. 1-23, tab. 1. [ISSN 0040-7496]. Published 10 December 1993.
Titanosticta and *Cnemisticta* are new genera of the Isostictidae described from the eastern Papuan - Melanesian region. New species *Titanosticta macrogaster* (New Britain), *Cnemisticta angustilobata* (New Britain), and *C. latilobata* (Bougainville, Gizo, Malaita, and Guadalcanal) are also described. The two genera bear no particularly close relationship with any of the Papuan (*Selysioneura, Tanymecosticta*), New Caledonia (*Isosticta*), or Australian (seven genera) taxa.
Dr. Thomas W. Donnelly, 2091 Partridge Lane, Binghamton NY 13903 USA.
Key words. – Odonata, New Guinea, Solomon Islands, new genera, new species.

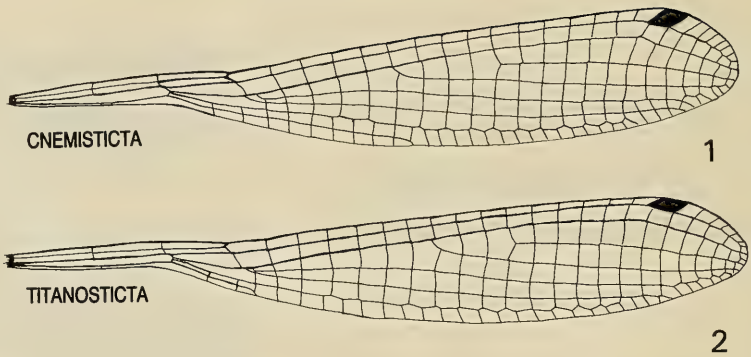
The damselfly family Isostictidae is reported from the Australian subcontinent, the Papuan region (extending westward to Tanimbar and Halmahera), and the island of New Caledonia, where the type genus occurs. In Australia, Watson et al. (1991) recognize seven genera. *Tanymecosticta* is widespread on New Guinea, has a single species in New Britain and another on Woodlark on the east, and occurs on Misool and Tanimbar on the west. *Selysioneura* is widespread on New Guinea, and occurs on Misool, Halmahera, and Morotai on the west, and Woodlark, D'Entrecasteaux, and the Louisiade Archipelago on the east. I herein describe two new Papuan genera: *Titanosticta* and *Cnemisticta,* which occur in New Britain and the Solomon Islands. The new genera overlap only slightly in range with either of the two Papuan genera: thus, they fill a geographic gap in the range of the family.

The Isostictidae had long been considered a subfamily of the Protoneuridae, but has recently been separated into a separate family, largely on the basis of larval characters (Lieftinck 1975). Adults resemble the protoneurids, and differ from most otherwise similar Oriental Coenagrionoid families by their narrow wings, with the anal portion highly reduced. They differ from the Protoneuridae by their absence of bright colours (protoneurid adults are almost invariably marked with bright colours, especially in the males), their generally longer CuP, and larvae (as far as known) with saccoid, rather than flat, caudal lamellae with subapical constriction. Some genera of Oriental protoneurids have a very short anal vein; this vein is always totally lacking in isostictids. Another character of most genera of the isostictids is a prominently and elaborately developed hind lobe of the prothorax; *Selysioneura* and one species of *Cnemisticta* are conspicuous exceptions.

Fraser (1955) discussed this group (which he considered a subfamily of the Protoneuridae) and suggested a relationship with the platycnemidids. In common with the Protoneuridae, but conspicuously different from the Platycnemididae, the Isostictidae have short legs with short leg spines. However *Cnemisticta* has a broader wing which is abruptly narrowed distal to the pterostigma and a relatively long CuP, both of which are reminiscent of the Platycnemididae. The larvae of the Platycnemididae have highly variable caudal lamellae and do not seem to form a single coherent group.

In the absence of larval forms for most genera it is not profitable at this time to suggest relationships within the family. The two new genera do not seem to have an especially close affinity with any other Papuan or Australian genus. *Cnemisticta* is notably distinct within the family because of its broader wing with abrupt terminal narrowing, and long CuP.

Abbreviations for collections in which type material is located: UZMC – Universitetets Zoologiske Museum, Copenhagen; RMNH – Rijksmuseum van Natuurlijke Historie, Leiden; TD – Collection of T. Donnelly, Binghamton.



Figs. 1-2. Venation of hind wings. – 1, *Cnemisticta angustilobata*, gen. n., sp. n. 2, *Titanosticta macrogaster*, gen. n., sp. n.

***Titanosticta* gen. n.**
(figs. 2, 3-7)

This is the largest damselfly in the family Isostictidae and one of the longest Zygoptera in the Oriental region. It is distinguished by the short CuP, which is two cells long (rarely one). Also, Ac is just proximal to Ax1 in the fore wing, and slightly distal in the hind wing; the arculus is distal to the Ax2 of both wings; IR2 arises at the 7-8th Px of the fore wing and at 6 or 7th (rarely 5th) in the hind wing; R4+5 arises distal to the subnodus. The pterostigma is rhombic and longer than broad. The wing is narrowed gradually distal to the pterostigma. The inferior appendage of the sole species is much larger than the superior. In common with other genera of the family, the legs are short with short spines, and the body colours are dull.

Type species: *T. macrogaster* sp. n.; the only known locality is New Britain.

Etymology: 'Titan', from mythology, signifying very large size, and '-sticta', the predominant suffix for genera in this family.

In addition to its very large size, *Titanosticta* is distinguished from all other isostictid genera by the following combination of characters: inferior appendage much larger than the superior; CuP two cells long, vein R4+5 arising distal to subnodus, very small tarsal claws, and Ac close to Ax1 in the fore wing and slightly distal to Ax1 in the hind wing.

Titanosticta macrogaster sp.n.
(figs. 2, 3-7)

Type material. – Holotype ♂: Papua New Guinea. New Britain. Yalom, 1000 m, 20 May 1962. Noona Dan Exped. (UZMC). Allotype ♀: Papua New Guinea. New Britain. Metelen River, 20 mi. S.E. of Ruango, July 1970, V. Jindrich (RMNH). Paratypes: 2 ♂ same locality as holotype, 19-20 May 1970 (RMNH, TD); 1♂ Papua New Guinea. New Britain. Metelen River, 20 mi. S.E. of Ruango, July, 1970, V. Jindrich (TD).

Additional material. – An additional ♀ in the Donnelly collection, with the same data as Metelen River paratype, is not designated a paratype because it lacks both a head and the terminal segments of the abdomen.

Male holotype. – This is an obscurely marked species varying from pale gray brown to dark, shining brown.

Head: Labium pale with rounded triangular central excavation about 2/5 the length of the segment. Face mainly pale; labrum shining black with thin apical yellow rim and pale central, basal spot; postclypeus pale with prominent black anterior and lateral margins; frons pale with small black spots anterior and posterior to antennae and irregular black central stripe enclosing front of lateral ocelli and median ocellus; pedicel about 1.5 times the length of the scape, both pale.

Prothorax: Pale, small paired central black spots on hind lobe and very small black marks on remainder pronotum; hind lobe sharply recumbent, broadly T-shaped, with a basal constriction.

Pterothorax: Mesostigmal laminae small, slightly tapered apically, with rounded tips; pterothorax grayish green; mesepisternum with stripe on dorsal carina occupying 1/6 of sclerite; very thin dark line on antehumeral suture; 2nd lateral suture with small dark spot on caudal sixth.

Legs: Yellow with contrasting dark spines: 4 on outer row of hind femur, 5 on hind tibia.

Wings: Venation described in generic diagnosis; venation brown, rhombic, pale red brown.

Abdomen: Pale, darker at tip; 1 and 2 greenish gray; 3 to 8 yellow, darkening apically; 9 and 10 shining dark brown. Superior appendage dark, shorter than 10, constricted apically to terminate in rounded, cylindrical tip, with low, rounded basal-ventral prominence. Inferior appendage 1.5 times length of superior, forcipate, laterally flattened, expanded abruptly in caudal half, excavate on dorsal-apical corner to

Table 1. Characters of genera of Isostictidae. – Explanation: CuP: Number of cells length; both wings considered. Inferior appendage: of male, whether large or smaller than superior appendage. Hind lobe of prothorax, male: whether prominent (flared, with horns, or with other processes) or low. Ac or Ax1: which crossvein is in more distal position in hind wing. Tarsal claws: size compared with other coenagrionoids. R4+5: origin of vein with respect to nodus.

Genus	Range	length of CuP, cells	male inferior appendages	hind lobe prothorax male	tarsal claws	R4+5 to nodus	hw: Ac or Ax1 distal
Isosticta	New Caledonia	1 - 6	equal	prominent	normal	distal, proximal, or aligned	Ax1; some spp. nearly aligned
Selysioneura	New Guinea, Misool, Halmahera, Morotai, Woodlark, D'Entrecasteau, Louisiade Arch.	0 - 1	smaller	low	very small	distal	Ax (nearly aligned in some spp)
Tanymecosticta	New Guinea, New Britain, Woodlark, Misool, Tanimbar	1	slightly smaller	prominent	small	distal	Ax
Titanosticta	New Britain	2 (1)	larger	prominent	very small	distal	Ax
Cnemisticta	New Britain, Bougainville, Solomon I.	(7) 8 - 10 (11)	larger	prominent or low	normal	proximal	Ac
Rhadinosticta	Australia	1	larger	prominent	normal	proximal	Ax1
Oristicta	Australia	1	smaller	prominent	very small	distal	Ac
Neosticta	Australia	5 - 6	smaller	prominent	normal	proximal	Ac (close)
Labidiosticta	Australia	0 - 2	smaller	prominent	very small	distal	Ax1
Eurysticta	Australia	1 - 2	smaller	prominent	normal	proximal	Ax1
Lithosticta	Australia	5 - 7	equal	prominent	normal	proximal	Ax1
Austrosticta	Australia	4 - 6	larger	prominent	normal	proximal	Ac (close)

form two rounded tips. Penis with terminal segment Y-shaped.

Female allotype. – Similar to male, but face more pale: labrum yellow with obscure paired lateral spots; anteclypeus mottled brown; postclypeus pale with brown anterior and lateral margins, this dark colour extended posteriorly in center and at lateral extremes; top of head gray-green, black as follows: short transverse dashes anterior to median ocellus; jagged transverse stripe enveloping median ocellus extending posterior to lateral ocelli.

Thorax: Hind lobe of prothorax quadrate, scarcely narrowed at base, the central portion of hind rim excavate in the center with a medial, rounded knob. Colour of side of thorax greenish yellow. Basal segments of abdomen as in male; 5 terminal abdominal segments lacking.

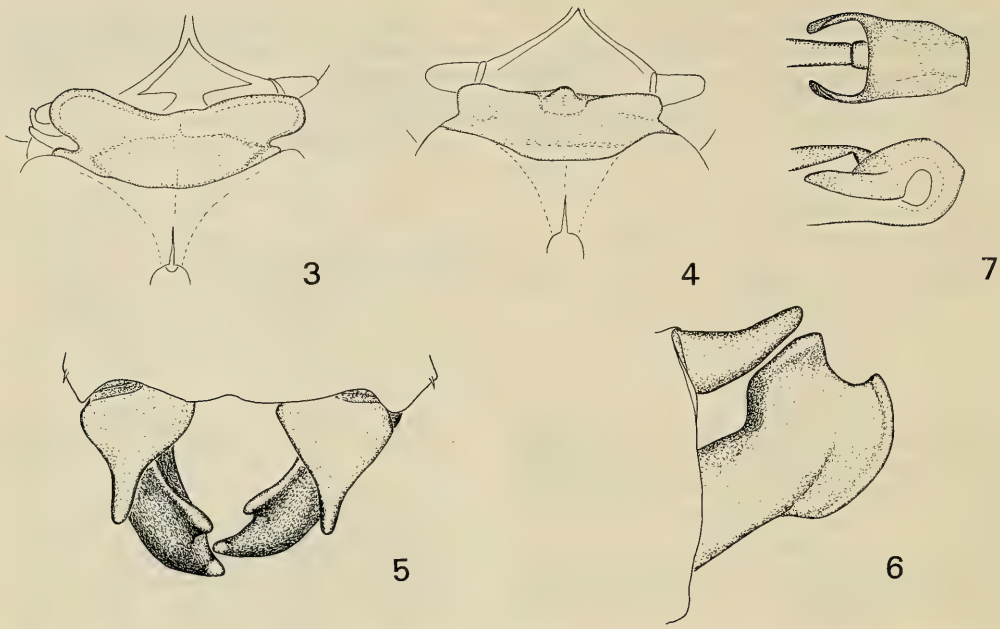
Dimensions. – Holotype male: abdomen 60.5 mm, hind wing 32 mm. Allotype female, hind wings dissimilar, 29.5 and 31 mm.

The dimensional range of the paratype series is as follows: two males have abdomens 46 and 63 mm, and hind wings 32-32.5 mm. The 2nd female has the hind wing 30 mm.

Variation within paratype series. – The three males have notably different abdomen lengths. The Metelen River male has the abdomen (46 mm) more than a centimeter shorter than the Yalom males (60.5 and 63 mm), but the hind wing of this specimen (29 mm) is only slightly shorter than the other two (32 mm). There are only trivial differences among the three males in colour pattern. One male has a broader black stripe on mesepisternum (⅓ rather than ¼ the width of the sclerite). The females, which are both regrettably incomplete, appear essentially identical.

Etymology. – The name, a noun in apposition, refers to the very long abdomen.

Remarks. – The difference in abdomen length of the males (which have very similar hind wing lengths) violates the normally firm linear allometric relationship (in this case the ratio between abdomen and hind wing) among Zygoptera. The constancy of this ratio can be attributed to the necessity of maintaining a uniform dimensional ratio to enable the insect to fly vigorously. There are similar disparities in this di-



Figs. 3-7. *Titanosticta macrogaster,* gen. n., sp. n. – 3, male hind lobe of prothorax, dorsal view. 4, female hind lobe of prothorax, dorsal view. 5, male abdominal appendages, dorsal - lateral - apical view. 6, male abdominal appendages, lateral view. 7, penis, ventral and lateral view.

mensional ratio among New World Pseudostigmatidae, which have extremely long abdomens and which fly much less vigorously than other Zygoptera. The violation of a constant ratio in the few specimens of *Titanosticta* raises the question as to whether the flight of this genus (which has not been recorded) might resemble the weak flight of the pseudostigmatids.

Cnemisticta gen. n.
(figs. 3, 8-23)

This genus contains two species of large isostictids. It is immediately recognized by the length of CuP, which in the type species *C. angustilobata* is 8 to 10 cells long in the fore wing) and 8 (rarely 7) to 10 (rarely 11) in the hind wing. IR2 arises at the 7-8th Px in the fore wing (rarely 9th) and 5 to 6th in the hind wing. In *C. latilobata* IR2 arises at the 5-6th (rarely 7th) Px in the fore wing and 4-5th Px in the hind wing; CuP is 8-10 cells long in the fore wing and 7-9 in the hind wing. In both species vein Ac arises just distal to the Ax1 of the fore wing and ⅗ the distance between the 1st and Ax2 in the hind wing; the arculus is distal to the Ax2 in both wings; R4+5 arises proximal to the subnodus in both wings. The pterostigma is rhombic and as wide as long. The tarsal claws are of normal length and the inferior abdominal appendage of the male is much larger than the superior. The two species range from New Britain to Bougainville, Gizo, Malaita, and Guadalcanal.

Type species. – *C. angustilobata* sp. n., from New Britain.

Etymology. – 'Cnem-' from the slight resemblance to some platycnemidids.

This genus is distinguished from all other isostictids by its much longer CuP and abrupt narrowing of the wing beyond the pterostigma. The two species vary from each other in the extent of development of the hind lobe of the prothorax. The species *C. latilobata* has a very prominent hind lobe, similar to that of *T. macrogaster,* and to most of the other members of the family. The species *C. angustilobata* has a highly reduced hind lobe, in common with the most widespread Papuan isostictid, *Selysioneura.*

Cnemisticta angustilobata sp. n.
(figs. 1, 8-15)

Type material. – Holotype ♂: Papua New Guinea. New Britain: Yalom, 1000 m, 18 May 1962, Noona Dan Exped. (UZMC). Allotype ♀: same data as holotype, except coll. 19 May 1962 (UZMC). Paratypes: 3♂ 1♀ same data as holotype except coll. 18-19 May 1962 (RMNH); Papua New Guinea. New Britain. Metelen River, 20 mi. S.E. of Ruango, July 1970, V. Jindrich (TD); 1 ♂ Papua New Guinea. New

Britain: Gazelle Pen., upper Warango, 250-600 m, 28-30 Nov 1962, J. Sedlacek (RMNH).

Additional material. – 4 additional ♂ collected by Sedlacek (RMNH) along with last named paratype are not designated as paratypes because they lack the terminal segments of the abdomen.

Description

Male holotype. – This is a dark, obscurely marked damselfly.

Head: labium pale with rounded excavation in apical ⅓; frons rounded; face and top of head black; labrum black with pale, obscurely defined central stripe; genae pale, anteclypeus obscurely pale; pedicel slightly longer than scape, both dark; rear of head pale.

Prothorax: Pale laterally, mottled dark on dorsum, with large tringular paired dark spots on median lobes; apodyne extended posteriorly as commissure nearly to hind lobe; hind lobe small and low, rounded triangular with central part slightly thickened.

Pterothorax: Mesostigmal laminae simple, parallel sided, rounded, slightly elevated lateral tip; mesepisternum black, mesepimeron dark with pale on mesal ¼ (adjacent to antehumeral suture) and cephalic ¼; mesinfraepisternum pale on outside, central half dark; the dark colour of the mesepisternum essentially extensive to metepisternum with only thin pale lines on the two lateral sutures; metepisternum pale with black spot on caudal ⅙; metepipimeron and metastermum pale.

Legs: Pale with thin dark dorsal lines on femora; spines brown, not contrasting with legs, 5 on hind femur and hind tibia.

Wings: Venation as for genus; IR2 arising at 7 (fore wing) and 5 (hind wing); CuP 9 cells long in fore wing and hind wing; pterostigma rounded, rhombic, as long as wide, pale reddish brown.

Abdomen: Pale, dark on dorsum of 1 and 2, obscurely dark on dorsum of 3 to 7, with apical ¼ distinctly darker on 3 to 6; 7 uniform; 8 with obscurely dark dorsal mark in caudal ⅔; 10 with obscure paired dark spots on caudal ⅓. Superior appendage shorter than 10, blunt, rounded, slightly expanded and branched in dorsal view, with mesal branch very short; with ventrally directed spine. Inferior appendage more than twice as long than superior, forcipate, laterally flattened, with caudal half expanded into prominent rounded keel on dorsal and apical portions. Penis with terminal segment Y-shaped.

Allotype female. – Similar to male. Face pale; postclypeus pale with dark lateral margins; top of head pale, about half dark, with an irregular dark mark centered on the ocelli, small dark spots anterior to antennae, and short transverse dark stripes posterior to lateral ocelli. Thorax: Hind lobe of prothorax similar to male but slightly larger, low triangular, with a stepped appearance. Colour of thorax: mesepisternum with pale stripe above antehumeral suture ¼ the width and in the cephalic ¾ of the sclerite; mesepimeron with short central elongate dark mark; Metepisternum with small caudal dark mark. Abdomen: Dorsum of 8 to 10 pale; ovipositor dark, extending distinctly beyond 10 (cerci).

Dimensions. – Holotype male: abdomen 44 mm, hind wing 29 mm. Allotype female: abdomen 45.5 mm. The dimensional range of the paratype series is as follows: 5 paratype males have the abdomens 43.5 to 47.5 mm; 8 males have the hind wing 26 to 29 mm. A paratype female has the abdomen 45.5 mm and the hind wing 32.

Variation within paratype series. – The Gazelle Peninsula and Metelen River males are paler than the Yalom series; the dark colour of the side of the thorax ranges to a short central dark mark on mesepimeron and metepisternum almost totally pale.

Etymology. – The name refers to the vary narrow hind lobe of the prothorax.

***Cnemisticta latilobata* sp. n.**
(figs. 16-23)

Type material. – Holotype ♂: Solomon Islands. Malaita I., Kware'a River and tributaries, 8 km E of Dala, 100m, 19 Feb 1987, T. Donnelly (RMNH); Allotype ♀ Solomon Islands. Guadalcanal I., Honiara, Rove Creek at Reservoir, 13-14 Feb 1987, T. Donnelly (RMNH). – Paratypes: 1♂ same data as holotype (TD), 1♂, Papua New Guinea, Bougainville I., South Nasiooi, Agriculture Field Station, 19 May 1975, Howard R. Wimmer (RMNH).

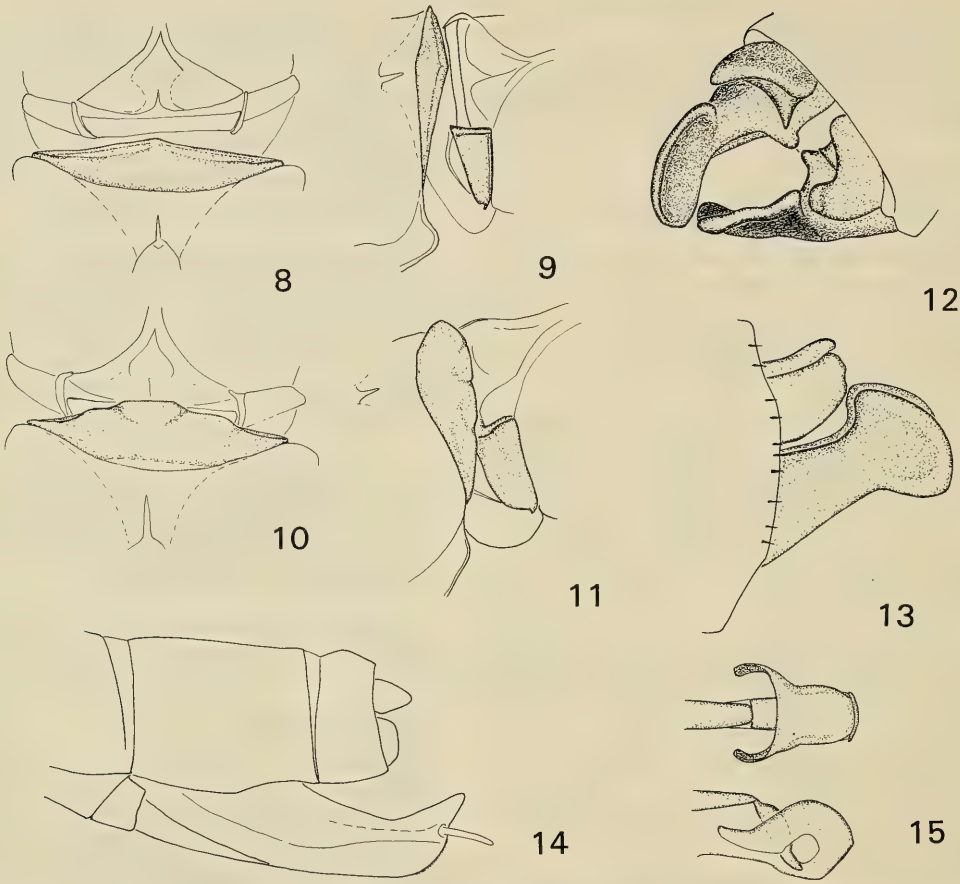
Additional material. – 1♂ Solomon Islands. Gizo I., low bush area in valley, 7,8 May 1975, H. Wimmer (specimen lacks terminal segments of abdomen) (RMNH), 1♂ Papua New Guinea. Bougainville I., Boku Bong, 5 June 1956, J. L. Gressitt (RMNH) (highly teneral specimen).

Description

Holotype male. – A pale, obscurely mottled, damselfly.

Head: Labium white, with a quadrate apical excavation ⅓ of its length; frons rounded; face black, labrum with thin yellow apical rim; genae brown with yellow mesal margin; pale pedicel slightly longer than dark scape; top of head black bordered at rear by yellow; obscure pale spots lateral to lateral ocelli; rear of head yellow.

Prothorax: pale, fore lobe with dark rim; medial lobes low, apodyne continued into a commissure nearly to hind lobe; hind lobe large, T-shaped, sharply recumbent, basally constricted, and sharply notch in center of hind rim.

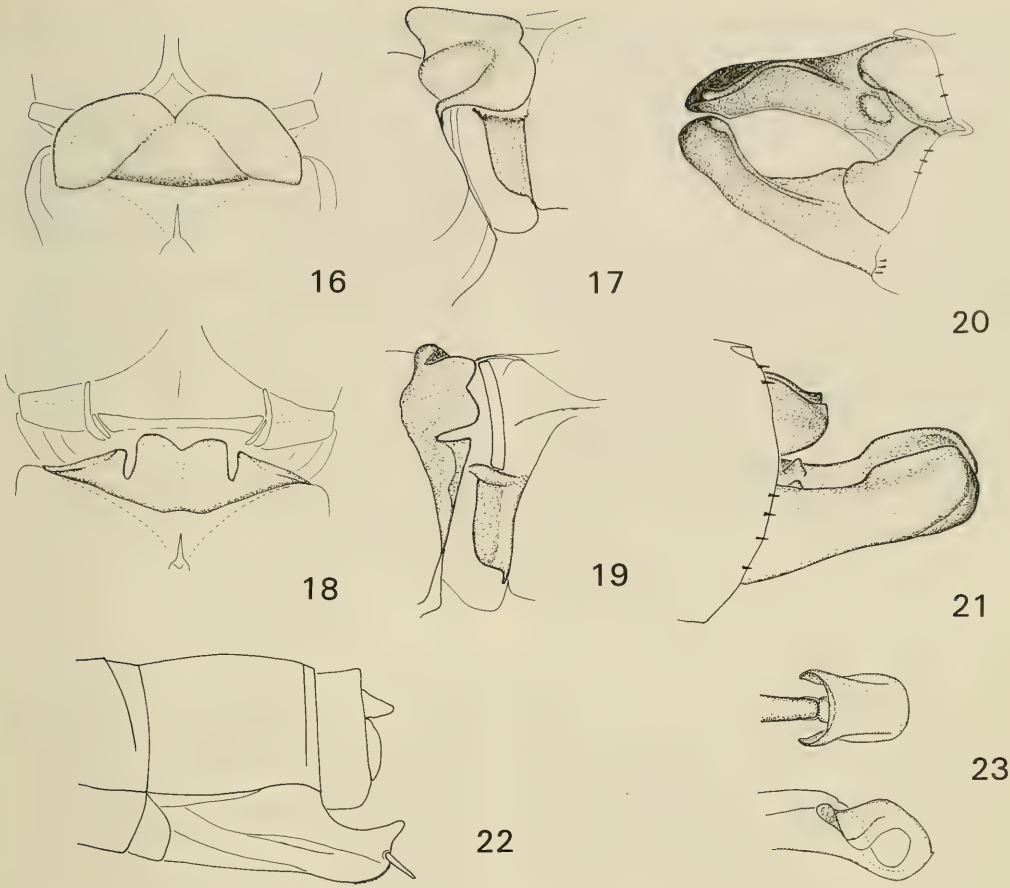


Figs. 8 - 15. *Cnemisticta angustilobata,* gen. n., sp. n. – 8, male hind lobe of prothorax, dorsal view. 9, male hind lobe of prothorax and mesostigmal lamina, dorsal- lateral view. 10, female hind lobe of prothorax, dorsal view. 11, female hind lobe of prothorax and mesostigmal lamina, dorsal- lateral view. 12, male abdominal appendages, dorsal - lateral - apical view. 13, male abdominal appendages, lateral view. 14, ovipositor. 15, penis, ventral and lateral views.

Pterothorax: Mesostigmal laminae parallel sided, flat, with rounded tips; colour of pterothorax pale; mesepisternum with dark stripe on dorsal carina occupying ¼ of sclerite; antehumeral suture with thin black line; 2nd lateral suture with tiny black spot on caudal ⅙. Legs: Yellow, with 4 contrasting black spines (outer row) on hind femur, 5 on hind tibia. Wings: Venation as in generic diagnosis; IR2 arising at 6 (fore wing) and 5 (hind wing); CiP 8 (fore wing), 9 (hind wing) cells long.

Abdomen: Pale laterally and darker dorsally; 3 and 4 dominantly pale dorsally, slightly darker in basal half and on apical ¼; 5 obscure, darker on apical ¼; 6 slightly pale in basal ⅙; 7-10 dark, with limited pale on sides, 8 and 9 with pale longitudinal dorsal lines on basal ½, tapering caudally. Superior appendage brown, shorter than 10, rounded and expanded apically in dorsal view, with rounded, upturned apices. Inferior apendage 3 times as long as superior, forcipate, with blunt, laterally flattened, rounded tip and dorsal keel on expanded apical half, and with low, rounded, conical, dorsally directed spine in basal ¼. Penis with terminal segment Y-shaped.

Allotype female. – Similar to male. Head: Face pale, paired dark spots anterior to lateral ocelli. Small rounded pale protuberances on rear of head. Thorax: Hind lobe of prothorax prominent, triangular, divided into three nearly equally wide lobes by deep sulci; the central lobe emarginate, and the two lateral lobes low and tapering laterally to points. Colour of thorax: Mesepisternum pale, thin black line adjacent to pale dorsal carina; thin black line along caudal half of antehumeral suture; mesepimeron with an obscure cen-



Figs. 16-23. *Cnemisticta latilobata* gen. n., sp. n. – 16, male hind lobe of prothorax, dorsal view. 17, male hind lobe of prothorax and mesostigmal lamina, dorsal-lateral view. 18, female hind lobe of prothorax, dorsal view. 19, female hind lobe of prothorax and mesostigmal lamina, dorsal- lateral view. 20, male abdominal appendages, dorsal-lateral-apical view. 21, male abdominal appendages, lateral view. 22, ovipositor. 23, penis, ventral and lateral views.

tral dark mark deflected laterally in cephalic portion. Abdomen: 9 and 10 with prominent pale basal-lateral spots; ovipositor pale, extends to end of 10 (cerci).

Dimensions. – Holotype male: abdomen 39 mm, hind wing 26 mm. Allotype female: abdomen 35.5 mm, hind wing 26.5 mm. The dimensional range of the paratype series is as follows: 2 paratype males have abdomens 37 and 38.5 mm; 3 paratype males have the hind wing 24 to 26 mm. The 2nd female specimen is very teneral; the hind wing is 27 mm.

Variation within paratype series. – The male from Bougainville has the pale colour of the top of the head more extensive than the holotype, extending anteriorly nearly to the antennal bases. A very teneral female specimen has the hind lobe of the prothorax longer and apparently more Y-shaped than the allotype. However the apparent difference in shape could be due to twisting upon drying.

Etymology. – The name refers to the wide and decorative hind lobe of the prothorax.

Remarks. – The two species of *Cnemisticta* resemble each other in their peculiarly wide and apically abruptly narrowed wings, the long CuP, and the male abdominal appendages. The species *angustilobata* is slightly larger than *latilobata*. The species differ most prominently in the hind lobe of the prothorax, which is prominently developed in *latilobata* and reduced in *angustilobata*. The species *latilobata* is pale, but with a darker abdomen, and *angustilobata* is dark, but with a paler abdomen. The allotype female of *latilobata* has

a rounded prominence on the rear of the head; this is lacking in *angustilobata*. The female of *angustilobata* has a much longer ovipositor than *latilobata*. The venation of the two species (above) differs more than is appropriate for the slight dimensional differences between the two species.

Acknowledgements

I am indebted to the RMNH, Leiden, for the loan of specimens which M. A. Lieftinck had been studying at the time of his death. I am further very grateful to Vladimir Jindrich, at that time a graduate student in our department, for specimens of two of the new species collected during a geological trip to New Britain. Comments from Drs. Jan van Tol and Anthony Watson on a draft of the manuscript have been very helpful and are gratefully acknowledged; I am further grateful to Dr. Watson for the loan of specimens of four Australian genera which enabled me to complete the table of generic characters.

References

Fraser, F. C., 1955. A new isostictine dragonfly from Australia with some remarks on the subfamily Isostictinae nov. (Odon., Protoneuridae). – Entomologist's Monthly Magazine 91: 227-230.

Lieftinck, M. A., 1975. The dragonflies (Odonata) of New Caledonia and the Loyalty Islands. Part 1. Imagines. – Cahiers O. R. S. T. O. M., série Hydrobiologie 9(3): 127-166.

Watson, J. A. L., G. Theischinger, and H. M. Abbey, 1991. The Australian dragonflies. – CSIRO, Canberra and Melbourne, 278 p.

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DESCRIPTION OF *NEUROBASIS DAVIESI* SP. N. FROM PALAWAN, WITH TAXONOMIC NOTES ON OTHER SPECIES OF THE *N. CHINENSIS* GROUP (ODONATA, CALOPTERYGIDAE)

Hämäläinen, M. 1993. Description of *Neurobasis daviesi* sp.n. from Palawan, with taxonomic notes on other species of the *N. chinensis* group (Odonata, Calopterygidae). – Tijdschrift voor Entomologie 136: 133-136, figs 1-4. [ISSN 0040-7496]. Published 10 December 1993.
Neurobasis daviesi sp. n. (holotype male, Brooke's Point, S. Palawan) is described in both sexes. The new species is closest to the Bornean *N. longipes* Hagen, 1887, which is considered to be specifically distinct from *N. chinensis* (Linnaeus, 1758). A key for both sexes to the three recognized species of the *N. chinensis* group is presented.
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Key words. – *Neurobasis*; Palawan; new species; key.

As well pointed out by Lieftinck (1949, p. 13-15), the definition of the limits of each species in the genus *Neurobasis* Selys, 1853 has always been difficult and subject to considerable personal interpretation. This applies well also to the present assessment of the taxonomic status of a new *Neurobasis* taxon from Palawan, work on which necessitated a reconsideration of Lieftinck's (1940, 1954) view of recognizing three subspecies in *Neurobasis chinensis* (Linnaeus, 1758), viz. *chinensis, florida* Hagen and *longipes* Hagen.

In my opinion it is difficult to regard *longipes* and *florida* to have an equal status as 'subspecies of *chinensis*'. Whereas the Javanese *florida* comes quite near to the continental forms, the Bornean *longipes* differs markedly from them and represents a distinct good species.

Neurobasis chinensis (Linnaeus, 1758)
(figs. 1-2).

N. chinensis is a widely distributed insect in South and South-East Asia. It is known to extend from NE Pakistan in the west to South China Sea in the east. In the western part of its range it spreads from NE Pakistan, Himachal Pradesh, Uttar Pradesh and Nepal in the north through whole India to Ceylon. In the eastern part its area extends from Fujien and Yunnan provinces in China southwards to the Malaya Peninsula, Sumatra (& Simalur and Nias) and Java.

In males the breadth of the wings and the relative size of the metallic area in the hind wing and in females the presence or absence as well as the size of pseudopterostigma and the size of the whitish nodal spots are subject to considerable variation within the vast range of the species. Documentation of this variability and revealing its nature is worth of a thorough study.

Results of this study would also be useful in deciding on the taxonomic status of the Javanese populations, which indeed differ most from the topotypical Chinese populations. Lieftinck (1940, 1954) considered the Javanese populations to represent a distinct subspecies - *florida* Hagen, 1854. He also pointed out the very confusing usage of the name *florida* in the early literature and concluded that the original description of *florida* applies to the Javanese specimens only. However, the correct citation to the author of *florida* should be Hagen in Walker, 1853.

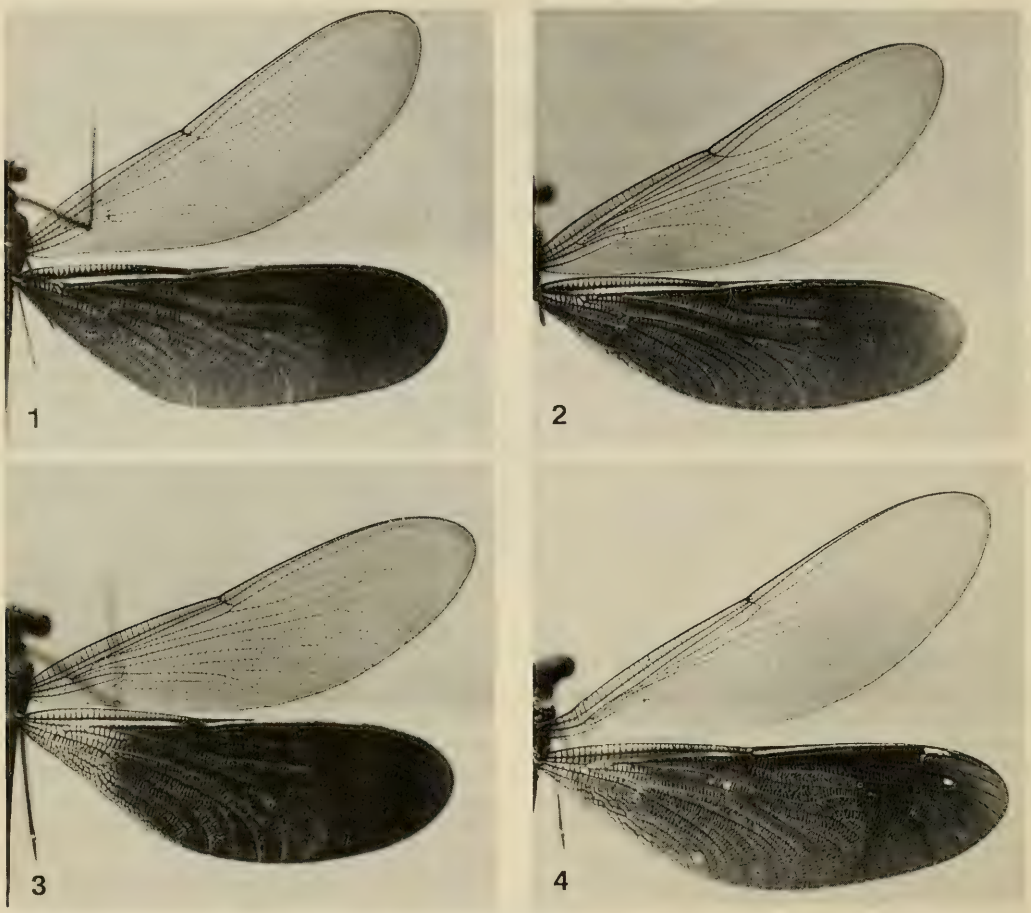
Neurobasis longipes Hagen, 1887 stat. n.
(fig. 3).

This species is universally distributed in Borneo and it occurs in lowland streams in forested areas.

The following brief comparison with *chinensis* explains my decision to consider *longipes* as a distinct species. In *longipes*

– the size is smaller and the whole appearance is '-slimmer'

– legs are proportionally longer in both sexes; espe-



Figs. 1-4. Wings of males (not in scale). - 1, *N. chinensis*, North Thailand; 2, *N. chinensis* (ssp. *florida*), West Java; 3, *N. longipes*, Borneo, E. Sabah; 4, *N. daviesi* sp. n., Palawan (paratype).

cially the anterior femora are very long, in male as long and in female longer than the length of the 3rd abdominal segment (in *chinensis* much shorter)
– in the male hind wing the opaque colouring is much more reduced at base (Fig. 3); in subcostal field starting at the level of ca. 10th antenodal and below at the level of apical end of quadrangle
– in male the shape of hind wings is different (Fig. 3), the broadest point is situated usually beyond the middle of its length; fore wing base with only 2 complete rows of cells between the lowest sector of IA and the wing border
– female is differently coloured; metallic green colour on thorax has a strong coppery tint instead of emerald metallic green in *chinensis*. In abdomen the shining metallic green colour on dorsum is restricted to segments 1 and 2, the rest being dark brownish; in *chinensis* the dorsum of segments 3 and 4 is similarly shining metallic green as on segment 2; the metallic colour getting darker green more apicad
– whitish nodal spots and pseudopterostigma are lacking in all wings of the female.

The species was originally described by Hagen (1887) as 'Abart' of *chinensis* on the basis of a single male specimen from Mindai. Hagen's contribution remained unnoticed by other authors, like Kirby (1890), de Selys Longchamps (1897) and Förster (1897), who treated the genus in detail. Lieftinck (1940), who had studied a series of specimens from different parts of Borneo, reintroduced the name *longipes* to apply to all Bornean specimens and presented a complete list of early references on this taxon.

***Neurobasis daviesi* sp. n.**
(fig. 4).

Type material. – Holotype ♂: Philippines, Palawan, Brooke's Point, (325 m), 1.viii. 1980, Leg. R. B. Rodriquez; in Museum Leiden (RMNH). – Paratypes: 2♂, locality and date as in the holotype (RMNH); 3♂, Philippines, S. Palawan, Brooke's Point, 1982, Leg. R. B. Rodriquez (RMNH); 19♂, 4♀, Philippines, Palawan, Matalangao River [between Roxas and Port Barton], 21.xii.1975, [collector data lost, probably R. B. Rodriquez] (coll. D. A. L. Davies, Cambridge, U.K. ; 6♂, 2♀ in coll. M. Hämäläinen).

Description

Instead of a detailed description, I prefer to highlight the characters by comparison of the new species with *N. longipes* and *N. chinensis*. *N. daviesi* is a somewhat larger insect than *chinensis* and very distinctly larger than *longipes*.

Male. – Colouring of head resembles that of *chinensis*. However, the yellow colour on labrum is restricted to form two widely separated spots. Thorax brilliant metallic green as in the related species. Sides of thorax showing, however, a slight coppery hue. Legs long; anterior femora proportionally longer than in *chinensis*, but shorter than in *longipes*; shorter than the length of the 3rd abdominal segment. Abdomen metallic green with pale markings on sides of segments 1-2 as in the other species.

Wings. The shape of hind wing is closer to that in *longipes* than in *chinensis* (Fig. 4). Opaque metallic area in hind wing extends more basad than in *longipes*, but base of hind wing distinctly less coloured than in *chinensis*. Hind wing border at base as broadly hyaline as in the Javanese specimens of *chinensis* (ssp.*florida*), but the line with the opaque patch much less distict. As in the other species the hind wing reflects brilliant metallic green or blue colour according to angle of view; the apical third with violaceous reflections. The intensity of the metallic reflections is less pronounced than in *chinensis*, thus the outer line of the metallic patch looks less sharp.

Measurements. Fore wing 35.5-37 mm, hind wing 33.5-35 mm; abdomen 48-49 mm.

Female. – Rather robust insect. Thorax less shining metallic green than in *chinensis*. The colouring of abdomen resembles that of *longipes*, metallic green colouring being restricted to dorsum of segment 1 and the basal 4/5th of segment 2. Rest of the abdomen brown, darker brown on dorsum of segments 6-10. Dorsal carina narrowly yellow broadening to a typical band on segments 8-10.

Legs very long, proportionally longer than in *chinensis*. Anterior femora as long as the 3rd abdominal segment. Hind femora extending (in enveloped specimens) beyond half of the 3rd abdominal segment as in *longipes*.

Wings hyaline with yellowish tint; as in *longipes*, the hind wings only slightly more heavily tinted than the fore wings. As in *longipes*, no trace of pseudopterostigma or whitish nodal spots in fore and hind wings.

Measurements. Fore wing 38.5-39 mm, hind wing 40-41 mm, abdomen 47.5-48.5 mm.

Etymology. – The new species is named after Dr D. A. L. Davies (Cambridge, U.K.) to appreciate his diligent efforts to search for dragonfly rarities in different corners of the globe.

Discussion. – In spite of the striking size difference, *daviesi* seems to be nearer to *longipes* than to *chinensis*. This is apparent especially from the female characters: long legs, absence of nodal spots and pseudopterostigma in all wings and brownish colouring of abdomen. However, the colouring of thorax is slightly different. Males show more 'intermediate' characters between *chinensis* and *longipes*.

I think that it is better to to treat *N. daviesi* as a distinct species, rather than a subspecies of *longipes*. Both taxa have well defined separate ranges in different islands, although separated only by the narrow Balabac Strait.

It is remarkable that *N. daviesi* is missing from the large dragonfly collection amassed by Roland A. Müller and his coworkers from many localities (even from Matalangao River) in different parts of Palawan in 1985-1992. *N. daviesi* is either a very rare species or (most likely) its flying period is confined to the advanced rainy season. The bulk of Müller's specimens have been collected at the beginning of the rainy season in May-June or during the dry season in March.

Key to the species of *Neurobasis chinensis* group

Males

1. Hind wing broadly hyaline at the base; opaque patch starts at the level of the apical end of quadrangle at the central part of the wing. In fore wing only two complete rows of cells between the lowest sector of IA and the wing border. Anterior femora as long as the length of the 3rd abdominal segment .....*longipes*
– Hyaline area in hind wing base less extensive. In fore wing at least 3 rows of cells between the lowest sector of IA and the wing border. Anterior femora shorter than the length of the 3rd abdominal segment 2
2. At hind wing base the whole subcostal and cubital fields opaque and reflecting strong metallic colour (only 1-2 basal cells of cubital field hyaline) .....*chinensis*
– Several hyaline or subhyaline cells in subcostal

and cubital fields at base; metallic reflections very slight at wing base .....*daviesi*

Females

1. All wings with (more or less distinct) whitish nodal spots. Abdominal segments 3-4 predominantly shining metallic green on dorsum .....*chinensis*
– No whitish nodal spots present on wings. Abdominal segments 3-4 predominantly brownish on dorsum 2
2. Anterior femora clearly longer than the length of the 3rd abdominal segment. Small species, hind wing less than 35 mm .....*longipes*
– Anterior femora as long as the length of the 3rd abdominal segment. Large species, hind wing over 37 mm .....*daviesi*

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References

Förster, F., 1897. Contributions a la faune odonatologique Indo-Australe. – Annales de la Societe Entomologique de Belgique 41: 204-211.

Hagen, H., 1887.Ueber Neurobasis und Vestalis. – Abhandlungen der Zoologisch-Botanischen Gesellschaft in Wien 37: 647-648.

Kirby, W. F., 1890. A synonymic catalogue of Neuroptera Odonata or dragonflies. With an appendix of fossil species. – Gurney & Jackson, London.

Lieftinck, M. A., 1940. Descriptions and records of Southeast asiatic Odonata (II). – Treubia 17: 337-390.

Lieftinck, M. A., 1949. The dragonflies (Odonata) of New Guinea and neighbouring islands. Part VII. Results of the Third Archbold expedition 1938-1939 and of the Le Roux Expedition 1939 to Netherlands New Guinea (II. Zygoptera). – Nova Guinea (N.S.) 5: 1-271.

Lieftinck, M. A., 1954. Handlist of Malaysian Odonata. A catalogue of the dragonflies of the Malay peninsula, Sumatra, Java and Borneo, including the adjacent small islands. – Treubia (Suppl.) 22: i-xiii + 1-202.

Selys Longchamps, E. de, 1897. Causeries Odonatologiques No 10. – Annales de la Societe Entomologique de Belgique 41: 427-432.

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AN ANNOTATED CHECKLIST OF THE SPECIES OF THE PARNASSIINAE (LEPIDOPTERA: PAPILIONIDAE)

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A total of 76 binominal taxa including 22 cases of questionable species status are listed for the Parnassiinae, a subfamily comprising eight genera of predominately palaeartic swallowtail butterflies. The taxonomic history of all doubtful species is briefly reviewed and possible affinites of these taxa are indicated. The majority of taxa contributing to a considerable increase in species number compared to previous accounts represent changes in status rather than genuine discoveries of new taxa. This is seen in relation to a change of attitude in taxonomic practise.
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The Parnassiinae represent one of the three currently recognized subfamilies of the Papilionidae, the 'Swallowtail Butterflies'. Among the swallowtails, the 'Apollo Butterflies' in particular have for long been highly sought after by butterfly collectors because of their great aesthetic appeal and considerable intraspecific variation in wing pattern. This specialized interest has led in the past to voluminous works devoted to catalog and illustrate all the many named species-group taxa and infraspecific forms of the Parnassiinae (e.g., Austaut 1889, Verity 1905-1911, Stichel 1907a, 1907b, Rothschild 1918a, 1918b, Bryk 1934, 1935, Eisner 1974, 1976). In contrast, comparatively little attention has hitherto been paid to species-level taxonomy, and to morphological or ecological pecularities of the group.

The subfamily is largely restricted to the palaearctic region with three species occuring in western North America, and completely absent from tropical zones (Stichel 1907a, 1907b, Reinig 1937, Ackery 1975). In an evolutionary view, the Parnassiinae have always been regarded as a basic stock of the Papilionidae from which all other higher taxa of the family arose (e.g., Spuler 1892, Reuter 1897, Ford 1944, Munroe 1961). In phylogenetic terms, the Parnassiinae are considered accordingly as the sistergroup of the Papilioninae, which comprise all remaining swallowtails, with the exception of one monotypic genus (Hancock 1983, Miller 1987, Häuser 1993).

Since the last comprehensive review of the Parnassiinae by Ackery (1975) several species have been described as new, mostly in the genus *Parnassius* (e.g., Koiwaya 1987, Korshunov 1988, Weiss & Michel 1989, Watanabe 1990). Furthermore, a number of formerly recognized species has been shown to consist of two or more closely related, but reproductively well isolated species, often on the basis of accumulated knowledge on their early stages and biology (e.g., Larsen 1973, de Freina 1985, Kreuzberg 1985). It seems therefore appropriate to provide an updated species checklist for this group. This list is also meant as a preliminary basis for a much needed phylogenetic analysis of the Parnassiinae at the species level, with the intention to point out all cases of presently problematic species delimitations.

Checklist

The present list can only be regarded as a first step towards a complete revision of the Parnassiinae even at species level. For this list, a 'splitter' approach was followed in many cases, in that geographically well separated and morphologically distinct taxa are rather given species status than treated as conspecific with their geographic vicariants. None of the many available infraspecific names appear in this list, but a number of former subspecies have been elevated here to species rank following suggestions elsewhere in the literature. Similarly, all recently described species in the genus *Parnassius* are retained here in binominal combination. However, all closely related, but strictly allopatric species-group taxa are indicated in the present list by indentation and omitting the generic name. Under a more rigorous application of the biological species concept, most of these cases might well turn out as conspecific, and could be treated as such

for purely classificatory purposes.

The Parnassiinae are seen here to comprise the eight genera listed below following recent classifications of the Papilionidae (Munroe 1961, Ackery 1975, Hancock 1983, Miller 1987), despite the fact that the subfamily as currently defined might not represent a monophyletic group in phylogenetic terms (Hiura 1980, Häuser 1990, 1993). All taxa are listed fully with author and year, and their sequence follows current ideas about taxonomic and phylogenetic relationships. Comments on individual taxa are presented as a series of notes, which are numbered consecutively and appear at the end of the checklist.

Subfamily Parnassiinae Swainson, 1840

Genus: *Hypermnestra* Ménétriés, 1848 01

Hypermnestra helios (Nickerl, 1846)

Genus: *Parnassius* Latreille, 1804 02
Subgenus: *Parnassius* Latreille, 1804 03

Parnassius apollo (Linnaeus, 1758)
P. nomion Fischer De Waldheim, 1823
P. phoebus (Fabricius, 1793)
sacerdos Stichel, 1906 04
ruckbeili Deckert, 1909 05
P. actius (Eversmann, 1843)
P. jacquemontii Boisduval, 1836
P. tianschanicus Oberthür, 1879
P. epaphus Oberthür, 1879
P. bremeri Bremer, 1864
P. honrathi Staudinger, 1882
P. apollonius (Eversmann, 1847)

Subgenus: *Driopa* Korshunov, 1988 06

P. mnemosyne (Linnaeus, 1759)
P. stubbendorfii Ménétriés, 1849
hoenei Schweitzer, 1912 07
P. glacialis Butler, 1866
P. eversmanni Ménétriés, 1855
felderi Bremer, 1861 08
P. ariadne (Eversmann, 1843) 09
nordmanni [Ménétriés] in Siemaschko, 1850 09, 10
clodius Ménétriés, 1855 09
P. orleans Oberthür, 1890

Subgenus: *Tadumia* Moore, 1902 11

P. hardwickii Gray, 1831
P. hunnyngtoni Avinoff, 1916 12
P. acco Gray, 1853
przewalskii Alpheraky, 1887 13
baileyi South, 1913 14
P. szechenyii Frivaldszky, 1886
P. cephalus Grum-Grshimailo, 1891
pythia Roth, 1932 15
P. maharaja Avinoff, 1916 16
labeyriei Weiss & Michel, 1989 17
nosei Watanabe, 1990 18
P. schultei Weiss & Michel, 1989 19

Subgenus: *Koramius* Moore, 1902 20

P. delphius (Eversmann, 1843)
maximinus Staudinger, 1891 21
P. cardinal Grum-Grshimailo, 1887 22
P. staudingeri Bang-Haas, 1882 23
stenosemus Honrath, 1890 24
P. stoliczkanus Felder & Felder, 1865 25
nandadevinensis Weiss, 1990 26
P. patricius Niepelt, 1911 27
priamus Bryk, 1913 28
hide Koiwaya, 1987 29
P. acdestis Grum-Grshimailo, 1891

Subgenus: *Sachaia* Korshunov, 1988 30

P. tenedius Eversmann, 1851
P. arcticus (Eisner, 1968) 31
ammosovi (Korshunov, 1988) 32
P. simo Gray, 1853
andreji Eisner, 1930 33
simonius Staudinger, 1889 34
P. boedromius Püngeler, 1901 35

Subgenus: *Kailasius* Moore, 1902 36

P. charltonius Gray, 1853
P. loxias Püngeler, 1901 37
autocrator Avinov, 1913 38
P. imperator Oberthür, 1883
P. inopinatus Kotzsch, 1940

Genus: *Archon* Hübner, [1822]

Archon apollinus (Herbst, 1798)
A. apollinaris (Staudinger, 1892) 39

Genus: *Zerynthia* Ochsenheimer, 1816 40

Zerynthia rumina (Linnaeus, 1758)
Z. polyxena ([Denis & Schiffermüller], 1775)

Genus: *Allancastria* Bryk, 1934 41

Allancastria cerisy (Godart, [1824]) 42
cretica (Rebel, 1904) 43
louristana (Le Cerf, 1908) 44

A. deyrollei (Oberthür, 1869) 45
A. caucasica (Lederer, 1864) 46

Genus: *Sericinus* Westwood, 1851

Sericinus montela Gray, 1853

Genus: *Bhutanitis* Atkinson, 1873 47

Bhutanitis mansfieldi (Riley, 1939) 48
B. thaidina (Blanchard, 1871)
B. lidderdalii Atkinson, 1873
B. ludlowi Gabriel, 1942

Genus: *Luehdorfia* Crüger, 1878

Luehdorfia puziloi (Erschoff, 1872)
L. japonica Leech, 1889
L. chinensis Leech, 1893 49
L. longicaudata Lee, 1982 50

Notes

01. – The genus *Hypermnestra* has long been included in the subfamily (Spuler 1892, Stichel 1907a, Bryk 1935, Ackery 1975), but recent phylogenetic investigations suggest that it might not form part of the Parnassiinae as a monophyletic group (Hiura 1980, Häuser 1993).

02. – The splitting of the genus *Parnassius* into several genera had started by Moore (1901-1903), and was further elaborated by Bryk (1935), and, most recently, by Korshunov (1988, 1990). This is not regarded here as useful taxonomic practice (Sokolov 1929, Munroe 1961, Ackery 1975), particularly as long as the genus is assumed to be monophyletic. Some of the generic names proposed, however, are retained here to designate presumably monophyletic species-groups, which for taxonomic purposes can be treated as subgenera (Munroe 1961; see notes 03, 06, 11, 20, 30, 36).

03. – The subgenus *Parnassius* or the so-called 'apollo-group' comprises a morphologically and ecologically homogeneous group of species with larval hostplants restricted to Crassulaceae and Saxifragaceae (Bryk 1935, Ackery 1975, Kreuzberg 1987a). The proper allocation of many taxa from Central Asia, where several species of the group coexist, is still problematic and awaits further detailed studies. For the present list, with the exceptions noted below, the arrangement of species by Ackery (1975) is followed.

04. – The separation of the European taxa as a species distinct from *P. phoebus* is largely based on peculiar ecological requirements and morphological differences of the larvae, in addition to considerable geographic separation. *P. sacerdos* is restricted to habitats along and near small streams of running water at elevations between 1500 and 2600 m in the European Alps, and its larvae exclusively feed on *Saxifraga aizoides* (Weidemann 1986, Descimon et al. 1989, Schweizerischer Bund für Naturschutz 1991). In contrast, habitat preferences are quite variable in *P. phoebus* in Northern Asia and Western North America where the species can occur from near sea level in Eastern Siberia and steppe zone habitats in the Altai Mountains (Kurentzov 1970, Mrácek 1989) up to the nival zone above the tree line in the Rocky Mountains (Ferris 1976). In North America, larval hostplants of *P. phoebus* are various species of *Sedum*, whereas local species of *Saxifraga*, as well as *S. aizoides* are not accepted by larvae in captivity (Scott 1986: 189, Nardelli 1991).

05. – *P. ruckbeili* had been originally described as a subspecies of *P. phoebus*, and was treated subsequently as such by most authors (Rothschild 1918b, Bryk 1935, Eisner 1976). The taxon, however, shows also affinities both in external appearence and male genitalia to *P. actius* (Bryk & Eisner 1935, Hering 1935), and Eisner (1961: 180) finally placed it as a separate species. The known geographic range of *P. ruckbeili* is restricted to mountains North-East of the Tarim basin completely separated from both *P. phoebus*, and *P. actius*, which leaves the species status doubtful. The name is often spelt as '*rückbeili*' or '*rueckbeili*' (e.g., Bryk 1935, Hering 1935, Eisner 1976), both of which represent unjustified emendations.

06. – The '*mnemosyne*-group' was in the older literature often referred to by the (sub-)generic name *Doritis* Fabricius, 1807 (Moore 1901-1903, Sokolov 1929, Bryk 1935, Munroe 1961), which, however, has *P. apollo* as its type-species, and thereby is invalid as an objective synonym of *Parnassius* Latreille, 1804 (Hemming 1967). The name *Adoritis* Koçak, 1989 is invalid as an objective synonym of *Driopa* Korshunov, 1988.

07. – *P. hoenei* from the Japanese Island of Hokkaido had originally been described as a subspecies of *P. stubbendorfii* and was subsequently treated as such by most authors (Bryk 1935, Eisner 1974, Ackery 1975). Recently, the taxon has been elevated to species rank by several Japanese authors (Fukuda et al. 1982, Kitahara 1990), but the conclusive evidence in support of such a view is not clear.

08. – *P. felderi* had been described as species and was accepted as such by most early authors (Stichel 1907a, Verity 1905-1911, Rothschild 1918b; but see Elwes 1886). Later on, the taxon was generally placed as a subspecies of *P. eversmanni* (Bryk 1922, Bang-Haas 1927, Eisner 1961, 1974, Kurentzov 1970, Ackery 1975), but some doubts about its proper status remained (e.g., Bang-Haas 1927: 8, Eisner 1974: 90). The allopatric distribution of *P. felderi* and typi-

cal forms of *P. eversmanni* (see Iwamoto & Inomata 1988), and the occurrence of apparent intermediate taxa (Bryk 1935, Eisner 1961), give little support to maintain it as a distinct species.

09. – *P. ariadne*, *P. nordmanni*, and *P. clodius* have always been treated as distinct species despite their close morphological and ecological similarity, and their strictly allopatric distribution (Elwes 1886, Stichel 1907a, Bryk 1935, Eisner 1974, Ackery 1975). This practice is followed here, but it should be pointed out that the degree of morphological difference between these taxa, for example, in male and female genitalia (Hering 1932, Orr 1988), especially, between *P. nordmanni* and *P. clodius* is not very large. For consistency, then, comparable cases of geographically vicariant taxa should also be classified as different species (e.g. 04).

10. – The author of *P. nordmanni* is sometimes been given as 'Nordmann 1851' (Ackery 1975, Hancock 1983), based on conclusions by Hemming (1934) that a description of the taxon by Ménétriés was never published. However, according to bibliographic studies by Nekrutenko & Kerzhner (1986) the original description of *P. nordmanni* by Ménétriés was indeed published in 1850 and thus takes precedence.

11. – In the subgenus *Tadumia*, the so-called '*acco*-group', Stichel (1907a), Bryk (1935), and Eisner (1976), had included *P. acco*, *P. simo*, *P. tenedius*, and related forms, but not *P. szechenyii*, *P. cephalus*, *P. maharaja*, and *P. hardwickii*, which were placed in different (sub-)genera. The separation of the *simo*- and *tenedius*- groups from *Tadumia* on morphological grounds (Munroe 1961, Ackery 1975) is further supported by biological characters (Kreuzberg 1985, 1987a). A close relationship between *P. acco*, *P. szechenyii*, *P. hardwickii*, and *P. cephalus* with all associated taxa is supported by similarity in male genitalia, sphragis structure, and larval hostplants (Hering 1932, Kreuzberg 1987a, Weiss & Michel 1989).

12. – *P. hunnyngtoni* had originally been described as a separate species on the basis of its extremely small size and different wing pattern (Avinoff 1916), but it was subsequently treated as conspecific with *P. acco* by Bang-Haas (1927), Eisner (1976), and Ackery (1975). In contrast to all other *Parnassius*, this species flies at high altitudes in early spring (Riley 1927, W.Eckweiler, pers. com.). Furthermore, its sympatric occurrence with *P. acco* (Riley 1927, Weiss & Michel 1989) leaves little doubt as to place it as a separate species. The species name is often found spelt as '*hannyngtoni*' or '*hanningtoni*' (Bryk 1935, Eisner 1976, Weiss 1992), both of which are unjustified emendations.

13. – *P. przewalskii* had been described as a separate species and was treated as such by Stichel (1907a), Verity (1905-1911), Bryk (1935), and Munroe (1961), whereas it was considered as conspecific with *P. acco* by Hering (1937), Ackery (1975), Eisner (1976), Hancock (1983), and Weiss (1992). Recent discoveries have extended the known range of *P. przewalskii* considerably (Huang & Murayama 1991, Schulte 1992), which now covers most of North-Western Tibet and Qinghai. Some of the new taxa described appear intermediate in wing pattern with *P. acco*, and leave further doubts about the species status of *P. przewalskii* (Weiss 1992).

14. – *P. baileyi* is another questionable species geographically separated but close to *P. acco*, which had originally been described as a subspecies of *P. acco* from South-Eastern Tibet. Subsequently Bryk (1932a) described *P. rothschildianus* as a species separate from *P. acco* from Western Sichuan, which he later united with *baileyi* and another new taxon (Bryk 1932b). All these taxa were later on placed by Bryk (1935) as subspecies of *P. przewalskii*, whereas Bang-Haas (1927), Eisner (1976), and Ackery (1975) considered them all conspecific with *P. acco*. New reports of 'typical' *P. acco* occurring in South-East Tibet (Nosé 1990), in addition to reported constant differences in genitalia (Weiss 1992) suggest that possibly two species might occur in that region, and give reason to tentatively maintain *P. baileyi* as a species. However, a thorough taxonomic revision of the entire *acco*-group is certainly needed and should yield a more definite conclusion.

15. – The description of *P. pythia* is based on a single small female specimen from South-Western Tibet. The taxon was placed as a subspecies of *P. cephalus* by Bryk (1935), but it was maintained as a separate species in a list by Munroe (1961). The type locality of *P. pythia* was at the time of its discovery well separated from the then known range of *P. cephalus*, but geographically intermediate populations have since been found, which all appear conspecific with *P. cephalus* (Weiss 1992).

16. – Originally, *P. maharaja* had been described as a separate species (Avinoff 1916), but it was placed as a subspecies of *P. cephalus* by Bryk (1922), Eisner (1958, 1976), and Ackery (1975) despite constant differences in wing venation and genitalia between the two taxa (Hering 1932, Bryk 1935). The sympatric occurrence of newly discovered taxa closely related to *P. maharaja* with *P. cephalus* in Southern and South-Eastern Tibet (see below, 17 + 18) give further support to maintain *P. maharaja* as a separate species from *P. cephalus* (Bryk 1935, Munroe 1961, Weiss 1992).

17. – The recently discovered *P. labeyriei* from Southern Tibet is morphologically very similar to *P. maharaja* from Ladakh (see Michel & Weiss 1989, Watanabe 1990), and probably just represents a geo-

graphic vicariant form of the latter. However, possibly intermediate records are currently missing from Western Tibet, which certainly is one of the areas that have never been adequately surveyed. Additional new discoveries indicate that this species is more widely distributed in Western China (Weiss 1991); see below, 18.

18. – *P. nosei* from E. Tibet is also very similar to *P. maharaja*, and has already been regarded as conspecific with *P. labeyriei* (Weiss 1991). However, both *P. labeyriei* and *P. nosei* reportedly occur next to each other in South-Eastern Tibet (Nosé 1990), which is the reason to retain the latter provisionally here as a distinct species. Probably at least one of the two taxa will turn out to be conspecific with *P. maharaja*.

19. – *P. schultei* has been described from only three worn specimens from Southern Tibet (Weiss & Michel 1989). The genitalia of the male holotype appear to differ considerably from *P. cephalus*, and also from *P. maharaja* and *P. labeyriei*, which gives reason to place it here as a distinct species.

20. – The status of most of the following species listed under the subgenus *Koramius* is still problematic, and a comprehensive revision of the entire '*delphius*-group' is much needed. Previous authors have generally recognized only a single (Stichel 1907a, Verity 1905-1911, Hering 1932), two (Elwes 1886, Bang-Haas 1915, Rothschild 1918b), three (Bang-Haas 1927, Ackery 1975, Hancock 1983), four (Bryk 1935, Collins & Morris 1985), or at most five different species (Munroe 1961). However, detailed comparative investigations on the ecology and genital morphology (Kreuzberg 1985) indicate that in several mountain ranges of Central Asia (Tian-Shan, Alai, Pamirs) two to four distinct species of the '*delphius*-group' coexist. The species recognized by Kreuzberg (1985, 1987a) are accepted for the present list (Weiss 1992), but it should be noted that an exact delimitation of these species and a proper allocation of the more than 50 taxa named formerly lumped under *P. delphius* still awaits to be accomplished.

21. – *P. maximinus* was recognized as a distinct species from *P. delphius* by Kreuzberg (1985) on the basis of different ecological requirements and differences in larval colouration. The species seems restricted to the Western Tian-Shan range and shows no significant overlap in its range with *P. delphius* (Weiss 1992), which leaves some doubt about its status as a separate species.

22. – *P. cardinal* had originally been described as a subspecies of *P. delphius*, and was first recognized as a separate species by Stshetkin (1979) based on its sympatric occurrence with another *delphius*-group taxon. Subsequent studies by Kreuzberg (1985) confirmed the coexistence of *P. cardinal* and *P. staudingeri* in Tadzhikistan, where *P. cardinal* occurs mainly at elevations between 3000 and 3200 m.

23. – *P. staudingeri* was reinstated as a different species from *P. delphius* by Kreuzberg (1985) on the basis of differences in male and female genitalia as well as wing pattern, in addition to ecological differences regarding habitat and larval hostplants. The species appears to co-exist in parts of its range with *P. cardinal*, but is strictly allopatric with *P. delphius* and *P. stenosemus* (Weiss 1992).

24. – *P. stenosemus* had been described as a subspecies of *P. delphius* and it was treated as such or as a subspecies of *P. stoliczkanus* by Stichel (1907a), Verity (1905-1911), Rothschild (1918b), Bang-Haas (1927), Eisner (1959a, 1976), and Ackery (1975). The taxon was first given species status by Moore (1901-1903), followed by Bryk (1935), Munroe (1961), and Weiss (1992), on the basis of constant differences in wing pattern and male genitalia with the sympatrically occurring *P. stoliczkanus*. However, the known range of *P. stenosemus* shows no overlap with *P. staudingeri*, and further studies are needed to confirm its species status.

25. – *P. stoliczkanus* had been described as a separate species, but was later considered a subspecies of *P. delphius* by Stichel (1907a), Verity (1905-1911), Avinov (1913), Rothschild (1918b), Eisner (1959a, 1976) and Ackery (1975). It occurs sympatrically with *P. stenosemus*, and had been already given species status by Elwes (1886), Bang-Haas (1927), Bryk (1935), Munroe (1961), and Collins & Morris (1985).

26. – The original description of *P. nandadevinensis* is based on a single worn male specimen from Northern Uttar Pradesh, India. According to illustrations of the holotype and parts of its genitalia, it appears intermediate between *P. acdestis* and *P. stoliczkanus*, and could possibly represent an aberrant specimen of the latter species.

27. – Since its original description *P. patricius* had generally been accepted as a species separate from *P. delphius* (Bryk 1935, Munroe 1961, Ackery 1975, Hancock 1983, Weiss 1992; but see: Bang-Haas 1915), and recent morphological and ecological studies further support this view (Kreuzberg 1985).

28. – *P. priamus* had been originally described as a subspecies of *P. acdestis*, and subsequently the taxon was considered as either belonging to this species or to *P. delphius* (Bang-Haas 1915, Bang-Haas 1927). Marked differences in the shape of the sphragis between *P. priamus* and *P. acdestis* led Bryk (1932b, 1935) to separate it from the latter species and to place it as a subspecies of *P. patricius*. Apparent differences in male genitalia between *P. priamus* and *P. patricius* could support the view of two different species (Weiss & Michel 1989), but both taxa occur allopatrically (Weiss 1992).

29. – *P. hide* has been described recently from the Kunlun range, and was subsequently also found in Western Sichuan and South-Eastern Tibet (Koiwaya 1987, Nosé 1990, Shinkai 1990). The taxon appears not to differ much in male genitalia from *P. priamus* from Southern Tibet, and probably is conspecific with the latter or with *P. patricius* (see Weiss & Michel 1989: 12).

30. – The type species of Sachaia is *P. tenedius* by original designation (Korshunov 1988), and *Kreizbergius* Korshunov, 1990 is available as a separate generic name for *P. simo* and related taxa in this group.

31. – Originally, *P. arcticus* had been described as a northern subspecies of *P. simo*, a species which does not occur in Siberia, but Eisner (1969) later himself corrected this misjudgement, and placed the taxon as a subspecies of *P. tenedius* (Eisner 1976). In 1984, however, another *Parnassius* species was discovered in Central Siberia that on ecological and morphological grounds is clearly separate from *P. tenedius*; without much consideration, this species has been repeatedly referred to as *P. arcticus* (Mrácek 1989, Weiss 1991), but proper identification must still await critical examination of the holotype (see below, 32).

32. – As judged from the original description (Korshunov 1988), *P. ammosovi* appears not to be conspecific with *P. tenedius*, and probably represents the second Siberian species of that group (see above, 31); this taxon, however, would then be a junior synonym of *P. arcticus* depending on the identity of the holotype of the latter.

33. – *P. andreji* has been separated recently together with another six subordinate taxa from *P. simo* by Weiss (1991), based on differences in wing pattern and male genitalia; both character sets, however, have not yet been adequately documented. The fact that *P. andreji* is not found sympatrically with *P. simo*, which occurs over most of Tibet into South-West China, makes this separation furthermore questionable.

34. – *P. simonius* had been described as a subspecies of *P. simo* and was treated as such by most authors (Bryk 1935, Munroe 1961, Ackery 1975). However, Avinov (1913) already had remarked on constant differences in male genitalia between *P. simonius* and *P. simo* (see also, Hering 1932), but did not separate both taxa at the species level. In a comparative study on the group, Kreuzberg (1985) elevated the taxon to species rank supported by constant differences in postabdominal morphology. As far as known, however, *P. simonius* and *P. simo* occur allopatrically and the ranges of the two taxa show no overlap (Weiss 1991).

35. – *P. boedromius* had originally been described as a separate species, but was since generally regarded as a subspecies of *P. simo* (Stichel 1907a, Bryk 1935, Ackery 1975), except for Avinov (1913) followed by Rothschild (1918b), who had recognized that it occurs sympatrically with typical forms of *P. simo*. Recent studies by Kreuzberg (1985) supported Avinov's early conclusions through the confirmation of sympatric occurrences of the two species, and ecological and morphological differences.

36. – The type species of *Kailasius* is *P. charltonius* by original designation, and a separate generic name, *Eukoramius* Bryk, 1935, is available for *P. imperator* (Hemming 1967).

37. – *P. loxias* had been described as a species and has since been treated as such by most authors (Verity 1905-1911, Bryk 1935, Eisner 1959b, Munroe 1961, Ackery 1975, Kreuzberg 1985), except for Bang-Haas (1927) who regarded it as a subspecies of *P. charltonius*. The recent discovery of its biology confirms its status as a separate species from *P. charltonius* (Kreuzberg & Pljushch 1989).

38. – *P. autocrator* was originally described as a subspecies of *P. charltonius* (Avinov 1913, Bryk 1935), but because of its unique wing pattern was later on universally accepted as a separate species (Bang-Haas 1927, Eisner 1959b, Ackery 1975). In terms of genitalia and ecology, however, it shows a close affinity to *P. loxias* (Bryk 1937, Kreuzberg 1987b), from which it is geographically well separated (Weiss 1991).

39. – *A. apollinaris* had always been regarded as a subspecies of *A. apollinus* (Stichel 1907a, Bryk 1934, Igarashi 1979), until de Freina (1985) proposed the existence of two distinct but allopatric *Archon* species based on differences in genitalia and larval colouration. The recent discovery of areas of sympatry of two distinct taxa in the province of Mardin in Southern Turkey further supports this view (Carbonell 1991).

40. – The generic name frequently used for *Zerynthia* in the older literature is *Thais* Fabricius, 1807, which is invalid as a junior primary homonym (Hemming 1967). The older replacement name *Parnalius* Rafinesque, 1815 has been suppressed for the principle of priority by the Plenary Powers of the International Commission on Zoological Nomenclature (Opinion 1134).

41. – The genus *Allancastria* has been synonymized by some authors with *Zerynthia* (Ackery 1975, Igarashi 1979, Olivier 1991), but it is retained here as a separate genus on the basis of considerable differences in genitalic structures (see: Bryk 1934, Nekrutenko 1990).

42. – The species name has often been incorrectly cited as '*cerisyi* Godart, 1822' (e.g., Rothschild 1918a, Bryk 1934, Bernardi 1970, Eisner 1974) based on a reference that was never published (see Cowan 1970: 17). *A. cerisy* was long regarded as the only species in the genus (Stichel 1907b, Bryk 1934, Munroe 1961, Eisner 1974, Ackery 1975, Igarashi

1979), and the discovery of two sympatric *Allancastria* species in Lebanon (Larsen 1973, 1975) has finally led to the separation of several other species (see below, 43-46). A complete revision of all *Allancastria* taxa appears, therefore, much needed (Olivier 1991).

43. – The elevation of *A. cretica* endemic to the isle of Crete as a different species from *A. cerisy* was first proposed by Koçak (1981), and is presumably based on differences in wing shape and colouration only. As a number of phenotypically different populations of *A. cerisy* from other Eastern Mediterranean islands have also been named as subspecies (see Bryk 1934, Olivier 1991), the single treatment of this taxon as a species (e.g., Kudrna 1986: 169) must appear questionable, and cannot be justified by a few distinguishing features and geographic separation alone.

44. – *A. louristana* had been described as a subspecies of *A. cerisy*, and it was first treated as a separate species by Kuhna (1977), followed by Blom & Eisner (1979), de Freina (1979), and Collins & Morris (1985). The distinguishing characters supporting such a view, however, have not been clearly stated. Areas of sympatry between *A. louristana* and either *A. cerisy* or *A. deyrollei* are presently not known, and the status of this taxon therefore remains questionable.

45. – Although *A. deyrollei* had originally been given species rank when first described, it was recognized only recently as a separate species from *A. cerisy* based on differences in wing pattern, genital morphology and early stages (Bernardi 1970, Larsen 1973, 1975). The species occurs partly sympatrically with *A. cerisy* in Southern Turkey and Lebanon (Kuhna 1977, de Freina 1979, 1986).

46. – *A. caucasica* had been described as a subspecies of *A. cerisy*, and it was first regarded as a different species by Kuhna (1977) based on characters of wing pattern, colouration and genitalia. This view has since been largely accepted (de Freina 1979, Collins & Morris 1985, Nekrutenko 1990), but the exact delimitation of the species and the allocation of various subspecific taxa to *A. cerisy* and *A. caucasica*, respectively, is not clear.

47. – At present, the genus *Bhutanitis* is held to comprise the four species listed here (Ackery 1975, Collins & Morris 1985). Recent field studies in South-West China, however, seem to indicate that, at least, three different *Bhutanitis* species exist in that area (Hou 1992). As so far only two species were known to occur in the region (Bryk 1934, Ackery 1975), the existence of an additional species in this genus is quite likely. Although several new taxa were named in Hou's abstract (1992), these names cannot be accepted as available. In the older literature, the genus is often referred to by the name *Armandia* Blanchard, 1871, which is invalid as junior homonym (Hemming 1967).

48. – A separate genus, *Yunnanopapilio* Hiura, 1980, has been proposed for *B. mansfieldi*, but a generic separation of this species from *Bhutanitis* seems not justified (Saigusa & Lee 1982), particularly when considering its biology and early stages (Lee 1986a, 1986b).

49. – *L. chinensis* had been described as a subspecies of *L. japonica*, and was treated as such by most authors (Verity 1905, Rothschild 1918a, Ackery 1975), except for Bryk (1934), and later on Eisner (1974) who placed it as a subspecies of *L. puziloi*. The taxon was first recognized as a species by Lee (1978) based on marked differences in the early stages, a view which has now become widely accepted (Collins & Morris 1985, Nosé 1990).

50. – *L. longicaudata* was recently discovered in Western China, and occurs partly sympatrically with *L. chinensis*. The differences seen in adult morphology and early stages seem to furthermore justify its status as a separate species (Nosé 1990).

Conclusions

In the present list, 76 species taxa are included in the subfamily Parnassiinae. Although 22 of these binominal taxa are indicated as questionable species some of which will eventually have to be synonymized, the remaining number of recognized species will still exceed the fourty to fifty species listed in most previous taxonomic reviews of the subfamily. Generally, species numbers for the eight genera included here in the Parnassiinae range from 39 species recognized by Stichel (1907a, 1907b) at the turn of the century, to 42 (Eisner 1974, 1976), 44 (Bryk 1934, 1935, Ackery 1975), 48 (Hancock, 1983), 49 (Munroe 1961), or, at most, 53 species listed by Collins & Morris (1985). This new increase in species number should come somewhat unexpected, particularly, in a much collected and taxonomically well studied group of papilionid butterflies. Most of the taxa recently recognized as distinct species, however, were already known at the beginning of this century, and only very few represent genuine discoveries (e.g., *Parnassius schultei*, *P. arcticus*, *Luehdorfia longicaudata*). Thus, the majority of recently discovered 'new' species in the Parnassiinae came about by a change of status rather than by the description of new taxa.

This recent increase in species number can probably be explained by a change of general concepts in systematics, which is well reflected by the different attitudes of specialists dealing with the Parnassiinae at different times. In the first half of this century, most authors were primarily concerned with the study of (intraspecific) variation in wing pattern exclusively based on large collections of adult specimens (e.g., Austaut 1899, Verity 1905-1911, Bryk 1934, 1935).

This approach produced an immense number of infraspecific taxa named for the Parnassiinae (Bryk 1922, Eisner 1974, 1976), and it naturally obscured somewhat the question of delimitation of species. In recent times, more and more authors tried to rely for their taxonomic decisions on other morphological, biological and ecological characteristics, many of which usually exhibit larger differences at the species level (e.g., Larsen 1975, Lee 1978, Kreuzberg 1985). This shift away from a purely descriptive taxonomy relying on a single set of adult characters was partly driven by and coincided with the change from a typological towards a biological species concept in systematics (Mayr 1982). In the Parnassiinae, the long applied taxonomic practise to record and name all forms of infraspecific variation in wing pattern still persists today (e.g., Schulte 1992, Weiss 1992), but is slowly giving way to a more biological aproach considering all possible characteristics and pecularities of the group. From this historical perspective it appears therefore understandable that, despite the considerable taxonomic efforts already undertaken in the past, a comparatively high number of unresolved cases at species level in the Parnassiinae remains. The primary purpose of this paper is to direct attention to these cases and encourage further, more detailed studies.

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References

Ackery, P. R., 1975. A guide to the genera and species of Parnassiinae (Lepidoptera: Papilionidae). – Bulletin of the British Museum (Natural History), Entomology 31 (4): 71-105.

Austaut, J. L., 1889. Les Parnassiens de la faune paléarctique. – E. Heyne, Leipzig, 223 pp.

Avinoff, A., 1916. Some new forms of *Parnassius* (Lepidoptera Rhopalocera). – The Transactions of the Entomological Society of London 1915: 351-360.

Avinov, A., 1913. Quelques formes nouvelles du genre *Parnassius* Latr.. – Horae Societatis Entomologicae Rossicae 40 (5): 1-21 [in Russian].

Bang-Haas, O., 1915. Zur Kenntnis von *Parnassius delphius* Eversm. und verwandter Arten. – Deutsche Entomologische Zeitschrift Iris 29: 148-170.

Bang-Haas, O., 1927. Horae Macrolepidopterologicae regionis palaearcticae. Vol. I. – Verlag Dr. O. Staudinger & A. Bang-Haas, Dresden-Blasewitz, XXVIII + 128 pp. 11 Tafeln.

Bernardi, G., 1970. Note sur la variation géographique d'*Allancastria cerisyi* Godart (Lep. Papilionidae). – Lambillionea 70 (7-8): 55-64.

Blom, W. & C. Eisner, 1979. Parnassiana nova LV. *Allancastria louristana boyrahmadiensis* subsp. nov. – Zoologische Mededelingen 54 (18): 277-278.

Bryk, F., 1922. Baroniidae, Teinoplapidae, Parnassiidae. – In: E. Strand et al. (eds.), Lepidopterorum Catalogus 27: 1-247. – W. Junk, Berlin.

Bryk, F., 1932a. Parnassier der Kelley-Roosevelt Expedition, 1929. – Novitates Zoologicae 37 (2): 381-383.

Bryk, F., 1932b. Parnassiologische Studien aus England. – Parnassiana 2 (1): 1-6.

Bryk, F., 1934. Baroniidae, Teinopalpidae, Parnassiidae pars I. – In: F. E. Schulze et al. (eds.), Das Tierreich 64: XXIII + 129 pp. – W. de Gruyter & Co, Berlin.

Bryk, F., 1935. Parnassiidae pars II (Subfam. Parnassiinae). – In: F. E. Schulze et al. (eds.), Das Tierreich 65: LI + 780 pp. – W. de Gruyter & Co, Berlin.

Bryk, F., 1937. Das Begattungszeichen als Ausdruck phyletischer Beziehungen. – Parnassiana 4 (3-8): 42-45.

Bryk, F., & C. Eisner, 1935. Kritische Revision der Gattung *Parnassius* unter Benutzung des Materials der Kollektion Eisner. (Fortsetzung). – Parnassiana 3 (4-5): 47-62.

Carbonell, F., 1991. Contribution à la connaissance du genre *Archon* Hübner 1822. Découverte de zones de sympatrie pour *Archon apollinus* (Herbst) et *A. apollinaris* Staudinger (Lepidoptera : Papilionidae). – Linneana Belgica 13: 3-12.

Collins, N. M. & M. G. Morris, 1985. Threatened Swallowtail Butterflies of the World. – International Union for Conservation of Nature and Natural Resources, Gland. viii + 402 pp. 8 plates.

Cowan, C. F., 1970. Annotationes Rhopalocerologicae 1970. – Berkhamsted, 70 pp.

Descimon, H., F. Genty & J.-P. Vesco, 1989. L'hybridation naturelle entre *Parnassius apollo* (L.) et *P. phoebus* (F.) dans les Alpes du Sud (Lepidoptera: Papilionidae). – Annales de la Société entomologique de France (N.S.) 25 (2): 109-234, 2 planches.

Eisner, C., 1958. Parnassiana nova XXI. Kritische Revision der Gattungen *Lingamius* und *Koramius*. – Zoologische Mededelingen 36 (6): 83-112.

Eisner, C., 1959a. Parnassiana nova XXIII. Kritische Revision der Gattungen *Lingamius* und *Koramius* (Fortsetzung 2). – Zoologische Mededelingen 36 (9): 143-163.

Eisner, C., 1959b. Parnassiana nova XXV. Kritische Revision der Gattung *Tadumia* (Fortsetzung). – Zoologische Mededelingen 36 (14): 233-246.

Eisner, C., 1961. Parnassiana nova XXX. Nachträgliche Betrachtungen zu der Revision der Subfamilia Parnassiinae (Fortsetzung 3). – Zoologische Mededelingen 37 (11): 167-188.

Eisner, C., 1969. Berichtigung. – Zoologische Mededelingen 43: 176.

Eisner, C., 1974. Parnassiana nova XLIX. Die Arten und Unterarten der Baroniidae, Teinopalpidae und Parnassiidae (Erster Teil) (Lepidoptera). – Zoologische Verhandelingen 135: 1-96.

Eisner, C., 1976. Parnassiana nova XLIX. Die Arten und Unterarten der Baroniidae, Teinopalpidae und Parnassiidae (Lepidoptera) (Zweiter Teil). – Zoologische Verhandelingen 146: 99-266.

Elwes, H. J., 1886. On butterflies of the genus *Parnassius*. –

Proceedings of the Scientific Meetings of the Zoological Society of London 1886: 6-53.

Ferris, C. D., 1976. A proposed revision of non-arctic *Parnassius phoebus* Fabricius in North America (Papilionidae). – Journal of Research on the Lepidoptera 15 (1): 1-22.

Ford, E. B., 1944. Studies on the chemistry of pigments in the Lepidoptera, with reference to their bearing on systematics. 4. The classification of the Papilionidae. – Transactions of the Royal Entomological Society of London 94: 201-223.

Freina, J. J. de, 1979. Zur Kenntnis der Gattung *Allancastria* unter Berücksichtigung der Arten *A. cerisyi* und *A. deyrollei* (Lepidoptera: Papilionidae). – Entomologische Zeitschrift 89 (12): 129-142.

Freina, J. J. de, 1985. Revision der Gattung *Archon* Hübner 1822 mit Angaben zur Biologie, Verbreitung, Morphologie und Systematik von *Archon apollinus* (Herbst 1798) und *Archon apollinaris* Staudinger [1892] 1891 (stat. nov.) (Lepidoptera, Papilionidae). – Nota lepidopterologica 8: 97-128.

Freina, J. J. de, 1986. Bemerkungen zur Biologie, Verbreitung und Systematik kleinasiatischer Papilioniden (Lepidoptera, Papilionidae). – Atalanta 17: 205-208.

Fukuda, H., E. Hama, T. Kuzuya, A. Takahashi, M. Takahashi, B. Tanaka, H. Tanaka, M. Wakahashi & Y. Watanabe, 1982. The life histories of butterflies in Japan. Vol. I. – Hoikusha Publishing Co., Osaka, XII + 277 pp. [in Japanese].

Hancock, D. L., 1983. Classification of the Papilionidae (Lepidoptera): a phylogenetic approach. – Smithersia 2: 1-48.

Häuser, C. L., 1990. Probleme der phylogenetischen Systematik am Beispiel der Parnassiinae (Lepidoptera, Papilionidae). – Verhandlungen der Deutschen Zoologischen Gesellschaft 83: 506.

Häuser, C. L., 1993. Critical comments on the phylogenetic relationships within the family Papilionidae (Lepidoptera). – Nota lepidopterologica 16: 34-43.

Hemming, F., 1934. Revisional notes on certain species of Rhopalocera (Lepidoptera). – Stylops 3: 193-200.

Hemming, F., 1967. The generic names of the butterflies and their type-species (Lepidoptera: Rhopalocera). – Bulletin of the British Museum (Natural History), Entomology, Supplement 9: 1-509.

Hering, M., 1932. Morphologische Untersuchungen in der Gattung *Parnassius* (Lepidopt.) als Beitrag zu einer Kritik am Begriff der Unterart. – Mitteilungen aus dem Zoologischen Museum in Berlin 18: 273-317.

Hering, M., 1935. Über einige geographische Formen von *Parnassius apollo phoebus* F. – Parnassiana 3 (4-5): 45-46.

Hering, M., 1937. Die systematische Bewertung von *Parnassius* (*Tadumia*) *przewalskii* Alph. – Parnassiana 5 (1-3): 8.

Hiura, I., 1980. A phylogeny of the genera of Parnassiinae based on analysis of wing pattern, with description of a new genus (Lepidoptera: Papilionidae). – Bulletin of the Osaka Museum of Natural History 33: 71-95 [in Japanese].

Hou, D., 1992. A new species and three new subspecies on the genus *Bhutanitis*. – Proceedings XIX International Congress of Entomology, Beijing, p. 47.

Huang, R.-X. & S.-I. Murayama, 1991. A new subspecies of *Tadumia przewalskii* from Xinjiang, China (Lepidoptera: Parnassiidae). – Acta Zootaxonomica Sinica 16 (3): 360-362 [in Chinese].

Igarashi, S., 1979. Papilionidae and their early stages. 2 vols. – Tokyo, 218 pp. 357 plates [in Japanese].

Iwamoto, Y. & T. Inomata, 1988. *Parnassius eversmanni* Ménétriés, 1855. – In: A. Ohya & T. Inomata (eds.), Illustrations of selected insects in the world. (A) 3: 33-48 [in Japanese].

Kitahara, H., 1990. Comparison of male genitalia of natural hybrids in sympatric habitat of *Parnassius glacialis* Butler and *P. hoenei* Schweitzer (Lepidoptera, Papilionidae). – Tyo to Ga 41 (2): 45-49 [in Japanese].

Koçak, A. Ö., 1981. Critical check-list of European Papilionoidea (Lepidoptera). – Priamus 1: 46-90.

Koiwaya, S., 1987. A new species of the genus *Parnassius* from Kunlun Mts., China. – Gekkan-Mushi 201: 3-6 [in Japanese].

Korshunov, J. P., 1888. Novye bulavousye tsheshuekrylye (Lepidoptera, Rhopalocera) iz Khakasii, Tuvy i Jakutii. – Novye i Maloizvestiye Vidy Fauny Sibiri 20: 65-80.

Korshunov, J. P., 1990. New genera of the subfamily Parnassiinae Swainson, 1840. – In: G. S. Zolotarenko (ed.), Arthropods and helminths: collected scientific works. – Nauka, Novosibirsk, pp. 99-105 [in Russian].

Kreuzberg, A. V.-A., 1985. Parusniki grupp *delphius, charltonius, simo* (Lepidoptera, Papilionidae) fauny SSSR. – In: Ministerstvo kultury Uzbekskoj SSR (ed.), Issledovanija flory i fauny srednej Azii. pp. 25-68. Taschkent.

Kreuzberg, A. V.-A., 1987a. Stenophagy in Parnassius (Lepidoptera: Papilionidae) of Central Asia and Altai. – Entomologist's Gazette 38: 95-102.

Kreuzberg, A. V.-A., 1987b. On the ecology of *Parnassius autocrator* (Lepidoptera) - a rare species of papilionids. – Zoologitsheski Journal 66 (7): 1106-1107 [in Russian].

Kreuzberg, A. V.-A. & I. G. Pljushch, 1989. The distribution, ecology and biology of *Parnassius loxias* Püngeler, 1901 (Lepidoptera: Papilionidae). – Entomologist's Gazette 40: 271-280.

Kudrna, O., 1986. Aspects of the conservation of butterflies in Europe. – In: O, Kudrna (ed.), The Butterflies of Europe. Vol. 8. – Aula-Verlag, Wiesbaden, 332 pp.

Kuhna, P., 1977. Über *Allancastria* in Kleinasien. – Atalanta 8: 99-107.

Kurentzov, A. I., 1970. The Butterflies of the Far East USSR. – Izdatelstvo Nauka, Leningrad. 164 pp. [in Russian].

Larsen, T. B., 1973. Two species of *Allancastria* (Insecta; Rhopalocera) in Lebanon. – The Entomologist 106: 45-52.

Larsen, T. B., 1975. Notes on the two species of *Allancastria* Bryk (Lep.: Papilionidae) in Lebanon. – The Entomologist's Record and Journal of Variation 87: 205-208.

Lee, C.-L., 1978. The early stages of Chinese Rhopalocera - *Luehdorfia chinensis* Leech (Parnassiidae: Zerynthiinae). – Acta Entomologica Sinica 21 (2): 161-163 [in Chinese].

Lee, C.-L., 1986a. Ecological and systematic studies of two chineses *Bhutanitis* butterflies I (*Bhutanitis mansfieldi* and *B. thaidina*). – Gekkan-Mushi 187: 1-6 [in Japanese].

Lee, C.-L., 1986b. Ecological and systematic studies of two Chineses *Bhutanitis* Butterflies II (*Bhutanitis mansfieldi* and *B. thaidina*). – Gekkan-Mushi 188: 1-8 [in Japanese].

Mayr, E., 1982. The growth of biological thought. – The Belknap Press of Harvard University Press, Harvard, xiii

+ 974 pp.
Miller, J. S., 1987. Phylogenetic studies in the Papilioninae (Lepidoptera: Papilionidae). – Bulletin of the American Museum of Natural History 186 (4): 365-512.
Moore, F., 1901-1903. Lepidoptera Indica. 5 Rhopalocera; Nymphalidae, Riodinidae, Papilionidae. – London, vii + 248 pp. 85 plates.
Mrácek, Z., 1989. Contribution à la connaissance des Lépidoptères diurnes de la Iakoutie (Lepidoptera Rhopalocera et Hesperiidae). – Linneana Belgica 12: 138-188.
Munroe, E., 1961. The Classification of the Papilionidae (Lepidoptera). – The Canadian Entomologist, Supplement 17: 1-51.
Nardelli, U., 1991. Anmerkungen zur Zucht von *Parnassius*-Arten sowie Bericht über eine Zucht von *Parnassius phoebus sternitzkii* (Lepidoptera: Papilionidae). – Nachrichten des entomologischen Vereins Apollo N.F. 12 (2): 141-152.
Nekrutenko, Yu. P., 1990. The Butterflies of the Caucasus. Part I. – Akademia Nauk Ukrainskoi SSR, Kiev, 215 pp. 32 tabl. [in Russian].
Nekrutenko Yu. P. & I. M. Kerzhner, 1986. On the species and varieties of *Parnassius* (Lepidoptera, Papilionidae) established by E. Ménétriés in the book of J. Siemaschko 'Russkaya Fauna'. – Entomologitsheskoe Obozrenie 65 (4): 769-779 [in Russian].
Nosé, Y. (ed.) 1990. Butterflies and Nature of China. Ressel Company, Osaka, vii + 255 pp. [in Japanese].
Olivier, A., 1991. The taxonomic status of the population of *Zerynthia cerisy* (Godart, [1824]) on the Greek island of Sámos (Lepidoptera : Papilionidae). – Phegea 19: 71-74.
Orr, A. G., 1988. Mate conflict and the evolution of the sphragis in butterflies. – Unpublished Ph.D. - thesis, School of Australian Environmental Studies, Griffith University, Nathan, Queensland, xvi + 348 pp. 39 plates.
Reinig, W. F., 1937. Zur Entstehungsgeschichte der Mannigfaltigkeit und Verbreitung der Parnassier. – Parnassiana 4 (3-8): 45-57.
Reuter, E., 1897. Über die Palpen der Rhopaloceren. Ein Beitrag zur Erkenntnis der verwandtschaftlichen Beziehungen unter den Tagfaltern. – Acta Societatis Scientiarum Fennicae 22: i-xvi, 1-577, Tafel I-VI.
Riley, N. D., 1927. The Rhopalocera of the third Mount Everest expedition (1924). – Transactions of the Entomological Society of London 75: 119-129.
Rothschild, W., 1918a. Catalogue of Zerynthiinae and allied genera in the Tring Museum, with critical notes. – Novitates Zoologicae 25: 64-75.
Rothschild, W., 1918b. Catalogue of Parnassiinae in the Tring Museum. – Novitates Zoologicae 25: 218-262.
Saigusa, T. & C.-L. Lee, 1982. A rare Papilionid butterfly *Bhutanitis mansfieldi* (Riley), its rediscovery, new subspecies and phylogenetic position. – Tyo to Ga 33: 1-24.
Schulte, A., 1992. Beschreibung einiger neuer *Parnassius*-Unterarten aus mehreren China-Ausbeuten 1991 (Lepidoptera, Papilionidae). – Nachrichten des entomologischen Vereins Apollo N.F. 13 (2a): 165-177.
Schweizerischer Bund für Naturschutz (ed.), 1991. Tagfalter und Ihre Lebensräume. 3. Auflage. – Schweizerischer Bund für Naturschutz, Basel, XII + 516 pp.
Scott, J. A., 1986. The Butterflies of North America. – Stanford University Press, Stanford, xvi + 584 pp.
Shinkai, A., 1990. A new subspecies of *Parnassius hide* discovered in Eastern Qinghai, China (Lepidoptera, Papilionidae). – Notes on Eurasian Insects 1: 11.
Sokolov, G. N., 1929. Die Struktur des männlichen Kopulationsapparates bei der Gattung *Parnassius* Latr. – Russkoe Entomologitsheskoe Obozrenie 23: 60-71 [in Russian].
Spuler, A., 1892. Zur Stammesgeschichte der Papilioniden. – Zoologische Jahrbücher, Abtheilung für Systematik, Geographie und Biologie der Thiere 6 (4): 465-495.
Stichel, H., 1907a. Lepidoptera. Fam. Papilionidae, Subfam. Parnassiinae. – In: Wytsman, P. (ed.), Genera Insectorum 58: 1-60 Tafel 1-3.
Stichel, H., 1907b. Lepidoptera. Fam. Papilionidae, Subfam. Zerynthiinae. – In: Wytsman, P. (ed.), Genera Insectorum 59: 1-27 Tafel 1-2.
Stshetkin, Ju. Ju., 1979. The species status of *Parnassius cardinal* Gr.-Gr. and a new subspecies of *Parnassius delphius* Ev. (Lepidoptera: Papilionidae). – Doklady Akademii Nauk Tadzhikskoi SSR 22 (1): 63-66 [in Russian].
Verity, R., 1905-1911. Rhoplaocera Palaearctica. – Florence, LXXXVI + 368 pp. 72 planches.
Watanabe, Y., 1990. A new species of genus *Parnassius* Latreille from Tibet, China (Lepidoptera, Papilionidae). – Notes on Eurasian Insects 1: 2-6.
Weidemann, H.-J., 1986. Tagfalter: Entwicklung - Lebensweise. Band 1. – J. Neumann-Neudamm, Melsungen, 282 pp.
Weiss, J.-C., 1991. The Parnassiinae of the World. Part 1. – Sciences Nat, Venette, 48 pp.
Weiss, J.-C., 1992. The Parnassiinae of the World. Part 2. – Sciences Nat, Venette, pp. 49-135.
Weiss, J.-C. & F. Michel, 1989. Description de nouveaux taxa du genre *Parnassius* provenant du Tibet (Chine) (Lepidoptera Papilionidae). – Bulletin de la Société Sciences Nat 61: 5-19.

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A MONOGRAPH OF *MERODON* (DIPTERA: SYRPHIDAE). PART 1

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This first part of a revision of the genus *Merodon* deals with 61 species characterized by two synapomorphies, viz. arcuate abdominal pruinose bands and abdomina with tapering second tergite. Eleven monophyletic species groups are recognized, accounting for 51 species. Seven species are placed in an undefined set while three species are discussed separately. Descriptions of the species groups are provided. All species are described and their important characters figured. Of the 91 nominal taxa mentioned in the checklist, 61 are species, 2 subspecies, 6 varieties and 22 synonyms, 4 of which are new. Of these, the following 28 species and one subspecies are new to science: *M. mariae*, *M. ottomanus*, *M. testaceoides*, *M. altinosus*, *M. hypochrysos*, *M. marginicornis*, *M. sophron*, *M. ankylogaster*, *M. auronitens*, *M. oidipous*, *M. persicus*, *M. tangerensis*, *M. xanthipous*, *M. aberrans isperensis* subsp. n., *M. cupreus*, *M. lusitanicus*, *M. splendens.*, *M. warnckei*, *M. kaloceros*, *M. vandergooti*, *M. bequaerti*, *M. elegans*, *M. lucasi*, *M. nitidifrons*, *M. satdagensis*, *M. schachti*, *M. taniniensis*, *M. toscanus*, *M. aureotibia.*
Lectotypes are designated for 23 nominal taxa; three new combinations are introduced. An annotated list of species excluded from *Merodon* is given. *Azpeytia shirakii* nom. n. is proposed for *Merodon scutellaris* Shiraki.
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Key words. – Diptera; Syrphidae; *Merodon*; new subdivision; new species; lectotypes; excluded species; nomen novum.

Contents

Introduction

The genus *Merodon* is a moderately large group of syrphid flies naturally occurring in the palaearctic and ethiopian faunal regions. As far as known the development of the larvae takes place in bulbs or rhizomes of Liliaceae and Amaryllidaceae. The last comprehensive discussion of the genus, by Sack (1931), is outdated, contains several errors, and deals with only about half the species currently known. The descriptions and discussions of *Merodon* species published so far largely disregard important male genital characters considered suitable for grouping purposes and species recognition.

This paper deals with eleven monophyletic species groups defined by apomorphies and a remaining undefined set of species. All species discussed in this paper are grouped by two synapomorphies, viz. arcuate pruinose bands on the abdominal tergites, and an abdomen with tapering second tergite. Only the males are used for grouping purposes, since their genitalia yield enough data for subdivision. The female genitalia are rather uniform; moreover the ornamentation of the legs and specialized pubescence areas are

usually much less developed in the females than in the males.

Material

Material was studied from the following institutes and private collections (with acronyms used in this paper): BMNH, British Museum (Natural History), London, England; MNHN, Muséum National d' Histoire Naturelle, Paris, France; LSF, Museo Zoologico della Specola, Florence, Italy; MCSN, Museo Civico della Storia Naturale, Milan, Italy; BSA, Benediktinerstift Admont, Admont, Austria; NHMW, Naturhistorisches Museum Wien, Vienna, Austria; ZMHB, Museum für Naturkunde, Von Humboldt Universität, Berlin, Germany; DEIC, Institut für Pflanzenschützforschung, Eberswalde, Germany; HLMD, Hessisches Landesmuseum, Darmstadt, Germany; MFNS, Museum für Naturkunde, Stuttgart, Germany; LAU, Musée Zoologique, Lausanne, Switzerland; KBIN, Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussels, Belgium; MRAC, Museum voor Midden Afrika, Tervuren, Belgium; ZMUC, Zoological Museum, Copenhagen University, Copenhagen, Denmark; SAL, Zoological Institute of Salamanca University, Salamanca, Spain; IEE, Instituto Espanol de Entomologia, Madrid, Spain; ZMAS, Zoological Institute of the Russian Academy of Sciences, St. Petersburg, formerly Leningrad, Russia; TMA, Természettudományi Museum Allättara, Budapest, Hungary; BTM, Bakonyi Természettudományi Museum, Zirc, Hungary; LHW, Entomological Institute, Agriculture University, Wageningen, the Netherlands; RMNH, Rijksmuseum van Natuurlijke Historie, Leiden, the Netherlands; JLR, J. A. W. Lucas, Rotterdam, the Netherlands (the most important single source of material; material from several other, mainly private collections was made available by Mr Lucas as well); ZMAN, Institute of Taxonomic Zoology, Zoological Museum, University of Amsterdam, Amsterdam, the Netherlands; PC, S. J. Paramonov collection. Many types of species described by Paramonov were formerly preserved in his private collection. After Liepa (1969) this collection is considered to have been lost.

Methods

Preparation of specimens

In order to study the male genitalia, specimens prior to examination were relaxed using dilute ethanol vapour at room temperature for 6 to 48 hours depending on specimen size. After relaxation the genitalia were extracted with an insect pin with hooked tip. Isolation of the genitalia often proved necessary; in such cases the genitalia were stored in microvials containing a 60%-40% mix of glycerol and ethanol. The genitalia were examined in the dry state since boiling or prolonged submersion in KOH led to maceration and damage to the pubescence. The pubescence found in many species could hardly be seen properly in wet state. We were confronted with the same problem with genitalia already isolated and stored in Canada balsam. Genitalia already stored in microvials (in ethanol/glycerol mixture) were repeatedly washed with 70% ethanol and left to dry prior to examination.

In *Merodon*, the female genitalia have been of little use for taxonomic purposes since they are hardly sclerotized. If dried they shrivel completely, and if stored in a liquid medium the various pubescences are difficult to distinguish.

Methods used in grouping

The species have been grouped on the basis of apomorphic characters. Characters were considered apomorphic after a preliminary survey of the corresponding characters in other species groups and in the genus *Eumerus*, the presumed sister group of *Merodon*, on the ground of similarities in the genitalia and the banding pattern on the abdomen of some species of *Eumerus* formerly placed in the genera *Megatrigon* Johnson and *Amphoterus* Bezzi (see also Hull 1949: 395). On the basis of this comparison a slightly oblique to parallel, straight banding pattern, comparatively simple male genitalia and a comparatively stout abdomen are therefore considered to be plesiomorphic.

Terminology

The terms used to describe the various structures are illustrated in figs. 1-4 (head), 5 (thorax), 6 (wing), 7 (leg) and 8-17 (male genitalia). The terms are mainly derived from McAlpine (1981), but some terms from Speight (1987), Van der Goot (1981), Hull (1949), Sack (1931) and Metcalf (1921) have been used for elements occurring specifically in Syrphidae. A few terms are introduced here to describe structures in the male genitalia; they are illustrated in figs. 8-17. The vertex angle and ocellar angle, as used here in describing the head, are illustrated in fig. 3.

The ratio obtained by dividing the compound eye touchline length by the vertex height, measured from its angle to the border with the occiput, is cited as the tl-v ratio. This ratio is often a useful distinguishing character. The antennal ratio, illustrated in fig. 2, is also frequently used. Sternites and tergites are counted in Roman numerals and abbreviated S and T, respectively.

Drawings and maps

All drawings are original; they were made with the

aid of various stereo microscopes with drawing tubes under 10-80× magnification; all scale lines represent 1 mm.

Distribution maps are provided for all species. On the distribution maps only those records are represented which are based on examined material or on reliable references. References from literature for species easily confused with other species have not been included. Where many records for a species occur, single records are represented by small symbols. The large symbols represent five records in the same area.

The genus Merodon Meigen, 1803

Merodon Meigen, 1803: 274. – Type-species *Syrphus clavipes* Fabricius, 1781: 427 [designation of Westwood 1840: 137].

Lampetia Meigen, 1800: 34 [Suppressed by the I. C. Z. N., Opinion 678]. – Type-species *Syrphus clavipes* Fabricius, 1781: 427 [designation of Coquillett 1910: 557].

Exmerodon Becker, 1912: 604 (as subgenus of *Merodon*). – Type-species *Merodon* (*Exmerodon*) *fulcratus* Becker, 1912: 604 [original designation].

Taxonomic and nomenclatural history

From 1781 to c. 1900

In 1800, Meigen established the genus *Lampetia* to accommodate *Syrphus clavipes* Fabricius, 1781 (Meigen 1800). In 1803 he introduced the new name *Merodon* for this genus, mentioning that *Syrphus curvipes* [error for *clavipes*] belongs in *Merodon* (Meigen 1803). The work of Meigen (1800) has been placed on the Official Index of Rejected and Invalid Works in 1963 (I. C. Z. N. Opinion 678); since then only the Meigen (1803) names should have been used. Several species described by Fabricius and Rossi prior to the description of *Merodon* were later incorporated in this genus by e.g. Fabricius (1805).

At the start of the nineteenth century species now included in *Merodon* were described in several genera such as *Eristalis* Latreille, 1804, and *Milesia* Latreille, 1804. As, in the first half of the nineteenth century, the concept of the various syrphid genera crystallized, many new species were rightly described in *Merodon*. During this period Fabricius (1805), Meigen (1822-1838), Macquart (1834, 1842) and Rondani (1843-1868) described and redescribed many species. Several synonyms were created through interpretation of colour forms as species. Walker (1849-1860) assigned many species to this genus, all but one incorrectly. Loew (1862a-b, 1869) described several new species and also provided redescriptions for several known species. Strobl (1893-1909) described several new, and redescribed many known taxa. The authors mentioned so far almost never discussed the differences between species, except when establishing a new taxon; they were not concerned with subdividing the genus or with discussing its position within the Syrphidae.

The twentieth century

The first author providing a comprehensive generic description for *Merodon* was Verrall (1901) who located this genus in the subfamily Eristalinae. Villeneuve (1909-1934) published several new species and recognized a number of synonyms within *Merodon*. Becker (1912) subdivided *Merodon* into two subgenera, the nominal subgenus *Merodon* and the new subgenus *Exmerodon* Becker, 1912. The latter subgenus at that time comprised only the type-species *Merodon fulcratus* Becker, 1912. Stackelberg (in Stackelberg & Richter 1968) included his new species *dichopticus* in the same subgenus, established to accommodate species with dichoptic eyes in the males. In the only monograph on *Merodon* so far, by Sack (1913a), *Merodon* was not assigned to any subfamily although it was compared with several genera in the Eristalinae. Other publications by Sack (1913-1938) contain a wealth of information on *Merodon*, many descriptions of new species and a subdivision of the genus based on external similarities. Major contributions to the knowledge of *Merodon* were made by Paramonov (1924-1937). He divided the genus into species groups, not all of which were published. These groups, like those of Sack (1913a), were based on external similarities. Moreover Paramonov critically reviewed papers by Becker (1912) and Sack (1931), rejecting some species and expressing his doubts about others.

Other contributions were made by Gil Collado (1930), Curran (1939) and, more recently, Séguy (1961), who surveyed the species known from western Europe. Van der Goot (1981) in his work on the north-west European Syrphidae provided a key for the species occurring in that area.

The works mentioned so far did not make use of genital characters to identify the species. In *Merodon* many problems existed as to the separation of species, which easily could have been solved by superficial examination of the genitalia. The first papers in which genitalia of *Merodon* are discussed and figured were by Glumac (1958) and Gaunitz (1969). Regrettably the drawings provided are insufficient, but they afford an insight into the great variety within the genus.

There is a considerable amount of literature on one single species, the narcissus bulb fly *Merodon equestris* (Fabricius, 1794), which is a pest in flower bulb cultivation. This species probably received more attention in terms of literature produced, than all other species together. This literature is mainly concerned with economical aspects, genetics and life cycle. Some of this literature is referred to under that species. No

other species of *Merodon* are of known economical importance.

Diagnostic characters

The genus *Merodon* is characterized by the following characters: (1) Radius 4+5 curves deeply into cell r5 (e.g. fig. 19 d); (2) the apical part of Media is strongly recurrent; its subapical portion is slightly sinuate (e.g. figs. 6, 19 d); (3) dm-cu is weakly, smoothly curved, not sinuate (e.g. figs. 6, 19 d); (4) femora 3 have a concave lower face and apically bear a single projection at the distal end (e.g. figs. 20 a through e).

These features are found in both sexes; the size and shape of the projection on femora 3 is rather variable, but this projection is always present although it is reduced in some species.

Species of *Merodon* have sometimes been assigned to other genera. More often, species of *Mallota* Meigen, 1822, and *Eumerus* Meigen, 1822, are wrongly assigned to *Merodon.* The genus *Azpeytia* Walker, 1865, includes species that can be mistaken for *Merodon.*

In *Azpeytia* the femora 3, which are less stout than in *Merodon,* bear two projections or series of spinules distally; the scutellum is much wider than in *Merodon*; R4+5 curves only weakly into cell r5; dm-cu is distinctly sinuate to kinked; moreover the oral margin is less projecting than in the majority of *Merodon* species (figs. 18 a, 19 b, 20 k, l).

In *Eumerus* the femora 3 have a convex lower face and bear two projections or spinule series as in *Azpeytia*; the 3rd antennal article is relatively larger and shorter in *Eumerus* than in most *Merodon* species; R4+5 does not or hardly curve into cell r5 while dm-cu is strongly kinked in *Eumerus*; in several *Eumerus* small appending veinlets of the dm-cu are found; these are not found in *Merodon* (figs. 18 c, 19 a, 20 f, g, h, j).

In *Mallota* the apical part of vein M is not recurrent as in *Merodon*; moreover *Mallota* species have a distinct facial knob, not found in *Merodon* (figs. 18 d, 19 c, 20 m, n).

Platynochaetus Wiedemann, 1830, is rather similar in appearance to *Merodon*; the males may be distinguished by their curious antennae, while both sexes show a facial knob; the position of the bands on the abdomen is different (anteriorly in *Platynochaetus*, in mid-region in *Merodon*). However, the wing venation and the shape of femora 3 are quite similar to that in *Merodon* (figs. 18 e, 19 e, 20 o, p).

The larvae of *Merodon* may be separated from those of other genera by using the key of Heiss (1938), who figured the larva of *Merodon equestris.* As the larvae of most species are still unknown, identification may be problematic. According to Maldonado Capriles & Berrios (1977) the puparium of *Merodon* can be confused with that of *Copestylum* species.

Description of the imagines
(fig. 23 d)

In all respects species of *Merodon* conform to the criteria established for the Syrphidae by many authors, e.g. Verrall (1901), Lundbeck (1916), Sack (1931), Hull (1949) and Van der Goot (1981).

Habitus: Stoutly built to moderately slender, rarely very slender syrphid flies. Body length 5-25 mm, wing span 6-35 mm. Head, thorax and abdomen about equally wide. Legs rather stout, the trochanters 3 and femora 3 in many species swollen and ornamented in the males. In many species pruinose bands of microtrichiae are present on the thorax and abdomen. The thoracic surface is black or dark brown, in several species metallic lustrous; the abdomen is black to brown, often with yellow to red lateral spots which may extend over all the abdomen. Wings mostly clear although infuscate wings rarely occur. A typical representative of the genus, *M. distinctus* Palma ♂ is shown in fig. 23 d. Many species mentioned in this paper are superficially similar, especially those of the *alagoezicus, avidus, crassifemoris, nigritarsis* and *vandergooti* groups.

Head: In the majority of species the males are holoptic while intermediate and dichoptic conditions occur in males of several species; females always dichoptic. Compound eyes dark brown to reddish, usually bearing moderately dense whitish pubescence. Antennae shorter than head except in a few species with lengthened third article; third article usually longest and widest, often conspicuous; arista inserted rather basally on dorsal margin. Coloration of antennae most variable. Face lacking knob; oral margin clear, often conspicuous, seldom weak; genae absent; facial surface little sculptured, dark, often metallic lustrous, often yellow to white pruinose and pubescent. Frons concolorous, often denser pubescent than face; in females lateral strips on frons often pruinose, leaving free a lustrous midstripe; species with an all lustrous or all pruinose frons occur. The pruinose frontal strips do not occur in dichoptic males. In males with incompletely touching eyes the narrow frontal strip is bald. Holoptic males show considerable variety in length of the touchline of the eyes. The vertex is dark, in some species metallic lustrous, and often conspicuously dark pubescent in the ocellar region. Occiput dark, pubescence concolorous, often white to yellow pruinose down sides (figs. 3-4, 18 b).

Thorax: Slightly elongate, humeral calli well marked, dorsal suture clear laterally only; colour dark, often metallic lustrous on dorsum, scutellum, kate-

pisternum, anepisternum and anepimeron. Pubescence often conspicuous, sometimes strongly coloured; length and density most variable; species with very even, and with uneven pubescence occur. Pruinose bands, if present, are longitudinal, often coalescent anteriorly; in some cases weak crossbands occur along the dorsal suture. The scutellum is without specialized structures or specialized pubescence (fig. 5).

Wings: The wing surface is clear to partially or strongly infuscate, in most species slightly, evenly troubled. All species show the *vena spuria* characteristic of the Syrphidae. Stigmal crossvein oblique, stigma absent; cell r1 open anteriorly; R4+5 strongly curving into r5, dm-cu proximally sinuous, distally rather strongly recurrent; r-m reaches M1+2 at approximately the middle of the anterior border of cell dm; no appending veinlets occur on R4+5 or dm-cu; the curves in CuA1 and dm-cu are smooth. The colour of the veins ranges from dark yellow to black and is rather constant within species. The alula is inconspicuous; the squama and antisquama (upper and lower calypters) are pale and bear a fringe of pale, yellow, even pubescence. The halteres usually are well clear of the thoracic pubescence; the stalk is yellow, the knob usually pale, sometimes dark (fig. 6, 23 d).

Legs: Legs 1 and 2 moderately robust. Leg 3 very robust, with specialized structures: a single, usually triangular projection on the femora 3 at the distal end in all *Merodon*. Various ridges and spines occur on the trochanters 3, femora 3, tibiae 3 and metatarsi 3 in the males, seldom so in the females, of many species. In several species the femora, the metatarsi, or both, may be swollen or modified strongly in the males, weakly in females. The colour is most variable, species with all orange and with all black legs occur. In many species the dark legs bear short, recumbent, golden pubescence giving a false impression of yellow leg colour. Specialized pubescences occur on the trochanters 3 where a tuft of stout hairs is found in some species, often inserted on a projection; on the tibiae 3 where a tibial floccus (a bunch of hairs) occurs in some species, in most cases inserted on a spur; and on the metatarsi 3 where stout short hairs occupy part of the lower face in some species (figs. 40 c, 42 d).

Abdomen: Outline variable, usually comparatively stout in the females, with some notable exceptions, more slender in the males. The abdominal apex in the males is posteriorly rounded with the genitalia often clearly visible, in females it is posteriorly rounded to more or less acute. In males of some species T IV is conspicuously swollen to hold the large genitalia. Colour in most species dark throughout with yellow lateral spots on T II; in other species all dark, or mainly to all red, yellow or orange. Pubescence often concolorous with surface, most variable in density, evenness, length and colour; pruinose bands often present, in many cases combined with yellow to red background. These bands are quite variable in width and curvature throughout *Merodon* and are lacking altogether in several species. In the males S IV is usually slightly modified posteriorly; in some species large paired appendages or a strong keel occur (figs. 36 b, 39 c, 40 b, 41 d, 42 e, 43 e, 44 b).

Male genitalia: The male genitalia are often intricate and show enormous variation. They consist of two main parts, the aedeagus and the surstyle. Both parts are basally connected, by epandrium and basale respectively, to the inside of the genital cap. The aedeagus is relatively the least variable, consisting of a usually tapering shaft, which apically bears paired chitinous plates, encasing the sperm duct. These plates vary in shape, size and degree of sclerotization and can be recumbent, erect or intermediate. The outer face of the shaft may bear paired spines, lobes or strongly sclerotized plates, or may have a subbasal excavation. The inner face may show pubescence. The curvature of the aedeagus varies between species; both slender and stout aedeagi occur, while the apical shaft part (defined in fig. 10 a) may be weakly to strongly lengthened. The surstyle which envelops the cercus is much more variable. In its most simple form it consists of a paired, more or less S-shaped sclerotized plate, the apical part of which is identified as the posterior surstyle lobe which is always present. In most species additional lobes of the surstyle occur; often there is an anterior surstyle lobe which may either be free and projecting, or coalescent to various degrees with the posterior surstyle lobe; in some cases a middle surstyle lobe is present as well. The anterior and posterior surstyle lobes may bear accessory lobes and / or specialized pubescences. The cercus is variable in shape and in the length and density of the pubescence. The genital cap (S X of Metcalf 1921, S VIII of McAlpine 1981, T VIII of Speight 1987) encasing the genitalia proper does not show much variability, although in one species, *Merodon caudatus* Sack, 1913, this cap is strongly elongate and bears an apical floccus conspicuous to the naked eye (figs. 8-17).

Female genitalia: Simple, consisting of a telescope tube terminally fringed with pubescence (see figs. 52-55 in Speight 1987). The structure of female genitalia is quite uniform throughout *Merodon* and of little significance in establishing species groups or in species recognition.

Sexual dimorphism: Rather pronounced in most species. In species with dichoptic males, eyes of females wider apart. Metallic lustre in females usually less strong. Wings in females often less infuscate. In females pubescence on head, thorax and abdomen shorter and duller, but in many species the pruinose bands on thorax and abdomen clearer. In species with

males showing interalar pubescence bands these are sometimes lacking in females.

Biology

Merodon is widely distributed over the Palaearctic and Ethiopian regions and contains about 150 species. In general, very little is known of the biology, in spite of several species being quite common. *Merodon* species may account for a considerable part of the Syrphidae in the fauna of a region or country. There are over 50 species of *Merodon* in Turkey, where many species are very common. In Israel about 20% of the Syrphid species belong to *Merodon* (Kaplan & Thompson 1981: 198).

The known larvae all develop in underground bulbs or rhizomes of monocotyledons. It is assumed that most if not all species share this way of life. Larvae were reared of *Merodon amaryllidis* Villeneuve de Janti, 1934 (Villeneuve de Janti 1934), *Merodon bombiformis* Hull, 1944 (Stuckenberg 1956) and *Merodon equestris* (Fabricius, 1794) (e.g. Lindner 1949).

In the temperate zone the larvae survive the winter underground. Various species occur in regions having severe winters, e.g. the eastern Turkish mountains at 3000 m altitude, where species of *Merodon* are common. The larvae are sheltered by the snow cover. On the other hand, *Merodon* occurs in tropical and subtropical regions as well. In these regions the larvae survive unfavourable climatic conditions, mainly drought, in their sheltered underground habitat. In relatively dry surroundings the various species seem to prefer relatively wet places (Hurkmans 1988). Some are mainly found at higher altitudes (e.g. Hurkmans 1988, Marcos Garcia 1989) where lower temperatures cause less evaporation, and therefore less extreme drought. In view of these adaptations *Merodon* should be considered xero-tolerant rather than xerophilic. In the northern and moister parts of the range, *Merodon* occurs in relatively drier habitats. This probably reflects that dry areas warm up quicker in spring and therefore allow a longer season. This is important given the restricted flight period. In view of the overall distribution, *Merodon* can be considered thermophilous, but this holds true only for the flight period. Cold season or drought conditions seem less important in view of the sheltered conditions during larval development.

The various species of *Merodon* appear to have a preference for flowers of Umbelliferae (e.g. Šuster 1959, Hurkmans 1985, 1988).

Territorial behaviour was recorded in several *Merodon* species, e.g. by Fitzpatrick & Wellington (1983) and Hurkmans (1985, 1988). Defence of territories is more or less aggressive according to territorial space available, presence of females, population density and weather. In some species the males emit piping sounds presumed to play a role in territorial defence and mating (Conn 1978; Treiber 1987; Hurkmans 1988).

Copulation is either airborne or sedentary; both modes may occur in the same species (Conn 1978; Hurkmans 1988) and may be linked with morphological differences (Conn 1978). *Merodon equestris* is capable of prolonged flight in copula. Duration of copulation is variable, from few seconds (Kabos 1939) to several minutes. In *Merodon rufus* copulation is accompanied by a loud piping sound (Treiber 1987).

During oviposition several modes appear to occur: Kabos (1939) recorded that in *Merodon equestris* eggs were not attached to plants but pressed into the soil, while Hurkmans (1988) found that in *Merodon loewi* (Van der Goot, 1964) the females pressed their abdominal tip to the stems of *Ornithogalum* plants as if ovipositing; regrettably no larvae could be reared from the plants dug out.

Apparently the number of generations per year varies throughout the range. Northern records are mainly from July, while Mediterranean records of a single species in one region may extend from May through September. Marcos García (1985) recorded that *Merodon avidus* (Rossi, 1790), and *Merodon aeneus* Meigen, 1822 are bivoltine in western-central Spain. Split occurrences of many species reflect only available collection data and do not indicate that these species are bivoltine.

Several species of *Merodon* have a dense and colourful pubescence and mimic bumblebees by their size and laborious flight, close to the soil. Brown (1951) noted that in *Merodon equestris* the colour forms most numerous in his samples mimicked the most common bumblebee. A cluster of small, strongly lustrous species resemble halictid bees in size, appearance and behaviour.

Division into species groups

The divisions of *Merodon* by Becker (1912), Sack (1913a) and Paramonov (1926b) are based on external similarities. The genitalia were not considered while some problematical species were not included in the species groups presented.

The subgenus *Exmerodon* Becker, 1912, established to accommodate the type-species [by original designation], *Merodon* (*Exmerodon*) *fulcratus* Becker, 1912, is based on the dichoptic condition in males of *fulcratus*. Sack (1913a, 1931) and Paramonov (1924-1937) did not follow Becker's subdivision. The subdivision by Becker is not followed here for two reasons: first, dichoptic males are also found in other

species not closely related to *fulcratus* and second, the *fulcratus* group does not occupy an isolated position.

A first attempt to present a subdivision based on synapomorphous characters, including those of the male genitalia, is given here for the species having arcuate pruinose bands and abdomina with tapering second tergite. These two characters are judged to be apomorphic. The corresponding plesiomorphic conditions are: straight, oblique pruinose bands and non-tapering abdomina.

Key to the species treated

Note: Several species had to be left out of the key. Their genitalia could not be checked, since type-material could not be studied. These are: *Merodon bessarabicus* Paramonov, 1924 (the types are presumably lost); *Merodon dobrogensis* Bradescu, 1982; *Merodon kiritshenkoi* Stackelberg, 1960; *Merodon tener* Sack, 1913 (the only types left are ♀, the ♂ types are presumably lost).

Males: Key to species groups and species

A. No anterior surstyle lobe present on genitalia, *or*: the surstyle consists of one mass in which the anterior part may be differentiated (e.g. figs.); *or*: the outline of the surstyle ridge is fluent, semicircular or broadly rounded; *or*: anterior surstyle lobe weak, posterior lobe very long (African species); *or*: anterior surstyle lobe medially recurved, totally coalescent with surstyle mass; *or*: three surstyle lobes of equal size, separated by two very deep sulci; *or*: abdomen relatively stout, T II not tapering, pruinose bands parallel to posterior tergite margins ... key in part II of this monograph

– Anterior surstyle lobe well-defined, moderately large to large, the surstyle lobes are well differentiated. The surstyle lobes are not all separated (by two deep sulci), if a middle lobe occurs it is small and coalescent with either anterior or posterior lobe, and the lobes are not of equal size. Anterior lobe not medially recurved and totally coalescent with stylus mass, but free (although the apex may be recurved). Abdomen relatively slender, T II (more or less strongly) posteriorly tapering, abdominal pruinose bands arcuate. Species fulfilling all these requirements can be identified using the following key.

1. Anterior surstyle lobe short, rounded, pubescent, coalescent with surstyle mass (*distinctus* assemblage) 12
– Anterior surstyle lobe more elongate, often well separated from surstyle mass, often with accessory lobes or specialized parts 2
2. Anterior surstyle lobe narrow, posterior lobe mediolaterally aligned, often overlapping (*alexeji* group) 17
– Posterior lobe dorsoventrally aligned 3
3. Basitarsi 3 swollen, with specialized (dense, short, golden) pubescence on medial face; tibiae 3 often with apical floccus; sternite IV often keeled or strongly modified (*tarsatus* group) 25
– Sternite IV never strongly modified, if keeled the basitarsi 3 normal 4
4. Legs all dark, many species with conspicuous pubescence; anterior surstyle lobe wide, elongate, large (*clavipes* group) 32
– Legs partly yellow 5
5. Flanges present on outer face of aedeagus (*elegans* group) 42
– No such flanges present 6
6. Secondary, lateral lobe present on posterior surstyle lobe; femora 3 much swollen, tibiae and tarsi all yellow; anterior surstyle lobe large, rather elongate, moderately wide; aedeagus with apical shaft part normal (*vandergooti* group) ....*vandergooti* sp. n.
– No secondary lateral lobe, or if present, femora 3 less swollen, anterior surstyle lobe narrow, elongate, ventrally recurved, anterior surstyle lobe narrow, ventrally recurved, apical shaft part of aedeagus lengthened 7
7. Anterior surstyle lobe separated from surstyle mass by a sulcus 8
-- Genitalia not with sulcate surstylus 9
8. Large species, averaging 17 - 21 mm body length; abdomen predominantly yellow, antennae normal (*pruni* group) ....*pruni* Rossi
– Smaller species, 7 - 15 mm, abdomen dark with crimson or dark red, antennae notably to extremely lengthened (*longicornis* group) 45
9. Posterior surstyle lobe with large, ventral accessory lobe (*crassifemoris* group) ....*crassifemoris* Paramonov
– This lobe without large ventral accessory lobe 10
10. Apical shaft part of aedeagus lengthened; anterior surstyle lobe usually not apically widened but if so, then bifid (*alagoezicus* group) 46
– Apical shaft part normal, anterior surstyle lobe apically widened, not bifid 11
11. Aedeagus with 2 pairs of spines on outer face, anterior surstyle lobe rectangular to diamond-shaped (*nigritarsis* group) 52
– Aedeagus smooth, anterior surstyle lobe ending in spathulate-semicircular apex (*avidus* group) ... .*avidus* (Rossi)
12. Femora 3 very much swollen 13
– Femora 3 only moderately swollen 14

13. Larger species, body length 13 - 15 mm; genitalia: aedeagus stouter, apical shaft of aedeagus shorter .....*femoratus* Sack
– Smaller species, body length 10 - 13 mm; genitalia: aedeagus slenderer, apical shaft of aedeagus longer .....*clunipes* Sack
14. Thorax and abdomen densely yellow pubescent; abdomen stout, T II strongly tapering; genitalia: both surstyle lobes elongate; body length 15 mm .....*mariae* sp. n.
– Pubescence less dense, abdomen slenderer; if body length approx. 15 mm then abdomen very slender 15
15. Genitalia: Posterior lobe very short; third antennal article subacute - acute; pubescence overall very long and thin .....*ottomanus* sp. n.
– Genitalia: Posterior lobe longer; third antennal article obtuse 16
16. Body length 13 - 15 mm; both surstyle lobes coalescent; abdomen very slender, dark with large yellow lateral spots .....*distinctus* Palma
– Body length 9-12 mm; surstyle lobes separated by a sulcus; abdomen yellow throughout ....*testaceoides* sp. n.
17. Genitalia: Anterior surstyle lobe showing elongate bald area; S IV deeply emarginate posteriorly .....*marginicornis* sp. n.
– Anterior surstyle lobe without bald area 18
18. Genitalia: Posterior surstyle lobe with rounded bald knob in antero-lateral part 19
– No such knob present, or knob very weak 21
19. Both surstyle lobes short; cercus relatively large, short,wide; T II with orange lateral spots bearing submetallic lustre; apical part of aedeagus covered by overlapping posterior surstyle lobes ....*sophron* sp. n.
– Both surstyle lobes longer, cercus relatively smaller, more elongate; no submetallic lustre on lateral spots; aedeagus entirely visible 20
20. Pubescence on thorax and abdomen recumbent to oblique, golden; triangular processus with clear apical spur and short stout bristles ....*altinosus* sp. n.
– Pubescence on thorax and abdomen less conspicuous, erect; no clear apical spur on triangular processus which bears longer, less stout bristles ....*alexeji* Paramonov
21. Anterior surstyle lobe with length/width ratio 1.2 - 1.3 in lateral view; posterior surstyle lobe short, rather spathulate in ventral view, coalescent ....*kawamurae* Matsumura
– Anterior surstyle lobe with length/width ratio of 2.0 or over; if posterior surstyle lobe short: accessory lobe present where anterior and posterior lobes meet, and anterior lobe strongly spathulate 22
22. Antennal ratio 2.1; genitalia: cercus placed far ventrad; accessory lobe present on posterior surstyle lobe; anterior lobe very elongate (an inconspicuous bald knob present antero-medially on posterior surstyle lobe) .....*alexeji* Paramonov
– Antennal ratio under 2.0; genitalia: cercus in normal position; no accessory lobe on posterior surstyle lobe 23
23. Abdomen with strong golden lustre; genitalia: anterior surstyle lobe widest in its mid-region; aedeagus with two separate subapical cavities, apical shaft part slightly lengthened ...*hypochrysos* sp. n.
– Abdomen without strong golden lustre; genitalia: anterior surstyle lobe equally wide throughout, or spathulate; aedeagus with one subapical cavity ... .24
24. Touchline of compound eyes incomplete, very short; all legs with tarsi orange, tibiae orange with wide dark distal band; genitalia: anterior surstyle lobe equally wide throughout .....*rufitarsis* (Sack)
– Touchline complete, tl-v ratio 0.9; all legs dark except joints; genitalia: anterior lobe somewhat spathulate .....*hirsutus* Sack
25. Genital cap much elongate, with floccus ....*caudatus* Sack
– Genital cap normally shaped, without floccus 26
26. S IV normal, slightly arched, emarginate posteriorly; basitarsi 3 with length/width ratio 2.5 and dense, short, golden pubescence on lower face; clear apical floccus present on tibiae 3 ....*auronitens* sp. n.
– S IV with small (single or paired) median projection 27
– S IV with large paired appendages 29
27. Antennal ratio over 2.8 .....*tangerensis* sp. n.
– Antennal ratio under 2.3 28
28. Antennal ratio approx. 2.1; S IV with small projections; legs pale brown .....*xanthipous* sp. n.
– Antennal ratio approx. 1.3; S IV with single median projection ending in acute spine ....*ankylogaster* sp. n.
29. S IV with long slender appendages; posterior proximal face of basitarsus 3 showing ovoid area of widely spaced setaceous pubescence bordered by long setae; apical floccus of tibiae 3 inserted on apical spur .....*tarsatus* Sack
– S IV with less long, robust appendages; if specialized area present on basitarsi 3, pubescence in centre and on margin similar 30
30. Genitalia: anterior surstyle lobe widening apically, angular, its apical part projecting ventrad, with a fringe of short yellow pubescence ....*persicus* sp. n.
– Genitalia: anterior lobe not widened apically, not projecting ventrad 31

31. Head: antennal ratio over 2.0; leg 3: length/width ratio of basitarsus 2.0; genitalia: anterior surstyle lobe tapering apically; aedeagus rather stout ....*turkestanicus* Paramonov
– Head: antennal ratio approx. 1.6; leg 3: length/width ratio of basitarsus 1.4; genitalia: anterior surstyle lobe slightly spathulate; aedeagus slenderer .....*oidipous* sp. n.
32. Wings strongly infuscate, deep brown except apically; large species (body length 15 - 18 mm) .... *velox* Loew
– Wings clear or slightly infuscate (yellowish at most) 33
33. Thorax and abdomen densely pubescent, obliterating background colour; pubescence often reddish or yellow 38
– Thorax and abdomen moderately dense pubescent, surface well visible 34
34. Pubescence on thorax uniform; relatively stout species, with T II only moderately tapering 35
– Pubescence on thorax with dark interalar band; T II strongly tapering, slenderer species 36
35. Genitalia: anterior surstyle lobe with long stalk; posterior lobe anteriorly with a low well-defined projection bearing dense pubescence; aedeagus rather stout; body length 14-15 mm ....*warnckei* sp. n.
– Genitalia: anterior surstyle lobe with short stalk; dense hair-tuft anteriorly on posterior lobe not inserted on a projection; aedeagus slender; body length 12 mm .....*brevis* Paramonov
36. Triangular processus modified, ending in large hooked spur; 3rd antennal article orange; Body length 14-15 mm .....*hamifer* Sack
– Triangular processus on femora 3 normally shaped; abdomen slender, with bronze lustre; body length 10-15 mm 37
37. Body length 11 - 15 mm; abdomen slender, with bronze lustre; pubescence yellow, rather dense; legs dark throughout ....*aberrans* ssp. *aberrans* Egger
– Body length 12 - 14 mm; abdomen slender, with bronze lustre; legs with yellow markings ....*aberrans* ssp. *flavitibius* Paramonov
– Body length 10 - 11 mm; abdomen extremely slender; with slate grey lustre and often purple reflections; pubescence grey to greyish yellow, rather sparse; legs dark throughout ....*aberrans* ssp. *isperensis* ssp. n.
38. Large species (body length 17 - 22 mm) ....*clavipes* Fabricius
– Smaller species (body length up to 16 mm) 39
39. Femora 3 normally swollen; triangular processus with a strong, erect, apical spur; body length 12 - 13 mm 40
– Femora 3 very much swollen; triangular processus without apical spur, or this spur low, stout; body length 14 - 16 mm 41
40. Tarsus 3: stout, with first article twice as long as second; apical spur of triangular processus on femora 3 shorter; pruinose band on T IV chevron-shaped .....*karadaghensis* Zimina
– Tarsus 3: slender, first article 1.4 x as long as second; apical spur of triangular processus on femora 3 erect, longer; pruinose band on T IV rounded .....*dzhalitae* Paramonov
41. Antennal ratio 1.4; body length 14 - 16 mm; triangular processus on femora 3 finely serrate, normal .....*cupreus* sp. n.
– Antennal ratio 1.8; body length 13 mm; triangular processus strong, with slight apical spur ....*splendens* sp. n.
42. Anterior surstyle lobe with rounded profile; sulcus between both surstyle lobes marked, but not very deep or wide; aedeagus rather stout 43
– Anterior surstyle lobe with angular profile; sulcus between both surstyle lobes very wide; aedeagus slenderer 44
43. Head: oa 35°; abdomen very slender; anterior surstyle lobe with lateral ridge; flanges on outer face of aedeagus low .....*testaceus* Sack
– Head: oa 50°; abdomen moderately slender; anterior surstyle lobe without lateral ridge; flanges on aedeagus higher .....*manicatus* Sack
44. Pruinose bands on abdomen conspicuous; S IV strongly arched; triangular processus on femora 3 bearing 6 - 9 bristles; posterior surstyle lobe with free anterior part separated by an oblique sulcus; cercus long, well projecting posteriorly ....*elegans* sp. n.
– Pruinose bands inconspicuous but visible; S IV strongly arched; triangular processus bearing 10 bristles; posterior surstyle lobe without free anterior part; sulcus rather quadrate; cercus shorter, not much projecting .....*bequaerti* sp. n.
45. Antennal ratio 4.0 - 4.5 .....*longicornis* Sack
– Antennal ratio 2.5 - 3.0 *kaloceros* sp. n.
46. Anterior surstyle lobe stalked, widening apically 47
– Anterior surstyle lobe narrow throughout 48
47. Both surstyle lobes separated by a deep sulcus.... .....*taniniensis* sp. n.
– Surstyle lobes coalescent; anterior lobe bifid ....*toscanus* sp. n.
48. Anterior surstyle lobe recurved mediad ....*nitidifrons* sp. n.
– Anterior lobe recurved ventrad to ventro-caudad 49
49. Anterior lobe recurved ventro-caudad, apical part more or less parallel with basal part 50
– Anterior lobe recurved ventrad, apical part protruding 51

50. Tibiae 3 without large distal spur; posterior surstyle lobe with semicircular ventral projection ....*lucasi* sp. n.
– Tibiae 3 with large, triangular spur; posterior lobe without semicircular projection; lateral spots on T II with postero-lateral digitiform dark indention . .....*alagoezicus* Paramonov
51. Anterior surstyle lobe simple; surstyle guarded by large lateral sclerotized plate, projecting far caudad; posterior surstyle lobe straight; aedeagus basally stout .....*schachti* sp. n.
– Anterior lobe with accessory lobe; no guarding lateral plate; posterior lobe twisted; aedeagus slender throughout .....*satdagensis* sp. n.
52. Anterior surstyle lobe with apical part rhomboidal; posterior lobe higher; aedeagus with outer face all convex; trochanter 3 often with clear knob; rather robust species .....*nigritarsis* Rondani
– Anterior surstyle lobe suddenly widened apically, profile of apical part quadrate; posterior lobe lower; aedeagus concave on basal outer face; trochanter 3 smooth; slenderer species ....*femoratoides* Paramonov

Key to females of species

1. Abdomen dark throughout on surface (the pubescence may be brightly coloured!), often metallic lustrous, without red or yellow lateral spots 2
– Abdomen showing yellow, orange or red lateral spots on T II, or with even more extensive yellow or red on abdomen 14
2. Legs all dark, at most femoral apices and tibial bases very narrowly paler (but check 7: *M. aberrans* ssp. *flavitibius*) 3
– Legs with yellow markings 11
3. Pruinose bands present on abdomen, pubescence on posterior abdomen concolorous 4
– No pruinose bands present on abdomen 10
4. Abdomen slenderer, in some cases with clear bluish lustre 5
– Abdomen stouter, dark, not clearly bluish lustrous (but if clear grey lustre is present, see 7: *aberrans* ssp. *isperensis*) 8
5. Femora 3 greatly swollen 6
– Femora 3 normal, not much swollen 7
6. Abdominal surface colour brownish, with narrower pruinose bands .....*clunipes* Sack
– Abdominal surface colour blackish, with wider pruinose bands, thorax bearing pruinose..... .....*femoratus* Sack
7. Abdomen with bluish metallic lustre, thorax often with inconspicuous pruinose bands; wings apically slightly infuscate; femora straight; triangular processus normally shaped; body length 13 - 15 mm (in the ssp. *isperensis* the metallic lustre is more greyish, while the abdomen is slenderer than in the nominal subspecies; the ssp. *flavitibius*, of which no records exist postdating the publication of the original description, shows yellow leg markings) .....*aberrans* Egger
– Habitus similar, triangular processus ending in large hook .....*hamifer* Sack
8. Thoracic pubescence unicolorous, species of some 12 mm, bands on abdomen rather clear, nearly continuous, paired pruinose spots on T II .....*hirsutus* Sack
– Thoracic pubescence bicolorous 9
9. Thoracic pubescence grey, dark interalar pubescence band present .....*cupreus* sp. n.
– Thoracic pubescence golden, but clearly paler posteriorly; relatively stout species with marked apical spur on triangular processus ....*karadaghensis* Zimina
10. Larger species, over 12 mm, densely pubescent at least on thorax, abdomen dark, blackish pubescent, with 2 pairs of outstanding, snow-white pubescent spots .....*quadrinotatus* (Sack)
– Smaller species, sparsely pubescent throughout, slight bluish lustre on thorax and abdomen, basitarsus 3 swollen; body length 7.5 - 9 mm ....*turkestanicus* Paramonov
11. Thorax with pruinose bands 12
– Thorax without bands, tibiae and tarsi partially dark, basitarsi 3 rather swollen 13
12. Species strikingly black-and-white with strong pruinose bands on abdomen .....*femoratus* Sack
– Duller coloured species, bands inconspicuous ....*warnckei* sp. n.
13. Bluish lustre on thorax and abdomen, pruinose abdominal bands nearly continuous ....*ankylogaster* sp. n.
– No bluish lustre, bands interrupted ....*tarsatus* Sack
14. Well marked whitish pruinose bands present on thorax 15
– Pruinose bands on thorax very weak, or longitudinal metallic bands present, or bands of different colour 32
– Thorax unicolorous, without traces of bands...36
15. Tergite II posteriorly strongly tapering, thorax with strong pruinose bands and extremely short, even pubescence; habitus very slender, body length 14 - 15 mm 16
– Tergite II less tapering or habitus stouter, or smaller or larger species, thoracic pubescence longer 17
16. Femora 3 reddish to orange; midstripe on frons extremely narrow .....*distinctus* Palma
– Femora 3 dark, midstripe normal ....*biarcuatus* Curran
17. Antennal ratio 2.2 or more 18

– Antennal ratio 2.0 or less 21
18. Abdomen relatively stout, tapering posteriorly ... .19
– Abdomen slenderer, more cylindrical, lateral spots extended over much of 2nd tergite at least, in many cases over 3rd as well, crimson coloured 20
19. Femora slender, abdomen with grey hue produced by overall whitish pubescence; no blue lustre on abdomen .....*kaloceros* sp. n.
– Femora swollen, abdomen dark with bluish lustre .....*lusitanicus* sp. n.
20. Antennal ratio 3.4 to 5.0 .....*longicornis* Sack
– Antennal ratio 2.2 to 2.8 ..*erivanicus* Paramonov
21. Legs dark throughout 22
– Legs yellow marked, or all yellow/orange 23
22. Large, robust species (17 mm), wings often infuscate, thorax with dense pubescence ...*velox* Loew
– Smaller species (8 - 11 mm), wings clear ....*alexeji* Paramonov
23. Large species (17 - 21 mm), wings slightly infuscate, abdomen clearly conoid in outline ....*pruni* Rossi
– Smaller species up to 15 mm, abdomen more cylindrical 24
24. Abdomen mainly pale orange, slender, pruinose bands on abdomen arcuate, posterior end of abdomen acute .....*testaceus* Sack
– Abdomen mainly dark 25
25. Antennal ratio 2.0, triangular processus strongly serrate .....*affinis* Gil Collado
– Antennal ratio up to 1.7 26
26. Tarsi 3 with dark upper face and contrasting, golden pubescence on sides; pruinose bands on thorax inconspicuous .....*nigritarsis* Rondani
– Tarsi without this contrast or if so, thorax with outstanding bands 27
27. Legs nearly all orange ..... *aureotibia* sp. n.
– Legs with extensive dark surface 28
28. Abdomen relatively lustrous, thorax with strong pruinose bands, often a fifth anteromedial band present .....*alagoezicus* group
Comprising the following species: *alagoezicus* Paramonov, *lucasi* sp. n., *nitidifrons* sp. n., *satdagensis* sp. n., *schachti* sp. n., *taniniensis* sp. n. and *toscanus* sp. n. These species cannot at present be well separated in the female sex, as the pairing with the males is not certain. *M. toscanus* is known only from Italy, the other species are mainly known from Turkey.
– Abdomen duller, usually no 5th band on thorax 29
29. Small species, about 10 mm body length, thorax clearly but weakly banded ..... *tener* Sack
– Larger species, 12 mm or over, bands more marked 30
30. Frontal depression present; 2nd tergite bright orange .....*elegans* sp. n.
– No depression on frons 31
31. Femora 3 swollen, curved ....*femoratoides* (Paramonov)
– Femora 3 less swollen, straighter .....*avidus* Rossi
32. Legs all dark 33
– Legs at least with yellow markings, thorax rather dull, dark 34
33. Femora 3 strongly swollen, abdomen bluish lustrous, body length 10 - 13 mm .*lusitanicus* sp. n.
– Femora 3 slenderer, if in doubt: no blue abdominal lustre; approx. 17 mm, wings infuscate ....*velox* Loew
34. Large species, 17 - 22 mm, wings often infuscate .....*pruni* Rossi
– Smaller, up to 15 mm 35
35. Abdomen mainly orange, legs dark ....*manicatus* Sack
– Abdomen mainly dark, third antennal article slender, acute to subacute, size 7.5 - 10 mm, pruinose abdominal bands conspicuous ....*kawamurae* Matsumura
36. Lateral spots on abdomen fiery orange or red, basitarsi 3 widened .....*caudatus* Sack
– Lateral spots less conspicuous, abdominal pubescence bands clear, large to very large species ...37
37. Large species, 12 - 15 mm, abdomen stout with parallel, often yellow pruinose, conspicuous bands .....*mariae* sp. n.
– Very large species, 17 - 22 mm, bands whitish, less conspicuous, or dense pubescence obliterating pruinosity.....*clavipes* (Fabricius)

SYSTEMATIC PART

The *distinctus* assemblage

This set is a paraphyletic group sharing no other than the 'general' synapomorphies of this section of the genus, viz. the tapering T II and arcuate pruinose bands.

Merodon biarcuatus Curran (figs. 21 a-c, 103)

Merodon biarcuatus Curran, 1939: 7. Holotype ♀: 'Forest of Namora, Robot, Morocco' [near Rabat, approx. 33° 55' N, 7° W] (AMNH) [examined].

Material examined. – France: 2♀ (BMNH, RMNH); Greece: 1♀ (ZMAN); Italy: 3♀ (NHMW, ZMAN, WH); Morocco: 2♀ (RMNH); Turkey: 12♀ (JLR, ZMAN, BMNH, WH).

Description

Female. – Head: Antennae orange, antenna 3 with upper margin convex, apex rounded, antennal ratio

2.2, ocellar angle 55°; pubescence pale yellow, rather sparse, erect, but moderately dense and darker on median, lustrous 1/3-1/6 of frons and on vertex; face densely pruinose except on narrow median line.

Thorax: Katepisternum, anepisternum and anepimeron, lateral dorsum and scutellum lustrous, bearing very short yellow even oblique pubescence; dark intaralar band present. Wings clear; halteres, squamae and antisquamae pale orange to yellow.

Legs: Trochanters brown, femora dark, tibiae and tarsi orange to yellow; pubescence yellow, trochanter 3 smooth, femora 3 swollen with normal triangular processus bearing 7-9 bristles on serrate distal margin, apical bristle conspicuous.

Abdomen: Extremely slender; T II orange, sometimes with small dark medio-anterior lunule, strongly tapering; T III with conspicuous wide arcuate whitish pruinose band, background orange anterior, dark posterior to band; T IV-V dark, with conspicuous arcuate pruinose band on T IV; pubescence on all tergites concolorous to pale throughout.

Body length 13-17 mm.

Male. – Unknown.

Diagnosis. – The extremely slender habitus will distinguish this species from other species, but *M. biarcuatus* is apparently closely related to *distinctus*. The pubescence on the frons of *distinctus* female is denser, oblique and golden; the lustrous midstripe is narrower, occupying 1/8 of its width; the pubescence on the thoracic dorsum is darker and shorter; the femora 3 are orange (dark in *biarcuatus*); the pruinose bands on the abdomen are narrower.

Period of flight and distribution (fig. 103). – This species seems to occur throughout the mediterranean where it flies from May to August.

Merodon clunipes Sack
(figs. 22 a-c, 104)

Merodon clunipes Sack, 1913a: 444. ♂ Holotype: 'Smyrna 49417' 'Billar' (on lower face of same label) [= Izmir, Turkey] (ZMHB) [examined].
Merodon clunipes; Peck 1988: 169.
Lampetia clunipes; Sack 1931: 311.

Material examined. – Austria: 1♂, 1♀ (RMNH); France: 15♂, 2♀ (RMNH); Greece: 15♂, 5♀ (NHMW, KBIN, RMNH, JLR, WH, MNHN); Hungary: 1♀ (RMNH); Italy: 14♂, 7♀ (NHMW, RMNH); Lebanon: 2♂, 1♀ (NHMW, KBIN); Spain: 1♂ (RMNH); Switzerland: 1♂ (RMNH); Turkey: 14♂, 12♀ (BMNH, NHMW, ZMAN); Yugoslavia: 10♂, 1♀ (RMNH).

Description

Male. – Head: Antennae dark, antenna 3 with upper margin convex, apex rounded, antennal ratio 1.2, pubescence dense, especially on face, erect, pale yellow; vertex angle 35°, ocellar angle 45°, tl-v ratio 0.5.

Thorax: Dark, without conspicuous lustre; pubescence dull yellow, pruinose bands clear. Wings very slightly infuscate; halteres, squamae and antisquamae yellow.

Legs: Femora dark, tibiae 1-2 apically brownish, tibiae otherwise dark; tarsi brownish, darker apically; trochanter 3 with ridged projection; femora 3 very much swollen, curved, with normally shaped triangular processus bearing 8-9 bristles on strongly serrate distal margin.

Abdomen: Dark; slender to very slender; T II-IV bearing arcuate somewhat vague rather wide pruinose bands; pubescence dark, paler laterally and on T IV; densest on pruinose bands of T II; S IV narrowly emarginate posteriorly.

Genitalia: Anterior surstyle lobe rather short, rounded, bearing dense, short, yellow, even pubescence throughout, showing a ridge bearing 5-6 strong bristles on medial face; posterior surstyle lobe coalescent, elongate, posteriorly with dense, moderately long, yellow pubescence. Cercus rounded, bearing long, yellow pubescence. Aedeagus moderately long, apical shaft part slightly lengthened, fringed plates on thecal apex recumbent.

Body length 8.5-13 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Head: Ocellar angle 50°, frons with lustrous midstripe occupying 1/3 of width. Thorax: Pruinose bands quite conspicuous, pubescence less dense, rather recumbent on sides. Legs: Apices of femora paler, femora 3 less swollen, but if compared to females of other *Merodon* species still very much so. Abdomen: T II largely reddish to orange laterally, this colour may extend over T III as well; dark parts brown, not black.

Body length 9-12 mm.

Diagnosis. – The males of this species are rather similar to *femoratus* from which they differ in being smaller (range 8.5-13 vs. 12-16 mm) and having a more slender aedeagus with slightly lengthened apical shaft part. In the females the size ranges are 9-12 and 12-17 mm in *clunipes* and *femoratus*, respectively; the females of *clunipes* have a more slender abdomen with clear orange markings (all dark in *femoratus* females) with vague bands; the bands in the females of *femoratus* are conspicuous and sharply bordered.

Variation. – The ridge on trochanter 3 is rather variable in size, and seems correlated with specimen size: small specimens have small ridges, large specimens having large ones.

Period of flight and distribution (fig. 104). – This

species occurs through central Europe and the northern Mediterranean where it flies in June and July.

Discussion. – One of the NHMW specimens identified as *clunipes* has an identification label '*M. striatus* Sack det. Sack'. As far as could be traced, this name is unpublished.

Merodon distinctus Palma
(figs. 23 a-d, 103)

Merodon distinctus Palma, 1863: 46. Holotype ♂: 'from the field of Sanseverino' [in the vicinity of Naples, Italy] [not located, not examined].
Lampetia dimorpha Szilady, 1940: 66. Holotype ♂: (and ♀ Paratype) 'Karacabey bei Brussa' [West of Bursa, Turkey on coast of Marmara inland sea] [lost, formerly in TMA, not examined]. **Syn. n.**
Merodon distinctus; Rondani 1868a: 22; Sack 1913a: 444; Peck 1988: 169.
Lampetia distincta; Sack 1931: 313.

Material examined. – France: 1♂ (BMNH); Greece: 23♂, 6♀ (KBIN, RMNH, BMNH, NHMW, JLR, WH); Italy: 1♂ (BMNH); Turkey: 5♀ (JLR); U. S. S. R.: 1♀ (RMNH); Yugoslavia: 1♂, 2♀ (JLR, RMNH).

Description

Male. – Head: Antennae bright orange, antenna 3 with upper margin convex, apex obtuse, antennal ratio 1.5, pubescence golden with dark tuft in ocellar region; vertex angle 40°, ocellar angle 45°, tl-v ratio 0.6.

Thorax: Dark, velvety lustrous on sides produced by recumbent pubescence, with clear pruinose bands on dorsum; pubescence golden, short, even. Wings clear; halteres, squamae and antisquamae yellow.

Legs: All femora dark, not black, femora 1-2 apically often brown to orangish; tibiae and tarsi yellow, legs with conspicuous golden pubescence throughout; trochanter 3 bearing distinct knob with apical obtuse ridge; femora 3 slightly swollen, rather straight, triangular processus with serrate distal margin; in some specimens vague orange spot present basally on femora 3; tibiae 3 rather abruptly widened distally (best seen in posterior view).

Abdomen: Slender; T II-IV dark with rather wide sharply defined arcuate yellowish pruinose bands, narrowly to hardly interrupted, the band on T IV widened laterally and in some specimens slightly recurved; T II with conspicuous yellow lateral spots; pubescence concolorous with surface; sternites I-III yellowish orange, IV darker, narrowly emarginate posteriorly, clearly though not strongly vaulted.

Genitalia: The anterior surstyle lobe short, rounded, with even, yellow, short, dense pubescence, coalescent with posterior surstyle lobe which is low and elongate and bears long, erect, yellow pubescence. Cercus rounded to obtusely angular, with same pubescence. Aedeagus rather stout, slightly tapering, apical shaft part somewhat lengthened, fringed plates on thecal apex rather wide and recumbent.

Body length 12-16 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Head: Midstripe on frons occupying 1/8 of width or even less; antenna 3 with dark upper margin in some specimens. Thorax: Pruinose bands more conspicuous, a thin praesutural crossband present in some specimens; pubescence extremely short, as if shaven; pubescence in mid region of dorsum often dark. Legs: Deep orange to yellow all through, but triangular processus often darker. Abdomen: Even more slender than in ♂; lateral spots larger, deeper coloured, pruinose bands less wide; T V bearing arcuate wide pubescence band; pubescence shorter than in ♂.

Body length 13-15 mm.

Diagnosis. – The combination of the very slender habitus, clear, sharply bordered pruinose bands, large lateral spots and genital structure will easily separate the males of *distinctus* from any other *Merodon*. The females are separated from the females of most other species by their relatively large size and extremely slender habitus. They can be separated from the females of the *alagoezicus* group by the more cylindrical abdomen, and from the very similar females of *biarcuatus* by the narrower frontal midstripe and the orange femora 3.

Period of flight and distribution (fig. 103). – *M. distinctus* occurs from May through August in the mediterranean parts of Europe and Turkey.

Discussion. – *M. dimorphus* Szilady, 1940 is tentatively considered a synonym of *distinctus*. In the original description *dimorphus* is stated to be allied to *clunipes* Sack, but the description points to very apparent differences with that species. From the description it can be inferred that *dimorphus* is very similar to, if not conspecific with, *distinctus*; the only difference apparent from the description is the colour of the pubescence on the head which is said to be pale in *dimorphus*. Regrettably several features are not or very superficially described; the 'spots' on the abdomen may either be lateral spots or pruinose bands, or both. The figure of the thoracic dorsum as given by Szilady closely resembles this element in *distinctus*. No material of *dimorphus* was examined, as the type-material (formerly in TMA), the only material known, was lost in 1956 (Dr. A. Dély-Draskovits, in litt.).

Merodon femoratus Sack
(figs. 24 a-b, 104)

Merodon femoratus Sack, 1913a: 446. Syntypes: 'Korsika, Griechenland und Kleinasien' [Corsica, Greece and Turkey]; depository unknown [not examined].
Merodon femoratus; Van der Goot 1981: 216, 218; Peck 1988: 169.
Lampetia femorata; Sack 1931: 315; Séguy 1961: 179.

Material examined. – Greece: 2♂, 5♀ (ZMUC, BMNH, KBIN, ZMAN, WH); Italy: 4♂ (ZMAN); Turkey: 15♂, 35♀ (JLR, BMNH, ZMAN, WH).

Description

Male. – Head: Antennae dark, antenna 3 with upper margin convex, apex obtuse, antennal ratio 1.8; pubescence pale yellow, face and occiput densely white pruinose; vertex angle 35°, ocellar angle 45°, tl-v ratio 0.5.

Thorax: Dark, katepisternum, anepisternum, anepimeron, lateral dorsum and scutellum metallic lustrous, hardly pruinose except four longitudinal bands on dorsum; pubescence pale brown, moderately dense, erect, more even on dorsum but less so on sides. Wings very slightly infuscate; halteres, squamae and antisquamae pale brown.

Legs: Dark, except for apices of femora and bases of tibiae of legs 1-2; trochanter 3 showing conspicuous hump, femora 3 very strongly swollen, strongly curved, with normally shaped triangular processus with strongly serrate, sometimes undulating margin bearing 5-10 bristles.

Abdomen: Dark; rather slender; T II tapering, without lateral spots; T II-IV with interrupted moderately wide strongly arcuate whitish pruinose bands; pubescence concolorous, densest laterally on T II; S IV strongly vaulted, deeply narrowly emarginate posteriorly.

Genitalia: The anterior surstyle lobe short, rounded; bearing even, erect, short, dense, yellow pubescence apically; coalescent with posterior surstyle lobe, which shows long yellow pubescence posteriorly, is elongate and medio-laterally aligned apically. Cercus wide, short, rounded, not far protruding beyond posterior surstyle lobe, bearing dense, long, yellow pubescence. Aedeagus short, stout, smooth on outer face, fringed plates on thecal apex rather wide, recumbent.

Body length 12-16 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Head: Ocellar angle = 50° to 60°, frons with lustrous midstripe occupying 1/4 of width. Thorax: Pruinose bands wider and clearer, often striking. Abdomen: Distinctly wider, typically black-and-white patterned, pruinose bands slightly less arcuate.

Body length 12-17 mm.

Diagnosis. – *M. femoratus* is nearly similar to *clunipes* from which it is distinguished in both sexes by the greater size (12-17 mm vs. 9-12 in *clunipes*), in the males by the stouter aedeagus, and in the females by the black and white abdomen (brownish red in *clunipes*). From other species it differs in having a combination of very strongly swollen and curved femora 3 and very simple anterior surstyle lobe in the males, and by a combination of strongly curved and swollen femora 3 and a striking black-and-white abdomen in the females.

Period of flight and distribution (fig. 104). – *M. femoratus* occurs in southern Europe and Turkey from May through August, both in lowland and mountain habitats (up to over 2000 m). It is absent from the western Mediterranean.

Merodon mariae sp. n.
(figs. 25 a-c, 105)

Type-material. – ♂ Holotype 'France, Corse V. S. van der Goot / Asco 620 m [42. 15' N, 9. 10' E] 11.vii.1967' (ZMAN). – Paratypes: 29♂, 10♀: same data as holotype 2♂, 1♀ (ZMAN); topotypic, 20.vii.1956, leg. v.d. Goot, 1♀ (ZMAN); topotypic, 5/6.vii.1961, leg. J. A. W. Lucas, 7♂ (JLR); topotypic, 9 /11.vii.1967, leg. Lucas, 3♀ (JLR); topotypic, 1/11.viii.1959, leg. P. M. F. Verhoeff, 1♂ (ZMAN); topotypic, 25.vii.1977, leg. P. Goeldlin, 2♂ (coll. Goeldlin, Lausanne); topotypic, 27.vii.1977, leg. P. Goeldlin, 5♂ (coll. Goeldlin, Lausanne); 'Corsica, La Foce de Vizzavona, 30.vi/ 31.vii.1893, Col. Yerbury' 5♂ (BMNH); 'Corte, Corsica, 2.vii.1893, Col. Yerbury' 1♂, 1♀ (BMNH); 'Evian, Corsica, 19.vii.1899 Col. Yerbury' 1♂ (BMNH); 'Corsica, Vizzavona 900 1000 m, 2.x.1906, leg. F. Guglielmi' 1♂ (BMNH); 'Italia Sardegna Alghero 27/28.iv.1957, leg. C. A. W. Jeekel' 1♂ (ZMAN); 'Italia Sicilia Misterbianco 215 m, 27.v.1966 leg. H. J. P. Lambeck' 1♂ (JLR); 'Environs de Salonique [Thessaloniki, Greece], Region du Mt. Profitis Ilias 768 m, Dr. A. Berton v.1918' 1♀ (MNHN); 'Greece, Phokis, Delphi 19/22.v.1984, 700-850 m, leg. W. Hurkmans' 2♂, 1♀ (WH).

Description

Male. – Head: Antennae dark, antenna 3 with upper margin straight, slightly sulcate longitudinally, apex acute, antennal ratio 1.6; vertex angle 25 to 30°, ocellar angle 40°; pubescence whitish yellow with dark tuft in ocellar region, very dense above antennae, causing silky lustre; tl-v ratio 0.35.

Thorax: Dark, katepisternum, anepisternum, anepimeron, lateral dorsum and scutellum slightly lustrous; pubescence rather dense, deep yellow, very even, short; vestigial longitudinal bands present in most specimens. Wings slightly infuscate; halteres, squamae and antisquamae pale yellow.

Legs: Dark, but tibial bases yellow marked; basitar-

sus 2 brown, not black in many specimens; trochanter 3 smooth, femora 3 slightly swollen, rather straight, triangular processus with distal margin wavy, weakly serrate, but apically with two strong pedestals, holding 6-9 bristles; tibiae 3 with short rounded apical spur on inner face, basitarsi 3 somewhat swollen.

Abdomen: Mainly yellow; moderately slender, T II conspicuously tapering; T II-IV bearing slightly arcuate, narrowly interrupted to continuous pale yellow pruinose bands and showing dark brown anterior strips and posterior lunules; pubescence erect to oblique, rather dense and long, pale orange to golden throughout; S IV strongly vaulted, posterior margin entire.

Genitalia: Anterior surstyle lobe apically bearing short, even, yellow pubescence; subapical-medial accessory lobe seen as acute angle in lateral view; coalescent with posterior surstyle lobe; this lobe very elongate, low, posteriorly showing long, erect, rather dense, yellow pubescence and bearing a subapical, medial accessory lobe as well. Cercus large, elongate, with membraneous ventral plates basally, with dense, long, erect, yellow pubescence apically; Aedeagus rather stout, the outer face with elongate subapical cavity showing paired elongate projections; apical shaft part slightly lengthened; fringed plates near thecal apex suberect.

Body length 15 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Habitus: slightly stouter than males. Head: Midstripe on frons occupying 1/3 of width, noticeably tapering posteriorly. Thorax: Longitudinal bands slightly clearer; less lustrous on sides. Abdomen: T II hardly tapering; pruinose bands wider, less arcuate, strongly marked; apart from the quite different colour, not unlike those in *femoratus*.

Body length 15-16 mm.

Diagnosis. – The males of *mariae* can be distinguished from those of other species by their possessing accessory lobes on both anterior and posterior surstyle lobe and robust habitus with typical dark yellow to orange abdominal pubescence. The females are stout and show a very sharply defined pattern of pruinose bands on the abdomen; they are unlikely to be confused with other species.

Period of flight and distribution (fig. 105). – *M. mariae* is apparently common on Corsica and is known also from Sardinia, Sicily and Greece. This distribution pattern is not known from other *Merodon*. The flight period is from May through October, probably in more than one generation.

Etymology. – It is a pleasure to dedicate this species to my wife, Marijke Wester, to commemorate her support and stimulation of my work. A noun in genitive case.

Merodon ottomanus sp. n.
(figs. 26 a-c, 106)

Type-material. – ♂ Holotype 'Turkey, Hakkari, Tanin-Tanin pass 2200 m, 12.vi.1984 leg. J. A. W. Lucas' (ZMAN). Paratypes: 7♂, 3♀, all with same data as holotype (JLR).

Description

Male. – Head: Antennae orange, antenna 3 with upper margin straight, apex subacute, antennal ratio 1.7: vertex angle 50°, ocellar angle 65°; pubescence long, pale ochre yellow, moderately dense, with dark tuft in ocellar region; pubescence on compound eyes pale yellow to white, moderately dense, conspicuously long; tl-v ratio 0.5.

Thorax: Dark, faintly blue metallic lustrous to naked eye, under magnification showing very strong lustre partially dulled by disperse whitish pruinosity, the lustre strongest on katepisternum, anepisternum and anepimeron; pubescence as on face but longer still. Wings slightly yellow tinged, halteres, squamae and antisquamae yellow to pale yellow.

Legs: All femora dark with yellow apices, tibiae yellow with wide dark distal band, tarsi yellow; trochanter 3 smooth, femora 3 slender, triangular processus low and bearing 4-6 bristles on serrate distal margin.

Abdomen: Slender; dark; bluish metallic lustrous laterally on T II, there showing dense pubescence, otherwise pubescence moderately dense, pale yellow, and conspicuously long; T III with vestigial narrow arcuate pruinose band in some specimens; S IV strongly vaulted, posteriorly hardly emarginate, partially hidden by curved sides of T IV and its pubescence.

Genitalia: Anterior surstyle lobe strongly yellow, short even pubescent, somewhat angular, coalescent with the short posterior surstyle lobe bearing long pubescence posteriorly. Cercus quadrate, with long dense yellow pubescence. Aedeagus with apical shaft part lengthened, fringed plates on thecal apex recumbent, aedeagus subapically constricted in lateral view.

Body length 9 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Head: ocellar angle 70°, frons lustrous, diffusely pruinose laterally. Thorax: Less lustrous. Abdomen: Pubescence slightly less dense and long, but still most conspicuous.

Body length 9 mm.

Diagnosis. – Apart from differences in the male genitalia, *ottomanus* can be distinguished from other

species by the long, pale erect pubescence of all exposed parts of the body; viewed with the naked eye this pubescence produces a hazy fringe around the insect.

Period of flight and distribution (fig. 106). – The species occurs in south-eastern Turkey where it flies in June.

Etymology. – The name *ottomanus* (an adjective) refers to the former Ottoman empire and was chosen to indicate the region of occurrence of the species, viz. Turkey.

Merodon testaceoides sp. n.
(figs. 27 a-c, 105)

Type-material. – ♂ Holotype 'Yugoslavia, 30 km ZW Gradsko, 41. 26' N, 21. 50' E, 13.viii.1963 exc. Leiden' (RMNH). – Paratypes: 1♂ (ZMAN), 1♀ (RMNH), 2♀ (JLR), same data as holotype.

Description

Male. – Head: Antennae dark, antenna 3 with upper margin slightly convex, apex obtuse, antennal ratio 1.5; vertex angle 25°; ocellar angle 40°; pubescence pale yellow; tl-v ratio 0.5.

Thorax: Dark, rather lustrous on katepisternum, anepisternum, anepimeron, lateral scutellum and dorsum; pubescence moderately dense, pale yellow; dorsum showing inconspicuous pruinose bands. Wings clear; halteres, squamae and antisquamae pale yellow.

Legs: All femora dark with yellow apices, tibiae yellow with broad dark distal band, tarsi yellow to red; trochanter 3 with low ridge; femora 3 swollen, curved, bearing normally shaped triangular processus with 8 bristles on slightly serrate distal margin, widest spaced basally.

Abdomen: Slender; conspicuously orange, T II tapering considerably, with dark anterior lunule in some specimens; T II-IV with arcuate pruinose bands, interrupted on T II-III; pubescence pale throughout, some dark pubescence often present on dark anterior lunule of T II; S IV orange, strongly vaulted, incised up to 2/3 its length from posterior margin.

Genitalia: Anterior surstyle lobe low, rounded-elongate, with short, dense, even, yellow pubescence throughout, separate from posterior surstyle lobe by moderately deep and wide sulcus; posterior surstyle lobe rounded, rather low, bearing moderately dense, erect, yellow pubescence throughout, slightly denser apically. Cercus rounded, rather small, bearing dense yellow pubescence. Aedeagus showing paired humps basally on outer face,and marked subapical cavity; apical shaft part slightly lengthened, fringed plates on thecal apex recumbent to somewhat suberect.

Body length 10-12 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Head: Lustrous midstripe occupying 1/3 of frons, ocellar angle 50°. Abdomen: pale reddish to yellow throughout, T II less tapering.

Body length 10-12 mm.

Diagnosis. – The relatively small size and striking orange abdomen in both sexes precludes confusion with all but a few species. *M. testaceoides* is similar externally to *testaceus* from which it is distinguished in the males by the very different genitalia; the females of *testaceoides* can best be distinguished by the paler colour of the abdomen and longer, denser abdominal pubescence. Both sexes differ from the species of the *longicornis* group by the all red to orange abdomen, which in that species group is partially crimson, partially black; moreover, the antennal ratio is less in *testaceoides.*

Period of flight and distribution (fig. 105). – This species is known only from Macedonia, where it was collected in August.

Etymology. – The epitheton *testaceoides* refers to *Merodon testaceus* to which this species is externally similar; the suffix -ides means 'in likeness of'. An adjective.

The *alexeji* group

Apomorphies: Anterior surstyle lobe elongate; posterior surstyle lobe high to very high, curving medially.

Description. – Head: Antennae dark, 3rd article red or orange in some species, antennal ratio 1.5 to 2.4; eyes with touchline incomplete to equalling 0.15-0.9 vertex height; pubescence golden to pale yellow with more or less conspicuous dark tuft in ocellar region. vertex angle and ocellar angle variable, oral margin well defined.

Thorax: Dark with some lustre and in some species with traces of longitudinal pruinose bands; wings mostly clear, veins brown, paler in *rufitarsis* and *sophron*; halteres, squamae and antisquamae yellow.

Legs: All dark or with yellow markings on tibiae and tarsi; trochanters 3 smooth, with faint (*hypochrysos*) or strong (*marginicornis*, *rufitarsis*) edge or knob; femora 3 mostly rather swollen, straight; basitarsi 3 somewhat swollen in *marginicornis.*

Abdomen: Rather slender; T II moderately tapering, with slightly to more strongly arcuate pruinose bands of variable clarity; lateral spots yellow to

orange, or bluish, or lacking; S IV normal.

Genitalia: The anterior surstyle lobe elongate to extremely elongate, bearing short, dense pubescence at least apically, separated from the posterior surstyle lobe by a shallow sulcus, or coalescent; the posterior surstyle lobes much extended medially, often overlapping, hiding part of the aedeagus from view. Aedeagus smooth on outer face, mostly slender, apical shaft part slightly lengthened, subapical cavity well defined.

Merodon alexeji Paramonov
(figs. 28 a, b, 29 a, 81)

Merodon alexeji Paramonov, 1925: 155. Holotype ♂ (and ♀ paratype) 'Kechanowka, Balta, Odessa, Ukraine, U. S. S. R., 1.vi.1924, leg. A. Paramonov' [not examined, presumably lost].
Merodon alexeji; Paramonov 1935: 164, 166; Liepa 1969: 20; Van der Goot 1981: 215, 218; Violovitsh 1983: 124; Peck 1988: 167.
Lampetia alexeji; Sack 1931: 304.

Material examined. – Algeria: 2♂ (ZMAN, WH); France: 5♂, 4♀ (MNHN, KBIN, ZMAN); Greece: 5♂, 4♀ (BMNH, KBIN, ZMUC, NHMW); Italy: 1♂ (NHMW); Mongolia: 1♀ (TMA); Morocco: 6♂, 1♀ (MNHN); Spain: 2♂ (ZMAN, WH); Tunisia: 2♂ (JLR); U. S. S. R. : 5♂, 3♀ [1♂ identified by original author, in KBIN] (BMNH, KBIN, ZMHB, H. Hippa, Helsinki).

Description

Male. – Head: Antenna dark brown, antenna 3 tapering, upper margin rather straight, apex subacute, antennal ratio 2.1; pubescence whitish to pale yellow, rather sparse with dark tuft in ocellar region; vertex angle 40°, ocellar angle 50°, ocelli rather large; tl-v ratio 0.45; pubescence on eyes pale, inconspicuous.

Thorax: Dark; katepisternum, anepisternum, anepimeron, dorsum and scutellum metallic lustrous, with short moderately dense, erect, uneven yellow pubescence, with variably clear interalar band; in some specimens vague pruinose bands present. Wings clear, brown veined; halteres, squamae and antisquamae yellow.

Legs: All dark; trochanters 3 smooth, femora 3 rather swollen, with normal triangular processus bearing 6-12 bristles, basitarsi 3 and other tarsi 3 normal, tibiae 3 rather slender.

Abdomen: Rather slender, with tapering T II, somewhat triangular, dark with slight metallic lustre overall (strongest laterally), bearing dark orange lateral spots on T II; T II-IV with rather narrow, arcuate, interrupted whitish pruinose bands, pubescence pale, inconspicuous medially.

Genitalia: The anterior surstyle lobe much elongate, slightly spathulate, with short, even, dense, erect, yellow pubescence apically and along dorsal margin; separated from posterior surstyle lobe by a sulcus; posterior surstyle lobe divided into basal and apical parts by a suture, anteriorly with smooth knob; apical part mediolaterally aligned, rather high, these parts on both sides overlapping; posterior surstyle lobe with rather dense, yellowish, erect pubescence but sparser on apical margin. Cercus conspicuous, rectangular, with dense, long, uneven, yellow pubescence. Aedeagus rather slender, smooth on outer face, apical shaft part slightly lengthened, fringed plates on thecal apex oblique to recumbent.

Body length 9-11 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Head: Ocellar region with darker pubescence; ocellar angle = 60°; lustrous midstripe on frons occupies all but fringes. Thorax: Pruinose bands clearer, less lustrous. Legs: The femora 3 rather variable in the degree of swelling. Abdomen: Triangular, pruinose bands wider, lateral spots variable, not always clear. T V acute, almost bald, mostly inconspicuous.

Body length 9-11 mm.

Variation. – Especially in the males *M. alexeji* is variable in the clearness of the abdominal lateral spots, the number of bristles on the triangular processus, and slightly so in the elongation of the knob on the posterior surstyle lobe and the position (not the shape) of the cercus.

Diagnosis. – *M. alexeji* can be separated from other species in the *alexeji* group by the presence of both the knob on the posterior surstyle lobe and the rectangular well protruding cercus. The latter feature separates from *altinosus* (cercus inconspicuous) and *sophron* (cercus short, very wide) which also have the posterior surstyle lobe knob. *alexeji* is separated from *altinosus* by the lack of dense abdominal pubescence as well.

Period of flight and distribution (fig. 81). – The imagines occur from May in the Mediterranean to July in the northern parts of the range, which includes the mediterranean countries and the temperate parts of western and central Eurasia.

Discussion. – Although type-material of this species was not available there is no doubt about the identity of *alexeji*. The original description mentions a number of diagnostic characters; moreover material examined and identified by S. J. Paramonov has been examined.

Merodon altinosus sp. n.
(fig. 29 b, 102)

Type-material. – ♂ Holotype 'Turkey, Hakkari, Suvarihalil pass 1250 m., W. side near Habul Deresi [37° 35' N, 43° 20' E], 13.vi.1984, leg. Lucas' (ZMAN).

Description

Male. – Head: Antennae blackish, antenna 3 with upper margin slightly concave, apex subacute, antennal ratio 2.4, pubescence golden, a dark tuft present in ocellar region; vertex angle 30°, ocellar angle 45°, tl-v ratio 0.6.

Thorax: Dark, slightly metallic lustrous on katepisternum, anepisternum, anepimeron, dorsum and scutellum, with moderately dense, longish, uneven, golden pubescence, without pruinose bands. Wings slightly troubled evenly, especially basally and on anterior margin; halteres, squamae and antisquamae yellow.

Legs: All dark; trochanters 3 smooth, femora 3 swollen, rather straight, bearing normal triangular processus with strong apical spur and 8 extremely short stout bristles; tibiae 3 and tarsi 3 normal.

Abdomen: Dark, tapering posteriorly; T II with yellow lateral spots; dense, golden, oblique pubescence present throughout; vestigial arcuate pruinose bands present on T II-IV, clearest on T III.

Genitalia: The anterior surstyle lobe elongate, anteriorly with dense, short, even, yellow pubescence, coalescent with posterior surstyle lobe; that lobe mediolaterally aligned in its apical part, overlapping; an elongate smooth knob present anteriorly on the posterior surstyle lobe; posterior part with long, rather dense, erect, uneven, yellow pubescence. Cercus moderately large, not far protruding, bearing dense, erect, long, yellow pubescence. Aedeagus rather slender, smooth on outer face, fringed plates on thecal apex suberect.

Body length 9.5 mm.

Female. – Unknown.

Diagnosis. – *M. altinosus* resembles *alexeji* from which it is separated by the conspicuous golden pubescence on the abdomen, the extremely short bristles on the triangular processus with its strong apical spur and the less protruding cercus; it is distinguished from *sophron* by the same features, and from other species in the *alexeji* group by the presence of a knob on the posterior surstyle lobe.

Period of flight and distribution (fig. 102). – The species is known from the holotype only, collected in eastern Turkey in June.

Etymology. – The name *altinosus* (an adjective) denotes the golden habitus of the species, and is derived from the Turkish altın, meaning gold, and the Latin suffix -osus, meaning full of.

Merodon hirsutus Sack
(figs. 30 a-c, 82)

Merodon hirsutus Sack, 1913a: 435. Lectotype ♂ (here designated): 'Djebel Akra [35° 35' N, 36° 15' E] vi.85 [1885], N. Syria, Dr. E. Leuthner/ Lampetia hirsuta Sack det. Sack' (NHMW) [examined].
Merodon hirsutus; Peck 1988: 171.
Lampetia hirsuta; Sack 1931: 318; Séguy 1941: 14.

Material examined. – Israel: 3♀ (BMNH, RMNH); Jordan: 2♀ (RMNH); Syria: 9♂ Paralectotypes, with same data as lectotype (NHMW, ZMAN) [examined]; 1♀ Paralectotype, 'Syria/ hirsutus Sack/ coll. J. Villeneuve: Lampetia hirsuta Sack RMHN Belg. 15.392' (KBIN); Turkey: 2♀ (BMNH).

Description

Male. – Head: Antennae blackish, antenna 3 with straight upper margin, apex acute, antennal ratio 1.9; pubescence yellow, dark tuft in ocellar region weak; vertex angle 40°, ocellar angle 50°, tl-v ratio 0.9; pubescence on eyes inconspicuous.

Thorax: Dark, slightly metallic lustrous on katepisternum, anepisternum, anepimeron, dorsum and scutellum; pubescence dense, erect, uneven, yellow, moderately long. Wings clear, brown veined; halteres, squamae and antisquamae yellow.

Legs: Dark with yellow markings on both ends of tibiae, rather slender; bearing normal triangular processus with short stout bristles, tibiae 3 and tarsi 3 normally shaped.

Abdomen: Dark, rather slender to somewhat stout, lacking strong lustre (not due to surface sculpturing); laterally slight micaceous lustre present; T II-IV with slightly arcuate, moderately wide whitish interrupted pruinose bands; pubescence rather long, yellowish, densest laterally, dark and sparser on posteromedian parts of T III-IV; sternites dark, with scattered whitish pubescence; S IV slightly vaulted.

Genitalia: Anterior surstyle lobe extremely elongate, anteriorly rather rectangular, bearing dense, short, yellow pubescence, slightly spathulate, separated from posterior surstyle lobe by shallow but clear sulcus; posterior surstyle lobe rounded, showing uneven, long, dense, yellow pubescence especially posteriorly. Cercus conspicuously protruding, with dense, long, yellow pubescence. Aedeagus smooth on outer face, stout basally, slender apically, apical shaft part slightly lengthened, fringed plates on thecal apex suberect.

Body length 10 mm.

Female. – Except for sexual dimorphism, differing

from the male as follows. Head: Ocellar angle 55°, shining midstripe on frons occupies 0.6 of width. Thorax: Pubescence comparatively shorter, more even. Legs: femoral apices very narrowly brownish. Abdomen: Slightly more slender; pruinose band on T II reduced; those on T III-IV clearer, wider, nearly continuous, more arcuate.

Body length 9.5-10.5 mm.

Variation. – There is little variation in the males (all specimens examined are from same locality); the females show slight size variation.

Diagnosis. – *Merodon hirsutus* is externally similar to *M. hirtus* Sack from which it is easily distinguished by its very different genitalia; study of the genitalia is essential since both species fly together in the same region. From the other species of the *alexeji* group, *hirsutus* can be separated by the extremely long anterior surstyle lobe, the relatively low posterior surstyle lobe and lack of yellow lateral spots on T II.

Period of flight and distribution (fig. 82). – *M. hirsutus* occurs in the eastern Mediterranean region from March through June.

Merodon hypochrysos sp. n.
(figs. 31 a-c, 82)

Type-material. . – ♂ Holotype 'Turkey, Adiyaman, 10 kms. North of Celikhan, Altı Haral Gölü [38° 05' N, 38° 22' E], 1450 m, 1.vii.1986, leg. Lucas' (ZMAN). Paratypes: 20♂ 'Turkey, Hakkari, Sat Daglari, Varegös [37° 25' N, 43° 55' E] 1600-1650 m, 15/18.vi.1984, leg. Lucas' (JLR).

Description

Male. – Head: antennae dark, antenna 3 red, upper margin convex, apex rounded, antennal ratio 1.5, vertex angle 40°, ocellar angle 45°, tl-v ratio 0.2; pubescence pale yellow, with dark tuft in ocellar region.

Thorax: Black, lustrous on katepisternum, anepisternum, anepimeron, dorsum and scutellum; pubescence rather sparse, golden, paler down sides and on scutellum, rather even. Wings slightly tinged, veins brown, halteres, squamae and antisquamae pale yellow.

Legs: Dark, apices of femora and bases of tibiae paler; trochanters 3 with inconspicuous edge; femora 3 much swollen, straight, bearing normal triangular processus with weakly serrate distal margin holding 5-8 small bristles; tibiae 3 long, slender, bearing small apical spur distally on medial face; tarsi 3 normal, relatively small.

Abdomen: Dark, golden metallic lustrous with bluish to bronze reflections on sides; T III-IV with moderately arcuate, whitish to pale yellow, interrupted, moderately wide pruinose bands; pubescence pale golden, densest laterally.

Genitalia: Anterior surstyle lobe elongate, slightly diamond-shaped, apically with short, even, dense, yellow pubescence, posterior surstyle lobe more or less coalescent but steeply rising, rather rounded, slightly mediolaterally aligned apically; posterior portion showing dense, erect, yellow pubescence. Cercus well protruding, moderately large, rounded, bearing dense yellow pubescence. Aedeagus basally stout, tapering, subapical cavity elongate and showing conspicuous paired chitinous plates; an accessory triangular cavity present just below the recumbent fringed plates on the thecal apex (which acutely protrudes well beyond the plates).

Body length 7 mm.

Female. – Unknown.

Diagnosis. – *M. hypochrysos* can be distinguished from other species in the *alexeji* group by its golden surface and pubescence of the abdomen; the lack of a knob on the posterior surstyle lobe distinguishes from the larger but superficially similar *altinosus*.

Period of flight and distribution (fig. 82). – This species is known from the mountains of eastern Turkey where it occurs in June and July.

Etymology. – The epitheton is derived from the Greek words hypo, i.e. under, less than, and chrysos, meaning gold, on account of the moderate golden lustre of the male. An adjective.

Merodon kawamurae Matsumura
(figs. 32 a-e, 79)

Merodon kawamurae Matsumura, 1916: 257. Described after an unknown number of specimens from Kumamoto, Kyushu, Japan, leg. Kawamura. [not examined].
Lampetia micromegas Hervé Bazin, 1929: 111. Lectotype ♂ (here designated): 'Tchen-Kiang, 13.iv.1918/ *Lampetia micromegas* H. B. type' [examined] (MNHN). **Syn. n.**
Merodon kawamurae; Paramonov 1925: 160; Shiraki 1930: 206.
Lampetia kawamurae; Hervé Bazin 1929: 111; Sack 1931: 319.
Merodon kawamurai; Shiraki 1968: 198; Peck 1988: 171.
Merodon micromegas; Peck 1988: 172.

Material examined. – China: Paralectotypes of *micromegas*: 19♂, 39♀: Topotypic 9♂, 18♀ (MNHN); 'Shia-Shu' 6♀ (MNHN, BMNH); 'Che-Mo' 9♂, 10♀ (MNHN, BMNH); 'Nanking' 3♀ (MNHN, BMNH); 'Hoa-Chan' 1♂, 2♀ (MNHN), Collection dates from 1.iv.1918 to 16.v.1918. – Non types: China: 1♀ (NHMW); Japan: 2♂, 1♀ (BMNH).

Description

Male. – Head: Antennae orange, antenna 3 with upper margin convex, apex acute to rounded, most variable, antennal ratio 1.6; vertex angle 35°, ocellar angle 50°, tl-v ratio 0.15 to 0.3; vertex sides straight to slightly concave; pubescence pale yellow, with dark tuft in ocellar region.

Thorax: Metallic lustrous on katepisternum, anepisternum, anepimeron, dorsum and scutellum, bearing moderately dense and long, uneven, yellow to white pubescence. Wings slightly tinged, halteres, squamae and antisquamae yellow; very faint longitudinal striation present in some specimens.

Legs: All femora dark brown, tibiae yellowish with broad dark band in distal half (in some specimens more extended), tarsi, especially tarsi 3 dark above, with golden pubescence underneath; trochanters 3 smooth to distinctly edged (seen as little spine in end-on view), femora 3 rather swollen, with normal triangular processus bearing 12-15 spinules of which the apical 1-3 are robust, the others rather fine; tibiae 3 and tarsi 3 normal.

Abdomen: Dark; T II-IV bearing widely to hardly interrupted, slightly arcuate, white, laterally widening pruinose bands; T II with rather large orange lateral spots, dark-centred in some specimens; pubescence inconspicuous, pale yellow to white, densest laterally on T II-IV and abdominal tip; S IV weakly vaulted, posterior margin entire to shallowly emarginate.

Genitalia: The anterior surstyle lobe rather large, slightly spathulate, elongate, rounded, apically with dense, short, even, yellow pubescence; posterior surstyle lobe coalescent, strongly mediolaterally aligned, overlapping, posteriorly with dense, erect, yellow pubescence. Cercus wide and short, bearing dense, erect, long, yellow pubescence. Aedeagus smooth on outer face, apical shaft part short, fringed plates on thecal apex large, suberect to erect.

Body length 7-11.5 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Head: Antenna 3 generally less acute than in males; ocellar angle 60°; frons strongly golden lustrous throughout, diffusely pruinose on margins, showing white pubescence; vertex slightly but clearly edged anteriorly in some specimens. Thorax: Clearly more lustrous; pubescence less dense; traces of striation clearer. Legs: Often relatively more yellow, especially on tibiae. Abdomen: Slenderer, lateral spots larger.

Body length 6-12 mm.

Variation. – *M. kawamurae* is one of the most variable species in *Merodon*. The variation observed seems to be size-correlated: the largest specimens show the strongest lustre, the most acute antenna 3, most edged trochanters 3 and most vaulted and emarginate S IV (males), or strongest edged vertex (females). In view of this variability, including size variation of 100%, more than one species would seem to be involved. There are however several strong arguments for considering all material conspecific: 1. there are gradual transitions in all variable features; 2. all males are completely similar in the genitalia; 3. many cases of such extreme variation are known in other insect species, some of which have been shown to be the direct effect of food availability.

Diagnosis. – *M. kawamurae* can be distinguished by its clearly spathulate anterior surstyle lobe in the males and by the golden lustrous vertex, slender abdomen and (some specimens) the edge on the vertex. Moreover it is the only small-sized *Merodon* species currently known from China and Japan, the only larger-sized species being *equestris* Fabricius. Of other *Merodon* species the only one possibly occurring in this region is *alexeji* which has a much longer anterior surstyle lobe and more protruding cercus (fig. 28 a). *M. alexeji* has been found in Mongolia but more eastward localities are unknown.

Period of flight and distribution (fig. 79). – *M. kawamurae* is known from eastern China and Japan, and occurs in April and May.

Discussion. – The synonymy of *M. micromegas* with *M. kawamurae* might be questioned since no type-material of *M. kawamurae* has been examined. After Horn and Kahle (1936) the Matsumura types might be at the Agricultural Department of Hokkaido University, Sapporo, Japan, but inquiries there have not confirmed the presence of the *kawamurae* types at this institute. The illustrations and descriptions of *kawamurae* and *micromegas* leave hardly any doubt as to their conspecificity; moreover, Hervé-Bazin himself already stated that *micromegas* might be conspecific with *kawamurae* and described *micromegas* since he 'thought the description of *kawamurae* as given by Matsumura (1916) insufficient' (Hervé-Bazin 1929). The Japanese material currently known is in the BMNH.

***Merodon marginicornis* sp. n.**
(figs. 33 a-c, 82)

Type-material. – ♂ Holotype 'Iran, Chiraz [26° 40' N, 52° 30' E], 11.iv.1937, Coll. F. H. Brandt' (RMNH).

Description

Male. – Head: antennae large, antenna 3 orange, apex acute, upper margin edged, concave, antennal

ratio 2.4; vertex angle 35°, ocellar angle 65°, tl-v ratio 0.4, pubescence pale yellow.

Thorax: Dark; katepisternum, anepisternum, anepimeron, dorsum and scutellum bronze lustrous; pubescence rather sparse, short, uneven, pale yellow; no traces of pruinose bands present. Wings slightly tinged, brown veined; halteres, squamae and antisquamae pale yellow.

Legs: Dark, but tarsi brownish orange; trochanters 3 with distinct knob; femora 3 swollen, rather straight, with low, strongly serrate triangular processus bearing 8 spinules; tibiae normal, basitarsi 3 slightly swollen, other tarsi 3 normal.

Abdomen: Dark, vaguely bluish lustrous, with rather vaguely bordered but well marked, slightly arcuate, interrupted whitish pruinose bands on T II-IV; T II bearing strongly lustrous bluish lateral spots; pubescence rather sparse, whitish, densest antero-laterally; S IV deeply emarginate posteriorly, somewhat vaulted.

Genitalia: Anterior surstyle lobe elongate, bearing short, even, yellow, erect pubescence dorsally and along margins, showing elongate bald area, bordered by a rim, on lateral face; the posterior surstyle lobe separated by a shallow sulcus, elongate, posteriorly with yellow, dense, erect pubescence. Cercus inconspicuous, with long, dense, yellow pubescence. Aedeagus smooth on outer face, with long subapical cavity, showing paired elongate, heavily sclerotized structures basally; fringed plates suberect, apical shaft part short.

Body length 9 mm.

Female. – Unknown.

Diagnosis. – *M. marginicornis* can be easily distinguished by the bald, rimmed area on the lateral face of the anterior surstyle lobe.

Period of flight and distribution (fig. 82). – *M. marginicornis* is known only from the holotype, collected in south-western Iran in April.

Discussion. – *M. marginicornis* has been assigned to the *alexeji* group in view of the structure of its male genitalia; it has somewhat swollen basitarsi 3 [a synapomorphy for the *tarsatus* group], but lacks the modification of S IV [the other synapomorphy for the *tarsatus* group]. Therefore this species may in fact occupy a position in between these two groups.

Etymology. – The epitheton *marginicornis* refers to the edged upper margin of the antenna 3; it is derived from the latin margo, meaning edge, and cornu, meaning horn, in insects often used in referring to antennae. A noun in apposition.

Merodon rufitarsis Sack stat. n.
(figs. 34 a-c, 83)

Merodon fulcratus Sack, 1913, subsp. *rufitarsis* Sack, 1913a: 438. Holotype ♂: 'Alai mont' [the Alajsski Mountains, Tadzhikistan, approx. 39° 30' N, 71° to 73° E] (ZMHB) [examined].

Merodon (*Exmerodon*) *fulcratus* ssp. *rufitarsis*; Peck 1988: 165.

Description

Male. – Head: Antennae dark, antenna 3 red, apex rounded, upper margin convex, antennal ratio 1.6; vertex angle 30°, ocellar angle 50°, pubescence pale yellow; touchline incomplete, tl-v ratio 0.15; compound eyes with inconspicuous white pubescence.

Thorax: Dark; katepisternum, anepisternum, anepimeron, dorsum and scutellum slightly lustrous, bearing moderately long and dense, yellow, rather uneven pubescence, without traces of pruinose bands. Wings clear, veins pale brown, halteres, squamae and antisquamae pale yellow.

Legs: All femora dark, tibiae orange with wide dark distal band, tarsi orange; trochanters 3 with low sharp edge, femora 3 moderately swollen, rather straight, bearing normal triangular processus with 10 spinules; tibiae 3 and tarsi 3 normal.

Abdomen: Dark, without lateral spots or pruinose bands; pubescence rather dense, uneven, yellow, suberect; S IV strongly keeled; abdominal surface slightly lustrous throughout, strongest laterally.

Genitalia: Anterior surstyle lobe much elongate, with short yellow even pubescence apically and down margins; posterior surstyle lobe separated by shallow sulcus, large, strongly mediolaterally aligned, showing rather long, yellow pubescence apically and posteriorly. Cercus rather short, wide, with dense, long, yellow pubescence. Aedeagus smooth on outer face, with paired chitinous plates in middle region of shaft; apical shaft part rather short, subapical cavity well marked, fringed plates on thecal apex suberect.

Body length 9 mm.

Female. – Unknown.

Diagnosis. – *M. rufitarsis* can be distinguished by the combination of lacking abdominal bands and lateral spots with the mediolaterally aligned posterior surstyle lobe.

Period of flight and distribution (fig. 83). – *M. rufitarsis* is known from Tadzhihistan; the flight period is unknown.

Discussion. – *M. rufitarsis* cannot be considered a subspecies of *M. fulcratus* Becker as originally established by Sack (1913a). From their respective descrip-

tions it is clear that Becker and Sack described two different species, although both were based on information provided by Loew. Type material belonging to the nominate form of *M. fulcratus* Sack has not been recovered. *Merodon fulcratus* Sack, 1913 (published August, 1913) is a junior homonym of *Merodon fulcratus* Becker, 1913 (published April, 1913), and should be renamed when its identity has become clear. The male genitalia are very different. For instance, in *M. fulcratus* Becker the aedeagus is abruptly tapering basally and the surstyle lobes are smaller. *M. rufitarsis* has completely touching eyes in the male, whereas in males of *fulcratus* Becker the eyes are widely separated. These species are assigned to different species groups, and are not considered closely related.

Merodon sophron sp. n.
(figs. 35 a-c, 81)

Type-material. – ♂ Holotype 'Morocco, Azrou [33° 25' N, 05° 20' W], 29.v.1925, E. Hartert' (BMNH).

Description

Male. – Head: Antennae dark, antenna 3 with slightly convex upper margin, apex acute, antennal ratio 2.0; vertex angle 30°, ocellar angle 60°, tl-v ratio 0.6; pubescence pale yellow, with dark tuft in ocellar region.

Thorax: Dark, katepisternum, anepisternum and anepimeron lustrous; pubescence greyish yellow, slightly uneven; no pruinose bands present. Wings clear, orange veined; halteres, squamae and antisquamae pale orange.

Legs: All dark; trochanters 3 smooth; femora 3 swollen, with normal triangular processus bearing 6 bristles; tibiae 3 and tarsi 3 normal.

Abdomen: Dark, comparatively stout; T II-IV with slightly arcuate, narrow, widely interrupted whitish pruinose bands and slight metallic lustre overall; T II with clear metallic lustrous lateral spots bearing rather dense, golden pubescence; pubescence otherwise paler, less conspicuous.

Genitalia: Anterior surstyle lobe elongate, rectangular, markedly curving dorso-anteriorly, spathulate, with dense, yellow, even pubescence apically; posterior surstyle lobe separated by small clear sulcus, rather large, very high, apical parts mediolaterally aligned and largely overlapping; the posterior surstyle lobe bears a bald, slightly elongate knob anteriorly; from here a suture runs toward the posterior margin, dividing the posterior surstyle lobe in basal and apical parts; the posterior margin bears dense, long, erect, yellow pubescence. Cercus very large with same pubescence. Aedeagus smooth on outer face, excavated on this face in hardly lengthened apical shaft part; fringed plates on thecal apex rather large, erect; in natural position aedeagus entirely covered by posterior surstyle lobe.

Body length 9.5 mm.

Female. – Unknown.

Diagnosis. – *M. sophron* is distinguished from other species by its very large overlapping posterior surstyle lobe and its golden pubescence on the metallic lustrous lateral spots on T II.

Period of flight and distribution (fig. 81). – *M. sophron* is known only from the holotype, collected in Morocco in May.

Etymology. – The epitheton *sophron* is derived from the greek words soos, meaning chaste, and phronein, meaning to act, and refers to the 'chaste' covering of the aedeagus in this species. A noun in apposition.

Merodon tener Sack
(fig. 81)

Merodon tener Sack, 1913a: 443. Lectotype ♀ (here designated): 'Sarepta [= Krasnoarmeysk near Volgograd, after Peck 1988]/ M. tener Sack det. Sack/ coll. Lichtwardt/ coll. D. E. I. Eberswalde' [examined].
Merodon tener; Becker 1921: 54; Van der Goot 1981: 215.
Lampetia tenera; Sack 1931: 329.

Material examined.- ♀ Paralectotype with same data as lectotype (DEIC).

Description

The lectotype and paralectotype are quite similar to *alexeji* females. The main differences are: ocellar angle 70° in the *tener* types, 60° in *alexeji*; coloration of abdomen reddish throughout in *tener* and slightly stouter than in *alexeji*. Lectotype and paralectotype differ slightly in the degree of swelling of the femora 3 but are otherwise similar among themselves and to *alexeji*.

Period of flight and distribution (fig. 81). – *M. tener* is known from the southern and eastern parts of Russia, where it has been collected in June (Sack 1931: 329).

Discussion. – Since no male type-material of *tener* has been traced it is impossible to ascertain the status of *tener* as a separate species. In view of the differences stated *tener* is here considered to be a separate species. In view of the similarity in the females the species is tentatively assigned to the *alexeji* group.

Merodon trizonus (Szilady)

Lampetia trizona Szilady, 1940: 67. Syntypes ♂ and ♀: La Calle [el Kala], Algeria and Ain Draham, Tunisia [not examined].

Discussion. – The extremely brief description provided by Szilady is insufficient to separate *trizonus* from other *Merodon*. The original description expressly states that the species is related to *hirsutus* Sack. Therefore the species is tentatively assigned to the *alexeji* group which also includes *hirsutus*. The types of this species, formerly stored in TMA, have been lost in 1956 (Dr. A. Dély-Draskovits, in litt.). No other material assigned to this species is known.

The *tarsatus* group

Apomorphies: Basitarsus 3 strongly swollen, specialized pubescence present on inner face; S IV at least keeled, mostly strongly modified.

Description. – Head: Antennae orange to brown, antennal ratio 1.3 to 1.7, compound eyes in male usually touching with tl-v ratio 0.1 to 0.3, pubescence yellow to white, oral margin well marked. Thorax: Dark, metallic lustrous. Wings clear to slightly tinged, orange to dark veined, halteres, squamae and antisquamae yellow. Legs: Femora 3 with normally shaped triangular processus, tibiae 3 in male often bearing apical floccus inserted on distal spur, basitarsi 3 swollen strongly to enormously, less conspicuously so in females; showing short thick-set pubescence on inner face. Abdomen: Tergites metallic lustrous, S IV strongly modified in males of all species except *auronitens* and *caudatus* where it is only keeled. Genitalia: Anterior surstyle lobe simple, often with short, dense pubescence distally, separated by small suture from higher posterior surstyle lobe bearing long posterior pubescence. Cercus well protruding. Aedeagus with apical part short.

Merodon ankylogaster sp. n.
(figs. 36 a-b, 84)

Type-material. – ♂ Holotype 'Iran, Fars, Road Chiraz-Kazeroun, Ft. Sine-Sefid [Southwestern Iran, about 29° 35' N, 52° E, in mountains], 29.iv.1937, coll. F. H. Brandt' (RMNH). Paratype ♀, same data as holotype (RMNH).

Description

Male. – Head: Antennae orange, antenna 3 with upper margin convex, apex obtuse, antennal ratio 1.3; pubescence pale yellow, dark hairs present in ocellar region; vertex angle 40°, ocellar angle 45°, vertex large, tl-v ratio 0.15.

Thorax: Coppery lustrous on katepisternum, anepisternum, anepimeron, dorsum and scutellum, dorsal surface rather roughly sculptured, showing yellow, erect, uneven pubescence. Wings orange veined, clear.

Legs: Dark, tibiae basally yellow; tarsi with dense golden pubescence; trochanters 3 smooth, femora 3 much swollen, slightly metallic lustrous, with normal triangular processus; tibiae 3 without apical floccus; basitarsi 3 strongly swollen, bearing dense, golden, short pubescence medially; other tarsi 3 normally shaped.

Abdomen: T II much tapering posteriorly, without lateral spots; pruinose bands interrupted, slightly arcuate; pubescence moderately dense, golden, oblique; S IV with conspicuous median projection; abdominal surface roughly sculptured on medial region of all tergites.

Genitalia: The anterior surstyle lobe elongate, slightly spathulate, apically bearing short, dense, erect, yellow pubescence, posterior surstyle lobe separated from anterior surstyle lobe by shallow sulcus, steeply rising, posteriorly with long dense yellow pubescence. Cercus subangular, oblong, with similar pubescence. Aedeagus stout, with fringed plates on thecal apex recumbent, apical part screened by the apical portion of the posterior surstyle lobe in natural position.

Body length 7.5 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Head: Ocellar angle 60°; frons lustrous throughout, laterally yellowish metallic lustrous. Thorax: Stouter than in male; sculpturing less strong, pubescence more whitish. Abdomen: Stouter, pruinose bands nearly continuous; pubescence whiter; S IV normal.

Body length 9 mm.

Diagnosis. – The male is unmistakable in view of the morphology of S IV; the female *ankylogaster* can be separated from *turkestanicus* by the partially orange legs, and from *caudatus* by the lack of lateral spots on the abdomen.

Period of flight and distribution (fig. 84). – The species is known only from the types, collected in Iran in April.

Discussion. – The shape of the anterior surstyle lobe and inward curve of the posterior surstyle lobe in *ankylogaster* suggest a certain degree of relationship with *alexeji* and its allies [note the discussion of *marginicornis* above]; in view of the modified S IV and the swollen basitarsi 3, *ankylogaster* has been assigned to the *tarsatus* group.

Etymology. – The epitheton *ankylogaster* is derived from the Greek ankylos, meaning spine, and gaster,

meaning belly, hence abdomen, and refers to the projection of S IV in the male of this species. The epitheton is to be treated as a noun in apposition.

Merodon auronitens sp. n.
(figs. 37 a-c, 84)

Type-material. – Holotype ♂ 'Israel, Mt. Carmel, Bat Slomo 32° 35' N, 35° 00' E, 22.iii.1981, W. B. M. Brantjes' (ZMAN). The antennae and the right leg 3 on cardboard tag, both anterior surstyle lobes attached to another cardboard tag.

Description

Male. – Head: Antennae black, 3rd article with upper margin concave, apex subacute, antennal ratio 1.7, vertex angle 35°, ocellar angle 40°, tl-v ratio 0.35; pubescence very dense, long, glossy golden on frons, slightly shorter and sparser on face and vertex.

Thorax: Dark; golden metallic lustrous laterally, bearing moderately dense, even, golden brown pubescence. Wings clear, halteres, squamae and antisquamae yellow.

Legs: Dark throughout, tibial bases and tarsi slightly lighter; trochanters 3 smooth, femora 3 much swollen, showing normally shaped triangular processus bearing 8 bristles; tibiae 3 show a clear, golden apical floccus; basitarsi 3 swollen, with very dense, short, golden pubescence on inner face.

Abdomen: T II slightly tapering, with traces of lateral spots; T II-IV with arcuate greyish pruinose bands, that on T II inconspicuous; pubescence rather long, even, yellow, moderately dense; sternite IV keeled, posteriorly slightly emarginate, but not deformed.

Genitalia: Anterior surstyle lobe somewhat elongate, with dense orangish pubescence throughout; connection to posterior lobe severed; posterior lobe rather high, curving mediad apically, with scattered yellow pubescence on apical margin; posterior end with dense yellow pubescence. Cercus well protruding, bearing dense, long, yellow pubescence. Aedeagus smooth on outer face, fringed plates on thecal apex recumbent.

Body length 11.5 mm

Female. – Unknown.

Diagnosis. – *M. auronitens* can be distinguished from other species in this group by the lack of a deformed S IV, like *caudatus*, but differs from that species by not having a deformed genital cap.

Period of flight and distribution (fig. 84). – *M. auronitens* is known only from the holotype, collected in Israel in March.

Etymology. – The epitheton *auronitens* is latin, and derived from the word aurum, meaning, gold, and the verb nitere, meaning, to shine, the construction meaning, shining with gold, as a reference to the glossy pubescence on the head. The epitheton is to be treated as an adjective.

Merodon caudatus Sack
(figs. 38 a-d, 84)

Merodon caudatus Sack, 1913a: 446. Holotype: Asia Minor [Turkey] [not examined, considered lost].
Merodon caudatus; Paramonov 1926b: 322; Peck 1988: 168.
Lampetia caudata; Sack 1931: 309.

Material examined. – Israel: 2♂, 1♀ 'Mt. Carmel, Beth Slomo, 22.3.1981 leg. Brantjes' (JLR); 1♀ 'Palestine, Beth Hakerem [near Jerusalem], 17.3.1951 leg. O. Theodor' (RMNH).

Description

Male. – Head: Antennae dark, antennal ratio 1.8, antenna 3 with apex obtuse, somewhat edged; vertex large, metallic lustrous, vertex angle 50°, ocellar angle 65°, pubescence yellow, whitish on face and occipital sides; compound eyes showing grey pubescence, tl-v ratio 0.2-0.25.

Thorax: Dark, brassy lustrous on katepisternum, anepisternum and anepimeron, dorsum and scutellum, showing dense, erect, yellowish, even pubescence, diffusely pruinose on lateral dorsum, scutellum and sides. Wings quite clear, halteres, squamae and antisquamae pale yellow.

Legs: All femora dark, apically paler, tibiae yellow with dark distal band, tarsi orange to brown, apical articles darkest; pubescence dense on tibiae and tarsi, yellow underneath; trochanters 3 smooth, femora 3 rather straight, triangular processus somewhat reduced, forming only slight knob; tibiae 3 curved and twisted, bearing apical floccus on drawn-out distal medial spur; basitarsi 3 short, swollen, with furrow giving twisted aspect, bearing short, even, dense, yellow pubescence; other tarsi 3 normal.

Abdomen: Tergites dark, metallic lustrous, T II with orange lateral spots and erect, orange pubescence (densest and longest on lateral spots); pruinose bands arcuate, interrupted on T III, continuous on T IV; S normal but S VIII (the genital cap) strongly modified, elongate, with apical floccus conspicuous to naked eye (hence the name *caudatus*).

Genitalia: The anterior and posterior surstyle lobes separated by deep wide sulcus; anterior surstyle lobe rounded-triangular, with short, even, dense, yellow pubescence, showing ridge running from ventro-posterior angle to mid region; posterior surstyle lobe short and high, with longish, uneven, yellow pubescence apically. Cercus well protruding, angular, with

very long, yellow pubescence. Aedeagus with short apical shaft part, the fringed plates on thecal apex recumbent.

Body length 12 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Head: Ocellar angle 70°, frons metallic lustrous, diffusely pruinose on sides; frons clearly tapering toward vertex. Thorax: Markedly stouter than in male. Legs: Slenderer than in males, basitarsi 3 quite similarly modified but pubescence duller. Abdomen: Stouter, rather triangular, with conspicuous lateral spots bearing fiery orange hair-tufts; pruinose band on T III nearly continuous.

Body length 9.5 mm.

Diagnosis. – The males are easily separated by their unique genital cap; the females are similar to those of *ruficornis* Meigen and allied species from which they are separated by the swollen basitarsi 3.

Period of flight and distribution (fig. 84). – The species is known from Israel and Turkey where it occurs in March.

Discussion. – In spite of the fact that no type-material was available, the identification of this species is certain in view of the extraordinary features present. The assignment of the female of *caudatus* as presented here seems justified in view of the striking similarities (basitarsi 3, lateral spots on T II) and the concurrent flight in the same area.

Merodon oidipous sp. n.
(figs. 39 a-d, 84).

Type-material. – ♂ Holotype 'Turkey, Hakkari, Suvarihalil pass 2100 m, 4.vi.1984, leg. J. A. W. Lucas' (ZMAN). Paratypes: 2♂, same data as holotype (JLR).

Description

Male. – Head: Antennae orange to brown, antennae III paler than I-II, upper margin straight to slightly concave, apex rounded, antennal ratio 1.6; vertex angle = 40°, ocellar angle = 60°, tl-v ratio 0.25; face and occiput slightly, vertex strongly blue metallic lustrous; pubescence whitish to pale yellow, face moreover diffusely pruinose; compound eyes with greyish pubescence.

Thorax: Dark, with some steel blue lustre on lateral dorsum and scutellum, stronger on sides; pubescence erect, moderately dense, rather short, uneven. Wings clear; halteres with knob yellow, stalk darker, squamae and antisquamae yellow.

Legs: All femora dark with narrow yellow apices, tibiae yellow with broad dark distal band, tarsi dark above, with dense pale pubescence underneath, upper faces orangeish to brown on legs 1-2, darker on 3; trochanter 3 bearing low projection with yellow hair-tuft; femur 3 swollen, bluish metallic lustrous; triangular processus rather large, with conspicuous apical spur, otherwise finely serrate, bearing some 9 bristles; tibiae 3 with long yellow apical floccus inserted on drawn-out distal inner angle; basitarsi 3 enormously swollen, almost globular, brownish, with dense golden short erect pubescence medially; other tarsi 3 normal.

Abdomen: Rather slender, dark; T II tapering posteriorly, T II-IV bearing slightly arcuate moderately wide interrupted pruinose bands; pubescence whitish, rather sparse, slightly denser laterally and on pruinose bands, darker medially; at certain angles vague metallic blue lustrous lateral spots on T II may be seen; S IV with paired, conspicuous appendages.

Genitalia: The anterior surstyle lobe somewhat spathulate, bearing dense, yellow, even, erect pubescence on distal margin; separated from the slightly elongate rounded posterior surstyle lobe by a shallow sulcus; posterior surstyle lobe incised dorsally, bearing dense, erect, yellow pubescence. Cercus conspicuous, elongate, with same pubescence. Aedeagus rather slender with short apical shaft part, fringed plates on thecal apex recumbent to suberect.

Body length 8.5 mm.

Female. – Unknown.

Diagnosis. – *M. oidipous* can be separated by its enormously swollen basitarsi 3 which are differently shaped than in other species of the *tarsatus* group, by the clear blue lustre on the vertex, and the more protruding cercus.

Period of flight and distribution (fig. 84). – The species, known only from the types, has been found in south-eastern Turkey in June.

Etymology. – The epitheton *oidipous* derives from the Greek and means, swollen foot. It refers to the enormously swollen basitarsi 3, conspicuous to the naked eye.

Merodon persicus sp. n.
(figs. 40 a-d, 85)

Type-material. – ♂ Holotype 'Iran, Fars, Ft. Sine-Sefid, Rd. Chiraz Kazeroun [29° 35' N, 52° E], Coll. F. H. Brandt 25.v.1937 / Lampetia smirnovi det. P. H. van Doesburg' (RMNH).

Description

Male. – Head: Antennae brown, antenna 3 orange,

upper margin straight to slightly concave, apex acute, antennal ratio 2.3; pubescence pale yellow, with dark hair-tuft in ocellar region; oral margin more protruding than in the other species in this group; face slightly diffusely pruinose; vertex angle 40°, ocellar angle 60°; tl-v ratio 0.25; compound eyes with whitish pubescence.

Thorax: Rather dull, surface dark brown, bearing uneven, short, erect yellow pubescence on dorsum, scutellum, katepisternum, anepisternum and anepimeron, with weak bronze lustre on these elements. Wings clear, halteres, squamae and antisquamae yellow.

Legs: Dark but bases of tibiae and tarsi brown; trochanter 3 showing well-defined low hump bearing rather short black bristly pubescence; femur 3 swollen, curved, with rather small triangular processus, strongly serrate on distal margin; tibiae 3 short, stout, with distinct apical floccus on distal medial angle; basitarsi 3 strongly swollen, showing dense, golden, short, erect pubescence throughout (densest on medial face). A slightly elevated, well defined area proximally on lower face bearing erect, dense dark bristly short pubescence obliterating the surface of this area; other tarsi 3 normal.

Abdomen: Moderately slender, all dark, with rather strong olivaceous metallic lustre; vaguely defined, arcuate pruinose bands present on T III-IV; pubescence golden throughout, some dark hairs present in posteromedian parts of T II-III. All S rectangular, S IV bearing conspicuous, paired appendages visible to naked eye.

Genitalia: The anterior surstyle lobe elongate, apical part widening and projecting dorsally, showing short, yellow, erect pubescence along ventral and distal margins; separated from posterior surstyle lobe by shallow suture, from which the rounded-rectangular posterior surstyle lobe steeply rises; posterior surstyle lobe with yellow, scattered, erect pubescence, longest on ventral and posterior margins. Cercus largish, bearing dense, long, yellow, erect pubescence. Aedeagus stout, fringed plates on thecal apex recumbent, apical shaft part short; in natural position the apical portion of the aedeagus is covered by the posterior surstyle lobe tops.

Body length 9.5 mm.

Female. – Unknown.

Diagnosis. – *M. persicus* seems to be most closely related to *tarsatus*, from which it differs in the smaller size, the entire basitarsi 3 with a small raised area (as opposed to excavated basitarsi 3 with large area in *tarsatus*), the elongate posterior surstyle lobe with dorsally projecting apical part, and the stronger inward curve of the apical posterior surstyle lobe region. *M. persicus* differs from the description of *smirnovi* in the smaller size, the smaller tl-v ratio and the colour of the antennae.

Period of flight and distribution (fig. 85). – The species is known to occur in Iran; it flies in May.

Etymology. – The epitheton *persicus* is derived from the classical name Persia, indicating the region of occurrence of the species.

Merodon tangerensis sp. n.
(figs. 41 a-d, 87)

Type-material. – ♂ Holotype 'Environs de Tanger [Morocco], Fevrier 1859' (MNHN).

Description

Male. – Head: Antennae dark, antenna 3 with upper margin convex, apex rounded, antennal ratio 3.3; pubescence pale yellow with dark hair-tuft in ocellar region; vertex angle 30°, ocellar angle 35°, touchline incomplete, tl-v ratio 0.15; face slightly, diffusely pruinose, occiput densely pruinose down sides, metallic lustrous; compound eyes showing whitish pubescence.

Thorax: Dark, slightly metallic lustrous on lateral dorsum and scutellum; katepisternum, anepisternum and anepimeron steel grey lustrous; dorsum with double paired anteriorly coalescent whitish pruinose bands; pubescence erect, yellow, moderately dense, distinctly uneven throughout, paler on sides. Wings clear, pale brown veined; halteres, squamae and antisquamae yellow.

Legs: Dark but apices of femora and bases and apices of tibiae lighter; trochanter 3 smooth, femur 3 swollen, black metallic lustrous, bearing normal triangular processus holding 6 bristles on serrate distal margin; tibiae normal, showing drawn-out distal medial angle bearing dense somewhat lengthened pubescence (this might be termed a subfloccus); basitarsi 3 swollen, with dense, yellowish, erect pubescence (densest medially); other tarsi 3 normal.

Abdomen: Dark, slender, tergites rectangular, slightly transverse, with white, slightly arcuate moderately wide pruinose bands, interrupted on T II, continuous on T III-IV; pubescence short, white on bands, dark elsewhere; S IV strongly keeled, deeply emarginate posteriorly.

Genitalia: The anterior surstyle lobe elongate, with apical part bearing short, even, yellow, dense pubescence, more scattered elsewhere; separated from posterior surstyle lobe by deep sulcus; posterior surstyle lobe high, apically curving medially; with marked antero-ventral angle, posteriorly rounded, there with moderately dense rather long yellow pubescence.

Cercus inconspicuous, bearing long dense yellow pubescence. Aedeagus slender, fringed plates recumbent, subapical cavity well marked.

Body length 8.5 mm.

Female. – Unknown.

Diagnosis. – *M. tangerensis* is distinguished from other species in this group by its very long antenna 3, the relatively small projection of S IV and the relatively large somewhat dorsally curving anterior surstyle lobe.

Period of flight and distribution (fig. 87). – This species is known only from the holotype, collected in northern Morocco in February.

Etymology. – The species is named after the site where the holotype was collected. The epitheton is to be used as an adjective.

Merodon tarsatus Sack
(figs. 42 a-e, 83).

Merodon tarsatus Sack, 1913a: 437. Holotype ♂: 'Pamir 49409/ Mer. tarsatus Sack det. Sack' (ZMHB) [examined].
Merodon smirnovi Paramonov, 1926b: 320. Holotype ♂: 'Ak-Tash, Prope Tashkent, Turkestan' [not examined, see discussion]. **Syn. nov.**
Merodon tarsatus; Paramonov 1926b: 320; Paramonov 1927: 76, 78; Peck 1988: 174.
Lampetia tarsata; Sack 1931: 328.
Merodon smirnovi; Paramonov 1927: 76, 78; Liepa 1969: 20; Peck 1988: 173.
Lampetia smirnovi; Sack 1931: 326.

Material examined. – U. S. S. R.: 1♂ 'Ak-Tash [41° 37' N, 69° 40' E], 9 vii 1923, Tashkent A.Zecholovtsev/ Lampetia smirnovi Param., S. Paramonov det. mm/ coll. J. Villeneuve' (KBIN); 1♀ 'Berkana, Turkestan, 24.vi.1925, Kuznetsov leg.' (ZMAS); 1♀ 'Outsj. Koydara, dol. R. Warzob, Tadzj.' [river Warzob valley in Tadzhikistan, North of Dushanbe in 68° 50' E, between 38° 20' and 38° 55' N] (ZMAS).

Description

Male. – Head: Antennae brown, antenna 3 with upper margin edged, straight, apex subacute, antennal ratio 1.9; pubescence yellow, with dark hair-tuft in ocellar region; vertex angle 40°, ocellar angle 70°; tl-v ratio 0.3; face and occiput metallic greenish lustrous; central ocellus only half as large as the lateral ones; compound eyes with whitish pubescence.

Thorax: Strongly lustrous on lateral dorsum and scutellum, katepisternum, anepisternum and anepimeron; dorsum and scutellum with diffuse golden pubescence and scattered pruinosity, with 4 faint pruinose bands also showing. Wings tinged brown on central portions, clear marginally, veins very dark; halteres, squamae and antisquamae yellow.

Legs: All joints and tibial bases yellow, otherwise dark; trochanter 3 sharply keeled, femur 3 swollen, metallic lustrous, triangular processus normal, bearing 6-8 bristles on serrate distal margin; tibiae 3 rather strongly curved, bearing large lamella on distal medial face with ruddy floccus inserted apically; floccus extends over half the length of basitarsi 3; these swollen, asymmetrical, with lower face showing large flat metallic lustrous area bearing stout bristle-like pubescence, bordered by very stout long pubescence; inner face of basitarsi 3 showing dense orange-yellow pubescence.

Abdomen: Dark, greenish yellowish metallic lustrous, rather slender; pubescence dense, moderately long, pale orange, partially obliterating roughly punctated surface; no pruinose bands; S IV modified, bearing large, slender paired appendages.

Genitalia: The anterior and posterior surstyle lobes separated by shallow sulcus, of about equal size; anterior surstyle lobe apically with short, dense, erect, yellow pubescence, of rectangular outline; posterior surstyle lobe moderately high, regularly rounded, bearing erect, long, yellow, uneven pubescence. Cercus of moderate size, with similar pubescence, slightly angular. Aedeagus robust, heavily sclerotized, apical shaft part short, fringed plates recumbent.

Body length 10.5-13 mm.

Female. – Rather different from the males, as noted by e.g. Sack, 1931; therefore a full description is given.

Head: Antenna 3 dark orange, subacute; antennal ratio 2-2.3; pubescence whitish; ocellar angle 70°; the central ocellus clearly smaller than the lateral ones; frons diffusely pruinose laterally, lustrous for median one-third; metallic lustre absent.

Thorax: Weakly greenish metallic lustrous on lateral dorsum and scutellum, katepisternum, anepisternum and anepimeron; pubescence rather short, erect, even, pale yellow. Wings as in male, slightly less tinged.

Legs: All femora dark, tibiae orange with dark distal band, femur 3 slightly swollen, triangular processus bearing 6 bristles on serrate distal margin; tibiae 3 short, otherwise normal; basitarsi 3 clearly swollen, not deformed, bearing dense golden pubescence; other tarsi 3 normal.

Abdomen: Dark, slightly metallic lustrous; pruinose bands on T II-IV narrow, whitish, arcuate, well defined, interrupted; pubescence yellow to white, deepest coloured and densest laterally on T II.

Body length 12 mm.

Diagnosis. – *M. tarsatus* can be distinguished in the males, by its deformed basitarsi 3 with the lustrous

area at the lower face which at once separates it from all other species; in the females, by the clearly swollen basitarsi 3 and the great antennal ratio.

Period of flight and distribution (fig. 83). – *M. tarsatus* occurs in Tadzhikistan, and adjacent regions, where it flies in June and July.

Discussion. – In the original description the colour of the pubescence of the holotype is said to be foxy-red, its size as 12 mm; the colour has apparently faded, while the specimen was measured recently at 10.5 mm only. The synonymy of *smirnovi* with *tarsatus* was established after examination of one of the specimens (originating from the type-locality of *smirnovi*) identified as *smirnovi* by Paramonov, and matching the description as well as the holotype of *tarsatus*. Moreover, the females, all identified previously as *smirnovi*, match the description of the ♀ *tarsatus* as provided by Sack. Furthermore Sack (1931) noted the specialized setaceous area on the basitarsus 3 of *smirnovi* which he failed to observe in *tarsatus*, but which is easily seen on the holotype of *tarsatus*. Sack gave a difference in the tl-v ratios between *tarsatus* and *smirnovi* (the ratio of *tarsatus* being greater) in his key to the species (Sack, 1931), but checking of the holotype of *tarsatus* showed that the tl-v ratio in that species is about 0.3, whereas the ratio given by Paramonov for *smirnovi* is 0.5. Therefore Sack' s interpretation that two species are involved is not followed here; in view of the above arguments *smirnovi* is considered synonymous with *tarsatus*.

Merodon turkestanicus Paramonov
(figs. 43 a-e, 86)

Merodon turkestanicus Paramonov, 1926b: 319. Holotype ♂ : 'Tashkent, Tadzhikistan, 12.v.1915' [U. S. S. R.] [not examined].
Merodon turkestanicus; Paramonov 1927: 75; Liepa 1969: 20; Peck 1988: 175.
Lampetia turkestanica; Sack 1931: 330.

Material examined. – Iran: 1♂ 'Kuh-e-Hazaran, S. Rayen Kerman [29° 24' N, 57° 22' E], 3800 m, 25.v.1978 leg. K. Warncke' (JLR); U. S. S. R.: 2♂ 'Outsj. Koydara, dol. R. Warzob Tadzj. [68° 50' E, 38° 20' to 38° 50' N], Warzob river, Tadzhikistan] Stackelberg 6.v.43' (ZMAS); two ♀ from same locality and collector, dated 2.v.44 (ZMAS, BMNH); 1♀ 'Outsj. Kwak. Werch. Koydarye Tadzh. [in same region as holotype] Stackelberg 27.v.43' (RMNH); 1♂ 'Hissar mountains Tadzhikistan [same region], Stackelberg 3.v.44' (RMNH).

Description

Male. – Head: Antennae dark, antenna 3 with upper margin straight, apex obtuse, antennal ratio 2.1; vertex conspicuously large; vertex angle 45°, ocellar angle 50°, ocelli large, tl-v ratio 0.15, touchline incomplete; pubescence pale yellow, dark in ocellar region, on compound eyes sparse, yellowish.

Thorax: Moderately strong metallic lustrous on lateral dorsum, scutellum and sides, background colour dark; pubescence rather sparse, uneven, pale yellow. Wings clear throughout; halteres, squamae and antisquamae pale yellow.

Legs: All dark, tibiae and tarsi 1-2 with dense yellow pubescence giving false impression of light colour; trochanter 3 with small rounded knob, femur 3 swollen, strongly metallic lustrous, with triangular processus strongly serrate apically, tibiae 3 with conspicuous apical spur bearing strong floccus; basitarsi 3 very much swollen, bearing dense, short, yellow, even pubescence medially; other tarsi 3 normal.

Abdomen: Outline rather stout, background colour dark, obliterated by strong metallic lustre and moderately dense, yellowish, even pubescence; no traces of pruinosity or lateral spots. S IV bears conspicuous paired appendages.

Genitalia: Anterior and posterior surstyle lobes separated by deep narrow sulcus; anterior surstyle lobe bearing rather dense, yellow, erect, even pubescence apically; posterior surstyle lobe showing scattered, long, yellow pubescence, densest posteriorly. Cercus rectangular, well protruding, bearing long, erect, yellow pubescence. Aedeagus stout, apical shaft part short, fringed plates on thecal apex recumbent.

Body length 9 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Head: Eyes separate widely, ocellar angle 55°, frons lustrous throughout, partially dulled laterally by light pruinosity. Legs: The basitarsi 3 slightly but distinctly swollen, with a length/width ratio about 3.0. Abdomen: Appendages on S IV lacking.

Body length 9 mm.

Diagnosis. – The males of *turkestanicus* can be distinguished from other species in this group by the large vertex, all dark legs, structure of tibiae 3 and basitarsi 3 and strong metallic lustre; the females by the swollen basitarsi 3 and dark legs.

Period of flight and distribution (fig. 86). – *M. turkestanicus* occurs in Tadzhikistan and Turkestan, and Iran, in mountain areas, flying there during May and June.

Discussion. – The identification of the specimens, some by Paramonov, seems to be correct; all specimens match the original description.

Merodon xanthipous **sp. n.**
(figs. 44 a-c, 85)

Type-material. – ♂ Holotype 'Iran, Chiraz, 11.iv.1937, coll. F. H. Brandt / L. crassicornis Sack, det. v. Doesburg' (ZMAN). 1 ♀ Paratype 'Iran, Rd. Chiraz Kazeroun, Ft. Sine-Sefid, 19.iv.1937, coll. F. H. Brandt / L. crassicornis Sack, det. v. Doesburg' (ZMAN) [both localities at about 29° 30' N, 52° E].

Description

Male. – Head: Antennae brown, antenna 3 orange, upper margin slightly concave, apex acute, antennal ratio 2.1; vertex angle = 35°, ocellar angle = 45°; pubescence pale yellow, with hardly any dark pubescence in ocellar region; tl-v ratio 0.15, touchline incomplete; head without metallic lustre.

Thorax: Dark, lacking metallic lustre; katepisternum, anepisternum and anepimeron with some dullish blue tinge; pubescence sparse, brown, uneven, moderately long; some diffuse pruinosity present on sutures; vestigial pruinose bands can be seen at certain angles on posterior dorsum. Wings clear; halteres, squamae and antisquamae pale yellow.

Legs: All pale brown; trochanter 3 with low knob bearing yellow hair-tuft, femur 3 slightly curved, swollen, with rather high triangular processus showing apical spur, bearing one strong and 5-6 lesser bristles; tibiae 3 with apical floccus reaching down basal half of basitarsi 3, inserted on drawn-out medial distal angle; basitarsi 3 swollen, bearing rather dense, brownish yellow, erect, short, even pubescence throughout, densest on medial face; other tarsi normal.

Abdomen: Very dark brownish red, tapering posteriorly, especially T II; slightly arcuate, faint, narrowly interrupted whitish pruinose bands present on T II-IV; pubescence pale brown, erect, uneven; S IV bearing robust large paired appendages that are smaller than in other species of this group, but still very conspicuous.

Genitalia: The anterior surstyle lobe rather spathulate, with dense, yellow, erect, even pubescence dorsally and apically, more scattered on other parts; separated from posterior surstyle lobe by shallow sulcus; posterior surstyle lobe steeply rising, anteriorly high, with distinct slight anteroventral angle and rather dense, erect, yellow, uneven pubescence posteriorly; cercus somewhat elongate, rather wide, with dense, long, yellow pubescence; aedeagus moderately slender, with marked subapical cavity, fringed plates on thecal apex suberect, apical shaft part slightly lengthened.

Body length 7 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Head: Antenna 3 rounded, more obtuse; frons lustrous (not metallic) throughout, eyes widely separate, ocellar angle 60°. Thorax: Showing dull bluish-greenish lustre on dorsum, scutellum and sides. Legs: Deeper brown than in male. Abdomen: Stouter than in males, darker, pruinose bands more marked; T II-V with a micaceous lustre.

Body length 7 mm.

Diagnosis. – The species can be distinguished in both sexes by the relatively pale, uniformly coloured legs; the males are also distinguished by the relatively smaller appendages on S IV and the steeply rising posterior surstyle lobe as well as by the absence of metallic lustre.

The former identification as *crassicornis* Sack, previously applied to the holotype and paratype, is incorrect in view of contradictions of characters in the types of *xanthipous* with the description of *crassicornis*. In the females of the latter species the abdominal pruinose bands are stated to be wide and clear, the antennae are dark, the compound eyes bearing very dense pubescence, the legs are black with yellow markings; moreover bands of long white pubescence are stated to be present on the posterior tergite margins. The male of *crassicornis* has not been described.

Period of flight and distribution (fig. 85). – The species, known only from the types, occurs in southwestern Iran in April.

Etymology. – The epitheton *xanthipous*, to be treated as a noun in apposition, refers to the golden brown leg coloration, and is derived from the greek xanthos, meaning blonde, and pous, meaning foot.

The *clavipes* group

Apomorphies: Anterior surstyle lobe elongate, densely pubescent and strongly to enormously enlarged.

Description. – Head: Antennae with antennal ratio 1.4 to 2.0, antenna 3 mostly subacute; pubescence on head whitish to yellow, usually dense on frons; face often bluish lustrous; tl-v ratio in the males 0.3 to 0.5. Thorax: Dark, lustrous on dorsum and scutellum, mostly with strong blue lustre on katepisternum, anepisternum and anepimeron; pubescence most variable in colour density and length; some species have slightly to strongly infuscate wings. Legs: Mostly all dark, in some cases tibiae 1 and 2 basally with orange markings; femur 3 usually much swollen, curved, in some cases straight and slender; triangular processus, tibiae 3 and tarsi 3 normally shaped. Abdomen: Moderately slender to slender or stout; T II tapering (less strongly in the females); arcuate pruinose bands present on T II-IV which may in some species be difficult to see through the dense abdominal pubes-

cence. Genitalia: The anterior surstyle lobe very large, rounded-rectangular, ridged laterally, usually with short even pubescence throughout; posterior surstyle lobe variously shaped, with dense pubescence, with specialized hair-tufts in *warnckei*, *aberrans*, *hamifer* and *brevis*; cercus variable; aedeagus mostly slender, apical shaft part short to slightly lengthened, fringed plates recumbent to oblique.

Merodon aberrans aberrans Egger
(figs. 45 a-d, 50 b, 89)

Merodon aberrans Egger, 1860: 10. Lectotype ♂ (here designated): 'Austria Alte Sammlung/ Merodon aberrans Egger' (NHMW) [examined].
Merodon obscuripennis Palma, 1863: 47. [No type material mentioned in original description].
Merodon kneri Mik, 1867: 415. Syntypes: 'Halicia' [not examined].
Merodon aberrans; Mik 1867: 417, 1883: 182; Bezzi 1900: 89; Sack 1913a: 435; Paramonov 1925: 153; Liepa 1969: 20; Gaunitz 1969: 82, 86; Van der Goot 1981: 215, 218; Peck 1988: 166.
Lampetia aberrans; Oldenberg 1919: 388; Sack 1931, 302; Séguy 1961: 174.
Merodon obscuripennis; Peck 1988: 166.
Merodon knerii; Mik 1883: 182; Peck 1988: 166.
Lampetia kneri; [sic!] Sack 1931: 302.

Material examined. – Albania: 8♂ (NHMW, RMNH); Austria: 8♂ paralectotypes and 2♀ paralectotypes of *aberrans*, with same label as lectotype; Czechoslovakia: 1♀ (ZMAN); France: 47♂, 8♀ (MNHN); Greece: 23♂, 11♀ (KBIN, BMNH, JLR, ZMUC, WH, RMNH, ZMAN); Hungary: 3♂ (NHMW, RMNH); Italy: 64♂, 46♀ (NHMW, BMNH, JLR, ZMAN); Lebanon: 1♂, 1♀ (KBIN, NHMW); Poland: 1♂, 1♀ (BMNH); Romania: 2♂ (BMNH); Turkey: 136♂, 45♀ (BMNH, JLR, WH); U. S. S. R.: 15♂, 14♀ (NHMW, ZMAS); Yugoslavia: 23♂, 5♀ (NHMW, JLR, BMNH, ZMAN, RMNH).

Description

Male. – Head: Antennae dark, antenna 3 with upper margin convex, apex obtuse to subacute, antennal ratio 1.6; pubescence yellow, with dark tuft in ocellar region; vertex angle 40°, ocellar angle 50°, tl-v ratio 0.4; compound eyes showing white pubescence; face variably bluish lustrous, mostly only weakly.

Thorax: Blue lustrous on lateral dorsum and scutellum, katepisternum, anepisternum and anepimeron; pubescence yellow, moderately dense, with dark interalar band mostly clear. Wings troubled evenly in distal half, anterior veins pale; halteres, squamae and antisquamae pale yellow.

Legs: All dark, all femora slender; femur 3 straight; trochanter 3 smooth, femur 3 bearing normally shaped triangular processus bearing 6-11 bristles; basitarsi 3, tibiae 3 and tarsi 3 normal. in most specimens tibiae and tarsi with bright yellow pubescence.

Abdomen: Dark, with characteristic rather strong bluish overall lustre; T II strongly tapering; T II-IV with slightly arcuate, well interrupted pruinose bands; vague mainly yellow pruinose lateral spots on T II present in some specimens; S IV moderately arched, deeply, narrowly emarginate posteriorly.

Genitalia: Anterior surstyle lobe large, anteriorly bearing dense, short, even, yellow pubescence, with scattered pubescence throughout, showing lateral ridge; coalescent with posterior surstyle lobe; the latter bearing low anteroventral projection with dense, long, yellow pubescence; posterior surstyle lobe with long, dense, yellow pubescence. Cercus conspicuous, rather quadrate with rounded corners. Aedeagus smooth on outer face, moderately slender, apical shaft part short, fringed plates on thecal apex recumbent.

Body length 12-16 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Head: Antenna 3 more obtuse; frons laterally pruinose, lustrous on median one-third or just over; ocellar angle = 40°, pubescence on frons less dense. Thorax: Pubescence brownish, interalar band less clear; vague longitudinal pruinose bands often present; wings in some specimens more clearly infuscate distally. Abdomen: T II less tapering, pubescence very dense in some specimens; T V relatively narrow, posteriorly more or less acute.

Body length 12-15 mm.

Diagnosis. – As the slender femora 3 are not found in other species and the blue lustre is uncommon in a species of this large size, *aberrans* is hardly ever confused with other species; only *hamifer* is very similar but can be separated at once by its deformed triangular processus; *brevis* is superficially similar but stouter, lacks the interalar band in the males which moreover have slightly different genitalia (see fig. 45); *splendens* has a wider, shorter abdomen, denser pubescence and the femora 3 are much more swollen than in *aberrans*.

Period of flight and distribution (fig. 89). – The species occurs from May through July in central Europe and the Mediterranean, in southern parts of Russia, Ukraine and in Asia Minor.

Merodon aberrans ssp. *flavitibius* Paramonov

Merodon aberrans ssp. *flavitibius* Paramonov, 1925: 153. Syntypes: 'Armenia' [not examined].
Merodon aberrans ssp. *flavitibius*; Liepa 1969: 20; Peck 1988: 166.
Lampetia aberrans ssp. *flavitibius*; Sack 1931: 302.

Description

Subspecies *flavitibius* differs from the nominate subspecies only in the colour of the legs, which in the

present subspecies show yellow markings on the basal parts of tibiae 1 and 2.

Period of flight and distribution. – This subspecies occurs in Armenia.

Merodon aberrans isperensis ssp. n.
(fig. 90)

Type-material. – ♂ Holotype 'Turkiye, Rize, Ovit Pass [near Ispır], S side 1800 m, 16.vii.1987, leg. J. A. W. Lucas' (ZMAN). 43♂, 24♀ paratypes, all from Turkey, all in (JLR) and all leg. Lucas, except where noted: Topotypic 1♀, 31.vii.1983; 1♂, 1♀, 16.vii.1986; 1♂ 'Turkey Hakkari, Suvarihalil pass 1250 m W side nr. Habul Deresi 13.vi.1984'; 4♀ 'Turkey Hakkari, Tanin-Tanin pass W side 1700 m, 12.vi.1984'; 1♀ 'Turkey, Kars, Handere 2100 2200 m, 20 km W of Sarıkamış, 1.viii.1983'; 2♂, 1♀ 'Turkey, Siirt 21 km W of Uludere, 12.vi.1984'; 3♂ 'Turkey, Kars, 25 km W. of Sarıkamış 5.viii.1985, 2100 m, C. J. Zwakhals leg.'; 3♂ 'Turkey, Kars, Bahnstat. Soganlı W. Sarıkamış 2100 m 5.vii.1985 W. Schacht'; 1♀ 'Turkey, Hakkari, Sat Dagi, Varegös, SW Yüksekova 1700 m 29.vi.1985 W. Schacht'; 13♂, 4♀ 'Turkey, Bingöl, Buğlan Geçidi 1640 m 5.vii.1986'; 1♂, 1♀ 'Turkey, Kars 11 km E of Karakurt 1450 m 6.vii.1986'; 6♂, 2♀ 'Turkey, Kars, 8 km W Sarıkamış, 2000 2050 m 6-9.vii.1986'; 2♂, 1♀ 'Turkey, Kars, Handere 20 km W Sarıkamış 2000 m 7.vii.1986'; 1♂, 1♀ 'Turkey, Kars, 12 km S Sarıkamış 2050 m, 7.vii.1986'; 10♂, 6♀ 'Turkey, Erzurum (Kayak) Palandöken Daği 2200-2300 m 1.vii.1986'. See map showing Turkish localities (fig. 79).

Description

Male. – Head: Pubescence more grey than in nominate subspecies, otherwise similar.

Thorax: Slenderer than in nominate subspecies, bearing less dense pubescence; interalar band less clear.

Legs: Similar to nominate subspecies, but pubescence pale yellow, not golden.

Abdomen: Clearly less wide than in nominate subspecies, showing slate grey instead of bluish lustre; pubescence slightly less dense.

Genitalia: completely similar to nominate subspecies.

Body length 10-15 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Thorax: The infuscation of the apical wing portions is less strong than in females of the nominate subspecies.

Period of flight and distribution (fig. 90). – This subspecies occurs in June through August in the mountains of eastern Turkey. The distributions of the nominate form of *aberrans* and of the ssp. *isperensis* are shown in figs. 89-90.

Etymology. – The adjective *isperensis* refers to the type-locality in the vicinity of the town of Ispır in north-eastern Turkey.

Merodon brevis Paramonov
(figs. 46 a-c, 86)

Merodon brevis Paramonov, 1925: 157. Holotype ♂: 'Inaklu, Bez. Etschmiadzin, Gouv. Erivan, (Armenien), Südlicher Abhang des Alagöz, 4500' [Gora Aragac, 40° 29' E, 44° 12' E]' [Armenia] [not examined, considered lost].
Merodon brevis; Peck 1988: 168.
Lampetia brevis; Sack 1931: 308.

Material examined. – U. S. S. R.: 1♂, Armenia, Abaran [Aparan, 40° 34' N, 44° 21 E], M. Karny-Iarich, 8000', 10.vii.26. A. Shelk / *Lampetia brevis* Param. ♂, S. Paramonov det./ Coll. J. Villeneuve, *Lampetia brevis* Param. (KBIN).

Description

Male. – Head: Antenna with articles 1-2 brown, 3 conspicuously orange, with upper margin convex, apex subacute, antennal ratio 1.7; pubescence white, long, dense on frons, sparser on face, golden on occiput, darker on vertex; face blue lustrous, partially with dense, pale pruinosity, vertex angle 35°, ocellar angle 50°, tl-v ratio 0.5.

Thorax: Dark, lateral dorsum and scutellum, katepisternum, anepisternum and anepimeron greenish lustrous, showing rather dense, golden, erect pubescence; two faint longitudinal pruinose bands present on dorsum; no interalar band. Wings rather clear, very pale brown veined; halteres, squamae and antisquamae yellow, halteres deepest coloured.

Legs: Dark, but tibiae 1 and 2 orange on basal half. Trochanters 3 smooth, femora 3 swollen, steel grey lustrous, bearing rather large triangular processus with strongly serrate distal margin bearing 5-6 bristles; tibiae and tarsi normally shaped, tarsi 3 with golden pubescence laterally, dark on upper face.

Abdomen: Relatively small, rather stout; dark, with interrupted well-defined arcuate interrupted pruinose bands; pubescence pale anterior and dark posterior, longest laterally; no lateral spots; S dark, S IV vaulted, moderately deep emarginate posteriorly.

Genitalia: Anterior surstyle lobe elongate, recurved dorsally, apically wide, stalked, with clear lateral ridge, with dense, short, erect, yellow pubescence throughout, bearing small dorsal basal projection; posterior surstyle lobe rather quadrate, two more sclerotized areas on ventral margin bearing dark bristle-like pubescence; pubescence otherwise as on anterior surstyle lobe but longer laterally. Cercus rather small, bearing short, dense, erect, yellow, uneven pubescence. Aedeagus moderately slender, apical shaft part short, fringed plates recumbent.

Body length 12 mm.

Female. – Unknown.

Diagnosis. – *M. brevis* most closely resembles *aberrans* from which it is distinguished by the shorter body, more elongate anterior surstyle lobe and uniformly coloured thoracic pubescence; the areas of specialized pubescence on the posterior surstyle lobe are not found in *aberrans*. Moreover, this species differs from *aberrans* by the orange markings on the legs. In this respect *brevis* resembles *aberrans* ssp. *flavitibius*. No material of the latter taxon has been examined, but the other characters mentioned should be sufficient to distinguish these taxa.

Period of flight and distribution (fig. 86). – *M. brevis* has been found in the mountains of Armenia [approx. 40° 30' N, 44° 20' E], where it was collected in July.

Discussion. – The identification as *brevis*, by Paramonov, is considered reliable; the specimen examined originates from a site less than 20 km from the locus typicus.

Merodon clavipes (Fabricius)
(figs. 47 a-c, 89)

Syrphus clavipes Fabricius, 1781: 427. Lectotype ♂ (here designated): '*clavipes*' in Sehestedt & Tønder Lund collection (ZMUC) [examined].
Merodon clavipes var. *albus* Paramonov, 1927: 90. Syntypes: 'Bezirk Balta, Gouv. Odessa' [Ukraine, U. S. S. R.] [not examined].
Merodon clavipes var. *ater* Paramonov, 1927: 91. Syntypes: locality unknown [not examined].
Merodon clavipes var. *niger* Paramonov, 1927: 90. Syntypes: 'Bezirk Balta, Gouv. Odessa [not examined].
Merodon canipilus Rondani, 1865: 131. Lectotype ♂ (here designated): '52' [number refers to description of *canipilus*] in coll. Rondani (LSF) [examined].
Musca clauda Villers, 1789: 463. Syntype(s): 'Gallia Australiori' [the southernmost of France] [not examined].
Musca curvipes Gmelin, 1790: 2871. Published in synonymy with *Syrphus clavipes* Fabricius, 1781.
Syrphus gravipes Rossi, 1790: 286. Syntypes: 'in provinciis Florentina et Pisana' [Toscana, Italy] [not examined].
Lampetia sacki Paramonov, 1937a: 3. Lectotype ♀ (here designated): 'Chiklana' [Chiklana de la Frontera, near Jerez, southern Spain] (ZBSM) [examined]. **Syn. n.**
Merodon senilis Meigen, 1822: 356. Lectotype ♀ (here designated): 'senilis' (NHMW) [examined].
Syrphus clavipes; Fabricius 1787: 337; Rossi 1790: 286; Fabricius 1794: 292.
Lampetia clavipes; Meigen 1800: 34; Coquillett 1910: 557; Oldenberg 1919: 388; Sack 1931: 310; Séguy 1961: 176.
Lampetia clavipes var. *alba*; Sack 1931: 311.
Lampetia clavipes var. *atra*; Sack 1931: 311.
Lampetia clavipes var. *nigra*; Sack 1931: 311.
Merodon clavipes; Fabricius 1805: 195; Latreille 1804: 443; Meigen 1822: 351; Macquart 1828: 291; Macquart 1834: 513; Westwood 1840: 137; Macquart 1842: 70; Rondani 1845: 256, 259; Macquart 1849: 466; Walker 1849: 597; Rondani 1857: 54, 62; Schiner 1857: 410; Schiner 1862: 344; Palma 1863: 46; Portschinsky 1877: 184; Strobl 1893: 76; Bezzi 1895: 16; Bezzi 1900: 89; Strobl 1900: 593; Verrall 1901: 559; Villeneuve 1903: 115; Sack 1913a: 433; Paramonov 1925: 146; Gil Collado 1930: 243, 246; Gaunitz 1969: 83, 86; Delfinado & Hardy 1975: 343; Marcos García 1985: 197; Hurkmans 1985: 69; Bradescu 1986: 123; Peck 1988: 165, 168 (see for additional references Kertész, 1907: 274).
Merodon clavipes var. *albus*; Liepa 1969: 20; Peck 1988: 169.
Merodon clavipes var. *ater*: Liepa 1969: 20; Peck 1988: 169.
Merodon clavipes var. *niger*: Liepa 1969: 20; Peck 1988: 169.
Milesia clavipes; Latreille 1810: 331.
Merodon canipilus; Peck 1988: 169.
Lampetia canipila; Sack 1931: 310 (as syn. of *clavipes*).
Musca clauda; Kertész 1907: 274; Peck 1988: 168.
Musca curvipes; Peck 1988: 168.
Merodon curvipes; Meigen 1803: 74 (erroneous); Peck 1988: 168.
Lampetia curvipes; Sack 1931: 310 (as syn. of *clavipes*).
Syrphus gravipes; Peck 1988: 168.
Merodon senilis; Peck 1988: 168.

Material examined. – Algeria: 32♂, 5♀ (MNHN, BMNH, ZMAN, ZMUC); Austria: 10♂, 2♀ (NHMW); France: 143♂, 61♀ (MNHN, NHMW,Bonn, BMNH, ZMUC, ZMAN); Greece: 117♂, 37♀ (ZMUC, den Hollander, NHMW, Bonn, BMNH, Thessaloniki, ZMAN, JLR, WH); Hungary: 5♂, 4♀ (BMNH, ZMUC); Italy: 116♂, 57♀ (ZMUC, JLR, NHMW, BMNH, ZMAN, WH); Morocco: 1♀ (BMNH); Spain: ♀ Paralectotype of *Lampetia sacki*: 'Chiklana' (ZSBM) and 20♂, 5♀ (JLR, ZMUC, BMNH, Bonn, ZMAN); Sweden: 1♀, Bohuslan, leg. Malm, 1862 (MNHN); Switzerland: 1♂, 2♀ (ZMUC); Yugoslavia: 31♂, 5♀ (BMNH, NHMW, JLR, ZMAN).

Description

Male. – Head: Antennae dark, antenna 3 with upper margin concave, apex subacute, vertex angle 50°, ocellar angle 60°, antennal ratio 1.8; pubescence yellowish, darker in ocellar region; face dense white pruinose; tl-v ratio 0.4.

Thorax: Dark, slightly metallic lustrous on lateral dorsum, scutellum, katepisternum, anepisternum and anepimeron, pubescence yellow to brown, erect, rather dense, with dark interalar band. Wings troubled evenly, halteres, squamae and antisquamae pale yellow.

Legs: All dark, trochanters 3 with high ridge shaped like chisel edge; femora 3 curved, very strongly swollen, often with oily lustre, and golden pubescence; triangular processus normally shaped, tibiae 3 and tarsi 3 normal.

Abdomen: Dark; T II-IV with interrupted arcuate wide pruinose bands and dense pubescence, yellow on T II and III (anteriorly) and orange on posterior abdomen; T II clearly but not very strongly tapering,

normally without lateral spots; S IV strongly vaulted, posterior margin widely and deeply emarginate.

Genitalia: The anterior surstyle lobe extremely large, bearing short, dense, yellow, even pubescence throughout, laterally ridged; posterior surstyle lobe coalescent, steeply rising, rather high, long, uneven, with less dense pubescence. Cercus well protruding, angular, with dense, long, yellow pubescence. Aedeagus slender, smooth on outer face, somewhat concave subbasally, apical shaft part slightly lengthened, fringed plates on thecal apex recumbent-oblique.

Body length 17-23 mm.

Female. – Quite different from the males, as they lack the dense abdominal pubescence. Apart from sexual dimorphism the main other differences are: Head: Frons whitish pruinose, leaving lustrous mid-stripe occupying one-fifth of width. Thorax: Pubescence greyish, shorter than in males, rather even, no interalar band. Legs: The femur 3 slightly less swollen, often pubescence duller; compared with other *Merodon* females, still very much swollen. Abdomen: Pubescence overall much less conspicuous; dense only in anterolateral areas of T II, and on pruinose bands; in some specimens large portions of the tergites bald altogether; colour of the pubescence mainly dark yellow to pale; in many specimens pale orange lateral spots can be seen.

Body length 15-22 mm.

Varieties of *clavipes* and variation. – In the var. *albus* the pubescence is white throughout, except for a black interalar band in both sexes with blue background lustre. In the var. *ater* the thoracic dorsum shows only black pubescence; of this variety only the males are known. In the var. *niger* the pubescence is black throughout, except on the face, while the pruinose abdominal bands are almost or completely absent in both sexes. No types of either of the varieties have been examined; they are considered to be lost (Liepa 1969: 4).

Apart from the described varieties and size variation the specimens of this species are remarkably uniform. A few aberrant individuals totally lack the pubescence on the abdomen and have strangely vaulted posterior tergite margins. These specimens are not considered to belong to a separate variety. Possibly they have suffered from frost damage, known to produce aberrances in insects.

Diagnosis. – *M. clavipes* is easily distinguished from other species in this group by its size. Moreover, the combination of enormously swollen femora 3 and chisel-edged trochanters 3 does not occur in males of any other species; the degree of swelling in the femora 3 in the females far exceeds that of any other *Merodon* currently known.

Period of flight and distribution (fig. 89). – *M. clavipes* occurs from late April through August in southern Europe, the Mediterranean and Asia Minor, though it may occasionally occur more northward; the specimen from Sweden seems unquestionable; reports of *clavipes* from Great Britain have been seriously doubted by Verrall (1901).

Biology. – The territorial behaviour of the males has been described by Hurkmans (1985). In the field the males visit flowers, mainly of Umbelliferae, and are conspicuous, but the females fly close to the soil through the vegetation.

Discussion. – The types of *canipilus*, *sacki* and *senilis* have been examined, and found conspecific with *clavipes*. The types of *clauda*, *curvipes* and *gravipes* have not been examined. The original description of *clauda* leaves hardly any doubt that this is a synonym of *clavipes*; this synonymy has been considered by Kertész (1907: 274), while Peck (1988: 168) also names *clauda* as synonym of *clavipes*. *Musca curvipes* was originally published as a synonym of *Syrphus clavipes*. *Syrphus gravipes* refers to the publication of the female of *clavipes*, a possibility already considered in the original description.

Merodon cupreus sp. n.
(figs. 48 a-c, 88)

Type-material. – ♂ Holotype 'Turkey, Kars, Handere 2100-2200 m, 20 km W of Sarıkamış, 1.viii.1983, leg. J. A. W. Lucas' (ZMAN). Paratypes: 29♂, 5♀: 24♂, 4♀ topotypic, with dates '1.viii.1983' and '2.viii.1983' (JLR), 1♀ with same data (ZMAN); 3♂ 'Turkey, Hakkari S. of Yüksekova 28.vi.1986 W. Schacht' (JLR); 2♂ 'Turkey, Kars, 8 km W. of Sarıkamış 2000-2050 m, 9.vii.1986' leg. J. A. W. Lucas (JLR).

Description

Male. – Head: Antennae dark, antenna 3 cordate, apex subacute; antennal ratio 1.4; vertex angle 30°, ocellar angle 35°, pubescence yellow, often with dark tuft in ocellar region; face and occiput white pruinose, somewhat bluish lustrous; tl-v ratio 0.35.

Thorax: Dark, metallic lustrous on lateral dorsum and scutellum, katepisternum, anepisternum and anepimeron; pubescence deep yellow to brown, even, rather dense, with dark interalar band. Wings clear; halteres, squamae and antisquamae pale yellow.

Legs: Dark, but tarsi laterally with golden pubescence, contrasting; trochanter 3 sharply keeled, with chisel edge, femur 3 rather swollen, slightly lustrous, with normally shaped triangular processus bearing 6-

7 bristles on very strongly serrate distal margin; tibiae 3 normal, basitarsi 3 slightly swollen.

Abdomen: Dark, no lateral spots on T II; T II-IV with white pruinose bands, straight on T II, arcuate on T III-IV; interrupted on T II-III, continuous on T IV; pubescence golden to brassy or orange, rather dense, recumbent; T II tapering; S IV vaulted, deeply, rather narrowly emarginate posteriorly.

Genitalia: The anterior surstyle lobe large, rounded, with basal projection on ventral margin, and dense, short, even, yellowish pubescence anteriorly; laterally weakly ridged; the posterior surstyle lobe separated by shallow sulcus, low, elongate, bearing yellow, moderately long, uneven pubescence along ventral and posterior margins. Cercus small but well protruding, with dense, long, yellow pubescence. Aedeagus moderately slender, fringed plates on thecal apex oblique, apical shaft part short.

Body length 12-15.5 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Head: Frons tapering posteriorly, sides white pruinose, lustrous midstripe occupying one-third of width; pubescence grey, but dark tuft present in ocellar region; ocellar angle 60°. Thorax: Dorsum dull, pubescence grey, dark interalar band present. Legs: Dark, with grey pubescence; on tibiae and tarsi yellow-grey pubescence with some contrast as in ♂ but weaker; trochanter 3 smooth; triangular processus as in males. Abdomen: Stouter than in male, with rather dense grey pubescence, pruinose bands moderately wide, continuous, arcuate; tergite V dark, with scattered grey pubescence.

Body length 13 mm.

Diagnosis. – At first sight, *cupreus* seems to be a small *clavipes*. Differences between those species are: antennal ratio in *cupreus* 1.4, in *clavipes* 1.8; antenna 3 with upper margin convex in *cupreus*, concave in *clavipes*; triangular processus stronger serrate in *cupreus* than in *clavipes*; in the males of *clavipes* the anterior surstyle lobe is much larger than in those of *cupreus*; in the female *cupreus* lateral abdominal spots lacking in, present in *clavipes*; size in *clavipes* 15-23 mm, as opposed to 12-15.5 mm in *cupreus*. The differences between *dzhalitae* (discussed hereafter) and *cupreus* are: antenna 3 with upper margin convex in *cupreus*, concave in *dzhalitae*; on the hind legs the tarsi II in *dzhalitae* are almost as long as the basitarsi; in *cupreus* they are less than half as long. Moreover, in the males of *cupreus* the S IV is deeply emarginate posteriorly while this element is entire in *dzhalitae*.

Differences with the description of *M. clavipes* var. *albus*, stated to have all black and white pubescence in both sexes, are: The size in *clavipes* var. *albus* is greater, in *cupreus* the pubescence is not black and white in both sexes. Moreover, the differences (with respect to *clavipes*) already mentioned apply. The ♀ *cupreus* are of the same size and habitus as those of *femoratus*. They are distinguished by their lack of pruinose bands on the thorax and much denser overall pubescence; also the shape of the antenna 3 is different: ovoid to cordate in *cupreus*, more elongate in *femoratus*.

Period of flight and distribution (fig. 88). – *M. cupreus* occurs in July and August in eastern Turkey.

Etymology. – The adjective *cupreus* refers to the colour of the larger portion of the abdominal pubescence in the male of this species.

Merodon dzhalitae Paramonov
(fig. 99)

Merodon dzhalitae Paramonov, 1927: 89. Holotype ♂: 'Hissar, Yalta' [south slope of the Crimea mountains, Crimea, Ukraine] [not examined, considered lost].
Merodon dzhalitae; Liepa 1969: 20; Van der Goot 1981: 215; Peck 1988: 169; Zimina 1989: 24.
Lampetia dzhalitae; Sack 1931: 313.

Description

The description of *dzhalitae* presented here is based on the original description, on Sack (1931: 313) and on Zimina (1989: 24) who described recently collected material of both sexes.

Male. – Head: Antennae dark, antenna 3 yellow-brownish, upper margin concave, lower margin convex, apex acute; face, frons and vertex with yellow pubescence, face sparsely pruinose; compound eyes with yellow pubescence; tl-v ratio 0.5.

Thorax: Dorsum dark with some weak blue lustre, with conspicuous orange pubescence throughout, scutellum concolorous, duller; wings slightly troubled; reddish pubescence clear, interalar band sometimes present.

Legs: All dark, with yellow pubescence, femur 3 normal, resembling this element in *avidus* [therefore less swollen than in e.g. *clavipes*], triangular processus with strong apical pedestal (cf. Zimina 1989: fig. 2); on hind legs the second tarsi almost as long as basitarsi.

Abdomen: T II slightly tapering only, clearly bluish lustrous, T III-IV with white pruinose bands, just interrupted on T III, just continuous on T IV; pubescence reddish, but black, short and recumbent on posterior margins of T II-III. S IV with posterior margin entire, keeled.

Body length 13 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Habitus: Pubescence overall

paler than in male. Head: With broad lustrous midstripe on frons. Antenna 3 less long than in ♂, ovoid, dark with paired yellow spots ventrally. Legs: Tibiae brownish basally. Abdomen: T II showing nearly triangular greenish metallic lustrous lateral spots which are reddish translucent mediad. Pubescence dark, short and recumbent on T II-III, reddish elsewhere.

Body length 13 mm.

Diagnosis. – The differences with respect to *cupreus*, which seems to resemble *dzhalitae* most closely, are as follows. Third antennal article concave in *dzhalitae*, convex in *cupreus*; tarsi II on hind leg as long as basitarsi in *dzhalitae*, only half as long in *cupreus*, and S IV entire in *dzhalitae*, deeply emarginate in *cupreus*.

Period of flight and distribution (fig. 99). – The species occurs in August and probably is endemic to the Crimea.

Discussion. – In view of the extensive original description and the full account by Zimina (1989) it seems clear that *dzhalitae* is a distinct species. The description of the recently collected material by Zimina (1989) matches the original description on all significant points. *M. dzhalitae* has been tentatively assigned to the *clavipes* group on account of its external similarities with e.g. *clavipes* and *cupreus*.

Merodon hamifer Sack
(figs. 49 a-b, 88)

Merodon hamifer Sack, 1913a: 436. Lectotype ♂ (here designated): 'Anatolien Ak-chehir [Akşehir] Korb 1900/ Mer. hamifer Sack det. Sack/ coll. Lichtwardt/ coll. D. E. I. Eberswalde' (DEIC) [examined].
Merodon hamifer; Paramonov 1926b: 322; Paramonov 1927: 78; Peck 1988 : 171.
Lampetia hamifera; Sack 1931: 318.

Material examined. – Greece: 1♂ 'Samos, Ampelos 22.vi.1932, Werner' (NHMW); Turkey: Paralectotype ♀, same data as lectotype.

Description

M. hamifer is similar to *aberrans* except in the following details.

Male. – Head: Antennal ratio 2.0; antennae all orange. Thorax: Pubescence less dense. Legs: All tibiae and tarsi orange, tibiae 3 basally brown; femora 3 bearing modified triangular processus, basitarsi 3 showing apical projection on medial face. Genitalia: Pubescence on posterior surstyle lobe denser.

Body length 13.5-14.5 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Head: Compound eyes separate, frons lustrous, slightly dulled down sides; antennae orange, antennal ratio 2.8. Legs: Similar to those of *hamifer* male, triangular processus slightly smaller. Abdomen: Pruinose bands wider; tergite V narrower.

Body length 14 mm.

Diagnosis. – This close relative of *aberrans* can be distinguished from all other species by the shape of the triangular processus in both sexes.

Period of flight and distribution (fig. 88). – *M. hamifer* occurs in the Greek Aegean islands and western Turkey, where it flies in June.

Merodon karadaghensis Zimina

Merodon karadaghensis Zimina, 1989: 24. Holotype ♂: 'Karadagh, Crimea, 5. ix. 1984, leg. Zimina'. Moscow Zoological Institute [not examined].

It appears that this species may be related to *M. dzhalitae*, with which it is compared by Zimina (1989). The differences are stated to be in the relative length of the tarsal joints, the outline of the triangular processus on the hind femora, while the abdominal pruinose bands also slightly differ.

Diagnosis. – After Zimina (1989), *M. karadaghensis* may be distinguished from *M. dzhalitae* by the length ratio of the basal tarsal joints (II:I) on tarsus 3, which is about 0.5 in *karadaghensis* and 0.8 in *dzhalitae*,and also by the abdominal pruinose band on T IV being chevron-shaped in *karadaghensis* while this is more rounded in *dzhalitae*.

Discussion. – This species is provisionally regarded as belonging to the *clavipes* group, on the grounds of resemblance to *M. dzhalitae*.

Merodon lusitanicus sp. n.
(figs. 50 a, 93)

Type-material. – ♀ Holotype 'Portugal, Algarve, Quarteira 27.iv.1985, J. A. W. Lucas' (ZMAN); paratype ♀, same data, but locality: 'Vilamoura' (JLR).

Description

Female. – Head: Antennae black, antenna 3 with upper margin concave, apex rounded, antennal ratio 2.8; pubescence white on face, black on frons and vertex, pale brown on occiput; frontal sides whitish pruinose, leaving lustrous midstripe on median one-third; ocellar angle 60°.

Thorax: Dark, dorsum with 4 vague pruinose

bands and yellow pubescence; pubescence duller on scutellum and sides, katepisternum, anepisternum and anepimeron steel grey lustrous. Wings clear; halteres, squamae and antisquamae yellow.

Legs: All dark, joints lighter; femora 3 extremely swollen for a female, triangular processus showing strongly serrate distal margin bearing 10 bristles.

Abdomen: Dark with some purplish lustre, triangular in outline, with clear lateral spots on T II combined with dense erect white pubescence; pubescence otherwise sparse; T II-IV bearing rather narrow, conspicuous widely interrupted somewhat arcuate pruinose bands; T V acute, all dark.

Body length 11-12 mm.

Male. – Unknown.

Diagnosis. – *M. lusitanicus* can be separated from *aberrans* by the lateral spots on T II and the swollen femora 3; *lusitanicus* is too dark to be confused with females of *avidus*, *nigritarsis* or *distinctus*; its habitus can be compared with that of *alexeji* from which it differs in larger size, longer antennae and more swollen femora 3.

Period of flight and distribution (fig. 93). – This species, known only from the types, has been found in Portugal in April.

Discussion. – In view of the shape, width and position of the abdominal pruinose bands, relative baldness of the abdomen with purplish lustre, and general habitus, *lusitanicus* is provisionally regarded as closely related to *aberrans*, and therefore assigned to the *clavipes* group.

Etymology. – The adjective *lusitanicus* refers to the classical name for Portugal, Lusitania.

Merodon quadrinotatus (Sack)
(figs. 51, 85)

Lampetia quadrinotata Sack, 1931: 324. Holotype ♀: 'Mesopotamia' [Iraq] [not examined, considered lost].
Merodon quadrinotatus; Peck 1988: 173.

Material examined. – Turkey: 1♀ 'Hakkari, Suvarihalil Pass W side 2300-2400 m 11.viii.1983 leg. J. A. W. Lucas' (ZMAN).

Description

Female. – Similar to the female of *clavipes*, but with the following differences. Head: Frons much tapering posteriorly, laterally whitish pruinose leaving a lustrous midstripe occupying a quarter of the width; pubescence white, but grey on occiput. Thorax: Grey pubescence on dorsum, with conspicuous black interalar band. Legs: Pubescence grey to black, background colour deep black.

Abdomen: Black, pubescence dense and black throughout but with two pairs of very conspicuous white spots, one each on T III-IV, and weak lateroposterior triangular spots of grey pubescence on same tergites.

Body length 14 mm.

Diagnosis. – The dense black, white-dotted pubescence of the abdomen is unique and at once separates *quadrinotatus* from all other species currently known.

Period of flight and distribution (fig. 85). – The species is known from 'Mesopotamia' [Iraq] (month not reported by Sack) and the eastern Turkish mountains where it was collected in August.

Discussion. – Sack (1931) did not indicate a depository of the holotype. He did provide a reasonably clear description of *quadrinotatus*. Given the unique features of the species the identification of the Turkish specimen is unquestionable. Since *quadrinotatus* is believed to be a close relative of *clavipes* the species is assigned to the *clavipes* group.

Merodon splendens sp. n.
(fig. 47 d, 91)

Type-material. – ♂ Holotype 'Sardaigne St. Ussassai 16.v.1977 P. Goeldlin' (LAU).

Description

Male. – Head: Antennae blackish, antennae 3 rounded-subacute, upper margin about straight, vertex angle 30°, ocellar angle 40°, tl-v ratio 0.4; pubescence pale yellow, face greenish lustrous, yellow pruinose; slight dark tuft present in ocellar region; oral margin weakly protruding.

Thorax: Dorsum and sides dark, weakly bluish lustrous on anepisternum, katepisternum and anepimeron; pubescence moderately dense, erect, pale yellow, with dark interalar band; no pruinose bands present. Wings clear, halteres, squama and antisquama pale yellow.

Legs: Black, with yellow pubescence; trochanters 3 with curved low chisel-edge; femora 3 very much swollen, with some oily lustre, curved.

Abdomen: T II strongly tapering, T III-IV cylindrical. Lateral spots on T II weak, micaceous; pruinose bands on T II-IV very clear, interrupted, arcuate; pubescence moderately dense, yellow on T II, deep orange on T III-IV.

Genitalia: Anterior surstyle lobe reniform, pubescence, although dense, so extremely short that it is inconspicuous; posterior surstyle lobe coalescent, much bulging outward anteriorly, rounded, with short,

erect, moderately dense pubescence. Cercus slightly protruding, bearing short, pale pubescence. Aedeagus slender, with smooth outer face, subapical cavity well marked, somewhat concave subbasally; fringed plates on thecal apex recumbent.

Body length 14.5 mm.

Female. – Unknown.

Diagnosis. – *M. splendens* is a close ally of *clavipes* and *velox*. From the latter it is distinguished by the clear wings. The differences with *clavipes*, apart from the smaller size, are: Antennae more slender, pubescence on head, thorax and abdomen less dense and shorter, T II more tapering, III-IV cylindrical. Differences with both species are: Anterior surstyle lobe more curving dorsad, differently shaped (cf. figs. 46 a and d), pubescence much less dense and very much shorter on anterior and posterior surstyle lobes and cercus. *M. splendens* can be distinguished from *cupreus* and *dzhalitae* by the swollen femora 3. The same character also separates *splendens* from *brevis*, to which it is slightly similar on account of its habitus. Moreover, the anterior surstyle lobe is quite differently shaped in *brevis*. It differs from *aberrans* by the strongly swollen femora 3 and denser pubescence.

Period of flight and distribution (fig. 91). – *M. splendens* is known only from the holotype, collected in Sardinia, in May.

Etymology. – The adjective *splendens* is latin and means splendid or beautiful. It was given in view of the colourful pubescence of this species.

Merodon velox Loew
(figs. 47 a-c, 91)

Merodon velox Loew, 1869: 253. Lectotype ♂ (here designated): 'Rhodus/ Alte Sammlung' (NHMW) [examined] .
Merodon velox var. *anathema* Paramonov, 1925: 149. Holotype ♀: 'Mons Takalta, prope Kulp, Transkaukasien' [in Turkey, approx. 38° 30 N, 41° 05 E] [not examined, probably lost].
Merodon velox var. *armeniacus* Paramonov, 1925: 147. Syntypes: 12♂ and 1♀ 'Eriwan' and 'Ordubad (Erivan)' [Armenia] [not examined, probably lost].
Merodon velox; Sack 1913a: 434; Paramonov 1925: 147; Paramonov 1926a: 15; Peck 1988: 175.
Merodon velox var. *anathema*; Liepa 1969: 20.
Merodon velox var. *anathemus*; Peck 1988: 175.
Merodon velox var. *armeniacus*; Liepa 1969: 20; Peck 1988: 175.
Lampetia velox; Sack 1931: 331.

Material examined. – Greece: ♀ Paralectotype with same label as lectotype; 100♂, 73♀ (BMNH, NHMW, RMNH, ZMAN, JLR, WH); Italy: 2♂, 1♀ (NHMW); Turkey: 16♂ and 3♀ paralectotypes 'As. Minor/ Alte Sammlung' (NHMW); 49♂, 37♀ (MNHN, RMNH, NHMW, BMNH, JLR); U. S. S. R.: 3♂, 1♀ (NHMW, RMNH); Yugoslavia: 2♂, 3♀ (NHMW).

Description

Male. – Head: Antennae dark, antenna 3 with upper margin concave, apex subacute, antennal ratio 1.8; pubescence pale yellow, with few dark hairs in ocellar region; face and occiput densely white to yellow pruinose; vertex angle 40°, ocellar angle 70°. to 85°, tl-v ratio 0.5.

Thorax: Dark, lateral dorsum and scutellum, katepisternum, anepisternum and anepimeron weakly blue lustrous; pubescence rather dense, erect, brownish, dark interalar band present. Wings strongly infuscate, except apical-posterior margin; halteres, squamae and antisquamae yellow.

Legs: All dark, with yellow pubescence; trochanter 3 sharply ridged, femur 3 strongly swollen, triangular processus normally shaped, tibiae 3 and tarsi 3 normal;

Abdomen: Rather slender; all dark; T II tapering, bearing vague pale orange lateral spots, T II-IV with widely interrupted arcuate whitish pruinose bands, pubescence moderately dense, orange; S IV vaulted, posteriorly deeply, widely emarginate.

Genitalia: Completely similar to those of *clavipes*.

Body length 17-23 mm.

Female. – Except for the rather marked sexual dimorphism, differing from the male as follows. Head: Frons with lustrous midstripe occupying one-third of width, laterally white pruinose. Thorax: Inconspicuous longitudinal pruinose bands present, pubescence brown to grey throughout; no interalar band; wings less infuscate, strongest on surface bordering veins. Legs: The trochanter 3 smooth, femur 3 slenderer than in ♂ but still much swollen, pubescence duller. Abdomen: Pruinose bands conspicuous, stronger arcuate, less interrupted, rather variable between specimens; pubescence almost restricted to T II where dense; lateral spots clearer.

Body length 17-18 mm.

Diagnosis. – *M. velox* is easily distinguished by the infuscate wings in the male; in the female it could be confused with *clavipes* and *pruni* from which it is distinguished by the veins bordered with infuscation (in *clavipes* wings clear; in *pruni* wings more evenly troubled), from *pruni* also by the all dark legs, less slender, much darker coloured abdomen and larger size. Moreover, in *pruni* the genitalia are quite different.

Period of flight and distribution (fig. 90). – *M. velox* occurs in the eastern Mediterranean where the imagines are found from May through August; the species may be bivoltine.

Biology. – The males of *velox*, observed by the author in May of 1984 in several Greek localities, were flying close to the soil on rather dry sunny hillsides with short vegetation.

Discussion. – Although the similarity of the genitalia with respect to *clavipes* is clear, the following arguments against synonymizing *velox* can be listed: (1) there are clear external differences; (2) the distribution of *velox* is quite restricted and purely Mediterranean, whereas *clavipes* occurs over all of southern and central Europe; (3) the flight period of *velox* is more restricted; (4) there is some evidence that *velox*, where it occurs together with *clavipes*, prefers more open, drier biotopes (author's observations; J. Lucas, pers. comm.); therefore, the ecological niches might be different; (5) behavioural differences seem to exist. When the *velox* males were observed in Greece, they did not show territorial behaviour. Males of *clavipes* observed at the same locality and date displayed territorial behaviour (cf. Hurkmans, 1988). This may indicate that either *velox* shows no territorial behaviour, or this behaviour takes place in a different period of the season.

Merodon velox var. *anathemus* Paramonov

Material examined. – Greece: 1♀ (WH); Turkey: 1♀ (WH).

Diagnosis. – Completely similar to the nominate form, except for the all dark pubescence. Only females are known.

Merodon velox var. *armeniacus* Paramonov

Material examined. – Turkey: 1♀ (WH)

Diagnosis. – Completely similar to the nominate form except in the abdomen where lateral spots are lacking and pruinose bands are reduced, in both sexes.

Discussion. – No recent male material is known; of the syntypes, all but one were males. Possibly some of the material might be present in the collection of the Museum of Armenia, Erivan.

Merodon warnckei sp. n.
(figs. 52 a-d, 88)

Type-material. – ♂ Holotype 'Turkey, Hakkari, 5.viii.1983, Gavaruk-lake Mt. Sat, 2900 m, leg. Warncke' [37° 20' N, 43° 35' E] (ZMAN). Paratypes: 4♂, 1♀; 1♂ 'Turkey, Hakkari, Sat Mountains north of Mt. Gavaruk 2900 m, 7.viii.1983 leg. Warncke' (JLR); 2♂, 1♀ 'Turkey, Hakkari, Sat Mountains, south of Sat Lake, 2800 m, 7.viii.1983, leg. Warncke' (JLR); 1♂ 'Turkey, Van, Mengene Daği north of Başkale, 2700-3000 m, 27/28.vi.1986, leg. Hurkmans' (WH).

Description

Male. – Head: Antennae dark, antenna 3 with upper margin convex, apax acute, antennal ratio 2.0; pubescence yellow throughout, pruinosity slight on face, dense on occiput; face strongly blue lustrous, occiput greenish lustrous; vertex angle 25°, ocellar angle 60°, tl-v ratio 0.3.

Thorax: Dark, greenish to blue lustrous on lateral dorsum and scutellum, katepisternum, anepisternum and anepimeron; slightly pruinose on sides; pubescence rather even, moderately dense, dull yellow. Wings slightly tinged; halteres, squamae and antisquamae yellow.

Legs: Dark except joints on legs 1-2, leg 3 all dark; trochanters 3 smooth, femora 3 bluish lustrous, swollen, with normally shaped triangular processus bearing 6-9 bristles, tarsi 3 normally shaped; pubescence yellow.

Abdomen: All tergites dark with some micaceous purple lustre; vague lateral pruinose spots present on T II; T II-IV with arcuate widely interrupted moderately wide yellowish pruinose bands; pubescence dull yellow, moderately dense throughout; S IV shallowly emarginate posteriorly, rather flat.

Genitalia: The anterior surstyle lobe very large, rather stalked, bearing dense, even, yellow pubescence apically, coalescent with posterior surstyle lobe; the latter with anterior low elongate projection bearing yellow, rather dense pubescence, posteriorly with long, dense, yellow pubescence. Cercus rather large, showing dense, very long, yellow pubescence. Aedeagus moderately slender, slightly widening apically, apical shaft part short, fringed plates on thecal apex recumbent.

Body length 14-15 mm.

Female. – Except for the conspicuous sexual dimorphism, differing from the male as follows. Head: Lustrous midstripe on frons occupying one-third of width; slight dark hair-tuft in ocellar region; face weakly lustrous, apex of antenna 3 subacute; pubescence grey. Thorax: Pruinose bands on dorsum more distinct; pubescence greyish yellow. Legs: With grey pubescence. Abdomen: Pruinosity more extensive on T II, weaker on T III-IV; pubescence grey, less dense than in male; lustre weaker; T V tapering, apex rounded.

Body length 14 mm.

Diagnosis. – *M. warnckei* males can be distinguished from those of other species in this group by

its relatively stout build, the stalked anterior surstyle lobe and the strong metallic lustre of the face; the females of *warnckei* are stouter and smaller, and have less swollen femora 3 than *clavipes* or *velox*, are much stouter than *pruni* or the species in e.g. the *avidus* and *alagoezicus* groups from which they differ as well in having much less conspicuous pruinose bands.

Period of flight and distribution (fig. 88). – The species is known from eastern Turkey; it has been collected in high altitudes only, where it occurs in June and August; in view of the few specimens collected, the split occurrence does not necessarily indicate that *warnckei* is bivoltine.

Etymology. – The species has been named after the German entomologist K. Warncke, who collected the holotype and most paratypes. A noun in genitive case.

The *pruni* group

Apomorphies: The ♂ genitalia with surstyle sulcate; vertex angle very small; yellow coloration on abdomen extensive.

Merodon pruni (Rossi)
(figs. 53 a-d, 94)

Syrphus pruni Rossi, 1790: 293. Syntypes: 'in provinciis Florentina et Pisana' [Toscana, Italy] [not examined].
Merodon pruni var. *obscurus* Gil Collado, 1929: 407. Holotype ♂: 'Tanger, Mz. Escalera/ M. pruni var. obscurus Gil Tipo, Gil Collado det./ M. N. C. N. Madrid' (IEE) [examined].
Merodon fulvus Macquart, 1834: 514. Syntypes 'France Méridionale' [not examined].
Merodon fuscinervis Von Röder, 1887: 73. Syntypes: 'bei Elos [Elous, 35° 20' N, 23° 36' E] in der Nahe von Kisamos auf der Insel Kreta' [not examined].
Merodon pallidus Macquart, 1842: 70. Lectotype ♂ (here designated): 'Baghdad' [examined].
Merodon sicanus Rondani, 1845: 258, 264. Lectotype ♀ (here designated): '58' [number referring to description of *M. sicanus* in catalogue by Rondani] [examined].
Merodon pruni; Schiner 1857: 415; Bezzi 1900: 90; Becker 1912: 602; Sack 1913a: 434; Paramonov 1925: 152; Paramonov 1926a: 15; Hurkmans 1985: 69.
Merodon pruni var. *obscurus*; Peck 1988: 173.
Lampetia pruni; Sack 1931: 323; Séguy 1961: 181; Van der Goot 1964a: 431.
Merodon pallidus; Brunetti 1923: 217.
Lampetia pallida; Sack 1931: 323.
Merodon sicanus; Rondani 1857: 55, 65; Schiner 1857: 411; Schiner 1862: 347; Palma 1863: 46; Strobl 1893: 76; Strobl 1900: 593.
Lampetia sicana; Sack 1931: 323.

Material examined. – Algeria: 6♂, 2♀ (BMNH, MNHN); Cyprus: 10♂, 10♀ (BMNH, NHMW, KBIN); France: 1♂, 1♀ (MNHN); Greece: 23♂, 11♀ (MNHN, NHMW, BMNH, JLR, Den Hollander, WH); Iran: ♀ paralectotype of *pallidus*: 'Baghdad' (MNHN); 1♂, 1♀ (RMNH); Italy: ♀ paralectotype of *sicanus*: '58'; 79♂, 32♀ (BMNH, NHMW, ZMAN, RMNH, JLR, WH); Israel: 16♂, 11♀ (KBIN, NHMW, MNHN, NHMW, BMNH); Lybia: 6♂, 7♀ (BMNH); Morocco: 5♂ (MNHN, RMNH); Pakistan: 11♂, 10♀ (BMNH); Syria: 1♂ (NHMW); Turkey: 8♂, 14♀ (JLR, ZMUC, MNHN).

Description

Male. – Head: Antennae brown to orange, antenna 3 with upper margin convex, apex subacute, antennal ratio 1.4; pubescence yellowish, darker in ocellar region; face and occiput rather densely pale yellow pruinose, weakly blue metallic lustrous; vertex angle 25°, ocellar angle 35°, tl-v ratio 0.4.

Thorax: Dark; katepisternum, anepisternum and anepimeron weakly blue lustrous; pubescence on dorsum and scutellum rather short, very even, yellow, in some specimens with more or less clear interalar band and/ or with more or less vague pruinose longitudinal bands; pubescence on sides concolorous, less even. Wings troubled, strongest in anterio-basal portion; halteres, squamae and antisquamae pale yellow.

Legs: The femora dark with yellow apices, tibiae yellow with broad dark distal band, tarsi 1 and 2 yellow, tarsi 3 dark with striking golden pubescence on sides contrasting dark upper face; trochanters 3 bearing acute projection, femora 3 strongly swollen, bearing much projecting triangular processus holding 6-9 bristles on serrate distal margin; all tarsi normal.

Abdomen: Rather slender; T II strongly tapering, with large yellow lateral spots; background colour dark brown, but in most specimens replaced with yellow to a large extent, in some specimens yellow throughout; pruinose bands pale yellow, arcuate, incomplete on T II, wide and hardly interrupted on T III-IV where they may occupy most of the tergite surface; pubescence rather dense, predominantly yellow, longest laterally; sternites yellow, S I-II pale, III-IV darker, the latter strongly vaulted, deeply, narrowly emarginate posteriorly.

Genitalia: Anterior surstyle lobe rounded, bearing short, erect, yellowish pubescence throughout except basally; separated from posterior surstyle lobe by shallow sulcus; posterior surstyle lobe bearing long, uneven, erect, yellow pubescence. Cercus conspicuous, wide, with long, dense, yellow pubescence, somewehat angular. Aedeagus rather short, moderately slender, apical shaft part short, fringed plates on thecal apex recumbent.

Body length 8-23 mm.

Female. – Very similar to the male. Except for sexual dimorphism, differing as follows. Head: Frons with lustrous midstripe occupying less than 0.2 of frontal width; ocellar angle 45°. Thorax: Narrower than in male; Pruinose bands often vaguely present

on dorsum; wings stronger infuscate. Legs: Femora 3 less swollen, but strongly swollen compared with females of other species of *Merodon*; trochanters 3 smooth. Abdomen: Pruinose bands wider medially, narrower laterally compared with males; T V tapering, all dark.

Body length 10-21 mm.

Variation. – *Merodon pruni* shows an immense variation in size, which does not seem to be correlated with locality or flight period. The specimens assigned to *pruni* can be arranged in a continuous series; the expression of several characters seems to be correlated with specimen size, e.g. relative size of projection on trochanters 3 and triangular processus. This phenomenon is also found in other species, most strongly in *kawamurae*. The differences between specimens may be the consequence of differing food availability in the larval stage.

Diagnosis. – The usual size in both sexes (normal range 17-21 mm) and predominantly yellow abdomen combined will distinguish *pruni* from all other species except *clavipes* and *velox*; from these two the males are easily distinguished by the more slender abdomen with less dense pubescence, moreover from *velox* by the absence of deep infuscation on wings; the females of *pruni* are paler and have more slender abdomina than those of *clavipes* and *velox*. Small specimens can be distinguished from other *Merodon*, in the males by the nearly all yellow abdomen and the genitalia; the dwarf females may cause some problems but can be distinguished by their triangular yellow abdomina and darkened wings. In *pruni* females of all sizes the darkening of the wings is black, without purple reflections.

Period of flight and distribution (fig. 94). – *M. pruni* has been recorded by Sack (1931: 324) to fly from May to August in southern Europe, north Africa and Asia Minor. The species is common in Toscana, Italy and in central Greece. From the specimens in collections it appears that *pruni* may be bivoltine at least in Italy and Greece. *M. pruni* seems to be rare in southern France and absent from Spain.

Biology. – *M. pruni* occurs in rather open habitats with scattered tall plants, mainly Umbelliferae and Liliaceae, on hillsides exposed to the sun (Hurkmans 1985); the males are territorial and aggressively expel invaders; the females are much less conspicuous in the field than the males as they fly close to ground level (Hurkmans 1985). This difference in flight behaviour might explain the sex ratio found among preserved material in museum collections studied, which is about 1.7 males to a female.

Discussion. – Type-material of *fulvus* Macquart, 1834 and *fuscinervis* Von Röder, 1887 could not be examined. To judge from the descriptions both taxa seem to fall well within the variation range of *pruni*. The synonymy with *pruni* was already given by Sack (1913a, 1931) and Peck (1988).

Merodon pruni var. *obscurus* Gil Collado

Diagnosis. – Rather similar to the nominal form, except for the following differences in the male (females unknown). Head: Antennae 3 dark brown [not black as indicated in description], truncate. Thorax: Pubescence very short, even, yellow, but darker in middle of dorsum, transition gradual; no pruinose bands present. Wings darkened along anterior margin, the brown veins bordered with slight infuscation.

Body length 18 mm.

The *longicornis* group

Apomorphies: Extreme lengthening of antenna 3; male genitalia with surstyle deeply sulcate and very slender aedeagus; vertex angle very small.

Description. – Head: Antennae 3 with upper margin straight, apex subacute to rounded, antennal ratio 2.2 to 4.8; vertex angle 25° to 30° in males, ocellar angle some 35° in males, 60° in females; in females lustrous midstripe on frons occupying 0.35 to 0.6 of width. Thorax: Dark, rather narrow, bearing 4 longitudinal, mostly clear pruinoise bands. Wings clear. Legs: All dark, sometimes joints paler, trochanters 3 smooth, femora 3, triangular processus and basitarsi 3 normally shaped.

Abdomen: Rather slender; T II somewhat tapering, T III-IV cylindrical in male, tapering in female; in *erivanicus* and *longicornis* dark background coloration partially replaced by crimson red colour typical of this group; pruinose bands narrow, arcuate and conspicuous. Genitalia; Anterior surstyle lobe quadrate to rectangular, anteriorly showing dense, yellow pubescence, separated from posterior surstyle lobe by deep sulcus, stalked; the posterior surstyle lobe low, short to elongate. Cercus well protruding. Aedeagus very slender, fringed plates on thecal apex recumbent to oblique.

Body length in both sexes 9-13 mm.

Merodon erivanicus Paramonov
(figs. 54 a-b, 55 a, 92)

Merodon erivanicus Paramonov, 1925: 151. Syntypes: 'Erivan, Armenien' [not examined].
Merodon erivanicus; Liepa 1969: 20; Peck 1988: 170.

Lampetia erivanica; Sack 1931: 315; Sack 1938: 22.

Material examined. – Greece: 2♀ (NHMW); Israel: 1♀ (BMNH); Turkey: 19♀ (BMNH, JLR, WH); Yugoslavia: 1♀ (NHMW) .

Description

Female. – Head: Antennae dark brown, antenna 3 with upper margin convex to straight, apex obtuse, antennal ratio 2.2 to 2.8; ocellar angle 60°, pubescence yellow, face and occiput with slight metallic lustre obliterated by dense whitish pruinosity; frons densely pruinose laterally, midstripe occupying 0.4 of width.

Thorax: Dark, dorsum with well marked pruinose bands, pubescence greyish yellow, short, dense, even; katepisternum, anepisternum and anepimeron greenish to bluish metallic lustrous, hardly pruinose, pubescence concolorous. Wings clear; halteres, squamae and antisquamae pale yellow.

Legs: Dark, tibiae 1 and 2 basally yellow; dense yellow pubescence on sides of tarsi, contrasting dark pubescence on upper faces; trochanters 3 smooth, femora 3 slightly swollen, triangular processus normal.

Abdomen: Slender, dark coloration partially replaced by crimson; the extent of the crimson colour is much variable between specimens; T II-IV with interrupted arcuate white pruinose bands; pubescence very short, inconspicuous, black on dark surface, yellowish on crimson surface; S I-II red, III-IV dark red to black.

Body length 10-12 mm.

Male. – Unknown.

Diagnosis. – *M. erivanicus* is distinguished from females of other *Merodon* species by the long antenna 3 and crimson colour on the abdomen; from *longicornis* by the shorter antenna 3 (antennal ratio in *longicornis* is 4.1 to 4.8).

Period of flight and distribution (fig. 92). – *M. erivanicus* occurs in June and July, in the eastern Mediterranean, in eastern Turkey and Armenia.

***Merodon kaloceros* sp. n.**
(figs. 54 d, 55 c, 56 a-c, 87)

Type-material. – ♂ Holotype 'Turkey, Antalya, H. Coene, J. Lucas & B. van Oorschot / Irmesan Gediği 12 km N of Akseki 1600 m 24.vii.1981' (ZMAN). Paratypes: 24♂, 1♀: 1♀, same data as holotype (JLR); 4♂ 'Turkey, Hakkari, Suvarihalil pass 1250 m, W side near Habul Deresı 13.vi.1984 leg. J. A. W. Lucas' (JLR); 2♂ 'Turkey Hakkari, Chilo Dağları N of Oramar 1400 m, 16/17.vi.1984, leg. J. A. W. Lucas' (JLR); 2♂ 'Turkey, Hakkari, Sat Dağ, SW Yüksekova 1600 m 18.vi.1984 J. A. W. Lucas' (JLR); 8♂ 'Turkey pr. Hakkari, Sat Dağ, Varegös SW Yüksekova 28. and 29. vi.1985' (JLR); 1♂ 'Turkey, Van, 40 km SW Akdamar 1720 m, 17.vii.1986, leg. P. van Ooijen' (ZMAN); 1♂ 'Dalmatien [Yugoslavia], Gravosa vi.28 [1928] Zerny' (NHMW); 1♂ 'Greece, Ithaca 6/11.vi.1965 F. J. Francois' (KBIN); 2♂ 'Hill Scrub 500 ft above lake/ Macedonia Prespa geul Otesevo 20/27.vi.1958/ Yugoslavia R. L. Coe' (BMNH); 1♂ 'Yugoslavia Kroatie Bribir (50 100) 10.viii.1964 H. J. P. Lambeck' (JLR); 1♂ 'Corfu, Erber 218' [Greece] (JLR).

Description

Male. – Head: Antennae dark, antenna 3 brown with base and apex paler, upper margin straight to convex, apex subacute to obtuse, antennal ratio 2.3 to 2.7; pubescence greyish yellow with dark tuft in ocellar region ; vertex angle 25-30°, ocellar angle 40°, tl-v ratio 0.55.

Thorax: Dark, dorsum with inconspicuous pruinose bands, katepisternum, anepisternum and anepimeron blue to green metallic lustrous; pubescence yellowish, rather even and short on dorsum and scutellum, longer, uneven on sides. Wings clear; halteres, squamae and antisquamae yellow.

Legs: Dark, tarsi with contrasting golden pubescence on sides and dark upper faces; trochanters 3 smooth, femora 3 slightly swollen, triangular processus normally shaped, distal margin much serrate; tibiae 3 and tarsi 3 normal.

Abdomen: Dark, slender, with conspicuous orange lateral spots on T II; T II-IV showing white conspicuous narrowly interrupted arcuate pruinose bands; pubescence concolorous with surface, yellow on lateral spots; S brown, S IV darkest, flat, posterior margin entire.

Genitalia: Anterior surstyle lobe large, more or less rectangular, rounded anteriorly, on margin with dense, yellow, even pubescence; the posterior surstyle lobe separated by deep sulcus, rather short, low, somewhat angular, showing dense, uneven, yellow pubescence. Cercus rather short, wide, with dense yellow pubescence. Aedeagus bearing paired humps basally on outer face, apical shaft part short, fringed plates on thecal apex recumbent to oblique.

Body length 13 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Head: Frons with lustrous midstripe occupying 0.3 of width. Thorax: Pruinose bands more conspicuous; pubescence denser, grey, even as if shaven. Legs: Pubescence greyish throughout. Abdomen: Outline more triangular; pubescence denser, greyish; pruinose bands wider, continuous; lateral spots extended over all of T II and anterior margin of T III; T V tapering, dark, with grey pubescence.

Body length 13 mm.

Diagnosis. – *M. kaloceros* can be distinguished from other *Merodon* except *erivanicus* and *longicornis* by the large antennal ratio and structure of the male

genitalia; it is distinguished from the two species mentioned by the coloration on the abdomen which is orange in *kaloceros* but crimson in *erivanicus* and *longicornis*.

Period of flight and distribution (fig. 87). – *M. kaloceros* occurs in the eastern Mediterranean region and Turkey in June through August. Given the collection dates from eastern Turkey, where most of the type material was collected, the species is univoltine.

Discussion. – In view of apomorphies shared with *longicornis*, e.g. the shape of the ♂ genitalia and large antennal ratio, *kaloceros* is assigned to the *longicornis* group.

Etymology. – The epitheton *kaloceros* is derived from the greek words kalon, meaning good, beautiful, and ceros, meaning horn; it refers to the large antennae (not as extremely long as in *longicornis*). The epitheton is to be treated as a noun in apposition.

Merodon longicornis Sack
(figs. 54 c, 55 b, 57 a-c, 93)

Merodon longicornis Sack, 1913a: 447. Lectotype ♀ (here designated): 'longicornis det. Sack/ Merodon longicornis Sack Type Turkestan/ longicornis det. Hermann' (NHMW) [examined].
Merodon longicornis; Paramonov 1925: 154, 1926a: 15; Van der Goot 1981: 214, 218; Peck 1988: 171.
Lampetia longicornis; Sack 1931: 320.

Material examined. – Greece: 2♂, 25♀ (KBIN, JLR, Coll. Thessaloniki, ZMAN, BMNH, NHMW); Italy: 30♂, 24♀ (RMNH, JLR, ZMAN); Israel: 1♀ (RMNH); Morocco: 1♀ (BMNH, doubtful); Syria: 1♀ (KBIN); Turkey: 16♂, 24♀ (BMNH, JLR, NHMW); Yugoslavia: 4♀ (BMNH, RMNH).

Description

Male. – Head: Antennae dark, antenna 3 with upper margin rather straight, apex rounded, antennal ratio 4.1 to 4.8; pubescence pale yellow, dark in large ocellar region; ocelli placed far forward; pruinosity on face and occiput dense, whitish; vertex angle 30°, ocellar angle 35°; tl-v ratio 0.3.

Thorax: Dark; dorsum with pruinose bands, pubescence rather sparse, even, moderately long; surface of katepisternum, anepisternum and anepimeron weakly lustrous, with some silky lustre produced by yellow recumbent pubescence. Wings clear; halteres, squamae and antisquamae pale yellow.

Legs: Dark, joints paler in specimens; trochanters 3 smooth, femora 3 rather strongly swollen, straight; triangular processus and tarsi normally shaped.

Abdomen: Dark; moderately slender; T II tapering; T II-IV showing conspicuous slightly arcuate white narrow pruinose bands; pubescence concolorous with surface; S IV moderately vaulted, posteriorly narrowly emarginate.

Genitalia: The anterior surstyle lobe rather rectangular, with short, even, yellow pubescence, separated from the rather long, low posterior surstyle lobe by a deep sulcus; the posterior surstyle lobe posteriorly bearing moderately long, yellow, uneven pubescence, its lateral face with several ridges and furrows. Cercus rather large, well protruding, showing long, dense, slightly wavy, yellow pubescence. Aedeagus normally wide in ventral view, extremely slender in lateral view, apical shaft part short, fringed plates on thecal apex oblique.

Body length 9-10 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Head: Lustrous midstripe on frons occupying 0.6 of width; pubescence dark on midstripe, grey laterally. Thorax: Pubescence shorter than in male. Legs: Yellow pubescence on basitarsi 3 found in some ♀. Abdomen: Strong crimson coloration always present in ♀, restricted to T II or extended over most of abdomen; T II more tapering than in male; T V acute, dark, scattered pale pubescence present.

Body length 9-10 mm.

Diagnosis. – The extremely large antennal ratio distinguishes *longicornis* from all other known species.

Period of flight and distribution (fig. 93). – The species occurs in May through July in the Mediterranean region, Turkey, Ukraine and southern Russia. It appears to be rare in the western, common in the eastern part of the range and in Turkey and adjacent areas.

The *vandergooti* group

Apomorphies: Lengthening of anterior surstyle lobe; extreme swelling of femora 3; extensive yellow coloration on legs.

Merodon vandergooti sp. n.
(figs. 58 a-c, 88)

Type-material: ♂ Holotype 'Turkey, Hakkari, Suvarihalil pass 1250 m W side near Habul Deresı, 13.vi.1984 leg. J. A. W. Lucas' (ZMAN). Paratypes: 20♂; 18♂ with same data as holotype (16 JLR, 2 WH); 1♂ [Turkey] 'Ankara 650 m, 1.vi.1971 leg. Kl. Warncke' (JLR); 1♂ [Turkey] 'Ankara, South of Ankara, 24.vi.1984 leg. J. A. W. Lucas'(JLR).

Description

Male. – Head: Antennae conspicuously orange, antenna 3 with convex upper margin, apex acute, an-

tennal ratio 1.5 to 1.7; pubescence golden yellow, rather dense, producing silky lustre on frons; face blue metallic lustrous, moderately dense white pruinose; vertex angle 40°, ocellar angle 40°, tl-v ratio 0.4.

Thorax: Dark, with vestigial pruinose bands on dark dorsum; katepisternum, anepisternum and anepimeron weakly blue lustrous; pubescence golden on dorsum and scutellum, greyish-golden on sides; in many specimens some dark hairs present between wing insertions giving suggestion of vague intaralar band; posterior fringe of scutellum bearing dense yellow pubescence. Wings clear; halteres, squamae and antisquamae yellow.

Legs: Bases of femora 1 and 2 dark, femora 3 all dark, otherwise legs fiery orange throughout, with orange pubescence; trochanters 3 showing distinct ridge ending laterally in a low but marked hump; femora 3 enormously swollen, rather strongly curved; triangular processus large, bearing 10-13 delicate bristles on hardly serrate distal margin.

Abdomen: Dark; T II relatively large, tapering, bearing vague yellow lateral spots; T II-IV with oblique slightly arcuate, yellow pruinose bands, pubescence concolorous with surface; S IV moderately vaulted, narrowly and deeply emarginate posteriorly.

Genitalia: Anterior surstyle lobe moderately wide, much elongate, the anterior part showing dense yellow pubescence throughout, ventral margin similarly pubescent; separated from posterior surstyle lobe by deep wide sulcus; posterior surstyle lobe low, elongate, bearing dense, long, yellow pubescence on ventral and posterior margins; there is a secondary lateral lobe, bearing moderately long yellow pubescence. Cercus rounded, well protruding, with dense yellow pubescence. Aedeagus moderately slender with short apical shaft part and fringed plates on thecal apex recumbent.

Body length 13-14 mm.

Female. – Unknown

Diagnosis. – *M. vandergooti* is easily separated from other *Merodon* species by the structure of the genitalia and the enormously swollen femora 3; the colour pattern of the legs is very unusual as nearly all species with partially yellow legs have dark bands on the tibiae. The colour pattern on the legs and orange antennae are also found in *aureotibia* females. In *vandergooti* the antenna 3 is acute, in *aureotibia* obtuse; the abdominal pruinose bands are much more arcuate in *aureotibia*, where the triangular processus has a strongly serrate distal margin with 6-7 robust bristles; in *vandergooti* the triangular processus bears 10-13 fine bristles on a hardly serrate distal margin. These differences cannot be accounted for by explaining them as sexual dimorphism and are thus considered valid distinctions on the species level.

Period of flight and distribution (fig. 88). – *M. vandergooti* occurs in June and has been found in central and south-eastern Turkey.

Etymology. – It is a pleasure to dedicate this species to Mr Volkert van der Goot who, over the last decades, has largely stimulated research work on Syrphidae in the Netherlands. A noun in genitive case.

The *nigritarsis* group

Apomorphies: Aedeagus with apical shaft part lengthened; two pairs of spines on outer face of aedeagus.

Description. – Head: Antennae dark, antennal ratio over 1.5, tl-v ratio about 0.4 in male; face bluish lustrous, strongest in male; in female, frons lustrous on median 0.25 of width.Thorax: Inconspicuous pruinose bands present; pubescence rather dense, short. Legs: Dark with yellow markings on tibiae, tarsi 1 and 2 in normal (not melanistic) specimens; trochanters 3 much variable between specimens, usually humped; golden pubescence on sides of tarsi 3 contrasting dark upper face. Abdomen: Moderately slender; T IV bulging in male; pruinose bands arcuate, clear; S IV in male strongly vaulted, deeply emarginate posteriorly. Genitalia: Anterior surstyle lobe elongate, stalked, diamond-shaped, posterior surstyle lobe elongate; aedeagus with 2 pairs of chitinous spines on outer face and lengthened apical shaft part.

Merodon femoratoides stat. nov.
(figs. 59 a-d, 95)

Merodon spinipes var. *femoratoides* Paramonov, 1925: 158. Lectotype ♂ (here designated): 'Karadagh bei Theodosia, Krym, 3.vi.1919' (ZMHB) [examined].
Merodon spinipes var. *femoratoides*; Liepa 1969: 20; Peck 1988: 174.
Lampetia spinipes var. *femoratoides*; Sack 1931: 328.

Material examined. – Algeria: 1♂ (BMNH); Greece: 2♂, 1♀ (JLR); Turkey: 12♂ (JLR, BMNH, NHMW, WH); U. S. S. R.: 2♂ Paralectotypes of *spinipes* var. *femoratoides*, 'Warnutka, Sevastopol, Krym 11.vi.1923' (ZMHB); 1♂, Krym, Karadagh 24.vi.25 [1925] Paramonov leg./ Typus Merodon spinipes var. femoratoides ♂ / B. Kurodke Pinob [in Russian script] (ZMHB) [This specimen cannot be considered as a type specimen since it is not mentioned in the original publication].

Description

Male. – Head: Antennae dark, antenna 3 with upper margin concex, apex subacute, antennal ratio 1.5; pubescence yellow, face strongly white pruinose; ver-

tex angle 30°, ocellar angle 45°, tl-v ratio 0.4.

Thorax: Dark, with four clear pruinose bands and a fifth anteromedian fainter one; pubescence dark yellow, rather short, even; katepisternum, anepisternum and anepimeron blue lustrous. Wings slightly evenly troubled; halteres, squamae and antisquamae yellow.

Legs: The tibiae basally and femora apically orange, otherwise dark; trochanters 3 smooth, femora 3 moderately swollen, triangular processus bearing 6-10 strong bristles on moderately serrate distal margin; tibiae 3 bearing dense golden pubescence, tarsi 3 with same pubescence on sides, contrasting dark upper face.

Abdomen: Moderately slender; T II much tapering; T II-IV with arcuate off-white pruinose bands; T II bearing clear to almost absent yellow lateral spots which may extend over part of T III; pubescence concolorous with background; S IV vaulted, acutely, narrowly emarginate posteriorly up to half its length.

Genitalia: Anterior surstyle lobe elongate, clearly stalked, the apical portion triangular, anteriorly showing dense yellow pubescence; posterior surstyle lobe with small anterior, accessory lobe bearing dense, long, yellow pubescence; itself low and elongate, showing dense yellow pubescence posteriorly. Cercus inconspicuous and hidden between projecting posterior surstyle lobes. Aedeagus rather slender, bearing two pairs of spines on outer face, apical shaft part lengthened, fringed plates on thecal apex oblique.

Body length 13-15 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Head: Frons lustrous on median one-third, whitish pruinose laterally. Thorax: Pubescence as if shaven, golden; four well marked pruinose bands present. Abdomen: T II tapering, lateral spots conspicuous, extended over part of T III; pruinose bands arcuate, widely interrupted and conspicuous.

Body length 12.5 mm.

Diagnosis. – *M. femoratoides* may be easily distinguished from *avidus* by the very different genitalia in the ♂ and the contrast of hair colour on tarsi 3 in both sexes. The distinction with *nigritarsis* is in the differently shaped anterior surstyle lobe in the males and the less dark abdomen with larger lateral spots in the females.

Period of flight and distribution (fig. 95). – The species occurs in the Mediterranean, Asia Minor and southern Russia and Ukraine from May through July; its distribution range is large, but the species is uncommon.

Merodon nigritarsis Rondani
(figs. 60 a-g, 97)

Merodon nigritarsis Rondani, 1845: 258, 264. Lectotype ♂ (here designated): '68/ Torino D. Ghiliani' in coll. Rondani (LSF) [the number 68 refers to the description of this species in Rondani's catalogue] [examined].
Merodon nigritarsis; Rondani 1857: 55, 65; Schiner 1857: 415; Rondani 1873: 295; Strobl 1893: 76; Bezzi 1895: 16; Strobl 1900: 91; Sack 1913a: 447; Paramonov 1925: 157, 1926a: 15; Gil Collado 1930: 254; Peck 1988: 174.
Lampetia nigritarsis; Sack 1931: 327; Séguy 1961: 177.

Material examined. – Austria: 4♂ (BMNH, NHMW, ZMUC); France: 96♂, 32♀ (MNHN, KBIN, RMNH, BMNH); Greece: 29♂, 19♀ (NHMW, ZMUC, den Hollander, KBIN, Bonn, ZMAN, RMNH, Thessaloniki, BMNH); Hungary: 2♂, 4♀ (RMNH, Bonn, ZMUC); Italy: 3♂, 3♀ paralectotypes, '68' in coll. Rondani (LSF); one ♀ paralectotype, '68/ Susa, D. Ghiliani' in coll. Rondani (LSF) and 13♂, 5♀ (LSF, KBIN, ZMAN, RMNH); Poland: 1♀ (BMNH); Spain: 9♂, 5♀ (MNHN, BMNH, JLR, NHMW); Turkey: 9♂, 6♀ (JLR, BMNH, NHMW, ZMAN, RMNH); Yugoslavia: 49♂, 19♀ (BMNH, NHMW, Bonn, ZMAN, RMNH).

Description

Male. – Head: Antennae dark, antenna 3 with upper margin convex, apex subacute, antennal ratio 1.6; pubescence yellow with dark tuft in ocellar region; vertex angle 30°, ocellar angle 40°, tl-v ratio 0.4.

Thorax: Dark, lustrous on lateral dorsum, scutellum and sides, bearing rather dense yellow pubescence. Wings clear; halteres, squamae and antisquamae yellow.

Legs: All femora dark, paler apically; tibiae yellow with broad dark distal band; trochanters 3 with much variable hump, usually well marked, femora 3 slightly swollen, with normal triangular processus bearing 6-9 bristles on serrate distal margin; tibiae 3 and tarsi 3 normally shaped; the basitarsi 3 with strong contrast between dark pubescence on upper face and golden pubescence on sides; this is a characteristic that can be of use in the field as it is conspicuous to the naked eye at short range.

Abdomen: Dark; T II with orange to yellow lateral spots of variable size and clearness; T III in many specimens with yellow anterior lunules; T II-IV bearing arcuate, narrowly interrupted pruinose bands; S IV very deeply, narrowly emarginate, strongly vaulted.

Genitalia: Anterior surstyle lobe elongate, widened subapically, more or less rounded apically, with dense yellow even short pubescence there; posterior surstyle lobe separated by small sulcus; rather elongate, moderately high, posteriorly bearing dense, long, yellow pubescence. Cercus rather inconspicuous, rounded, pubescence as on posterior surstyle lobe. Aedeagus bearing two pairs of spines on outer face; apical shaft part clearly lengthened; fringed plates on thecal apex recumbent.

Body length 12-16 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Head: Frons lustrous on median quarter, sides white pruinose, pubescence concolorous; dark tuft in ocellar region less clear than in male; ocellar angle 45 to 50°. Thorax: Shorter pubescence; pruinose bands clearer. Legs: Trochanters 3 always smooth.

Body length: 12-17 mm.

Variation. – *Merodon nigritarsis* is one of the more variable species of the genus; the hump on the trochanters 3 and the shape of the anterior surstyle lobe are notoriously variable between specimens, even those collected together at the same site. There are many local forms, each with their own peculiar aberrations, notably in the shape of the anterior surstyle lobe. Since a fluent, continuous series can be arranged using these specimens, I have refrained from describing local subspecies.

Diagnosis. – *M. nigritarsis* can be distinguished from other *Merodon* except *femoratoides* in the males by the general morphology of the genitalia and the spines on the aedeagus and the contrast on the basitarsi 3 in both sexes; from *femoratoides* it may be distinguished in the males by the differently shaped anterior surstyle lobe and basally convex aedeagus, smaller lateral spots and less wide interrupted pruinose bands; in the females by the darker abdomen.

Period of flight and distribution (fig. 97). – *M. nigritarsis* occurs in the Mediterranean and the southern parts of central Europe from May through August; possibly the species is bivoltine.

Discussion. – *M. nigritarsis* has been considered a variety or subspecies of *avidus*. In view of the completely different genitalia a close relation between *avidus* and *nigritarsis* is out of the question. *M. nigritarsis* was named for the dark basitarsi 3; however, this feature also occurs in other species externally resembling *nigritarsis*, such as *alagoezicus* and its allies; the lengthened apical shaft part of the aedeagus is another shared feature.

The *avidus* group

Apomorphies: Anterior surstyle lobe anteriorly much widened; T II extremely tapering.

Merodon avidus (Rossi)
(figs. 61 a-g, 96)

Syrphus avidus Rossi, 1790: 292. Syntypes: 'in provinciis Florentina et Pisana' [Toscana, Italy] [not examined].
Syrphus spinipes Fabricius, 1794: 296. Lectotype ♂ (here designated): '*spinipes*' in coll. J. C. Fabricius (ZMUC) [seriously damaged] [examined]
Merodon serrulatus Wiedemann *in* Meigen, 1822: 360. Lectotype ♂: (here designated) 'Portugall coll. Winthem/ serrulatus Wied.' (NHMW) [examined]
Merodon italicus Rondani, 1845: 257, 259. Lectotype ♀ (here designated): '67b' in coll. Rondani (LSF); the '67b' number refers to the description of *italicus* in Rondani's catalogue. [examined] **syn. n.**
Merodon rufitibius Rondani, 1845: 259, 265. Lectotype ♂ (here designated): '72' in coll. Rondani (LSF) [examined]; the '72' number refers to the description of *rufitibius* in Rondani's catalogue.
Merodon graecus Walker, 1852: 243. Lectotype ♀ (here designated): 'Albania/ graecus Walker' (BMNH) [examined].
Merodon aurifer Loew, 1862a: 83. Lectotype ♂ (here designated): 'Melatia [Malatya, Turkey] Erber/ coll. H. Loew/ Zool. Mus. Berlin'; on separate pin: '... *Merodon aurifer* n. Berl. Zeit. vi.1862 pg 82 ...' (ZMHB) [examined].
Merodon quadrilineatus Lioy, 1864: 473. [Type-material probably never existed. Lioy published only theoretical works and had no intention to describe new species.]
Merodon avidus; Rondani 1845: 259; Schiner 1857: 415; Strobl 1893: 76; Bezzi 1895: 16, 1900: 91; Strobl 1900: 593; Villeneuve 1903: 115; Gil Collado 1930: 254; Van der Goot 1971: 106, 1981: 216, 218; Barendregt 1982: 80; Marcos García 1985: 196; Bradescu 1986: 123; Peck 1988: 167; Hurkmans 1988: 107.
Lampetia avida; Séguy 1961: 176; Van der Goot 1964a: 431.
Milesia spinipes; Latreille 1804: 331.
Merodon spinipes; Fabricius 1805: 197; Meigen 1822: 361; Macquart 1828: 295, 1834: 516, 1842: 70; Rondani 1845: 258, 264, 1857: 55, 66; Schiner 1857: 414; Strobl 1893: 76; Bezzi 1895: 16, 1900: 91; Strobl 1900: 593; Villeneuve 1903: 115; Czerny & Strobl 1909: 204; Sack 1913a: 444; Paramonov 1925: 146, 1926a: 15; Gil Collado 1929: 409; Gil Collado 1930: 243; Bankowska 1980: 38, 40, 83; Marcos García 1985: 137; Peck 1988: 174.
Lampetia spinipes; Oldenberg 1919: 388; Sack 1930: 96, 1931: 327, 1938: 21; Šuster 1959: 243; Séguy 1961: 176.
Merodon serrulatus; Schiner 1857: 413, 1862: 348; Strobl 1893: 76; Bezzi 1895: 16; Strobl 1900: 593; Czerny & Strobl 1909: 203, 204; Gil Collado 1930: 254.
Lampetia serrulata; Sack 1931: 322.
Merodon italicus; Rondani 1857: 54, 62; Schiner 1857: 413, 1862, 347.
Lampetia italica; Sack 1931: 322.
Merodon rufitibius; Rondani 1857: 55, 66; Palma 1863: 46; Becker 1907: 253.
Lampetia rufitibia; Sack 1931: 327.
Merodon graecus; Schiner 1857; Schiner 1862: 347; Van der Goot 1964b: 218; Peck 1988: 167.
Merodon aurifer; Peck 1988: 174.
Lampetia aurifera; Sack 1931: 327.
Merodon quadrilineatus; Peck 1988: 174.
Lampetia quadrilineata; Sack 1931: 327.

Material examined. – Albania: 1♂, 1♀ (NHMW); Algeria: 2♂, 24♀ (MNHN, KBIN); Austria: 53♂, 63♀ (NHMW, MNHN, BMNH, RMNH); Belgium: 3♂ (MNHN, KBIN); Cyprus: 13♂, 4♀ (KBIN, BMNH); Czechoslovakia: 1♂, 1♀ (BMNH,

JLR); France: 266♂, 210♀ (MNHN, BMNH, NHMW, RMNH, JLR, ZMAN, WH); Germany: 3♂ (MFNS, JLR); Greece: 96♂, 62♀ (BMNH, RMNH, NHMW, KBIN, MNHN, JLR, den Hollander, ZMUC, Bonn, Coll. Thessaloniki, WH); Hungary: 29♂, 17♀ (Bonn, ZMUC, NHMW, BTM); Italy: 2♀ Paralectotypes of *italicus* '67b' in coll. Rondani (LSF); 2♂, 7♀ Paralectotypes of *rufitibius* '72' in coll. Rondani (LSF); 319♂, 122♀ (ZMUC, KBIN, NHMW, JLR, RMNH, ZMAN, BMNH, LSF, Coll. Marogna (Verona, Italy), WH); Lebanon: 1♀ (KBIN); Lybia: 4♂, 2♀ (BMNH); Morocco: 5♂, 8♀ (BMNH, MNHN, JLR, NHMW); Netherlands: 6♂, 2♀ (RMNH, JLR); Poland: 1♂ (ZMUC); Romania: 2♂, 1♀ (BMNH); Spain: 70♂, 20♀ (ZMUC, ZMAN, RMNH, JLR, WH); Switzerland: 5♂, 6♀ (RMNH, ZMAN, JLR); Turkey: 57♂, 30♀ (JLR, WH, BMNH,NHMW); U. S. S. R.: 4♂, 8♀ (MNHN); Yugoslavia: 70♂, 40♀ (NHMW, BMNH, RMNH, JLR, MNHN, Bonn, ZMAN).

Description

Male. – Head: Antennae with antenna 3 showing subacute apex and convex upper margin, antennal ratio 1.5, pubescence yellow, dark hair-tuft often present in ocellar region; face rather densely white pruinose, partially obliterating blue lustrous surface; occiput concolorous; vertex angle 35°, ocellar angle 40°-45°, tl-v ratio 0.5.

Thorax: Moderately wide, dark, rather dulled by diffuse yellowish pruinosity, dorsum bearing longitudinal pruinose bands of most variable clearness, katepisternum, anepisternum and anepimeron very weakly to conspicuously blue lustrous; pubescence erect, yellowish, moderately dense. Wings clear, veins pale to dark brown; halteres, squamae and antisquamae yellow.

Legs: Dark on trochanters and femora, pale on tibiae and tarsi, but both ends of femora paler and dark band present on tibiae is the usual pattern; there is an immense variation resulting in relatively pale or all dark legs; the femora always mainly dark; trochanters 3 may be acuminate; femora 3 moderately swollen, bearing 6-9 bristles on serrate distal margin of triangular processus.

Abdomen: Slender; dark; T II much tapering, usually with clear yellow lateral spots; pruinose bands on T II-IV clear, arcuate, interrupted, of variable width and colour; pubescence often concolorous with surface, erect, longest anterolaterally; S IV strongly vaulted, deeply acutely emarginate posteriorly.

Genitalia: Anterior surstyle lobe stalked, widening to semicircular apical margin with short even yellow pubescence; posterior surstyle lobe moderately high, slightly elongate, with moderately dense, long, yellow pubescence. Cercus rather large, bearing dense, long, yellow, often wavy pubescence. Aedeagus moderately slender, apical shaft part short, fringed plates on thecal apex recumbent.

Body length 11.5-18 mm.

Female. – Except for sexual dimorphism, differing ferom the males as follows. Head: Lustrous midstripe on frons occupying 1/4 to 3/4 of width, the lateral pruinose strips usually well defined; face and occiput less lustrous. Thorax: Pruinose bands clearer, slightly wider. Abdomen: Lateral spots often reddish, conspicuous and extending over part of T III; in some cases however virtually absent; pruinose bands less clear, less wide. T V dark.

Body length 12-17 mm.

Variation. – There is much variation in the coloration in both sexes. Head: The antennae may range from black to bright yellow. Thorax: Lustre most variable, density and colour of pubescence more constant. Legs: The colour is extremely variable; all joints, the tarsi and both ends of the tibiae are paler than the rest of the legs, but the colour may be all black or all yellow throughout. The pubescence is whitish to yellow even in dark specimens. Abdomen: The extent of the yellow colour is variable; the females often show a deeper colour than the males, and are less variable in this respect. Genitalia: The male genitalia are rather constant. The main variation occurs in the length and density of the pubescence on the posterior surstyle lobe and the cercus.

The large degree of variation found in *avidus* is not randomly distributed over the specimens. Many series collected at one site on one date, show uniform characteristics. Size and colour are probably correlated with quantity and quality of food ingested during the larval stages. There is no clear trend in size, morphology or colour of the various local forms over the entire range. Therefore, to present descriptions of local forms, varieties or subspecies is considered inappropriate.

Diagnosis. – *M. avidus* males could possibly be confused with *toscanus* from which they are distinguished by the longer stalk of the anterior surstyle lobe (which in *toscanus* is bifid), the shorter apical shaft part of the aedeagus and the usually much darker abdomen. The unique genitalia are sufficient to distinguish *avidus* males from any other *Merodon* males at first sight. The females are posing many problems since they cannot always be separated from females of the species in the *alagoezicus* group. The best separating characteristic is the pruinosity on the thorax where *avidus* females always show four longitudinal bands, whereas in the females of the *alagoezicus* group there usually is a fifth, anteromedian band as well. Moreover, the abdomen of females in the *alagoezicus* group is usually narrower overall.

Period of flight and distribution (fig. 96). – *M. avidus* occurs in Europe, except the northern parts, in north Africa, the Middle East and Asia Minor from

March through October; the species is very likely multivoltine in the southern parts of its range (cf. Marcos García, 1985). The distribution does not appear to be associated with human activity. As *avidus* is not particularly easy to collect and seems to occur in rather the same habitats as other *Merodon* the relative abundance in collections probably reflects abundance in the field.

Biology. – Few details are known (if the great distribution and abundance is borne in mind). This second most common *Merodon* occurs both in generally wet, and in dry areas, such as the Vosges mountains of France and the inland steppe region of Turkey. There are indications that in the driest parts of its range *avidus* prefers relatively wet biotopes such as lush strips along streams or marshes. Moreover imagines occur early in the season in the hot, dry parts of its range, probably to avoid water shortage later on. Water shortage influences the vegetation and therefore the possibilities for the larvae which are probably phytophagous (all known *Merodon* larvae are phytophagous). There seems to be a preference for flowers of Umbelliferae, as recorded by Šuster (1959) and confirmed by Mr. Lucas' s (Pers. Comm.) and the author's observations in e.g. France, Italy, Greece and Turkey. Some notes on the behaviour of the species are provided by Hurkmans (1988).

Discussion. – No type-material of *avidus* has been found; it might be supposed to be in the Rossi collection at ZMHB (Horn & Kahle 1936), but is not currently present there (dr. H. Schumann, in litt.). The types of *spinipes* are mentioned purely formally as they are too much decayed to be of any value whatsoever. There are considerable difficulties in distinguishing *avidus* from externally similar species, if the genitalia are not used for identification. The existence of the type-specimens in their present state does regrettably forestall designation of a neotype, which would seem to be necessary, given the identification problems mentioned. The original description by Rossi (1790) and following emendations are detailed enough to define *avidus* with respect to the external characteristics. No examination of the genitalia had been made until comparatively recently; especially in *avidus* the use of genital characters for separation from externally resembling species is essential. It is however considered fair to rule that as the overwhelming majority of museum specimens identified as *avidus* examined fulfil the requirements of the original description these specimens must be regarded as the true *avidus*. Moreover most other species externally resembling *avidus* can be (and have been) separated by external characteristics as well, e.g. *nigritarsis* Rondani and *alagoezicus* Paramonov.

The *crassifemoris* group

Apomorphies: Posterior surstyle lobe very high, with large anteriorly projecting lobe; cercus reduced.

Merodon crassifemoris Paramonov stat. n.
(figs. 62 a-c, 95)

Merodon spinipes (Fabricius) var. *crassifemoris* Paramonov, 1925: 158. Holotype ♂: 'Theodosia, Krym, 13.vi.1923 [Crimea, U. S. S. R.] [not examined].
Merodon spinipes var. *crassifemoris*; Liepa 1969: 20; Peck 1988: 174.
Lampetia spinipes var. *crassifemoris*; Sack 1931: 328.

Material examined. – France: 1♂ (ZMAN); Greece: 2♂ (ZMAN); Turkey: 8♂ (WH, JLR); U. S. S. R.: 1♂, labelled 'Karadagh Krym 16 vii 1929 S. Paramonov. leg. / Typus *Merodon spinipes* Fbr. var *crassifemoris* var. nov. ♂ / v. Karodke Pinab' (wrongly labelled as a type!) (ZMHB); Yugoslavia: 1♂ (ZMAN).

Description

Male. – Head: Antennae dark, antenna 3 with upper margin convex, apex very obtuse, antennal ratio 1.5, vertex angle = 30°, ocellar angle = 40°, tl-v ratio 0.5; pubescence creamy white with dark tuft in ocellar region, face dense whitish pruinose, compound eyes bearing dense white pubescence.

Thorax: Dark, metallic blue lustrous on lateral dorsum and scutellum, katepisternum, anepisternum and anepimeron, longitudinal pruinose bands vestigial to absent; pubescence dark yellow to brownish with vague dark interalar band. Wings clear; halteres, squamae and antisquamae yellow.

Legs: All dark except joints; trochanter 3 angular, femora 3 markedly curved and swollen, with smallish rather steeply rising triangular processus bearing 6-10 bristles on weakly serrate distal margin; tibiae 3 with distal outer angle drawn out into small spur; tarsi 3 with golden pubescence on sides contrasting dark pubescence on upper face, as in *nigritarsis*.

Abdomen: Dark; T II with vague brownish lateral spots, distinctly tapering; T II-IV bearing arcuate conspicuous greyish interrupted pruinose bands; pubescence yellowish grey on bands, dark elsewhere; S IV keeled throughout, posteriorly deeply emarginate.

Genitalia: The anterior surstyle lobe relatively small, reniform, showing dense, short, yellow, even pubescence apically and on margins; coalescent with enormously elongate posterior surstyle lobe which bears rather dense, yellow, uneven pubescence ventrally; posterior part of posterior surstyle lobe with free anteriorly projecting cuneiform part, with dense yellow pubescence laterally and postero-ventrally. Cercus very small, bearing dense, long, yellow pubescence. Aedeagus rather stout, apical shaft part short, fringed plates on thecal apex oblique to erect.

Body length 12-14 mm.

Female. – Unknown.

Diagnosis. – *M. crassifemoris* can be easily separated from other *Merodon* by the anteriorly projecting posterior surstyle lobe; externally the species resembles *avidus, nigritarsis, femoratoides* and the species in the *alagoezicus* group.

Period of flight and distribution (fig. 95). – The species occurs in the Mediterranean and Black Sea regions in June and July.

Discussion. – Because type-material of *crassifemoris* was not available, identification of this species is largely based on the original description and the specimen in ZMHB, identified as *crassifemoris* by Paramonov himself. Paramonov described var. *crassifemoris* as a variety of *spinipes* Fabricius (= *avidus* Rossi) in view of several external similarities. The genitalia however are rather different and do not indicate a close relationship between *avidus* and *crassifemoris.*

The *elegans* group

Apomorphy: Thin chitinous flanges running along outer face of aedeagus.

Description. – Head: Antennae orange to dark, antennal ratio 1.5-1.8, vertex angle 25-35°, ocellar angle 35-55°, tl-v ratio 0.35-0.6; pubescence white to yellow. Thorax: Pubescence rather short, even; whitish to pale brown. Legs: Dark, usually with yellow markings on apices of femora and at both ends of tibiae; trochanter 3 often edged; femora 3 swollen, strongly curved. Abdomen: Slender to rather stout, T II strongly to moderately tapering; T II-IV bearing arcuate pruinose bands, lateral spots variable. Genitalia: The anterior surstyle lobelarge, elongate with concave dorsal margin except *manicatus*; anterior and posterior surstyle lobe separated by sulcus; aedeagus with chitinous flanges on outer face.

Merodon bequaerti sp. n.
(figs. 63 a-c, 98)

Type-material: ♂ Holotype 'Noiseux Oran Algeria Dr J Bequaert, 23.IV.10' (written on lower face) / *Merodon parietum* Mg, ♂' (MNHN). 1♀ paratype, with label as holotype (MNHN).

Description

Male. – Head: Antennae dark, antenna 3 somewhat paler, densely yellowish pruinose, upper margin slightly concave, apex acute, antennal ratio 1.8; vertex angle 30°, ocellar angle 40°, tl-v ratio 0.6; pubescence pale yellow with strong dark tuft in ocellar region, occiput deep yellow pubescent; face rather bald, black-bluish lustrous; compound eyes with rather sparse, pale, yellow, short pubescence.

Thorax: Rather dull, some bluish lustre on sides; pubescence even, short, pale brown, erect. Wings tinged evenly, halteres, squamae and antisquamae yellow.

Legs: All dark; the tarsi, especially tarsi 3 with dense recumbent golden pubescence; trochanters 3 with ridge on lower face, femora 3 quite swollen, rather curved, with triangular processus bearing 10 bristles; tibiae 3 rather slender, tarsi 3 normally shaped.

Abdomen: Dark, moderately slender, with hardly conspicuous interrupted arcuate whitish pruinose bands; T II somewhat tapering, with orange lateral spots; pubescence rather dense, orangish brown (partially worn off on holotype); T III-IV laterally with cupreous lustre; all S dark, bearing scattered pale erect pubescence; S IV slightly vaulted, its posterior margin entire.

Genitalia: The anterior surstyle lobe ovoid, bearing yellowish pubescence anteriorly and along ventral margin and showing ventro-posterior angle; deep sulcus present between surstyle lobes, connected by a stalk, visible as a broad chitinous plate in top view; the posterior surstyle lobes square, with strong centro-posterior and lesser ventral accessory lobe; pubescence golden, longest, erect on ventral margin and lobes; the centro-posterior lobe bears a single black bristle. Cercus short, wide, showing pale, yellow, long, erect pubescence. Aedeagus with outer face excavate subbasally on outer face, there with paired free chitinous plates, and bearing paired flanges running along all of the outer face; apical shaft part slightly lengthened, fringed plates on thecal apex suberect to recumbent.

Body length 13.5 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Head: Antenna 3 rounded apically, though clearly concave on upper margin; frons dark, slightly greenish metallic lustrous, sparsely pubescent (probably artifact; head has been glued on to the body at some time) ocellar angle 50°. Thorax: Pubescence shorter than in male. Legs: Trochanters 3 smooth. Abdomen: Less dense pubescent except on lateral spots; T II less tapering; T V dark, tapering.

Body length 13 mm.

Diagnosis. – *M. bequaerti* can be easily recognized by the stout build of both sexes in comparison with other species of the *elegans* group. The females may

pose problems but the combination of swollen femora 3 and arcuate pruinose bands on the abdomen will separate this species from e.g. *ruficornis* and its allies which have more conspicuous, less arcuate pruinose bands.

Period of flight and distribution (fig. 98). – This species is known only from the types, collected in Algeria in April.

Etymology. – The epitheton *bequaerti* has been derived from the collector's name on the labels of both type specimens. A noun in genitive case.

***Merodon elegans* sp. n.**
(figs. 64 a-c, 99)

Type-material: ♂ Holotype 'Italia Sicilia V. S. v. d. Goot/ Etna rif. Filiciusa 1400-1500 m 22-28.vii.1961 / Lampetia spinipes det. V. S. v.d. Goot 1963 / Type A' (ZMAN). – Paratypes: 52♂, 24♀; 19♂, 10♀ with same data as holotype but collectors V. S. v.d. Goot & J. A. W. Lucas (14♂ JLR, 5♂, 10♀ RMNH); 1♂ 'Italia, S. Castaldo vi.1937, A. Løken leg.' (ZMUC); 3♂ 'Sicilia Schiødte' (ZMUC); 1♂ 'Italia, Calabria 18.v.1954 F. F. Tippmann' (RMNH); 1♂ 'France Aveyron 19.vii.1980 D. Prins' (Coll. D. Prins, Rhenen, The Netherlands); 3♂ 'France Vaucluse Cheval Blanc 7.vii.1973 H. I. Meuffels' (JLR); 1♀, same data, collected 9.vii.1973 (JLR); 2♂ 'France Estagel 22.vi.1982 exc. LH Wageningen' (LHW); 2♂ 'France, Chateau de Peypertuse 25.vi.1982 exc. LH Wageningen (LHW); 1♂ 'France, Mts. de Tauch, exc. LH Wageningen 23.vi.1982' (LHW); 1♂ 'S. F. Chaines des Alpilles, Les Baux 21.vii.1980 Barkemeyer' (Coll. C. Claussen, Flensburg); 3♂ 'Espana Torla Huesca 1035 m, 8/26 vii.1974 J. Wolschrijn' (JLR); 5♂ 'Espana Valencia Moraira 16/30.v.1981 van Aartsen (3 JLR, 1 RMNH, 1 ZMAN); 4♀ 'Espana, Guadalajara, Molina 1100 m 11.vii.1977 W. Schacht' (JLR); 1♀ 'Espana Tragacete 1300 m, 17.vii.1974 W. Schacht' (JLR); 2♂ 'Espana Catalonia, Espluga de F., 3.vii.1920 Codina' (RMNH); 1♂ 'Espana Catalonia Carretera [=road] de Espluga de F. a Massies' (RMNH); 1♂, 1♀ 'Espana Teruel M. J. & J. P. Duffels / Rafales 35 km ZO v. Alcaniz 600 m 12.vii.1972' (ZMAN); 3♂ 'Espana, Lebena (Santander) 5.vii.1986 Ma. A. Marcos García' (SAL); 1♂, 1♀ 'Algerie, Alger Dr. Bequaert, Foret de Buïnen (MNHN); 1♂ 'Algerie, Alger Dr. Bequaert Benandreit' (MNHN); 1♂ 'Algeria, Le Tarf 27.vii.1896 A. E. Eaton' (BMNH); 3♂ 'Maroc Mehdia (Ft. Lyautey) 31.v 1.vi.1950 P. M. F. Verhoeff' 3♂ (-RMNH).

Description

Male. – Head: The antennae orange to brown, antenna 1 darkest, antenna 3 with upper margin slightly convex, apex obtuse, antennal ratio 1.6; pubescence dull yellow, erect, even, with rather large dark tuft in ocellar region; vertex angle 30°, ocellar angle 50°, tl-v ratio 0,6; face and occiput diffusely whitish pruinose, blue metallic lustrous.

Thorax: Dark, with inconspicuous longitudinal pruinose bands; lateral dorsum and scutellum as well as sides blue metallic lustrous; pubescence brownish to yellow, erect, short, rather even, a dark interalar band present in some specimens; pubescence on posterior margin of scutellum longer; some diffuse pruinosity on dorsum and sides. Wings clear to evenly slightly tinged throughout; halteres, squamae and antisquamae yellow.

Legs: Dark with yellow markings apically on femora, both ends of tibiae and most of tarsi; trochanter 3 smooth, femora 3 quite swollen, metallic lustrous, with normally shaped triangular processus bearing 6-9 bristles on moderately serrate distal margin.

Abdomen: Dark; T II strongly tapering, with large pale yellow to deep orange vaguely bordered lateral spots; pruinose bands white, interrupted, moderately wide, arcuate; pubescence yellowish, densest laterally; S IV rather vaulted, narrowly emarginate posteriorly.

Genitalia: The anterior surstyle lobe large, reniform, with short, dense, even, yellow pubescence; separated from posterior surstyle lobe by deep sulcus; posterior surstyle lobe high, large, bearing rather long, dense, yellow pubescence laterally and on ventral-posterior margin, with lateral accessory lobe bearing dense concolorous pubescence. Cercus angular, well protruding, densely long yellow pubescent. Aedeagus rather slender, with paired high chitinous flanges on outer face and bearing paired basal humps; apical shaft part short, fringed plates on thecal apex oblique to recumbent.

Body length 13-15.5 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Head: Frons with lustrous midstripe occupying less than one-third of width; clear frontal depression of ovoid outline present. Thorax: Pruinose bands clearer, in some specimens a fifth anteromedial band can be found. Legs: Orange markings on basal femora more extensive, femora 1 and 2 often apically widely yellow. Abdomen: T II conspicuously bright orange; pruinose bands on T III IV continuous; pubescence sparser than in male.

Body length 13-15 mm.

Diagnosis. – The conspicuous flanges on the aedeagus distinguish *elegans* from species outside the *elegans* group. *M. elegans* may be separated from *bequaerti* by the longer posterior surstyle lobe, the slenderer habitus and greater size; from *manicatus* by the different shape of the surstyle and possession of an accessory lobe on the posterior surstyle lobe in *elegans*; from *testaceus* also in the surstyle shape, the height of the aedeagal flanges, the overall size and the absence of typical red abdominal coloration as in *testaceus*. The females of *elegans* are similar to the females of the *alagoezicus* group, *avidus* and many other species,

from which they can be distinguished by their frontal depression.

Period of flight and distribution (fig. 99). – M. *elegans* occurs from May to July in the western part of the Mediterranean.

Discussion. – Van der Goot (1964a) noticed differences among sets of specimens then considered to belong to *avidus*, and distinguished between types A and B. Examination of the genitalia showed that type B corresponded to *avidus* whereas type A was shown to be a new species, described here. The flight period coincides with that of *avidus* in the mediterranean region; the distribution of *elegans* is much more restricted than that of *avidus* and seems to be Mediterranean. As the species are very similar externally (*elegans* has longer, rougher pubescence on the thorax and more metallic lustre on face and femora 3, which is more swollen than in *avidus*) and their flight period overlaps, some of the *avidus* records in literature probably pertain to *elegans*.

Etymology. – The adjective *elegans* is latin, meaning well-formed, and refers to the slender habitus of the species.

Merodon manicatus (Sack)
(figs. 65 a-c, 98)

Lampetia manicata Sack, 1938: 21. Holotype ♂: 'Štip, v.1937, leg. R. Meyer/ *Lampetia manicata* Sack det. Sack' (HLMD) [examined].
Lampetia manicata; Sack 1938: 21.
Merodon manicatus; Peck 1988: 171.

Material examined. – Macedonia: ♀ Paratype with same labels as holotype (HLMD).

Description

Male. – Head: Antennae dark, antenna 3 ovoid, upper margin strongly convex, apex obtuse, antennal ratio 1.6; pubescence pale yellow with some dark pubescence in ocellar region; vertex angle 30°, ocellar angle 55°, tl-v ratio 0.35; face rather densely white pruinose; compound eyes bearing rather short, dense, white pubescence.

Thorax: The dorsum and scutellum showing weak olivaceous lustre laterally; same lustre stronger on katepisternum, anepisternum and anepimeron; longitudinal pruinose bands weak; pubescence golden, erect, moderately dense, even, slightly longer and paler laterally. Wings tinged overall; halteres, squamae and antisquamae pale yellow.

Legs: Dark, with some olivaceous lustre on femora 3; tibiae with yellow markings at both ends; tarsi dark, but with recumbent dense golden pubescence on lower face, strongest on tarsi 3; trochanter 3 with distinct sharp ridge, femora 3 strongly swollen, much curved, bearing normally shaped triangular processus bearing 7 bristles on moderately serrate distal margin.

Abdomen: Dark; T II with large orange lateral spots, continued on T III; T II-IV showing rather faint white pruinose arcuate bands best observed from behind, hardly interrupted medially; all S orange, bearing erect white pubescence; S IV darker, slightly keeled, deeply narrowly emarginate posteriorly; abdominal pubescence in general very sparse compared to other *Merodon*, concolorous with surface and very short medially.

Genitalia: The anterior surstyle lobe reniform, bearing dense short even yellowish pubescence anteriorly and ventrally, separated from the posterior surstyle lobe by a moderately deep sulcus; the posterior surstyle lobe with yellow pubescence, bearing distinct anteromedial accessory lobe with pubescence erect and long; main disc of posterior surstyle lobe bearing shorter pubescence, somewhat diamond-shaped. Cercus angular, with same pubescence as posterior surstyle lobe. Aedeagus moderately slender, bearing paired translucent, twice interrupted (artifact?) chitinous flange on outer face, apical shaft part slightly lengthened, fringed plates on thecal apex oblique; paired humps present basally on outer face.

Body length 11.5 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Head: Frons with lustrous midstripe occupying rather less than a quarter of the frontal width just above the antennae, but wider posteriorly; ocellar angle 60°. Thorax: Pruinose bands more clear due to shorter, less dense pubescence; sides much less lustrous than in male. Legs: The femora 3 less swollen, less curved, less lustrous. Abdomen: Predominantly orange; T V with dark median zone; pruinose bands widely interrupted; pubescence very sparse, even shorter than in male.

Body length 11 mm.

Diagnosis. – The males *manicatus* are distinguished from those of *bequaerti* by the much slenderer habitus and more rounded anterior surstyle lobe as well as the sparse pubescence; from those of *elegans* also by the rounded anterior surstyle lobe, and much smaller size; from those of *testaceus* by the less slender habitus of *manicatus* and its less tapering T II, and the more rounded anterior surstyle lobe; from all other species by the aedeagal flanges. The females of *manicatus* are slenderer than those of *elegans* and *bequaerti*, but are hard to separate from those of *testaceus*; they can however be distinguished by the more acute ocellar triangle with ocellar angle 60°, (70° in *testaceus*). From all other species they differ in the combination of ex-

tremely slender build, moderate size and red abdominal colour, which is of a quite different type than found in the *longicornis* group where the colour is deep crimson.

Period of flight and distribution (fig. 98). – The species occurs in Macedonia in May, and is currently known only from the types.

Merodon testaceus Sack
(figs. 66 a-c, 98)

Merodon testaceus Sack, 1913a: 445. Lectotype ♂ (here designated): 'Asia minor/ Alte Sammlung/ *Merodon testaceus* type Sack/ *testaceus* det. Sack' (NHMW) [examined].
Merodon testaceus; Paramonov 1925: 154; Peck 1988: 175.
Lampetia testacea; Sack 1931: 329, 1938: 21.

Material examined. – 3♂, 1♀ Paralectotypes, 'Asia Minor/ idae det. Schiner/ Alte Sammlung/ testaceus det. Sack' (NHMW); 2♀ Paralectotypes, 'Mann, Brussa [=Bursa, Turkey], 1863/ idae det. Schiner/ Alte Sammlung/ testaceus det. Sack' (NHMW).

Description

Male. – Head: Antennae orange to brown, antenna 3 with upper margin convex, apex obtuse, antennal ratio 1.8; vertex angle 25°, ocellar angle 35°, pubescence pale yellow, tl-v ratio 0.35.

Thorax: Dark, with pruinose bands inconspicuous; dorsum and scutellum dark, katepisternum, anepisternum and anepimeron blue metallic lustrous, pubescence rather sparse, short, whitish. Wings clear, halteres, squamae and antisquamae yellow.

Legs: The femora dark, tibiae dark with yellow markings at both ends, tarsi brown to yellow, in some specimens with faint dark band; trochanters 3 with conspicuous edge, femora 3 strongly swollen, curved, with normally shaped triangular processus bearing 6 stout bristles on rather weakly serrate distal margin with relatively large apical spurlet.

Abdomen: Slender; T II strongly tapering; predominantly orange to reddish brown, with clear arcuate narrowly interrupted white pruinose bands on T II-IV; S IV slightly keeled, deeply emarginate posteriorly. Genitalia: The anterior surstyle lobe bearing dense, short, yellow, even pubescence apically and on margins, with incision on dorsal margin, ridged laterally, separated from the posterior surstyle lobe; the posterior surstyle lobe with anterior accessory lobe bearing dense long yellow pubescence; main disc rather elongate, protruding far posteriorly, bearing rather dense yellow pubescence posteriorly. Cercus angular, with dense long yellow pubescence. Aedeagus moderately slender, bearing large paired humps subbasally on outer face as well as paired chitinous flanges; apical shaft part short, fringed plates on thecal apex recumbent.

Body length 10 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Head: Frons black, lustrous on median one-third, sides diffusely whitish pruinose, pubescence concolorous, ocellar angle 70°. Thorax: Pubescence notably short, pruinose bands more conspicuous.Legs: Femora 3 less swollen. Abdomen: Slightly stouter than in male, orange to brown throughout, pruinose bands slightly less conspicuous.

Body length 10.5 mm.

Diagnosis. – The males of *testaceus* can be distinguished from those of *bequaerti* by the less stout habitus, from males of *elegans* and *manicatus* by the lower aedeagal flanges, and from those of *elegans* by smaller size as well. Moreover, they differ from males of *manicatus* also by slenderer abdomen, less rounder antenna 3 and shorter thoracic pubescence. From all other *Merodon* they differ by the aedeagal flanges. The females can be distinguished by their red abdominal coloration, size and slender habitus from all species. The differences with females of *manicatus* are: the larger ocellar angle (70° here, 60° in *manicatus*) and the slightly greater antennal ratio (1.8 versus 1.6 in *manicatus*).

Period of flight and distribution (fig. 98). – *M. testaceus* occurs in Turkey; the flight period is unknown.

The *alagoezicus* group

Apomorphies: Apical shaft part lengthened in aedeagus of the ♂; fringed plates on thecal apex of aedeagus oblique to erect.

Description

Head: Antennae variably coloured but antenna 3 often paler than rest; face with often strong blue metallic lustre; pubescence yellow to whitish; vertex angle in the males 25-35°, ocellar angle in both sexes approximately 45°.

Thorax: Dark, with longitudinal pruinose bands on dorsum more or less clear; katepisternum, anepisternum and anepimeron often with very strong blue lustre. The females show 5 longitudinal pruinose bands.

Legs: The usual pattern of coloration is: femora dark, tibiae yellow with wide dark band and sometimes with distal spur, tarsi dark; the tarsi 3, especially basitarsi 3 often with dense golden recumbent pubescence on sides, contrasting dark pubescence on upper face; this contrast is less strong in the females.

Abdomen: Slender, T II strongly tapering, T IV often bulging to hold the relatively large genitalia in the males; usually slender, triangular in the females; pruinose bands strongly arcuate, the one on T IV in the males often recurving laterally; lateral portions of tergites often metallic lustrous.

Genitalia: The anterior surstyle lobe lengthened, extremely lengthened in some species; accessory lobes may be present on both main surstyle lobes. Cercus usually large, always well protruding. Aedeagus slender, invariably with extremely lengthened apical shaft part, outer face often with humps or plates; fringed plates on thecal apex suberect to erect.

Identification of females in the *alagoezicus* group. – Apart from the females of *satdagensis* which have been so assigned on the grounds of associated capture, the females in this group cannot be assigned to any species yet. As a group these females can be distinguished from those of other groups by the presence of 5 pruinose bands on the thorax (4 bands in other groups), relatively large size and slender, usually triangular abdomen.

Merodon alagoezicus Paramonov
(figs. 67 a, 68 a-d, 99)

Merodon alagoezicus Paramonov, 1925: 151. Syntypes ♂: 'Inaklu, Etschmiadzin, Erivan district, Armenia, Southern slope of Mount Alagöz' [not examined].
Merodon alagoezicus; Paramonov 1926a: 15;1926b: 318; 1927: 74; Liepa 1969: 20; Peck 1988: 166.
Lampetia alagoëcica; Sack 1931: 303 [orthographic error].

Material examined. – Greece: 3♂ (ZMUC); Turkey: 81♂ (JLR, WH, BMNH).

Description

Male. – Head: Antennae brown to pale brown, antenna 3 palest, with upper margin convex, apex obtuse, antennal ratio 1.7; pubescence pale yellow, conspicuously dense on frons; face strongly blue metallic lustrous, sparsely pruinose throughout; vertex angle 30°, ocellar angle 40°, tl-v ratio 0.65; compound eyes bearing inconspicuous pale pubescence.

Thorax: Dark; blue lustrous on lateral dorsum and scutellum, katepisternum anepisternum and anepimeron; pubescence rather even, moderately long, pale yellow on dorsum, longer and less even on sides; in many specimens vague dark interalar band present; longitudinal pruinose bands vestigial to well-defined. Wings clear; halteres, squamae and antisquamae yellow.

Legs: The femora dark with narrow paler apices; tibiae dark with yellow apices and, in most specimens, yellow bases; tarsi dark, golden pubescence on sides and lower face, upper face dark; trochanter 3 with inconspicuous low ridge, femora 3 swollen, slightly curved, with normally shaped triangular processus bearing 6-9 bristles on serrate distal margin; tibiae 3 with distal outer angle much projecting, spur-like; tarsi 3 normally shaped.

Abdomen: Dark; T II tapering, bearing yellow to orange lateral spots with deep lanceolate postero-lateral dark indention; T II-IV with arcuate interrupted moderately wide pale pruinose bands, on T IV recurving laterally; pubescence mainly pale, with some dark pubescence on dark surface in most specimens; S IV widely, rather acutely emarginate posteriorly up to two-thirds of its length.

Genitalia: Anterior surstyle lobe ventro-posteriorly recurved, enormously elongate, its apical portion showing dense, even, yellow, short pubescence; the posterior surstyle lobe coalescent, rather low, with moderately dense, yellow, erect pubescence along entire medio-apical margin and posteriorly. Cercus large, rounded, showing dense, long, erect, yellow pubescence. Aedeagus smooth, with paired recumbent chitinous plates on outer face guarding the subapical cavity; apical shaft part long, the fringed plates on thecal apex erect.

Body length 12-15 mm.

Female. – Unknown (see preceding observation).

Diagnosis. – In view of the curious genitalia *alagoezicus* can be confused with *lucasi* only; from that species it is distinguished by the projection at the distal outer angle of tibiae 3 and the lack of a semicircular projection on the posterior surstyle lobe; *alagoezicus* can be easily distinguished from the other members of this group by the much longer anterior surstyle lobe.

Period of flight and distribution (fig. 99). – The species occurs from June through August in southeastern Europe, Turkey and Armenia.

Biology. – Specimens have been collected in wet grassland on white- and yellow-flowering Umbelliferae; the majority of the specimens was collected in mountains at altitudes over 1500 metres.

Merodon lucasi sp. n.
(figs. 67 d, 69 a-c, 102)

Type-material: ♂ Holotype 'Turkey, Hakkari, Suvarihalil pass 2300-2400 m, 11.viii.1983, leg. J. A. W. Lucas' (ZMAN). Paratypes: 22♂: 8♂ with same data as holotype (JLR); 4♂ 'Turkey, Konya 1300 m, 5/6.viii.1981, leg. H. Coene et al.' (JLR); 1♂ 'Turkey, Hakkari, Suvarihalil pass 2.viii.1982 M. Kuhbandner' (JLR); 2♂ 'Turkey Pr. Hakkari Suvarihalil Pass SE Beytisebap 2300 m 2.viii.1982 and

27.vi.1985 W. Schacht (JLR); 1♂ 'Turkey, Kars, Handere 20 km W. Sarıkamış 2100 2200 m, 1.viii.1983 leg. J. A. W. Lucas' (JLR); 2♂ 'Turkey, Hakkari, Suvarihalil pass 2300 m 27.vi.1985 C. J. Zwakhals (JLR); 1♂ 'Turkey, Hakkari S of Yüksekova, Sat Dağlari 1700 m 28.vi.1985 leg. W. Schacht (JLR); 1♂ 'Turkey, Hakkari, Varegös Sat Dağlari 1700 m 29.vi.1985 W. Schacht' (JLR); 1♂ 'Turkey, Hakkari, Habero Deresı valley 1200 m 25.vi.1985 W. Schacht (JLR); 1♂ 'Turkey, Erzurum, Palandöken Dagi 2300 m 11.vii.1986 leg. J. A. W. Lucas' (JLR).

Description

Male. – Head: Antennae dark, antenna 3 with upper margin concex, apex obtuse to subacute, antennal ratio 1.4; vertex angle 35°, ocellar angle 45°, tl-v ratio 0.6, pubescence pale yellow, denser on frons where causing silky lustre; face bronze to blue lustrous, sparsely white pruinose.

Thorax: Dark; blue lustrous on katepisternum, anepisternum, anepimeron and (less strong) on lateral scutellum and dorsum; pubescence pale brown to yellow, moderately dense; pruinose bands inconspicuous, the median bands clearest; a fifth anteromedian band often present; these bands often cross-connected along dorsal suture. Wings clear; halteres, squamae and antisquamae pale yellow.

Legs: Dark with yellow markings on femoral apices and both ends of tibiae; trochanter 3 with low but well marked sharp ridge; femora 3 swollen, curved, triangular processus bearing 7-9 bristles on weakly serrate distal margin with clear apical pedestal; tibiae 3 with apical outer angle projecting slightly, tarsi 3 normally shaped.

Abdomen: Dark; slender; T II strongly tapering, T IV bulging; T II with conspicuous orange lateral spots, T II-IV with arcuate interrupted moderately wide, well bordered white pruinose bands; pubescence concolorous but many pale yellow hairs mixed in laterally and posteriorly on T III-IV, densest on lateral spots; S IV widely acutely emarginate up to half its length.

Genitalia: Anterior surstyle lobe ventro-posteriorly recurved, enormously elongate, apically with dense even short yellow pubescence; the posterior surstyle lobe coalescent, anteriorly showing semicircular ventral projection and bearing yellow moderately dense erect pubescence. Cercus large, quadrate, with dense, long, yellow pubescence. Aedeagus rather slender, with paired humps on basal outer face and bearing chitinous plates guarding subapical cavity, apical shaft part long, fringed plates on thecal apex narrow, long, erect.

Body length 11-15 mm.

Female. – Unknown (see preceding observation).

Diagnosis. – *M. lucasi* can be distinguished from the other members of the *alagoezicus* group by the much longer anterior surstyle lobe, and moreover from *alagoezicus* by the semicircular plate on the posterior surstyle lobe and by having no large spur on tibiae 3.

Period of flight and distribution (fig. 102). – The species is known from Turkey where it was collected in June and August.

Etymology. – It is a pleasure to dedicate this species to Jan Lucas who collected an enormous amount of specimens which were generously placed at the author's disposal. A noun in genitive case.

***Merodon nitidifrons* sp. n.**
(figs. 70 a-d, 101)

Type-material: ♂ Holotype 'Turkey, Hakkari, Suvarihalil pass 2300 m [37° 25' N, 43° 03' E], 13.vi.1984, leg. J. A. W. Lucas' (ZMAN).

Description

Male. – Head: Antennae orange, antenna 3 with convex darkened upper margin, apex subacute, antennal ratio 1.3; vertex angle 25°, ocellar angle 35°, tl-v ratio 0.55; pubescence yellow, densest and recumbent on frons where causing silky lustre; face densely white pruinose over blue metallic surface; some dark pubescence present in ocellar region.

Thorax: Dark, blue lustrous on katepisternum, anepisternum and anepimeron, lateral dorsum and scutellum; conspicuous longitudinal bands on dorsum in two pairs and a fainter anteromedian band; pubescence dull golden, moderately dense, most even. Wings clear; halteres, squamae and antisquamae yellow.

Legs: Dark but femoral apices and both ends of tibiae orange; trochanters 3 smooth, femora 3 slightly swollen, triangular processus rather low, bearing 4-6 rather weak bristles on hardly serrate distal margin; tibiae 3 with distal outer angle somewhat projecting.

Abdomen: Slender, T II much tapering, T IV bulging; T II-III with pale orange lateral spots, T II-IV with arcuate rather wide pale pruinose bands (interrupted on II-III, continuous and laterally recurved on IV), pubescence concolorous; on closer examination T IV shows small orange anterolateral spots.

Genitalia: The anterior surstyle lobe much elongate, narrow, evenly wide throughout, apically recurved medially and bearing dense, short, even, yellow pubescence; basally bearing accessory lobe on medial face; this lobe is visible as a ridge in lateral view and has same pubescence as apical anterior surstyle lobe part; the posterior surstyle lobe coalescent, moderately high, elliptical, bearing moderately dense

long yellow pubescence in strip along margins. Cercus wide, with long, dense, somewhat wavy, yellow pubescence. Aedeagus very slender, bearing paired chitinous plates guarding subapical cavity, apical shaft part long, fringed plates on thecal apex suberect.

Body length 15.5 mm.

Female. – Unknown. (see preceding observation)

Diagnosis. – *M. nitidifrons* is easily distinguished from other members of the *alagoezicus* group by the ribbon-shaped, medially recurved anterior surstyle lobe.

Period of flight and distribution (fig. 101). – This species is known only from the holotype, collected in eastern Turkey in June.

Etymology. The epitheton *nitidifrons* derives from the latin nitere, to shine, and frons, a part of the head so indicated, and refers to the silky lustrous frons. It is to be treated as a noun in apposition.

***Merodon satdagensis* sp. n.**
(figs. 67 c, 71 a-c, 101)

Type-material: ♂ Holotype 'Turkey, Hakkari, Suvarihalil pass 2300 m, SE Beytisebap 2.viii.1982 leg. W. Schacht' (ZMAN). Paratypes: 31♂, 2♀; 2♂ with same data as holotype (JLR); 5♂ topotypic, 4.viii.1982, leg. J. A. W. Lucas (JLR) 5♂ topotypic, 11.viii.1983, leg. J. A. W. Lucas (JLR); 3♂ 'Turkey, Hakkari, Varegös S. of Yüksekova 1700 m 29.vi.1983 leg. W. Schacht' (JLR); 12♂ from same locality, 5-8.viii.1983, leg. Schacht (JLR), 1♂, 2♀ from same locality, 5-8.viii.1983, leg. Lucas (JLR); 1♂ 'Turkey, Hakkari, Sat Dağ, North of Mt. Gavaruk 2900 m, 7.viii.1983 leg. Kl. Warncke' (JLR); 1♂ 'Turkey, Hakkari, Habur Deresı S. of Yüksekova, 26.vi.1985, leg. Schacht' (JLR); 1♂ 'Turkey, Hakkari, S of Yüksekova 1700 m, 28.vi.1985, leg. W. Schacht' (JLR).

Description

Male. – Head: Antennae dark orange to brown, antenna 3 paler, upper margin convex, apex obtuse, antennal ratio 1.3, vertex angle 35°, ocellar angle 45°; pubescence yellowish white, rather dense on face and frons; face and vertex blue metallic lustrous, moderately dense white pruinose; tl-v ratio 0.3.

Thorax: Dark, katepisternum, anepisternum anepimeron, lateral dorsum and scutellum blue to green or slate grey lustrous; two pairs of narrow longitudinal pruinose bands present; pubescence pale brown to yellow, moderately dense, rather even. Wings clear; halteres, squamae and antisquamae pale yellow.

Legs: Dark, but tibiae yellow with wide dark distal band, femora apically yellow in most specimens; trochanters 3 smooth, femora 3 swollen, curved, triangular processus normally shaped, bearing 7-9 bristles on serrate distal margin; tibiae 3 apically with spurlike outer angle.

Abdomen: Dark, slender, T II strongly tapering,- with large pale yellow lateral spots; T II-IV with moderately wide interrupted (continuous on T IV) whitish strongly arcuate well bordered pruinose bands, sometimes combined with red surface coloration; T IV bulging; pubescence concolorous but many pale hairs prsent throughout; S IV deeply widely emarginate, strongly vaulted; T IV posteriorly pruinose.

Genitalia: The anterior surstyle lobe much elongate, apical part recurved, dorso-ventrally aligned, with subbasal ventral accessory lobe; both apical part and this lobe short dense erect even yellow pubescence; the anterior and posterior surstyle lobes separated by shallow sulcus; posterior surstyle lobe elongate, twisted, with long, yellow pubescence posteriorly and along medial distal margin. Cercus large, elongate, with denser pubescence than posterior surstyle lobe. Aedeagus extremely long, slender, bearing paired chitinous flanges guarding subapical cavity which due to extreme length of apical shaft part is situated halfway up the aedeagus; fringed plates on thecal apex erect, rather long and narrow.

Body length 12-15 mm.

Female. – Except for sexual dimorphism, differing from the male as follows. Head: Lustrous midstripe on frons occupying 1/4 of width; ocellar angle 45°, antennae with third article darkest. Thorax: Pubescence shorter, more even, a fifth anteromedian pruinose band present. Legs: the spurlet on tibiae 3 lacking. Abdomen: T II less tapering, lateral spots larger, pruinose bands less wide; T IV posteriorly pruinose.

Body length 13 mm.

Diagnosis. – *M. satdagensis* males will be easily distinguished by the long anterior surstyle lobe with subbasal accessory lobe and twisted posterior surstyle lobe. The females are very similar to other females of species in this group; they can preliminarily be distinguished from those of other species by the strongly serrate triangular processus; see preceding observation.

Period of flight and distribution (fig. 101). – *M. satdagensis* is known from south-eastern Turkey where it occurs late in June and in August. The known range of the species is restricted to the Sat Mountains in the Turkish province of Hakkari near the Iranian and Iraqi borders.

Discussion. – The females have been assigned to *satdagensis* given their concurrent flight in the same biotope at Varegös in the Sat mountains of eastern Turkey; moreover the much serrate triangular proces-

sus in these females occurs in males of only two species of the *alagoezicus* group, viz. *satdagensis* and *taniniensis*, of which the latter is stouter, much lighter coloured and in the possession of much wider abdominal pruinose bands; the females concerned being relatively dark and slender were assigned to *satdagensis*.

Etymology. – The epitheton is an adjective, and named after the Sat Dağlari, a mountain range in south-eastern Turkey.

***Merodon schachti* sp. n.**
(figs. 67 b, 72 a-c, 100)

Type-material: ♂ Holotype 'Turkey, Hakkari, Suvarihalil pass 2300 m, 2.viii.1982 leg. W. Schacht' (ZMAN). Paratypes: 9♂; 2♂ topotypic, 11.viii.1983 leg. J. A. W. Lucas (JLR); 1♂ topotypic, 13.vi.1984 leg. Lucas (JLR); 1♂ 'Turkey, Hakkari, Tanin-Tanin pass 1700 m (W side near Habul Deresı) 12.vi.1984 leg. Lucas' (JLR); 3♂ from same locality, 25.vi.1985 leg. W. Schacht (JLR), 1♂ from same locality, 25.vi.1985 leg. C. J. Zwakhals (JLR); 1♂ 'Turkey, Hakkari, Habur Deresı valley 26.vi.1985 1700 m leg. Schacht' (JLR).

Description

Male. – Head: Antennae orange-brown, antenna 3 slightly paler, upper margin convex, apex obtuse, not rounded, antennal ratio 1.3; pubescence whitish, densest on frons; face blue metallic lustrous, diffusely white pruinose (densest medially); vertex angle 25°, ocellar angle 40°, tl-v ratio 0.4.

Thorax: Dark, blue lustrous on katepisternum, anepisternum and anepimeron, lateral dorsum and scutellum; pruinose bands on dorsum in anteriorly coalescent pairs, narrow; pubescence sparse, pale brown to yellow. Wings clear; halteres, squamae and antisquamae pale yellow.

Legs: Dark with yellow markings on apices of femora and both ends of tibiae; trochanter 3 smooth, femora 3 swollen, somewhat curved, triangular processus bearing 7-9 bristles on slightly serrate distal margin (less serrate than in *satdagensis* but more than in *alagoezicus*); tibiae 3 with distal outer angle extended, tarsi 3 normally shaped.

Abdomen: Dark: slender; T II strongly tapering, T IV bulging, T II-III with large and small orange lateral spots respectively; T II with weak, T III-IV with strong whitish interrupted arcuate pruinose bands, the one on T IV recurved laterally; posterior margins of T III-IV pruinose; pubescence pale, but strictly dark on posterior, dark surface of T III; S IV acutely emarginate posteriorly up to 3/4 its length or even more.

Genitalia: Anterior surstyle lobe very elongate, recurved apically, there dorso-ventrally aligned, apically bearing dense, yellow, short, even pubescence; anterior surstyle lobe coalescent with gradually rising posterior surstyle lobe elongate, low, and bearing moderately long, yellow pubescence along its distal margin and posteriorly; posterior surstyle lobe laterally guarded by a free chitinous plate basally attached to the surstyle base; this plate has a distinct antero-ventral angle and a lateral approximately dorso-ventral ridge and posteriorly shows dense yellow pubescence. Cercus large, with dense, long, erect, yellow pubescence. Aedeagus quite robust, apical shaft part lengthened much, fringed plates on thecal apex erect, long and narrow, some scattered short pubescence present on inner face.

Body length 13 mm.

Female – Unknown (see preceding observation).

Diagnosis. – *M. schachti* can hardly be confused with any other species given the very conspicuous lateral guarding plate alongside the posterior surstyle lobe in the males; moreover, the robust aedeagus separates it from other species in the *alagoezicus* group.

Period of flight and distribution (fig. 100). – The species is known exclusively from the south-easternmost region of Turkey where it has been collected in June and August.

Etymology. – The species is named after the collector of the type, the German entomologist Dr. Wolfgang Schacht, of Munich. A noun in genitive case.

***Merodon taniniensis* sp. n.**
(figs. 73 a-c, 100)

Type-material: ♂ Holotype 'Turkey, Hakkari, Tanin-Tanin pass W. side 1700 m, 12.vi.1984 leg. J. A. W. Lucas' (ZMAN). Paratypes: 6♂; 2♂ with same data as holotype (JLR); 2♂ 'Turkey, Hakkari, Tanin-Tanin pass E Uludere 2300 m 25.vi.1985 leg. W. Schacht' (JLR); 1♂ 'Turkey, Hakkari, Suvarihalil pass near Habul Deresı 1250 m 13.vi.1984 leg. Lucas' (JLR); 1♂ 'Turkey, Malatya, Sarıhacı 45 km W. Malatya 21.vi.1984 leg. Lucas' (JLR).

Description

Male. – Head: Antennae brown, antenna 3 with upper margin convex, apex obtuse, antennal ratio 1.6, pubescence whitish pale yellow throughout; vertex angle 25°, ocellar angle 45°, tl-v ratio 0.4; face blue metallic lustrous, densely white pruinose.

Thorax: Dark, lustrous on katepisternum, anepisternum, anepimeron and lateral dorsum and scutellum; dorsum showing 5 pruinose bands; pubescence yellow, very even, moderately dense. Wings clear; halteres, squamae and antisquamae pale yellow.

Legs: Dark but tibiae yellow with wide dark distal band; trochanter 3 with low sharp ridge, femora 3 swollen, curved, triangular processus bearing 6-8 bristles on somewhat serrate distal margin.

Abdomen: Slender; T II strongly tapering, T IV bulging, predominantly orange, with connected anterior and posterior dark lunules on T II and weaker brown medial coloration on T III; posterior lunules on T III-IV pale brown to orange; T II-IV bearing rather wide strongly arcuate, interrupted to continuous whitish pruinose bands (recurved on T IV); pubescence pale yellow, moderately dense (also on dark surface); all S orange, S IV widely, obtusely emarginate, slightly vaulted.

Genitalia: The anterior surstyle lobe large, rather quadrate, slightly bifid anteriorly, bearing dense short erect yellow even pubescence; connected by a slender stalk to the base of the posterior surstyle lobe, a deep narrow sulcus separating from the apical part; the posterior surstyle lobe twisted, bearing two apical ridges, both bearing long, erect, yellow, sparse pubescence, posterior part of posterior surstyle lobe with dense pubescence. Cercus large, mainly hidden between the elongate posterior parts of the posterior surstyle lobes, with dense, long, yellow pubescence. Aedeagus slender, apical shaft part lengthened, ring paired chitinous plates guarding subapical cavity (these plates do not resemble those found in the *elegans* group); fringed plates on apex aedeagi erect, long and rather narrow.

Body length 14-16 mm.

Female. – Unknown (see preceding observation).

Diagnosis. – *M. taniniensis* can be distinguished from other species of the *alagoezicus* group by the relatively very large, rather quadrate anterior surstyle lobe and the double ridges on the posterior surstyle lobe.

Period of flight and distribution (fig. 100). – Known from the central and southern parts of eastern Turkey where it has been collected in June.

Etymology. – The epitheton *taniniensis*, an adjective, refers to the Tanin-Tanin pass, the type locality of the species in south-eastern Turkey.

***Merodon toscanus* sp. n.**
(figs. 74 a-c, 99)

Type-material: ♂ Holotype 'Italia Toscana, Careggi (Firenze) 19-21.v.1986 W. Hurkmans' (ZMAN).

Description

Male. – Head: Antennae brown, antennae 3 with upper margin convex, apex obtuse, antennal ratio 1.6, vertex angle 20°, ocellar angle 35°; pubescence pale yellow, face metallic blue lustrous, densely whitish pruinose; a dark hair tuft present in ocellar region.

Thorax: Dark, metallic lustrous on katepisternum, anepisternum, anepimeron, lateral dorsum and scutellum; pubescence dull yellow, even, rather sparse; two pairs of rather faint pruinose bands present. Wings clear, halteres, squamae and antisquamae pale yellow.

Legs: All femora dark brown, tibiae orange with distal wide dark bands, tarsi deep orange to brownish; trochanter 3 smooth, femora 3 rather strongly swollen, curved, triangular processus bearing 7 bristles on weakly serrate distal margin.

Abdomen: Rather slender; T II tapering; T IV bulging; colour mainly deep orange, T II bearing connected anterior and posterior dark lunules, T III with deep orange posterior and paler anterior part, T IV deep orange throughout; T II-IV with arcuate moderately wide pruinose bands, just interrupted on T II-III, continuous and laterally recurved on T IV; all S orange, S IV with drop-shaped emargination, strongly vaulted.

Genitalia: Anterior surstyle lobe elongate, rounded, bifid anteriorly, bearing dense short erect yellow even pubescence throughout (sparser posteriorly); connected to base of posterior surstyle lobe by a short stalk; the posterior surstyle lobe low, elongate, bearing an accessory lobe with dense long erect pubescence medially; its anterior part bald, lustrous, approximately ovoid, its posterior part with sparse yellow pubescence, but denser on margins and posteriorly. Cercus large, with dense, erect, yellow, long pubescence. Aedeagus very slender, with large paired basal humps on outer face; apical shaft part much lengthened; fringed plates on thecal apex suberect, rather narrow.

Body length 12 mm.

Female. – Unknown (see preceding observation).

Diagnosis. – *M. toscanus* has an accessory lobe on the posterior surstyle lobe and a bald anterior part of the posterior surstyle lobe not found in the other species of the *alagoezicus* group. The bifid anterior surstyle lobe is much stronger than in *taniniensis*.

Period of flight and distribution (fig. 99). – The unique holotype was collected in May in Toscana, Italy.

Etymology. – The species has been named after Toscana, the region where the holotype was collected. An adjective.

REMAINING SPECIES

Two of the three species discussed under this heading are known only after female specimens. Since these species share character states considered apomorphic for some species treated in this paper, they are discussed here. Of the third species, *M. viaticus* no material was examined, but according to its description it might occupy a position close to some of the species treated in this paper.

Merodon affinis Gil Collado

Merodon affinis Gil Collado, 1930: 243, 255. Holotype ♀: 'Escorial, Arias Encobet, vii.1905' [probably El Escorial, Madrid] (IEE) [examined].
Merodon affinis; Peck 1988: 166.

Description

Female. – In many respects the female *affinis* is similar to *avidus*, with following differences. Head: According to the original description, antenna 3 slightly curved, antennal ratio 2.0, apex acute (antenna 3 missing on the holotype on both sides). Legs: Femora 3 with distal margin of triangular processus much stronger serrate than in *avidus*. Abdomen: Outline triangular, pruinose bands narrowly interrupted, less arcuate than in *avidus*.

Body length 12 mm.

Male. – Unknown.

Discussion. – Because of several differences in the females, *affinis* cannot simply be regarded a synonym of *avidus*, especially not in absence of the males. The status of this species remains uncertain. In view of the mentioned similarities with the females of *avidus*, *affinis* could conceivably belong to the *avidus* group but to e.g. the *alagoezicus* or *nigritarsis* group as well.

Period of flight and distribution. – Known only from the holotype, collected in central Spain in July.

Merodon aureotibia sp. n.
(fig. 106)

Type-material: ♀ Holotype 'Turkey, Adiyaman, Nemrut Dağları, 1.vi.1983, leg. M. Kuhbandner' (ZMAN). Paratypes: 3♀ 'Tk [Turkey] 5-6-1988 10 km S. Ankara leg. Warncke' (JLR).

Description

Female. – Head: Antennae bright orange, antenna 3 rather broad in outline, apex subacute, upper margin straight, arista long, suddenly tapering, antennal ratio 2.8; pubescence golden; lustrous midstripe occupying 1/3 of width, ocellar region showing dark pubescence; ocellar angle 70°, lateral ocelli larger than central ocellus; pubescence on compound eyes rather thin, whitish.

Thorax: Rather narrow, black with weak bluish lustre on katepisternum, anepisternum, anepimeron, lateral scutellum and dorsum, with four longitudinal yellow pruinose bands on dorsum, coalescent anteriorly; pubescence rather short, erect, uneven, golden yellow, but darker, brownish in interalar band. Wings clear; halteres, squamae and antisquamae pale yellow.

Legs: All orange except coxae and trochanteres brownish; femora 3 swollen, rather straight, bearing 6 bristles on normal triangular processus.

Abdomen: Rather slender, dark with micaceous lustre; T II bearing large orange lateral spots, T II-IV with slightly arcuate, moderately wide, interrupted, golden pruinose bands combined with golden pubescence; pubescence concolorous otherwise, but yellow laterally and on posterior fringe of T III-IV; T V far projecting, rounded posteriorly.

Body length 11 mm.

Male. – Unknown.

Diagnosis. – *M. aureotibia* can be distinguished from all other females of *Merodon* by its extensively orange leg coloration.

Period of flight and distribution (fig. 106). – This species occurs in June in central and south-eastern Turkey.

Discussion. – In view of the unique leg coloration, the narrow thorax and striking golden pubescence on especially head and abdomen *aureotibia* has been described as a new species. It is reminiscent of females of *aberrans* but differs from it by the leg colour, shape and colour of the antennae, narrower thorax and conspicuous orange lateral spots on T II. Moreover the femora 3 in *aureotibia* are more swollen.

In the coloration of the legs the females of *aureotibia* resemble *vandergooti*, known only after males. Reasons for not considering *aureotibia* as the female sex of *vandergooti* are: (1) *aureotibia* has obtuse antennae, orange and slightly swollen hind femora, arcuate pruinose bands not obliquely placed and a serrate distal triangular processus margin with 6-7 bristles, (2) *vandergooti* has acute antennae, dark and enormously swollen hind femora, oblique bands and a hardly serrate distal triangular processus bearing 10-13 bristles.

These differences are far too great and of a wrong type to be considered as sexual dimorphism.

In view of the slender habitus, relatively long antenna 3 with suddenly tapering arista, *aureotibia* might possibly be related to the *longicornis* group. However, none of the species in that group has

orange legs and relatively wide pruinose bands, whereas *aureotibia* lacks the typical crimson abdominal colour of the *longicornis* group.

Merodon viaticus Fabricius

Merodon viaticus Fabricius, 1805: 197. Lectotype, sex unknown (here designated): 'viaticus', [the upper half of a thorax with basal wing fragments attached] in Sehestedt & Tønder Lund coll. (ZMUC) [examined].
Merodon viaticus; Wiedemann *in* Meigen 1822: 364; Macquart 1828: 296; Rondani 1845: 258; Walker 1849: 598; Schiner 1857: 414.
Lampetia viatica; Sack 1931: 327.

Material examined. – Paralectotype, sex unknown '*viaticus*' [part of a thoracic dorsum] in Kieler coll. (ZMUC).

Description

The size of the thoracic dorsum indicates an overall size of about 12 mm. The background coloration is dark, pubescence largely rubbed off, but where remaining, erect and whitish; pruinose bands rather clear. Wing fragments clear, brown veined.

Discussion. – The original description by Fabricius (1805) does not mention the sex of the fly described. As however a dark median line on the frons is mentioned it must have been a female. The habitus should be similar to that of *annulatus* which is a synonym of *natans*. Stated differences with *viaticus* are the all dark abdomen in *natans* (with a red base in *viaticus*), the all dark legs and smaller size, averaging 9 mm for *natans*.

Wiedemann (in Meigen 1822) gives an extensive description of *viaticus*, in which the abdomen is said to be red on T I II and anterior T III; size is given by Wiedemann as 5 to 6 lines, i. e. 10.5 to 12.2 mm. Wiedemann's description is considered to include both sexes as he comments on differences in the colour of antennae and tarsi between sexes.

Some specimens from Sicily, leg. Schiødte, labelled 'viaticus', without any further data (ZMUC) have been re-identified as *elegans* sp. n.; differences with the description of *viaticus* are the size (14 mm), much swollen femora 3 (not mentioned in either of the descriptions); legs yellow, not reddish or rusty brown-yellow as in the descriptions; abdomen dark brown with extensive yellow coloration, not red, orange or purplish as in descriptions.

M. viaticus is assigned a place in the section of *Merodon* containing the species with arcuate pruinose bands since these are mentioned in the original description.

As there are no females of species in this section of *Merodon* with a cupreous lustre on the abdomen and at the same time partially dark, partially orange legs, *viaticus* cannot be synonymized with any of the species. It was listed by Sack (1931: 327) as a synonym of *spinipes* (=*avidus*); no reasons for this synonymy were given.

Annotated list of species discussed in this paper

Abbreviations used to describe status: H = Holotype examined; ? = Type material not located, not examined; S = syntype(s) examined; P = paratype(s) examined; L = lectotype examined (here designated); PL = paralectotype(s) examined.

	Deposition	Status	Ann
***distinctus* assemblage**			
biarcuatus Curran, 1939	AMNH	H	–
clunipes Sack, 1913	ZMHB	H	–
distinctus Palma, 1863	?	?	1
dimorphus (Szilady, 1940) syn. n.	TMA	[lost]	2
femoratus Sack, 1913	?	S?	3
mariae sp. n.	ZMAN	H, P	–
ottomanus sp. n.	ZMAN	H, P	–
testaceoides sp. n.	RMNH, ZMAN	H, P	–
***alexeji* group**			
alexeji Paramonov, 1925	PC	[lost]	4
altinosus sp. n.	ZMAN	H	–
hirsutus Sack, 1913	NHMW	L, PL	–
hypochrysos sp. n.	ZMAN	H, P	–
kawamurae Matsumura, 1916	?		5
micromegas (Hervé-Bazin, 1929) syn. n.	MNHN, BMNH	L, PL	5
marginicornis sp. n.	ZMAN	H	–
rufitarsis Sack, 1913 stat. nov.	ZMHB	H	–
sophron sp. n.	BMNH	H	–
tener Sack, 1913	DEIC	L, PL	6
trizonus (Szilady, 1940)	TMA	[lost]	2
***tarsatus* group**			
ankylogaster sp. n.	RMNH	H, P	–
auronitens sp. n.	ZMAN	H	–
caudatus Sack, 1913	FIS	[lost]	3
oidipous sp. n.	ZMAN	H, P	–
persicus sp. n.	RMNH	H	–
tangerensis sp. n.	MNHN	H	–
tarsatus Sack, 1913	ZMHB	H	–
smirnovi Paramonov, 1926 syn. n.	PC	[lost]	4
turkestanicus Paramonov, 1926	PC	[lost]	4
xanthipous sp. n.	ZMAN	H, P	–
***clavipes* group**			
aberrans aberrans Egger, 1860	NHMW	L, PL	–
knerii Mik, 1867	NHMW?	S?	–

obscuripennis Palma, 1863	?	S?	1
aberrans ssp. *flavitibius* Paramonov, 1925	PC	[lost]	4
aberrans ssp. *isperensis* ssp. n.	ZMAN	H, P	–
brevis Paramonov, 1925	PC	H	–
clavipes (Fabricius, 1781)	ZMUC	L	
canipilus Rondani, 1865	LSF	L	–
clauda (Villers, 1789)	?	?	7
curvipes (Gmelin, 1790)	?	?	8
gravipes (Rossi, 1790)	?	?	9
sacki Paramonov, 1937 syn. n.	ZSMB	L, PL	–
senilis Meigen, 1822	MNHN	L	–
clavipes var. *albus* Paramonov, 1927	PC	[lost]	4
clavipes var. *ater* Paramonov, 1927	PC	[lost]	4
clavipes var. *niger* Paramonov, 1927	PC	[lost]	4
cupreus sp. n.	ZMAN, JLR	H, P	–
dzhalitae Paramonov, 1926	PC	[lost?]	4
hamifer Sack, 1913	NHMW, DEIC	L, PL	–
karadaghensis Zimina, 1989	Moscow	–	–
lusitanicus sp. n.	ZMAN, JLR	H, P	–
quadrinotatus (Sack, 1931)	FIS	[lost]	3
splendens sp.n.	LAU	H	–
velox Loew, 1862	NHMW	L, PL	–
velox var. *anathema* Paramonov, 1925	PC	[lost]	4
velox var. *armeniacus* Paramonov, 1925	PC	[lost]	4
warnckei sp. n.	ZMAN, JLR	H, P	–
***pruni* group**			
pruni (Rossi, 1790)	ZMHB	[lost]	9
fulvus Macquart, 1834	?	?	10
fuscinervis Von Röder, 1887	?	?	10
pallida Macquart, 1842	MNHN	L, PL	–
sicanus Rondani, 1845	LSF	L, PL	–
pruni var. *obscurus* Gil Collado, 1929	IEE	H	–
***longicornis* group**			
erivanicus Paramonov, 1925	PC	[lost]	4
kaloceros sp. n.	ZMAN, JLR	H, P	–
longicornis Sack, 1913	NHMW	L	–
***vandergooti* group**			
vandergooti sp. n.	ZMAN, JLR	H, P	–
***nigritarsis* group**			
femoratoides (Paramonov, 1925) comb. n.	ZMHB	L, PL	4
nigritarsis Rondani, 1845	LSF	L, PL	–
***avidus* group**			
avidus (Rossi, 1790)	ZMHB	[lost]	9
spinipes (Fabricius, 1794)	ZMUC	L	11
serrulatus Wiedemann *in* Meigen, 1822	NHMW	L	–
italicus Rondani, 1845	LSF	L, PL	–
rufitibius Rondani, 1845	LSF	L, PL	–
graecus Walker, 1852	BMNH	L	–
aurifer Loew, 1862	ZMHB	L	–
quadrilineatus Lioy, 1864 nom. nud.	–		12
***crassifemoris* group**			
crassifemoris Paramonov, 1925 comb. n.	PC	[lost]	4, 13
***elegans* group**			
bequaerti sp. n.	MNHN	H, P	–
elegans sp. n.	ZMAN e. a.	H, P	14
manicatus (Sack, 1938)	HLMD	H, P	–
testaceus Sack, 1913	NHMW	L, PL	–
***alagoezicus* group**			
alagoezicus Paramonov, 1925	PC	[lost]	4
lucasi sp. n.	ZMAN, JLR	H, P	–
nitidifrons sp. n.	ZMAN	H	–
satdagensis sp. n.	ZMAN, JLR	H, P	–
schachti sp. n.	ZMAN, JLR	H, P	–
taniniensis sp. n.	ZMAN, JLR	H, P	–
toscanus sp. n.	ZMAN	H	–
Remaining species			
affinis Gil Collado, 1930	IEE	H	–
aureotibia sp. n.	ZMAN	H	–
viaticus (Fabricius, 1805)	ZMUC	L, PL	15

Annotations

1. The types from the Palma collection have not been located. The descriptions and drawings provided by Palma (1863) of *obscuripennis* and *distinctus* are extensive enough to be used for diagnostic purposes. Sack (1931) has been followed in considering *obscuripennis* synonymous with *aberrans*.

2. The type-material, formerly at TMA, is lost (Dr. A. Dély-Draskovits, in litt.).

3. The holotypes of *caudatus* and *quadrinotatus*, and the syntypes of *M. femoratus*, all formerly in Sack's private collection, were bequeathed to the Forschungsinstitut Senckenberg, Frankfurt/ Main. According to Dr. W. Tobias, curator of Syrphidae in the said museum, no Sack types of any *Merodon* are currently there. When Sack left his collection to SMF the material was presumably still stored in his own house which was plundered shortly after World War II. All Sack types of *Merodon* left to the Senckenberg Museum are therefore to be considered lost.

4. Many type-specimens from the S. J. Paramonov collection have not been located. According to Liepa (1969) most of the types originally in that collection are lost. Some material which probably originated from that collection has been found in ZMHB, including type-material of *Merodon femoratoides* and *M. crassifemoris.* Dr O. G. Ovchinnikova of the USSR Academy of Sciences (St. Petersburg) informed me that some types from the Paramonov collection might still be preserved at the Kiev Zoological Museum. This is also the view of Dr. Y. Nekrutenko, Kiev (pers. comm.). Regrettably this cannot be confirmed. The type of *M. smirnovi* should be stored in the Zoological Institute, Moscow University but this also could not be confirmed.

Reliably identified material, in some cases det. S. J. Paramonov, was present of the following species: *alagoezicus* (ZMAN); *alexeji* (KBIN); *brevis* (KBIN); *crassifemoris* (ZMHB); *erivanicus* (ZMAN); *femoratoides* (ZMHB) and *turkestanicus* (ZMAN). No material which can be reliably assigned to *smirnovi* is known; in view of its description this species is here considered synonymous with *tarsatus.*

5. The deposition of the type(s) is not mentioned in Matsumura's original publication. After Horn & Kahle (1936) the Matsumura collection is at the University of Sapporo. Following enquiry to the department of Entomology, Hokkaido University, Sapporo, the presence of the types of *M. kawamurae* there cannot be confirmed. The type(s) (sex and number unknown) originate from Kumamoto, Kyushu. However, this is the name of both a city and an extensive district. The description of the species presented here is based on 2♀, 2♂ from Harima [inland sea of Japan at 34° 30' N, 134° 30' E], in BMNH and fully complying with the original description.

6. Only female type-specimens have been examined, no male types have been found. The male from Saratow, formerly preserved at TMA, is lost (Dr. A. Dély-Draskovits, in litt.). The male and female syntypes from the Becker collection are not at ZMHB and have not been located elsewhere. A male type from Uralsk, stated in the original publication to be in NHMW, was not found there during a visit in 1987. The 2 female syntypes from which the lectotype has been designated are stored in DEIC, Eberswalde.

7. This species has been described without mention of material, although it is stated by Villers (1789) that *Musca clauda* occurs in Europe, in Bressia [? = Brescia].

8. *Musca curvipes* Gmelin is directly referred to Fabricius' original description of *Syrphus clavipes* by Gmelin (1790). Therefore type-material of this taxon does not exist.

9. No type-material of *Syrphus gravipes, Syrphus pruni* or *Syrphus avidus* has been located. After Horn & Kahle (1936) the Rossi collection was transferred to ZMHB; after Dr. H. Schumann (in litt.) no Rossi types of *Merodon* are currently present there.

10. No material was examined of *fulvus* Macquart or *fuscinervis* Von Röder. Both original descriptions suggest a great similarity to *pruni.* Both species were listed by Peck (1988) as synonyms of *pruni.* This synonymy has been followed.

11. The type-material of *spinipes* consists of a single, quite completely decayed probable syntype in ZMUC. This taxon is here synonymized with *avidus* on the ground of complete compliance of the descriptions and figures throughout the literature, starting from the first publications. It must of course be borne in mind that Rossi or Fabricius may have been describing any species of the large group externally resembling *avidus.*

12. No type-material of this taxon was probably ever in existence, as Lioy, after Horn & Kahle (1936) did only theoretic systematic work.

13. The holotype has not been located (see annotation 1). In ZMHB a specimen dating from 1929, with a label attached marking it as a type, was found. As this specimen was collected after the publication of var. *crassifemoris* it is not available as a type specimen; however the labels are in Paramonov' s handwriting. The specimen fully complies with the description of the var. *crassifemoris.* It is therefore available as a check on identifications.

14. A large number of paratypes spread over many institutions was designated to facilitate genital study. This was done since *elegans* externally resembles *avidus* and could well be confused with it.

15. The two syntypes from ZMUC, one from the Kieler coll. and one from the Sehestedt and Tønder Lund coll., are so seriously damaged that no conclusion can be drawn as to the status of this species. No other material identified as *viaticus* and complying with the description of that species has been found. Therefore the descriptions given are the only base for identification.

Annotated list of species excluded from Merodon

The status of the species described by Walker (1849, 1852, 1857a, 1860) is not clear in all cases. As not all material was available, the specimens studied have been referred to as type-specimens. The present author does not intend to designate lectotypes of species excluded from *Merodon.*

Merodon angustiventris Macquart, 1855: 90. Lectotype ♂ (designated by Thompson 1988) (BMNH) [examined] not considered to belong to *Merodon* in view of morphology of femur 3 and wing venation. According to Thompson (1988) the lectotype belongs to *Quichuana angustiventris* (Macquart), a species occurring in the Neotropical region.

Merodon balanus Walker, 1849: 600. A ♂ type-specimen (BMNH) [examined] belongs to the genus *Mallota* in view of femur 3 and wing venation. Specimen originates from New York [Nearctic region, U. S. A.] where a natural occurrence of *Merodon* is unknown.

Merodon bardus Say (in Walker 1849: 598). The ♂ type-specimen [examined] does not belong to *Merodon.* After Osten-Sacken (1878: 135) this specimen belongs in *Mallota.*

Merodon bautias Walker, 1849: 600. Two syntypes, ♂ and ♀ (BMNH) [examined]. Both syntypes originate from Georgia, United States. The facial knob and wing venation are not compatible with *Merodon.* After Osten-Sacken (1878: 135) this species belongs in *Mallota.*

Merodon bicolor Walker, 1852: 243 [type-material not examined]. In the original description 'feelers' [interpreted as antennae] are stated to possess six joints, therefore the species is considered not to belong to the Syrphidae. The type-material originated from Brazil [Neotropical region] where *Merodon* species do not naturally occur.

Merodon bipartitus Walker, 1849: 599. The ♀ type-specimen (BMNH) originates from Georgia, United States [examined]. In view of the wing venation, this species probably belongs to *Mallota.* See Osten-Sacken (1878: 135).

Merodon chiragra Fabricius, 1805: 198 [type-material not examined]. Not included in a shipping of all other available *Merodon* types from ZMUC; this species belongs in *Sphegina.*

Merodon coerulea Becker, 1912: 602 [type-material not examined]. On the basis of the original description this species belongs in *Eumerus.*

Merodon contrarius Walker, 1849: 599. Both ♂ and ♀ type-specimens (BMNH) [examined]. This material originated from New Holland and belongs to *Orthoprosopa grisea* (Walker).

Merodon edentulus Macquart, 1855: 90. Holotype, ♀ from Cape of Good Hope [not examined]; a ♀ non type (BMNH) dating from XIX century identified as *edentulus* [examined] belongs to *Mallota.* The original description mentions a facial knob, unknown in *Merodon.*

Merodon interveniens Walker, 1860: 120. ♂ Type-specimen (BMNH) [examined]. This specimen originated from Macassar [Sulawesi] and does not belong in *Merodon* in view of wing venation, shape of leg 3 etc.

Merodon melota Seguy, 1941: 13. ♀ Holotype from Agadir, Morocco (MNHN) [examined]. This species belongs to *Eumerus.*

Merodon morosus Walker, 1849: 599. A ♀ type-specimen (BMNH) [examined]. This does not belong to *Merodon* but according to Osten-Sacken (1878: 135) is *Polydontomyia curvipes* O.-S.

Merodon ornatus Brunetti, 1915: 232. Holotype in Indian Museum, Calcutta [not examined] could not be shipped in view of its conservation state. After original description the wings have a brown stigma, there is no triangular processus on the femur 3 and the face is projecting; therefore this species is considered not to belong to *Merodon.*

Merodon scutellaris Shiraki, 1968: 200. [Type-material not examined]. From the description and photographed holotype it can be concluded that this species belongs to the genus *Azpeytia.*

Merodon tenebricus Walker, 1849: 601. Lectotype ♀ (designated by Thompson 1988) (BMNH) [examined]. In view of the shape of femur 3 and wing venation this species does not belong to *Merodon.* The identification as *Palpoda furcata* was given by Thompson (1988: 220).

Merodon torpidus Walker, 1857a: 152. Lectotype ♂ (designated by Thompson 1988) (BMNH) [examined]. This does not belong to *Merodon* given the shape of femur 3 and wing venation. The identification as *Orthoprosopa grisea* Walker was given by Thompson (1988: 220).

Merodon tuberculatus Brunetti, 1923: 214. The types, in the Indian Museum, Calcutta, [not examined] were too fragile to be shipped; the description of this species was based on that of *Helophilus tuberculatus.* The description and the figures (Brunetti, 1908) make clear that this species does not belong to *Merodon.*

Merodon umbrifer Walker, 1849: 601. The ♂ type-specimen from Sierra Leone does not belong to *Merodon* in view of leg morphology and wing venation.

Merodon varicolor Walker, 1857b: 122. The ♂ type-specimen from Borneo, in BMNH, belongs to *Mallota* in view of the shape of femur 3 and the wing venation pattern.

Proposal of *Azpeytia shirakii* nomen n. for *Merodon scutellaris* Shiraki, 1968

Since *Merodon scutellaris* Shiraki is incorrectly assigned to *Merodon* (see above), it is here proposed to transfer this taxon to *Azpeytia*, where it clearly belongs. As there already exists an *Azpeytia scutellaris*, published by Walker (1857b: 113), the epitheton of the species described by Shiraki, when transferred to *Azpeytia*, must be changed; the nomen novum *Azpeytia shirakii* is hereby proposed for this taxon.

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References

Aubert, J., J-J. Aubert & P. Goeldlin, 1976. Douze ans de captures systématiques de Syrphides (Dipteres) au Col de Bretolet (Alpes Valaisannes). – Mitteilungen der Schweizerischen Entomologischen Gesellschaft 49: 115-142.

Barendregt, A., 1982. Zweefvliegentabel (7th Ed.) – Jeugdbondsuitgeverij Amsterdam, 83 pp.

Becker, Th., 1907. Die Ergebnisse meiner Dipterologische Frühjahrsreise nach Algier und Tunis 1906. – Zeitschrift für Hymenopterologie und Dipterologie 7: 225-256.

Becker, Th., 1912. Persische Dipteren der Expedition des Herrn M. Zarudny 1898 und 1901, unter Mitwirkung von P. Stein. – Annales de l' Académie des Sciences de St. Petersburg 17: 503-652.

Becker, Th., 1921. Neue Dipteren meiner Sammlung. – Mitteilungen des Zoologisches Museum Berlin 10: 1-93.

Bankowska, R., 1980. Fly communities of the family Syrphidae in natural and anthropogenic habitats of Poland. – Memorabilia Zoologica 33: 3-93.

Bezzi, M., 1895. Contribuzioni della Fauna Ditterologica Italiana I: Ditteri della Calabria. – Bollettino della Societa Entomologica Italiana 27: 39-78.

Bezzi, M., 1900. Contribuzioni della Fauna Ditterologica Italiana II: Ditteri delle Marche e degli Abruzzi A: Osservazioni ed Aggiunte ai due fascicoli precedenti. – Bollettino della Società Entomologica Italiana 32: 77-102.

Bradescu, V., 1986. Etudes Diptérologiques (Syrphidae) dans la Reserve Naturelle Domogled Vallee de la Cerna. – Travaux du Musee d' Histoire Naturelle 'Grigore Antipa' 28: 121-131.

Brown, E. S., 1951. Variation and Polymorphism in *Lampetia equestris* (F.) (Dipt., Syrphidae) and other British insects. – Entomologists' Monthly Magazine 87: 16-18.

Brunetti, E., 1907. Notes on Oriental Syrphidae with descriptions of new species. – Records of the Indian

Museum I: plates I-XIII.
Brunetti, E., 1908. Notes on Oriental Syrphidae with descriptions of new species. – Records of the Indian Museum 2: 49-96.
Brunetti, E., 1915. Notes on Oriental Syrphidae, with descriptions of new species part II. – Records of the Indian Museum 11: 201-256.
Brunetti, E., 1923. Pipunculidae, Syrphidae, Conopidae, Oestridae. – Fauna of British India including Ceylon and Burma, Diptera III: xi + 424 pp.
Conn, D. L. T., 1978. Morphological and behavioural differences in populations of *Merodon equestris* (F.) (Diptera: Syrphidae). – Entomologists' Monthly Magazine 114: 65-66.
Coquillett, D. W., 1910. The type-species of the North American genera of Diptera. – Proceedings of the United States National Museum 37: 499-647.
Curran, C. H., 1939. Records and descriptions of African Syrphidae III (Diptera). – American Museum Novitates 1025: 1-11.
Czerny, L. & G. Strobl, 1909. Spanische Dipteren III. – Beiträge zur Verhandlungen der Kaiserlichen Königlichen Zoologisch-Botanischen gesellschaft in Wien 59: 121-301.
Delfinado, M. D. & D. E. Hardy, 1975. Catalog of the Diptera of the Oriental Region. – x + 459 pp.
Egger, J., 1860. Fortsetzung der Beschreibung neuer Zweiflügler und Diagnostische Bemerkungen. – Verhandlungen der Kaiserlichen Königlichen Zoologisch-Botanischen Gesellschaft in Wien 10: 663-665.
Fabricius, J. C., 1781. Species Insectorum exhibentes eorum differentias specificas, Synonyma auctorum, loca natalia, metamorphosis adjectis observationibus, descriptionibus vol. 2. – Hamburgi et Kilionii [Hamburg and Kiel, F. R. G.]. 317 pp.
Fabricius, J. C., 1787. Mantissa Insectorum sistens species nuper detectas vol. 2. – Hafniae [Copenhagen]. 382 pp.
Fabricius, J. C., 1794. Entomologia Systematica emendata et aucta vol. 4. – Hafniae [Copenhagen]. 427 pp.
Fabricius, J. C., 1805. Systema Antliatorum secundum Ordines, Genera et Species. – Brunsviquiae [Braunschweig, F. R. G.]. 373 pp.
Fitzpatrick, S. M. & W. G. Wellington, 1983. Contrasts in the territorial behavior of three species of hoverflies (Diptera: Syrphidae). – Canadian Entomologist 115: 559-566.
Gaunitz, Sv., 1969. Studien uber die Unterfamilie Eristalinae. – Entomologisk Tidskrift 90: 73-99.
Gil Collado, J., 1929. Sírfidos de Marruecos del Museo de Madrid (Dipt. Syrph.). – Memorias de la Real Sociedad Español de Historia Natural 12: 403-415.
Gil Collado, J., 1930. Monografia de los Sirfidos de España. – Trabajos del Museo Nacional de Ciencias Naturales de Madrid (Zoologia) 54: vii + 1-376.
Glumac, S., 1958. The structure of the male genitalia of certain species of flowerflies (Syrphidae, Diptera) and their significance in phylogenetical classification. – Glasnodi Prirodo Museu Srpske Zemlje (B) 12: 77-167 [in Serbo-Croatian, with English Summary].
Gmélin, J. F., 1790. Caroli a Linne, Systema Naturae per Regna tria Naturae, editio 13 vol. 1 Regnum Animale, 5: 2225-3020. – Lipsiae [Leipzig].
Goot, V. S. van der, 1964a. Summer records of Syrphidae (Diptera) from Sicily, with field notes and descriptions of new species. – Zoologische Mededelingen, Leiden 39: 414-432.
Goot, V. S. van der, 1964b. Fluke's catalogue of neotropical Syrphidae (Insecta, Diptera), a critical study with an appendix on new names in Syrphidae. – Beaufortia 10: 212-221.
Goot, V. S. van der, 1971. Enkele naamsveranderingen bij Nederlandse Syrphiden en nog enkele opmerkingen. – Entomologische Berichten, Amsterdam 31: 105-110.
Goot, V. S. van der, 1981. De Zweefvliegen van Noordwest Europa en Europees Rusland, in het bijzonder van de Benelux. – Amsterdam. 275 pp.
Goot, V. S. van der & J. A. W. Lucas, 1964. Aantekeningen over Nederlandse Syrphiden. – Entomologische Berichten, Amsterdam 24: 3-13.
Heiss, E. M., 1938. Classification of the larvae and puparia of the Syrphidae of Illinois exclusive of aquatic forms. – Illinois Biological Monographs 16 (4): 1-66.
Hervé Bazin, J., 1929. Un nouveau *Lampetia* (*Merodon*) de Chine (Dipt. Syrphidae). – Bulletin de la Société Entomologique de France 69: 111-115.
Horn, W. & I. Kahle, 1936. Über Entomologische Sammlungen, Entomologen und Entomo-Museologie (Ein Beitrag zur Geschichte der Entomologie). – 535 pp. Berlin.
Hull, F. M., 1949. The morphology and inter-relationship of the genera of syrphid flies, recent and fossil. – Transactions of the Zoological Society of London 26: 257-408.
Hurkmans, W. E. G., 1985. Territorial behaviour of two *Merodon* species (Diptera: Syrphidae). – Entomologische Berichten, Amsterdam 45: 69-70.
Hurkmans, W., 1988. Ethology and ecology of *Merodon* in Turkey (Diptera: Syrphidae). – Entomologische Berichten, Amsterdam 48: 107-114.
International Commission on Zoological Nomenclature, 1963. Opinion 678. – Bulletin of Zoological Nomenclature 20 : 339.
Kabos, W. J., 1939. Over de biologie van *Merodon equestris* Fabr. (Narcisvlieg). – Entomologische Berichten, Amsterdam 10: 136-139.
Kaplan, M. & F. Christian Thompson, 1981. New Syrphidae from Israel (Diptera). – Proceedings of the Entomological Society of Washington 83(2): 198-212.
Kertész, K., 1907. Cyclorrhapa Aschiza, Cyclorrhapa Schizophora: Schizometopa. – *In*: Th. Becker, M. Bezzi, K. Kertesz & P. Stein (ed.), Katalog der paläarktischen Dipteren, III: 824 pp.
Latreille, P. A., [1804]. Histoire naturelle générale et particulière des Crustacés et des Insectes. Ouvrage faisant suite aux oeuvres de Leclercq et Buffon, etc., 4. – Paris, 432 pp.
Latreille, P. A., 1810. Considérations générales sur l' ordre naturel des animaux composant les classes des crustacés, des arachnides et des Insectes; avec un Tableau méthodique de leurs Genres, disposés en Familles. – Paris. 444 pp.
Liepa, Z. R., 1969. Lists of the scientific works and described species of the late Dr. S. J. Paramonov, with locations of types. – Journal of the Entomological Society of Australia (New South Wales) 5: 3-22.
Lindner, E., 1949. Die Larve der Narzissenfliege *Lampetia equestris* FABR. (Diptera: Syrphidae). – Entomon 1: 4-9.
Lioy, M., 1864. I Ditteri distributi secondo un novo metodo di classificazione naturale. – Atti del Imperiale Regiale

Instituto Veneto di Scienze, Lettere ed Arte (3) 9: 738-760.

Loew, H., 1862a. Über Griechische Dipteren. – Berliner Entomologische Zeitschrift 6: 69-89.

Loew, H., 1862b. Über einige bei Varna gefangene Dipteren. – Wiener Entomologisches Monatschrift 6: 161-175.

Loew, H., 1869. Beschreibung Europäischer Dipteren I. – Wien. xiv + 310 pp.

Lundbeck, W., 1916. Diptera Danica, genera and species of flies hitherto found in Denmark, vol. 5: Lonchopteridae, Syrphidae. – Copenhagen, London. ii + 603 pp.

Macquart, J., 1828. Insectes Diptères du Nord de la France, Syrphides. – Mémoires du Société des Sciences Agricoles de Lille 1827-1828 : 149-371.

Macquart, J., 1834. Histoire naturelle des Insectes, Diptères I. – *In*: Roret, Collection des Suites a Buffon. Paris. 578 pp.

Macquart, J., 1842. Diptères exotiques nouveaux ou peu connues (2) 2. – Paris. 140 pp.

Macquart, J., 1849. Histoire naturelle des animaux articulés, cinquième classe Insectes. – *In*: Lucas, Exploration scientifique de l' Algérie pendant les années 1840, 1841 et 1842. – Paris. 527 pp.

Macquart, J., 1855. Diptères exotiques nouveaux ou peu connus, 5e Supplement. – Mémoires du Société Imperiale des Sciences Agricoles et des Arts de Lille 1854: 25-156.

Maldonado Capriles, J. & Angel Berrios, 1977. The immature stages of *Copestylum vacuum* (Diptera: Syrphidae), a new record for Puerto Rico. – Research Note of the Journal of Agriculture of the University of Puerto Rico 61: 395-399.

Marcos García, M. A., 1985. Los Syrphidae (Dip.) de las Sierras occidentales del sistema central Español, subfamilias Eristalinae, Lampettiinae [sic!], Microdontinae, Milesiinae y Cerianinae. – Boletín de la Asociación Español de Entomologia 9: 187-210.

Marcos Garcia, M. A., 1989. *Merodon escorialensis* Strobl, 1909 stat. nov. (Diptera, Syrphidae) (1). – Annales de la Société entomologique de France, Nouvelle série 25 (2): 243-247.

Matsumura, S., 1916. Thousand insects of Japan additamenta II. – Tokyo. 505 pp.

McAlpine, J. F. et al., 1981. Manual of nearctic Diptera vol. 1. – Ontario. 674 pp.

Meigen, J. W., 1800. Nouvelle classification des Mouches a deux ailes, d' apres un plan tout nouveau. – Paris. 40 pp. [reprinted in Bulletin of Zoological Nomenclature 1 (1945): 121-160]

Meigen, J. W., 1803. Versuch einer neuen Gattungseintheilung der europäischen Zweiflügeligen Insekten. – Illiger's Magazin für Insektenkunde 2: 259-281.

Meigen, J. W., 1822. Systematische Beschreibung der bekannten europäischen zweiflügelige Insekten 3. – Hamm. x + 416 pp.

Meigen, J. W., 1830. Systematische Beschreibung der bekannten europäischen zweiflügelige Insekten 6. Nachträge und Berichtigungen zum dritten Theile. – Hamm. 401 + 3 unnumbered pp.

Meigen, J. W., 1838. Systematische Beschreibung der bekannten Europäischen zweiflügelige Insekten 7. – Hamm. xii + 434 pp.

Metcalf, C. L., 1921. The genitalia of male Syrphidae, with especial reference to its taxonomic significance. – Annals of the Entomological Society of America 14: 169-214.

Mik, J., 1867. Dipterologische Beiträge zur 'Fauna Austriaca' I. Beschreibung neuer Arten. – Verhandlungen der Kaiserlichen Königlichen Zoologisch-Botanischen Gesellschaft in Wien 17: 413-424.

Mik, J., 1883. Dipterologische Bemerkungen I: Synonymisches. – Verhandlungen der Kaiserlich Königlichen Zoologisch-Botanischen Gesellschaft in Wien 33: 181-192.

Oldenberg, L., 1919. Die *Lampetia* Arten meiner Ausbeute. – Deutsche Entomologische Zeitschrift, Jahrgang 1919: 387-389.

Osten-Sacken, C. R. von, 1878. Catalogue of the described Diptera of North America, 2nd edition. – Smithsonian miscellaneous collections vol 16(2): 1-276.

Palma, G., 1863. Ditteri della fauna Napolitana. Memoria del socio ordinario Giuseppe Palma. – Annali dell' Accademia di Aspiranti Naturalisti di Napoli, serie 3: 37-66.

Paramonov, S. J., 1924. Zwei neue Syrphiden Arten (Diptera) aus dem südwestlichen Russland. – Konowia 3: 249-252.

Paramonov, S. J., 1925. Zur Kenntnis der Gattung *Merodon*. – Encyclopédie Entomologique (B), 2: Diptera, 2, fascicule 3: 143-160.

Paramonov, S. J., 1926a. Fragmente zur Kenntnis der Dipterenfauna Armeniens. – Societas Entomologica 41: 33-34; 38-39; 44; 46-47.

Paramonov, S. J., 1926b. Dipterologische Fragmente 5. Über einige *Merodon* Arten. – Bulletin de l' Académie des Sciences de l' Ukraine IV (4) vol. 2: 317-323 [Also in Travaux du Musée Zoologique de Kiev 2: 73-79].

Paramonov, S. J., 1927. Über einige Arten und Varietäten von Dipteren (Fam. Stratiomyidae et Syrphidae). – Travaux du Musée Zoologique de Kiev 2: 87-93.

Paramonov, S. J., 1929. Dipterologische Fragmente 19. Über die Gattung *Merodon*. – Travaux du Musée Zoologique de Kiev 7: 181-195.

Paramonov, S. J., 1935. Dipterologische Fragmente 31, 32. Wass ist ein echtes Weibchen von *Lampetia armipes* Rond.?; Die Unterschiedsmerkmale zwischen *L. monticola* Villeneuve und *L. alexeji* Paramonov; *Lampetia monticola* Villeneuve ♂. – Travaux du Musée Zoologique de Kiev 15: 163-166.

Paramonov, S. J., 1937a. Beiträge zur Monographie der Gattung *Lampetia* (*Merodon* olim.), Syrphidae, Diptera, 1. Teil. – Travaux du Musée Zoologique de Kiev 17: 3-13.

Paramonov, S. J., 1937b. Dipterologische Fragmente 36. Über einige *Lampetia* (*Merodon*) Typen. – Travaux du Musée Zoologique de Kiev 17: 69-77.

Peck, L. V., 1988. Syrphidae. – *In:* A. Soós (ed.), Catalogue of Palaearctic Diptera vol. 8 Syrphidae, Conopidae pp. 11-230. Amsterdam, etc.

Portschinsky, I., 1877. Materiali dlye Istorie Fauny Rossiye e Kavkaza. – Trudy Rosskago Entomologicheskago Obshtshestva 10: 102-198.

Röder, H. von, 1887. Insekten der Insel Kreta. – Berliner Entomologische Zeitschrift 31: 73-74.

Rondani, C., 1843. Dipteres nouveaux d' Italie. – Revue Zoologique, Fevrier 1843: 43-44.

Rondani, C., 1845. Sulle specie Italiane del Genere Merodon; Memoria decimaquarta, per servire alla Ditterologia Italiana. – Nuovi Annali di Società delle

Scienze Naturale di Bologna, (serie II) 4: 254-267.
Rondani, C., 1857. Dipterologiae Italicae Prodromus II. Species Italicae ordinis dipterorum in genera characteribus definitae, ordinatim collectae, methodo analitica distinctae, et novis vel minus cognitis descriptis, pars I: Oestridae, Syrphidae, Conopidae. – Parma. 264 pp.
Rondani, C., 1865. Diptera Italica non vel minus descripta vel annotata observationibus nonnulis additis, fsaciculo 1: Oestridae, Syrphidae, Conopidae. – Atti della Societa Italiana delle Scienze Naturale di Milano 8: 127-146.
Rondani, C., 1868a. Diptera Italica non vel minus descripta vel annotata observationibus nonnulis additis, speciebus Italicis adde sequentes: Familia II Syrphidae, genere *Merodon* Latr. – Atti della Societa Italiana delle Scienze Naturale di Milano 11: 22-23.
Rondani, C., 1868b. Specierum Italicarum Ordinis Dipterorum Catalogus Geographicis auctus, fasciculo 1. oestridae, Syrphidae, Conopidae. – Atti della Societa Italiana delle Scienze Naturale di Milano 11: 559-575.
Rondani, C., 1873. Species aliquae in Oriente lecta a Marchese J. Doria, anno 1862 63 Fragmentum II. – Annali di Museo Civico di Genova 1873: 295.
Rossi, F., 1790. Fauna Etrusca, sistens Insecta quae in provincias Florentina et Pisana praesertim collegit. – Pisa 1-451 (2 vols.).
Rossi, F., 1794. Mantissa Insectorum, exhibens species nuper in Etruria collectas adjectis faunae Etruscae illustrationibus ac emendationibus (2). – Pisa. 154 pp.
Sack, P., 1913a. Die Gattung *Merodon* Meigen (*Lampetia* Meigen olim.). – Abhandlungen des Senckenbergische Gesellschafts der Naturforscher 31: 427-462.
Sack, 1913b. Zwei neue Paläarktische *Merodon*-Arten. – Annales Musei Nationalis Hungarici 11: 620-622.
Sack, P., 1930. Zweiflügler (Diptera) IV: Schwebfliegen (Syrphidae). – Tierwelt Deutschlands 20: 1-118.
Sack, P., 1931. Syrphidae. – *In:* Lindner, die Fliegen der paläarktischen Region IV (6): 1-451.
Sack, P., 1934. *Lampetia crymensis* Paramonov ♀. – Konowia 13: 273-274.
Sack, P., 1938. Zwei neue Syrphiden vom Balkan. – Konowia 17: 19-23.
Schiner, J. R., 1857. Diptera Austriaca, Aufzahlung aller im Kaisertüme Oesterreichs bisher aufgefundene Zweiflügler, III: die Oesterreichischen Syrphiden. – Verhandlungen der Kaiserlichen Königlichen Zoologisch-Botanischen Gesellschaft in Wien 7: 279-506.
Schiner, J. R., 1862. Fauna Austriaca, die Fliegen (Diptera) 1. Theil vi + xlii + 672 pp.
Séguy, E., 1941. Dipteres accueillis par M. L. Berland dans le Sud Marocain, Syrphidae. – Annales du Société Entomologique de la France 110: 13-14.
Séguy, E., 1961. Dipteres Syrphides de l' Europe occidentale. – Mémoires du Musée d' Histoire Naturelle, Nouvelle Série, Série A Zoologie 23: 1-248.
Shiraki, T., 1930. Die Syrphiden des Japanischen Kaiserreiches, mit Berücksichtigung der benachbarten Gebiete. – Memoirs of the Faculty of Agriculture, Taihoku Imperial University 1: i-xx; 1-446.
Shiraki, T., 1968. Fauna Japonica II: Insecta Diptera, vol III Syrphidae, subfamily Merodontinae (Lampetiinae): 194-252.
Speight, M. C. D., 1987. External morphology of adult Syrphidae (Diptera). – Tijdschrift voor Entomologie 130: 141-175.
Stackelberg, A. A. & Richter, V., 1968. Hower-Flies (Diptera: Syrphidae) of the Caucasus. – Trudy Vsesoyuznogo Entomologicheskogo Obschestva 52: 224-274.
Strobl, G., 1893. Beiträge zur Dipterenfauna der Oesterreichischen Littorale. – Wiener Entomologische Zeitung 12 (2): 74-408.
Strobl, G., 1900. Die Dipterenfauna von Bosnien, Hercegovina und Dalmatien. – Wissenschaftliche Mitteilungen aus Bosnien und der Hercegovina (III. Naturwissenschaft) 7: 352-670.
Stuckenberg, B. R., 1956. The immature stages of *Merodon bombiformis* Hull, a potrential pest of bulbs in South Africa (Diptera: Syrphidae). – Journal of the Entomological Society of South Africa 19: 219-224.
Šuster, P., 1959. Diptera, Syrphidae. – Fauna Republicis Populare Romine, Insecta II pars III. Bucuresti. 286 pp.
Szilady, L., 1940. Über Paläarktische Syrphiden. – Annales Musei Nationalis Hungarici 33: 34-70.
Thompson, F. C., 1988. Syrphidae (Diptera) described from unknown localities. – Journal of the New York Entomological Society 96 (2); 200-226.
Treiber, R., 1987. Beobachtungen zur Ökologie von *Merodon rufus* (Meigen, 1846). – Naturkundliche Beitrage des DJN 18: 64.
Verrall, G. H., 1901. British Flies, vol. 3: Platypezidae, Pipunculidae, Syrphidae of Great Britain: 17-121 (Catalogue); 127-691. – [reprint E. W. Massey, Faringdon 1969]
Villeneuve, J., 1903. Contributions au Catalogue des Diptères de France. – Feuille de la Jeunesse Naturaliste 33: 113-119.
Villeneuve, J., 1909. Description d' un nouveau Syrphide. – Wiener Entomologische Zeitung 28: 338-339.
Villeneuve, J., 1910. Notes synonymiques. – Wiener Entomologische Zeitung 29: 304-305.
Villeneuve, J., 1912. Notes synonymiques. – Wiener Entomologische Zeitung 31: 96-97.
Villeneuve, J., 1924. Dipteres nouveaux. – Encyclopédie Entomologique (B) 2: Diptera 1: 5-8.
Villeneuve de Janti, J., 1934. Notes diptérologiques. – Revue Francaise d'Entomologie 1: 180-181.
Villers, R., 1789. Linnaeus, Entomologia, fauna Suecicae descriptionibus aucta, tomus tertius IV Insecta Diptera: *Musca* 1-657. – Lugduni [Lyon].
Violovitsh, N. A., 1983. Sirfydi Sibiri, Siberian Syrphidae (Diptera). – Verslagen en technische gegevens van het Instituut voor Taxonomische Zoologie (Zoologisch Museum), Universiteit van Amsterdam; [Translated by V. S. van der Goot and L. Verlinden; Foreword and keys only: 2-228. – published in Amsterdam, 1986].
Walker, F., 1849.List of the specimens of dipterous insects in the collection of the British Museum vol. 3: 485-687.
Walker, F., 1852. Insecta Saundersiana, or characters of undescribed insects in the collection of William Wilson Saunders, esq. – London. 474 pp.
Walker, F., 1857a. Characters of undescribed Diptera in the collection of W. W. Sunders, esq. – Transactions of the Entomological Society of London, New Series 4: 119-157.
Walker, F., 1857b. Catalogue of the dipterous insects collected at Sarawak, Borneo by Mr A. R. Wallace, with descriptions of new species. – Journal of the Proceedings of the Linnaean Society, Zoology vol. 1: 105-136.
Walker, F., 1860. On Diptera collected at Makassar: *Merodon.* – Proceedings of the Linnaean Society of London 4: 120.

Westwood, J. O., 1840. An introduction to the modern classification of insects: Synopsis of the genera of British Insects, Order 13: Diptera Aristotle (Antliata Fabricius, Halteriptera Clairv.). – pp. 125-158.

Zimina, L. V., 1989. Novie Sirfidy Poda *Merodon* (Diptera, Syrphidae) iz Vostozhogo Kryma [New species of the genus *Merodon* (Diptera, Syrphidae) from the east Crimea] – Vestnik Zoologia 1989 no. 1: 24-29. (in Russian).

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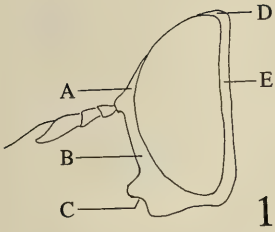
Figs. 1-10. General morphology of *Merodon*. – Fig. 1. Lateral view of head. a, face; b, frons; c, oral margin; d, vertex; e, occiput. – Fig. 2. Lateral view of antenna. a, antenna with 3rd article showing convex upper margin, apex rounded; b, 3rd article with upper margin basally convex, apically concave, apex acute; c, 3rd article straight margined, apex subacute; d, 3rd article strongly widened, upper margin convex, incised subapically. Lines above and below mark measured lengths of articles 2 and 3 respectively; the antennal ratio (length 3 : length 2) is often used in descriptions. – Fig. 3. Dorsal view of vertex and frons in ♂. Line portion a marks the length of tl, portion b the vertex height; angle alpha is vertex angle, beta is ocellar angle. – Fig. 4. Dorsal view of vertex and frons. (left), tl complete; (middle), tl incomplete: a linear strip separates the eyes, this condition might be termed subholoptic; (right), eyes separate (this occurs in some species in the ♂, and in all ♀). The ocellar region is hatched. – Fig. 5. Lateral view of thorax (wings and legs omitted). 1, humeral knob; 2, dorsum with suture; 3, scutellum; 4, mesopleuron (katepisternum); 5, pteropleuron (anepisternum); 6, sternopleuron (anepimeron); 7, coxa I; 8, coxa II; 9, coxa III; W, wing insertion area; R, respiratory orifice (trachaea). – Fig. 6. Dorsal view of right wing. 1, anal cell (a); 2, discal medial cell (dm); 3, combined 4th+5th radial cell (r4+5); 4, basal medial cell (bm); 5, basal radial cell (br); 6, 2nd+3rd radial cell (r2+3); 7, 1st radial cell (r1); 8, subcostal cell (sc); 9, costal cell (c); A, Costa (C); B, Subcosta (Sc); C, 1st branch of Radius (R1); D, main branch of Radius (R); E, 2nd & 3rd fused branches of Radius (R2+3); F, 4th & 5th fused branches of Radius (R4+5); G, Media (M); H, anterior Cubital (Cua1); I, discal-medial Cubital (dm-cu); J, apical part of Media (M); K, analis (A); L, humeral (h); M, radial-medial (r-m); N, 2nd anterior Cubital (Cua2); O, basal part of Cua1; P, basal-medial Cubital (bm-cu). – Fig. 7. Lateral view of leg III. a, trochanter (spine shown is present in ♂ of some species only); b, femur, with c, triangular processus; d, tibia, with e, apical spur; f, metatarsus; g, tarsus. – Fig. 8. Ventral view of ♂ genitalia (*alagoezicus* group). A, cercus; B, posterior surstyle lobe; C, apical margin of surstyle; D, ridge on inner face (medial face) of surstyle; E, epandrium; F, membraneous part of surstyle; G, apical extension of anterior surstyle lobe; H, anterior surstyle lobe; J, accessory lobe. – Fig. 9. Lateral view of ♂ genitalia (*alagoezicus* group). A through J as in fig. 8; L, aedeagus; M, genital cap. – Fig. 10. Ventral view of aedeagus. A, apical shaft part; B, apex aedeagi; C, fringed plates; D, chitinous plates; E, subapical cavity; F, thecal ridge basally bordering same; G, basal humps.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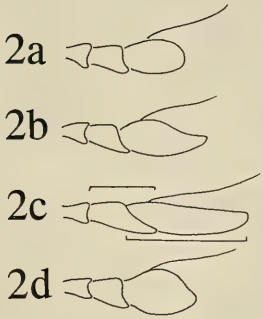
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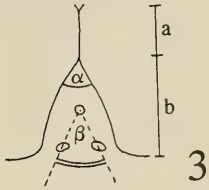
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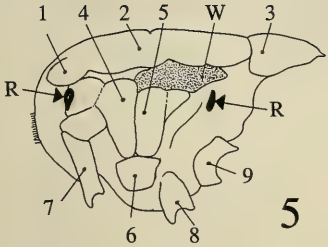
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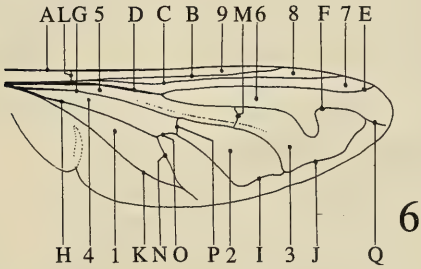
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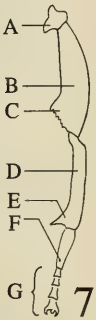
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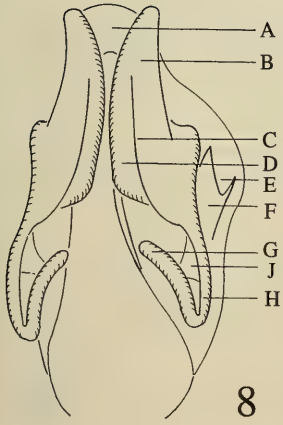
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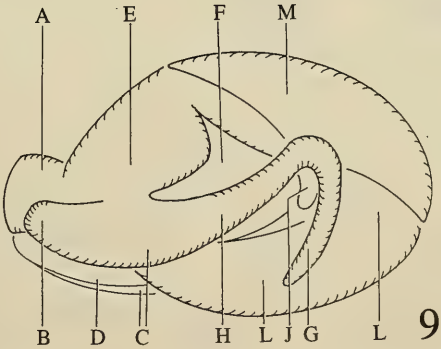
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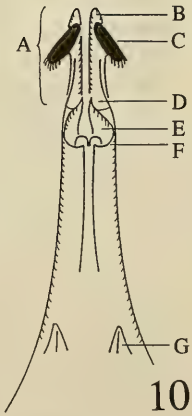
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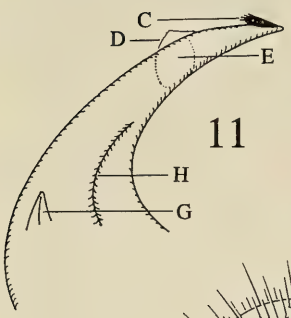
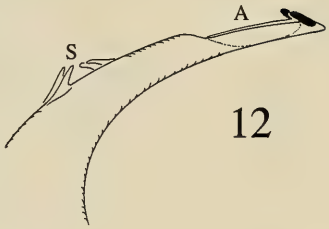
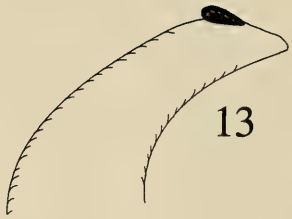
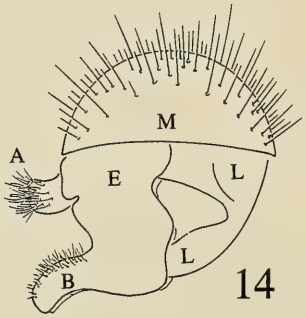
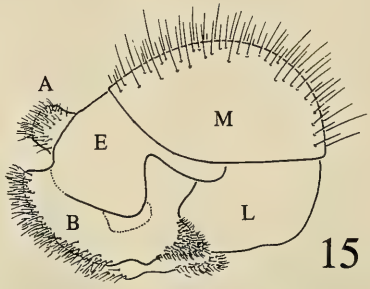
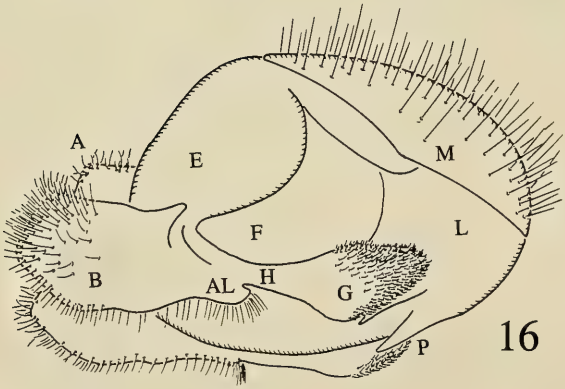


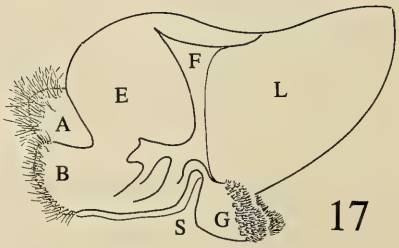


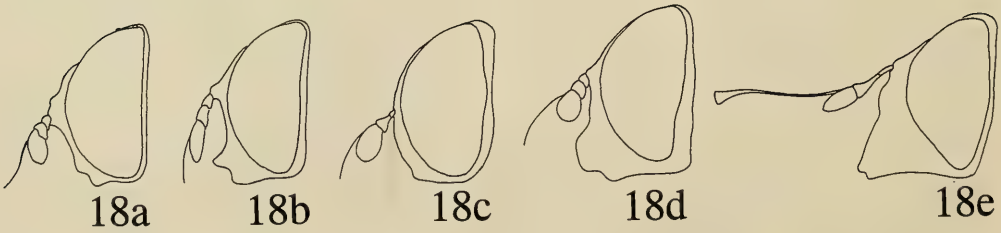












Figs. 11-13. Aedeagus in *Merodon*. – 11, lateral view, lettering as in fig. 10, H, lateral ridge; 12, slender aedeagus with lengthened apical shaft part A; S, paired spines; 13, stout aedeagus with recumbent fringed plates. – Figs. 14-17. Lateral view of ♂ genitalia of *Merodon*, lettering as in Fig. 9. – 14, *M. apimimus;* 15, *M. distinctus*; 16, *M. nigritarsis*; 17, *M. longicornis*. – Fig. 18. Lateral view of head in ♂ of different Syrphidae. – a, *Azpeytia scutellaris* Walker; b, *Merodon avidus*; c, *Eumerus strigatus* Fallen; d, *Mallota takasagoensis* (Matsumura); e, *Platynochaetus armipes* Bezzi.

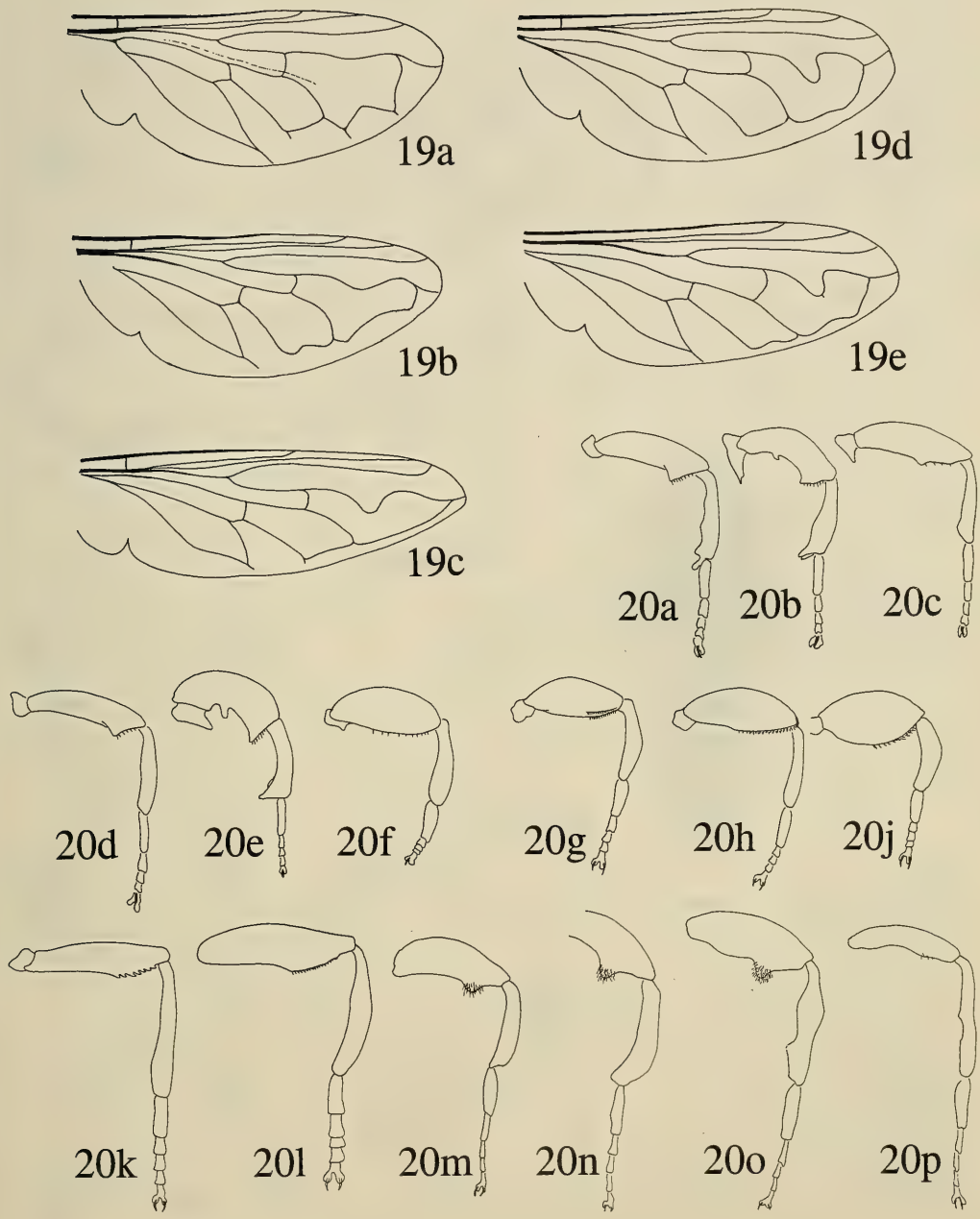


Fig. 19. Dorsal view of right wing in ♂ of different Syrphidae. – a, *Eumerus strigatus* Fallen; b, *Azpeytia scutellaris* Walker; c, *Mallota takasagoensis* (Matsumura); d, *Merodon avidus*; e, *Platynochaetus armipes* Bezzi. – Fig. 20. Lateral view of leg III in ♂ of different Syrphidae. – a, *Merodon equestris*; b, *M. armipes*; c, *M. minutus*; d, *M. aberrans*; e, *M. ruficornis*; f, *Eumerus sulcitibius* Rondani; g, *E. tuberculatus* Rondani; h, *E. olivaceus* Loew and *E. nudus* Loew; j, *Eumerus strigatus* Fallen; k, *Azpeytia scutellaris* Walker; l, *Azpeytia shirakii* nomen novum; m, *Mallota cimbiciformis* Fallen; n, *Mallota takasagoensis* (Matsumura); o, *Platynochaetus armipes* Bezzi; p, *Platynochaetus rufus* (Macquart).

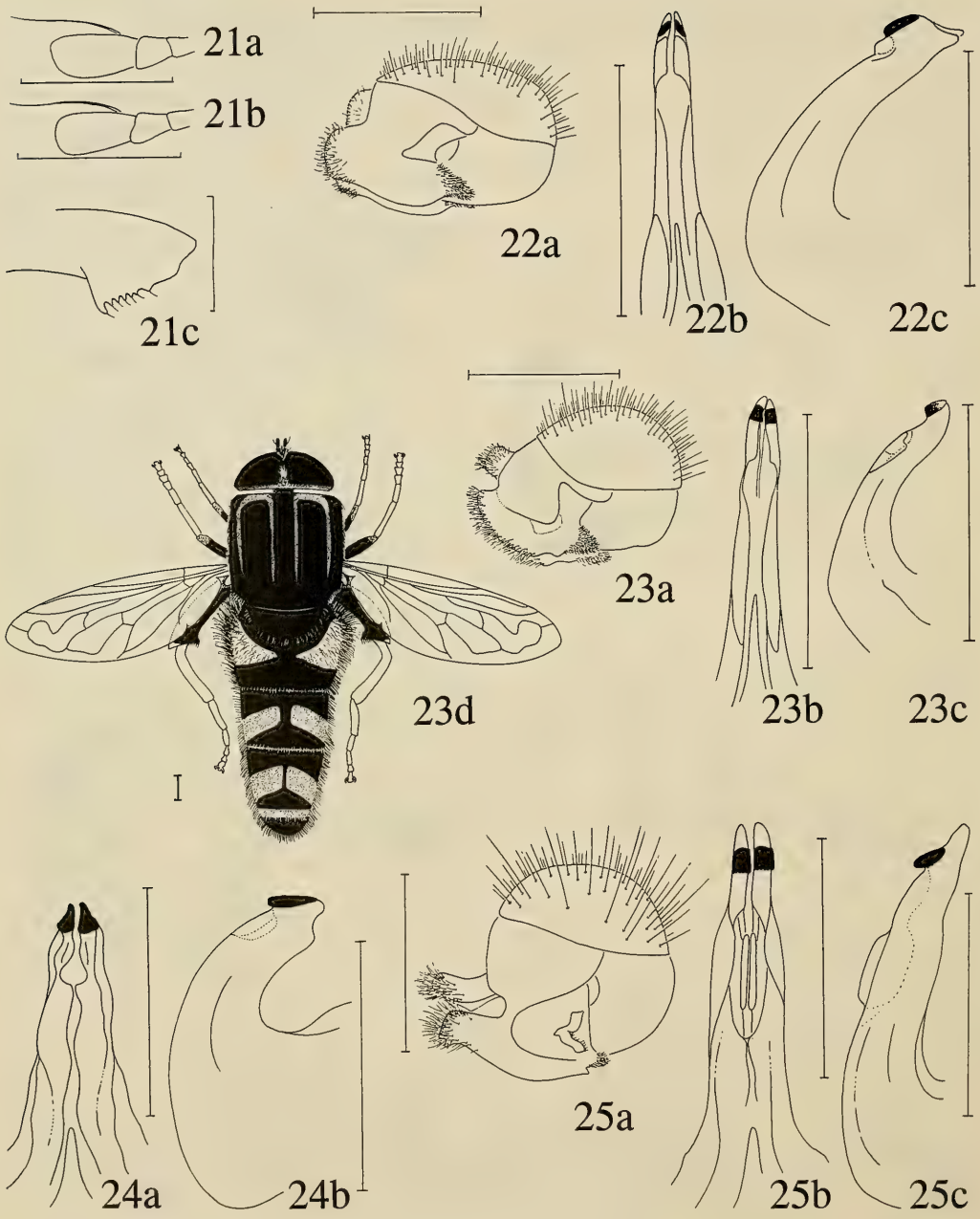


Fig. 21. *Merodon biarcuatus.* a, b, variation in antennal shape; c, distal end of f3. – Fig. 22. *M. clunipes.* a, lateral view of ♂ genitalia; b, c, ventral and lateral view of aedeagus. – Fig. 23. *M. distinctus.* a, lateral view of ♂ genitalia; b, c, ventral and lateral view of aedeagus; d, habitus of ♂. – Fig. 24. *M. femoratus.* a, b, ventral and lateral view of aedeagus; for lateral view of genitalia compare fig. 22a. – Fig. 25. *M. mariae.* a, lateral view of ♂ genitalia; b, c, ventral and lateral view of aedeagus.

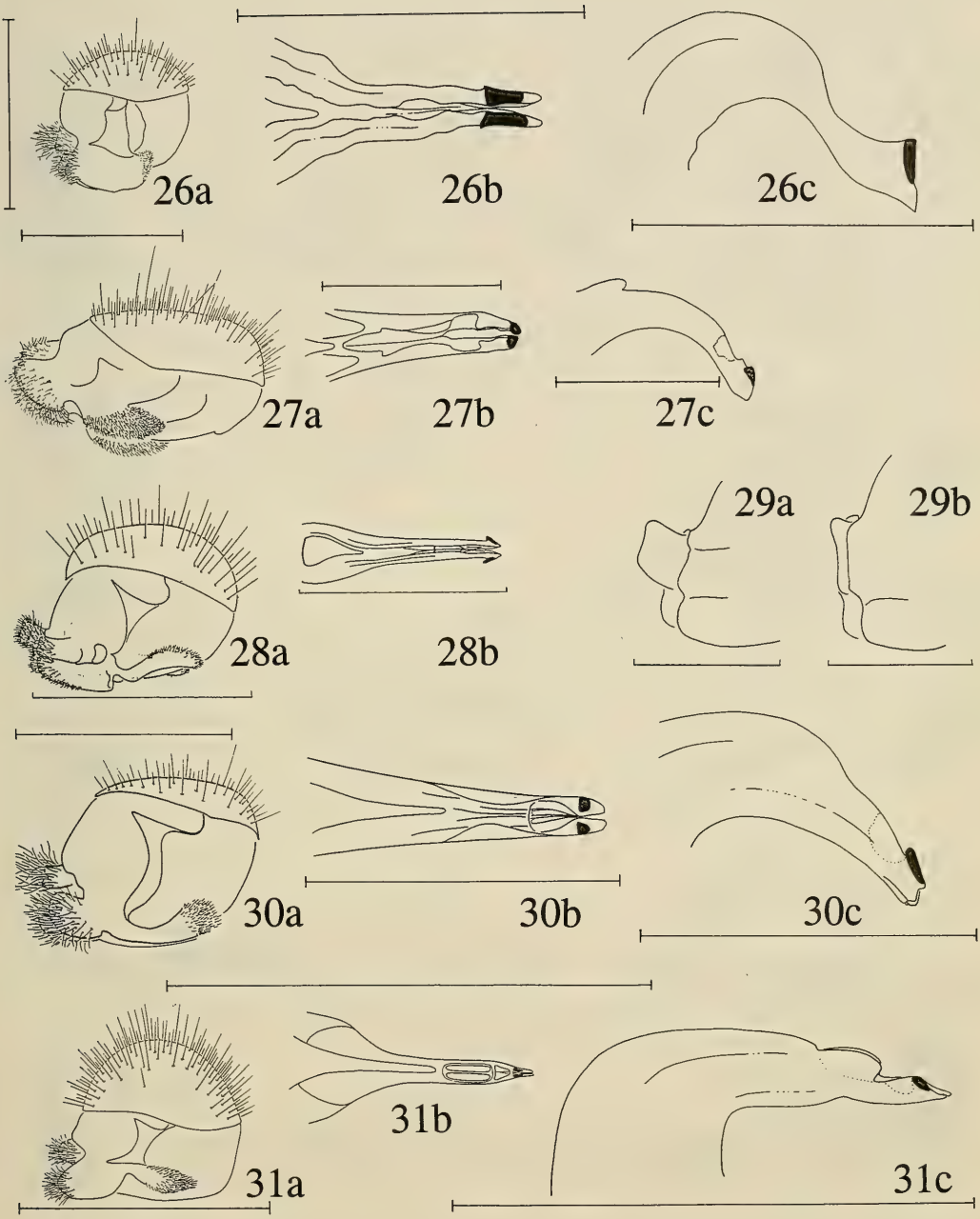


Fig. 26. *Merodon ottomanus.* a, lateral view of ♂ genitalia; b, c, ventral and lateral view of aedeagus. – Fig. 27. *M. testaceoides.* a, lateral view of ♂ genitalia; b, c, ventral and lateral view of aedeagus. – Fig. 28. *M. alexeji.* a, lateral view of ♂ genitalia; b, ventral view of aedeagus. – Fig. 29. Posterior end of surstyle and cercus in *M. alexeji* (a) and *M. altinosus* (b). Pubescence deleted to show difference in outlines. – Fig. 30. *M. hirsutus.* a, lateral view of ♂ genitalia; b, c, ventral and lateral view of aedeagus. – Fig. 31. *M. hypochrysos.* a, lateral view of ♂ genitalia; b, c, ventral and lateral view of aedeagus.

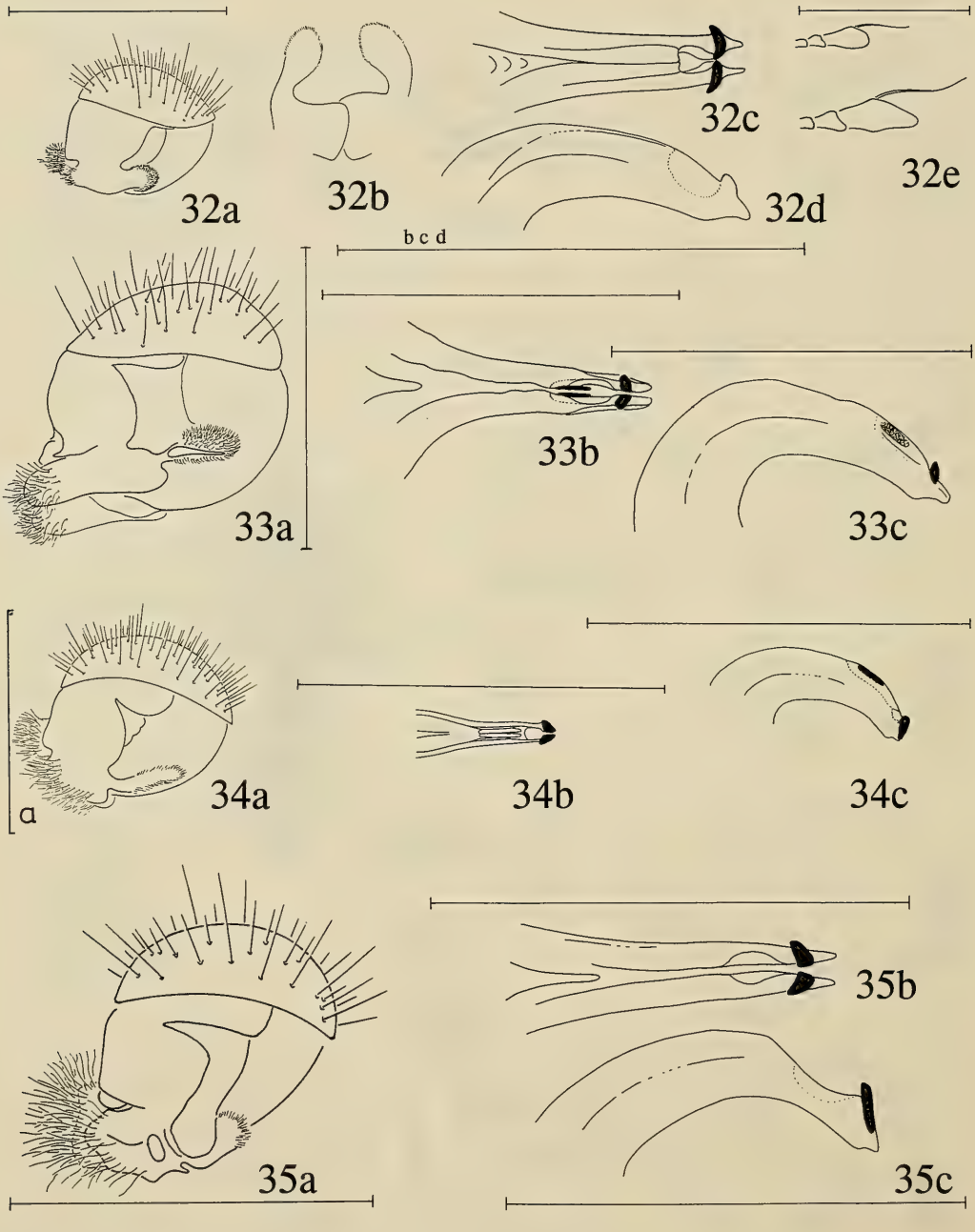
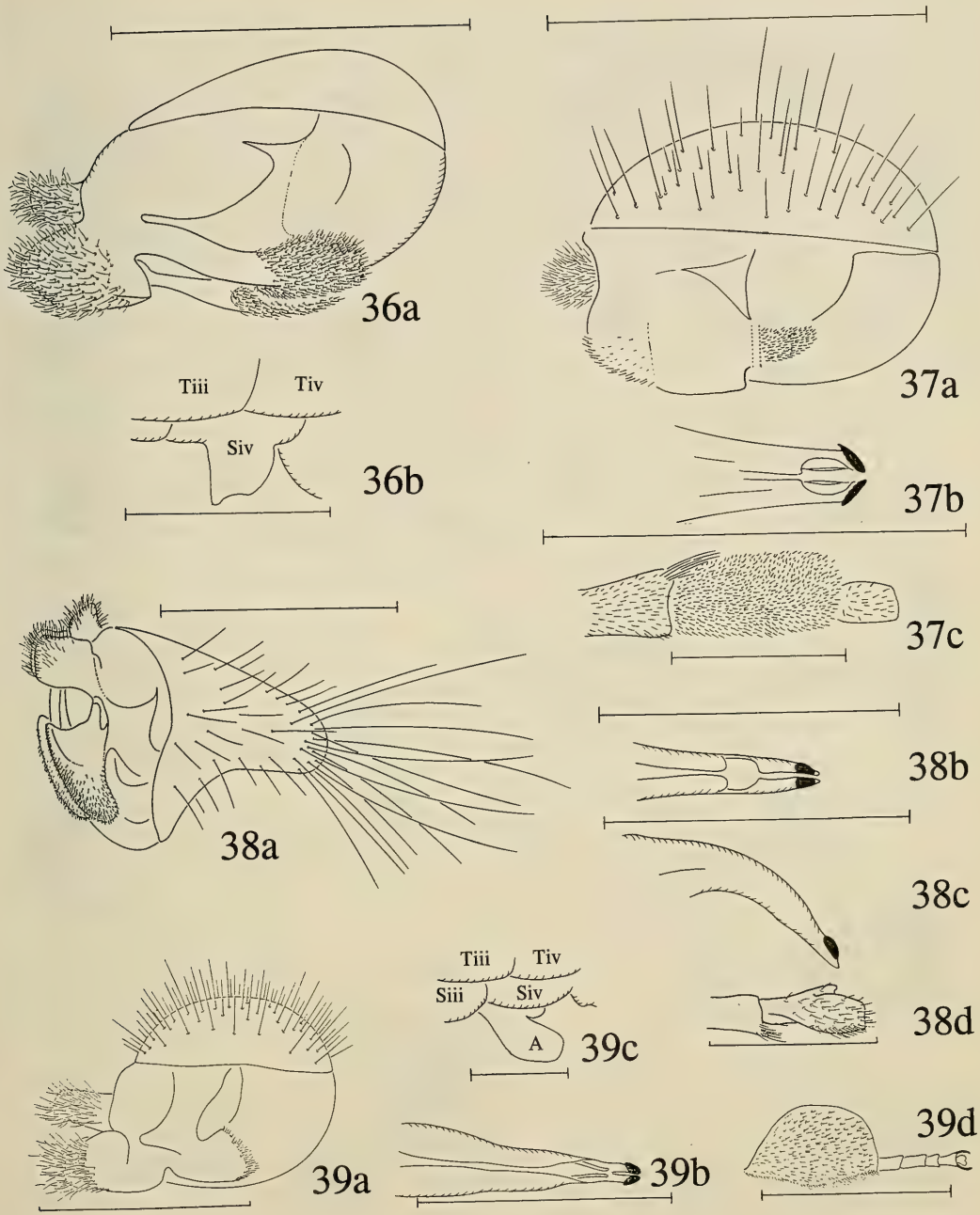


Fig. 32. *Merodon kawamurae.* a, lateral view of ♂ genitalia; b, ventral view of overlapping posterior surstyle lobes; c, d, ventral and lateral view of aedeagus; e, size correlated shape variation in antennae. – Fig. 33. *M. marginicornis.* a, lateral view of ♂ genitalia; b, c, ventral and lateral view of aedeagus. – Fig. 34. *M. rufitarsis.* a, lateral view of ♂ genitalia; b, c, ventral and lateral view of aedeagus. – Fig. 35. *M. sophron.* a, lateral view of ♂ genitalia; b, c, ventral and lateral view of aedeagus; overlap of surstyle lobes as in Fig. 32b.



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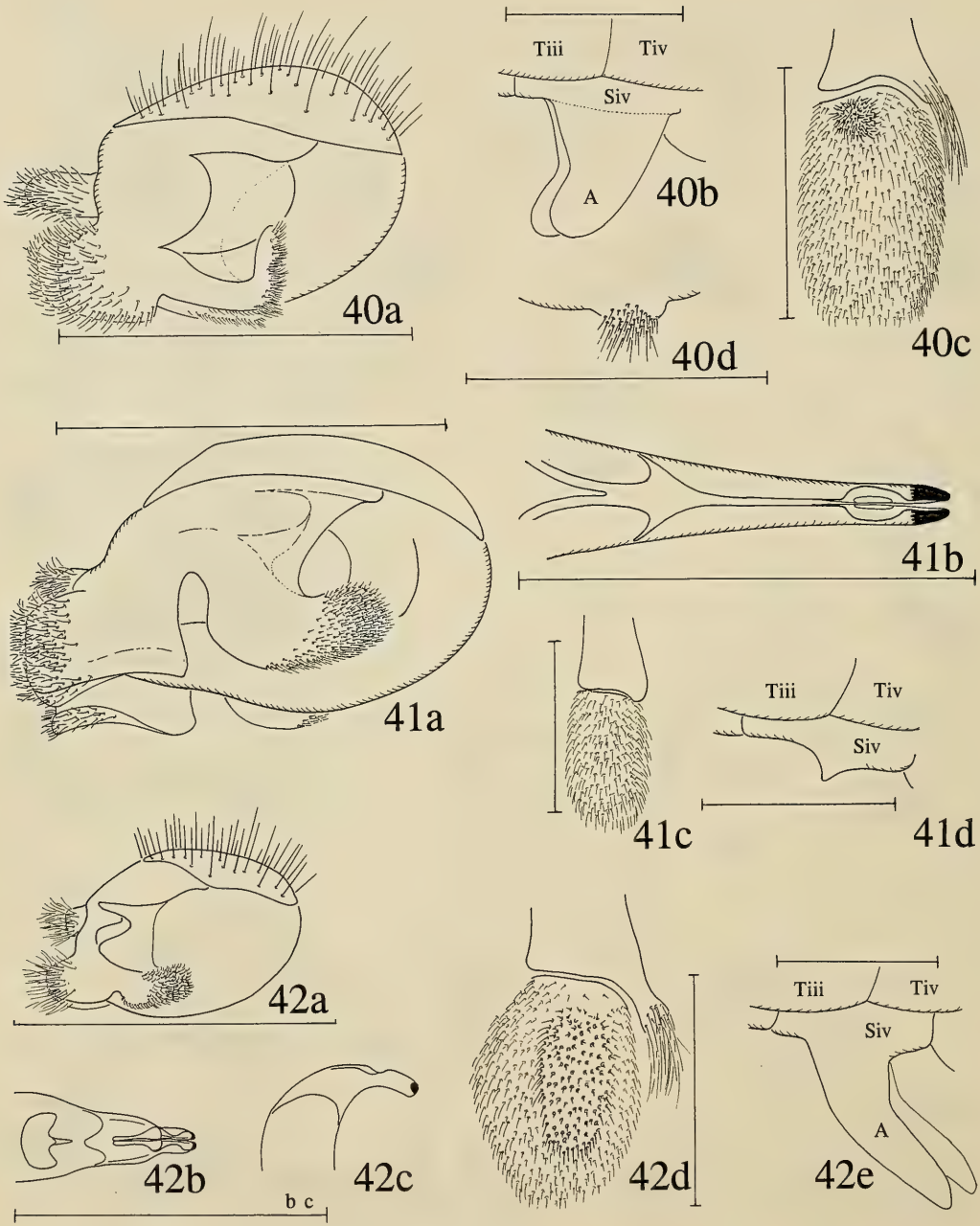

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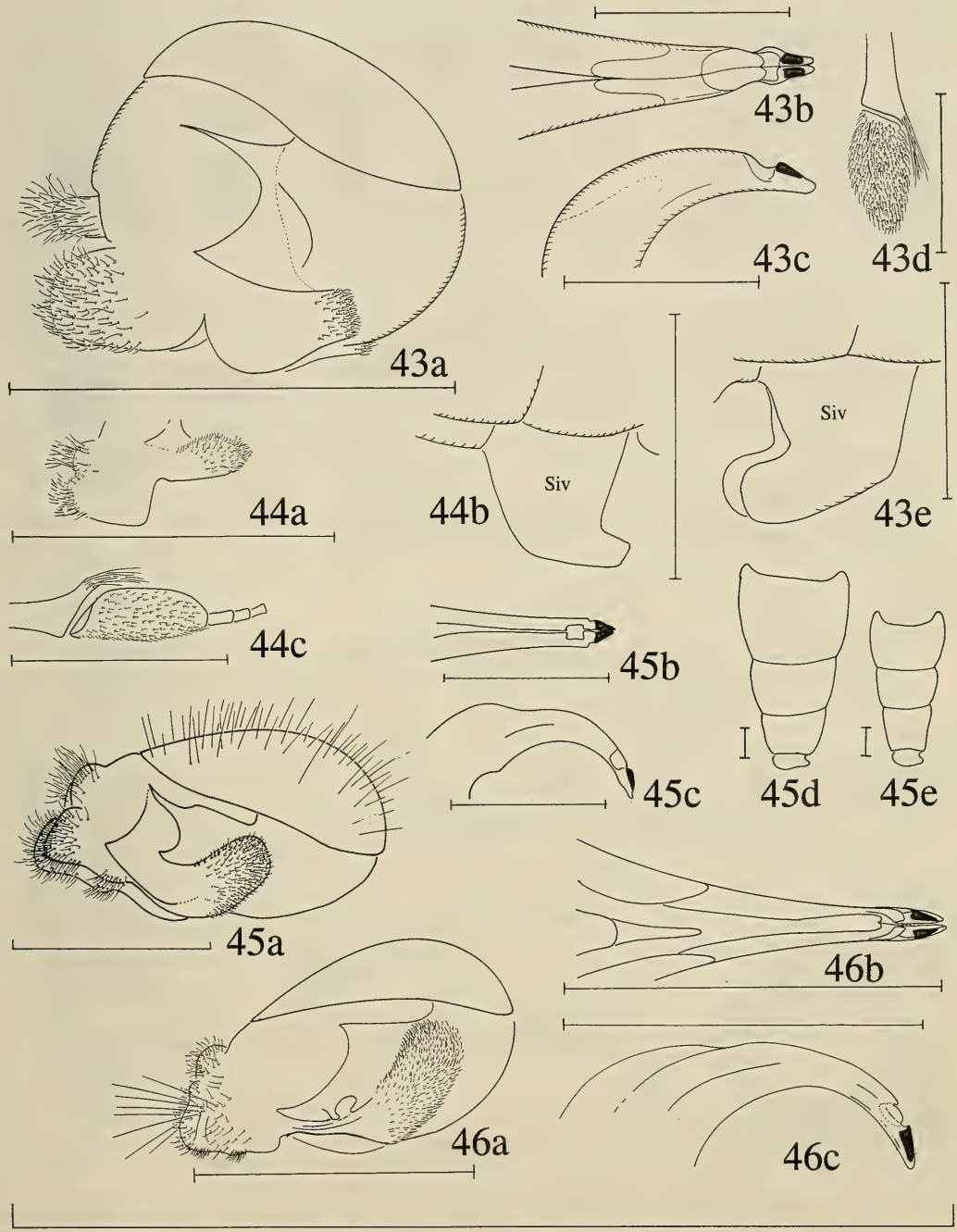

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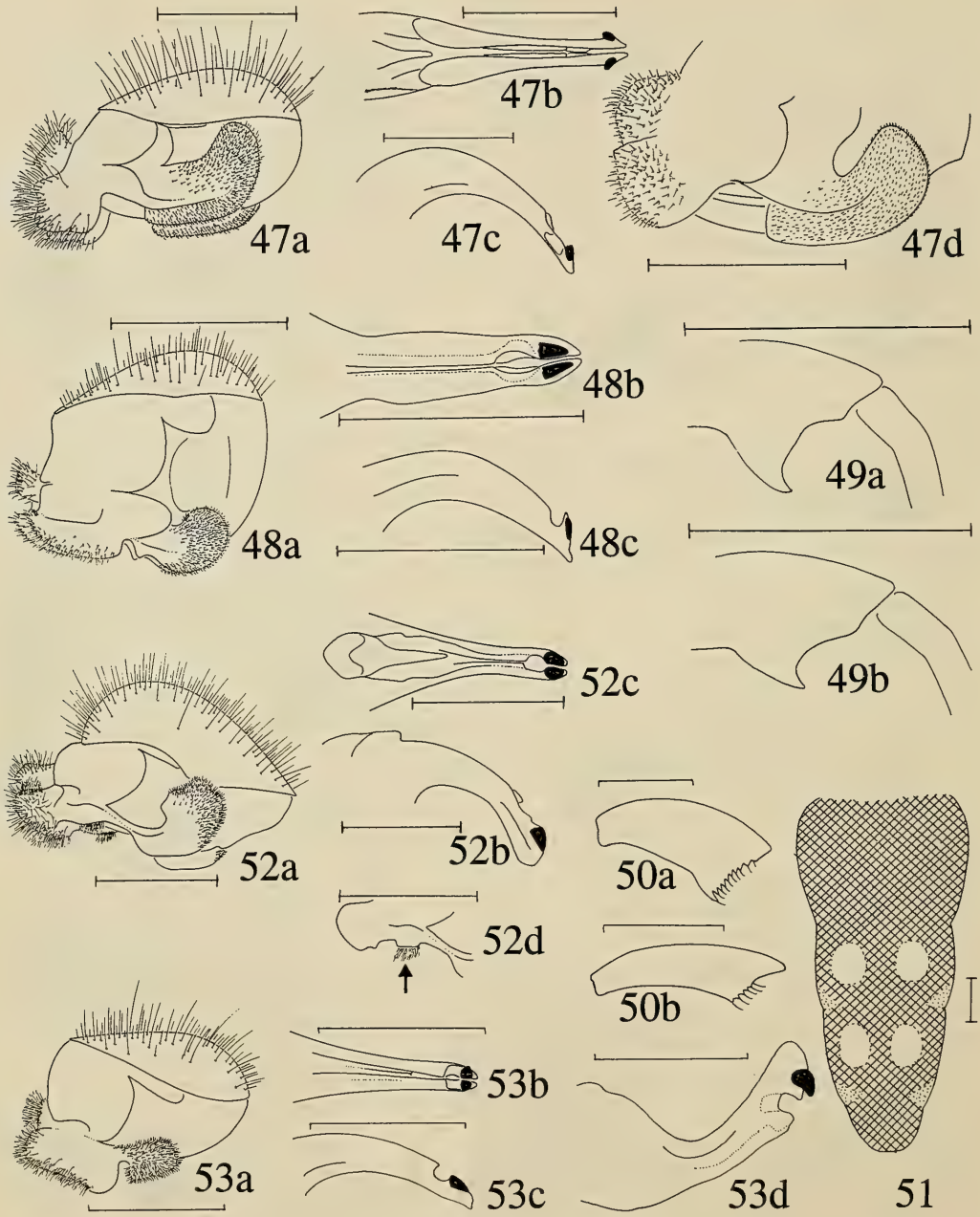

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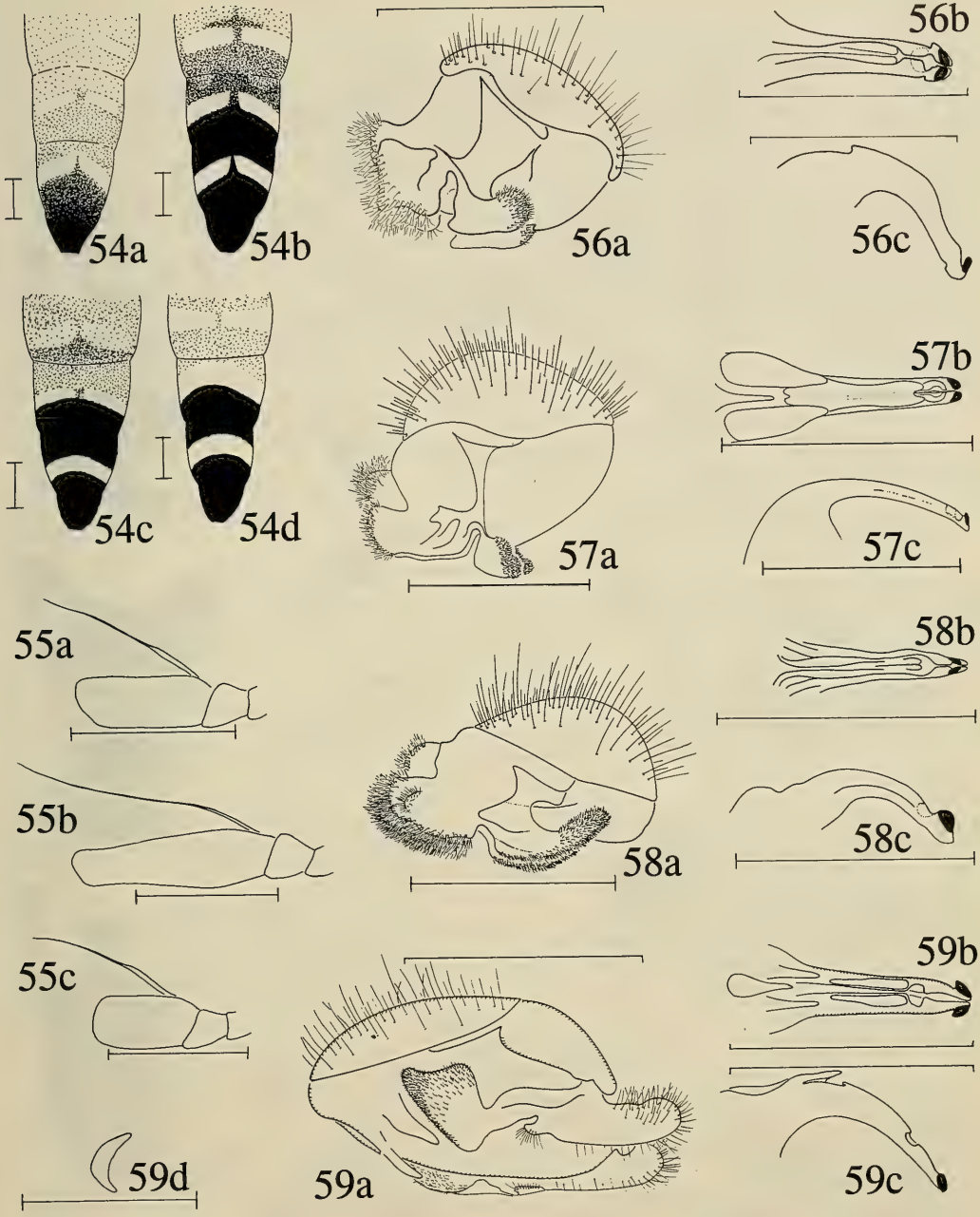

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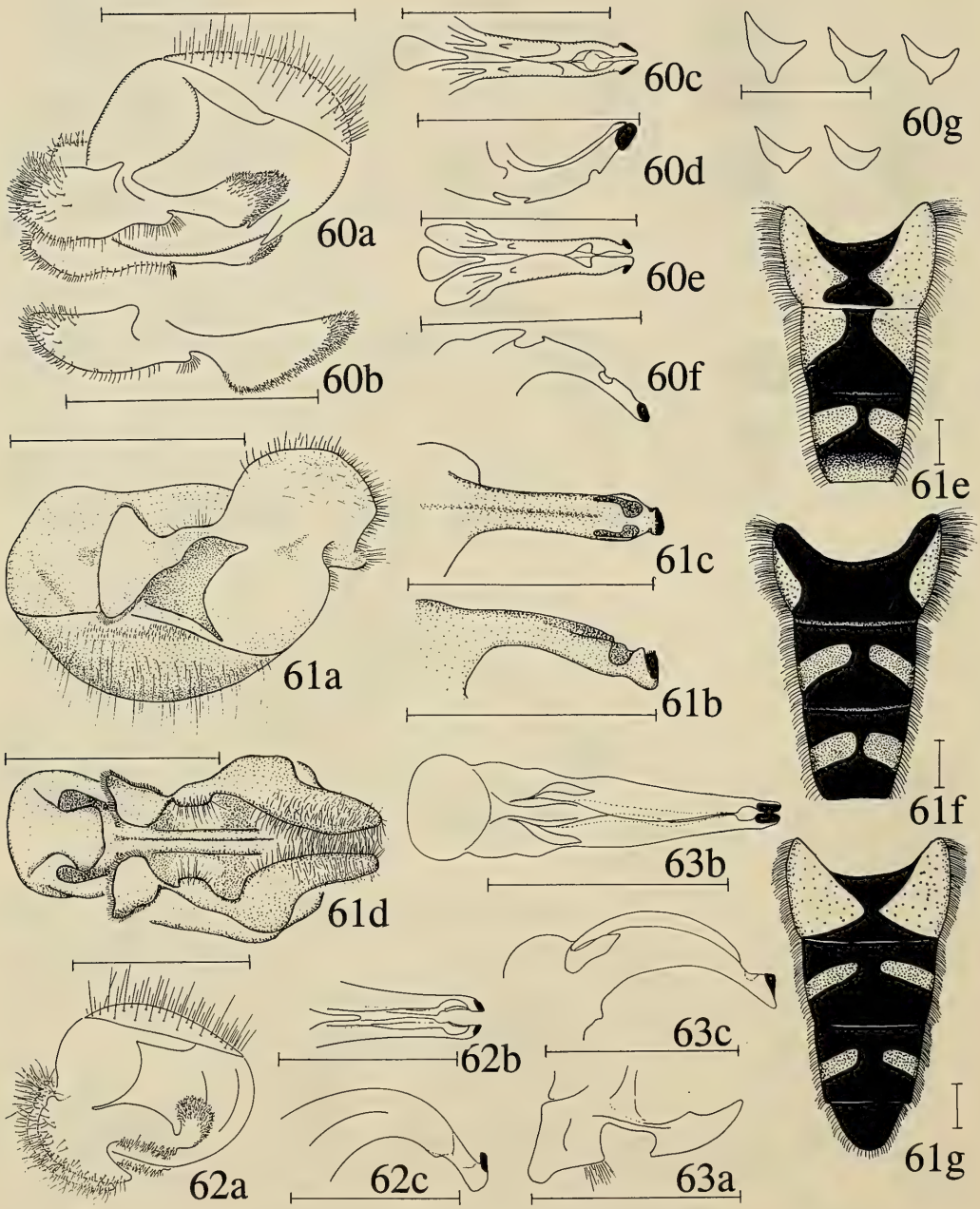

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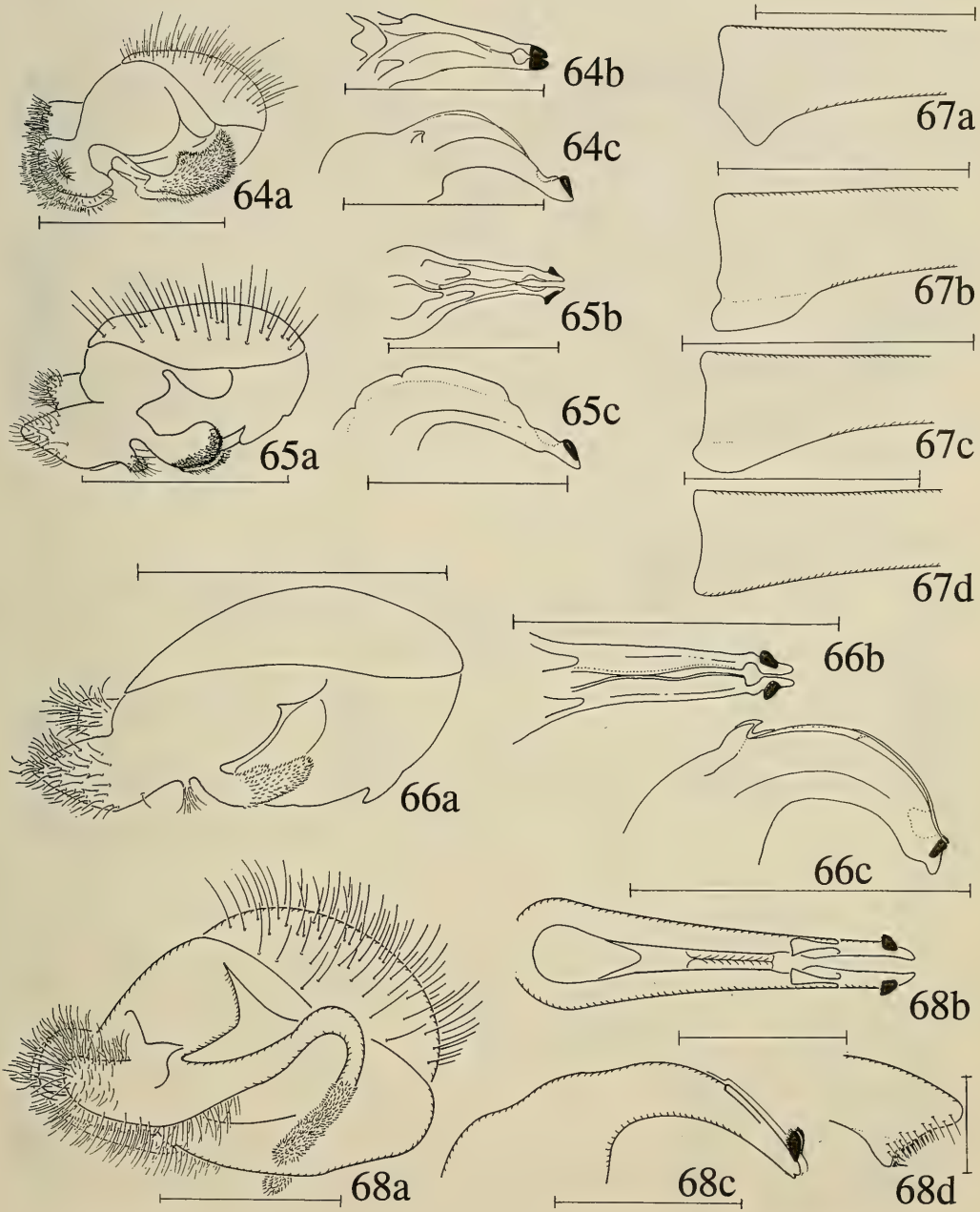

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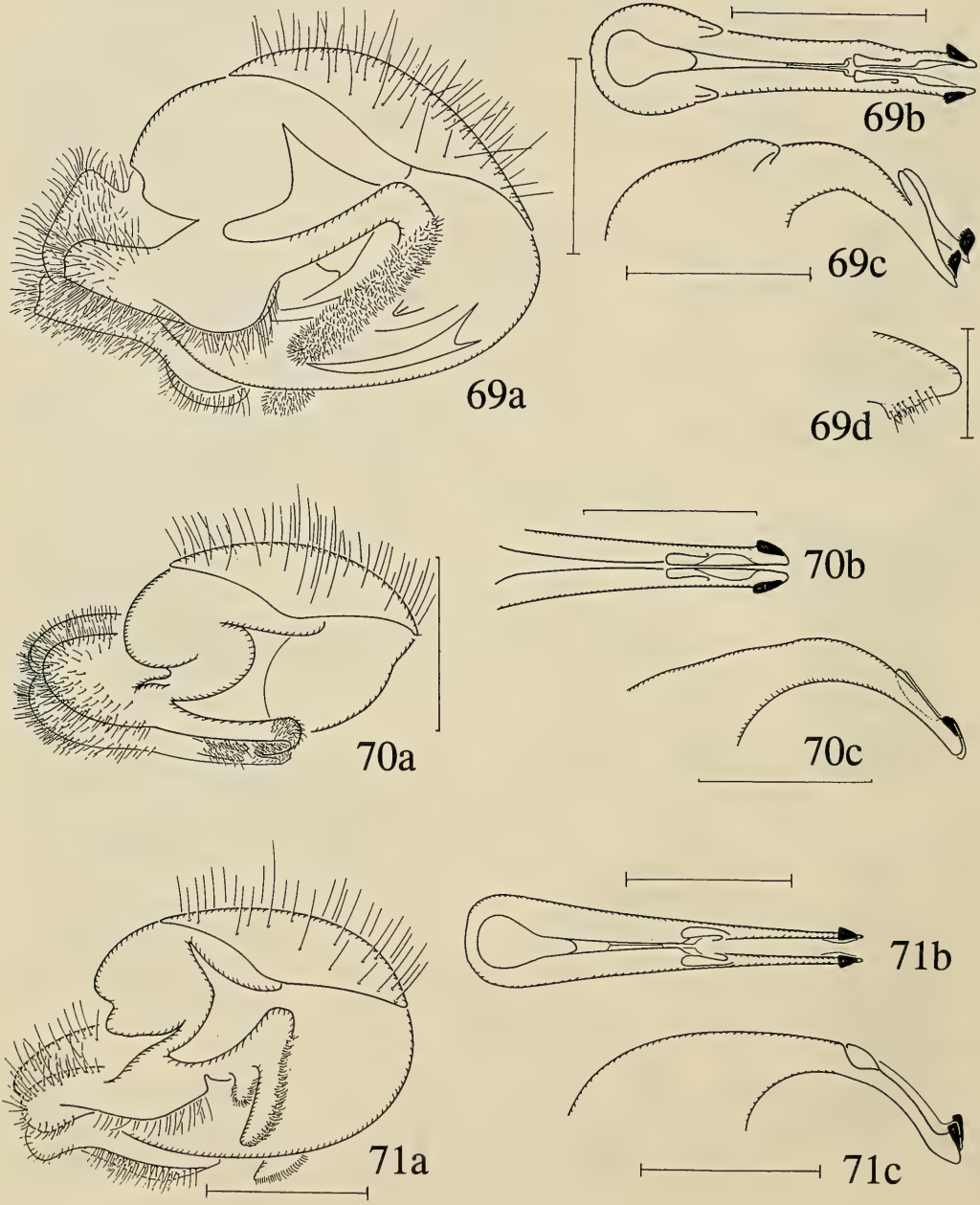

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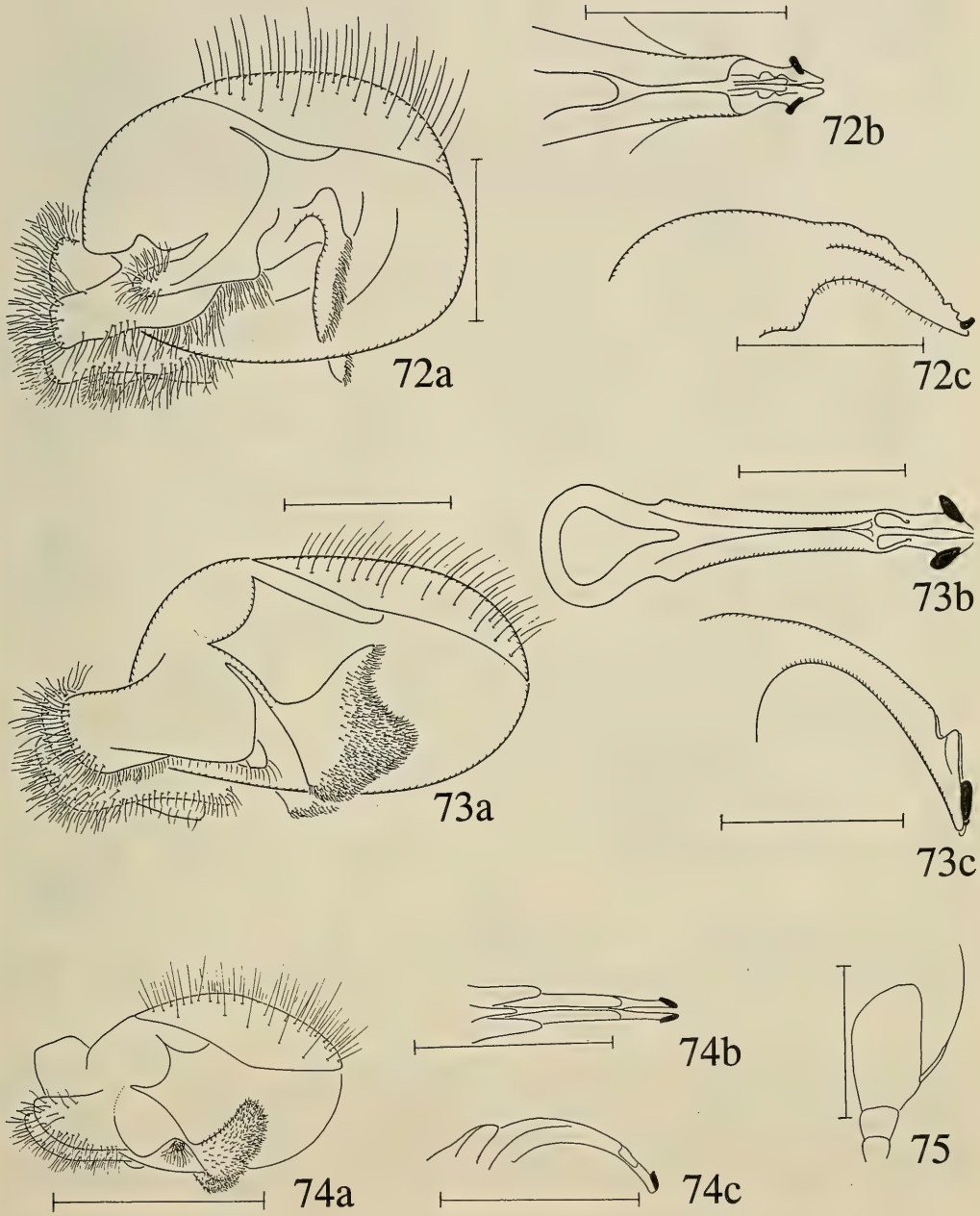

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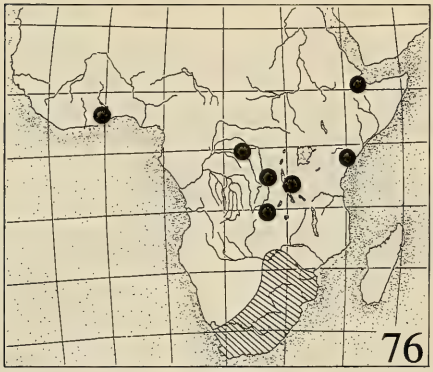

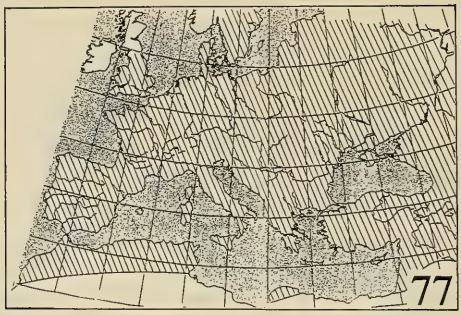

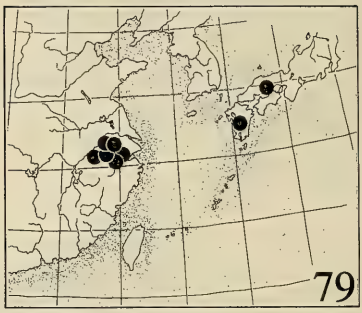

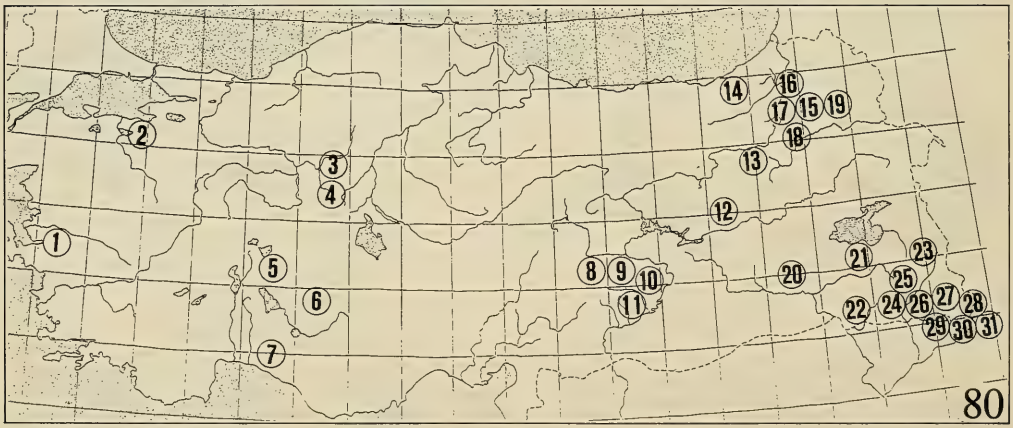

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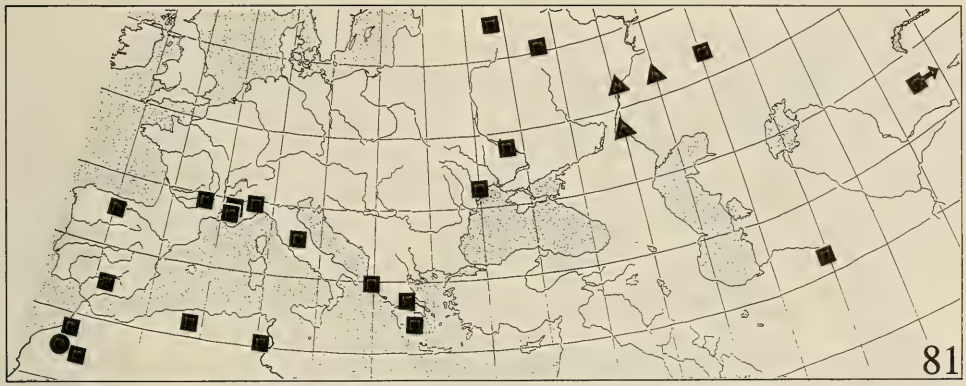
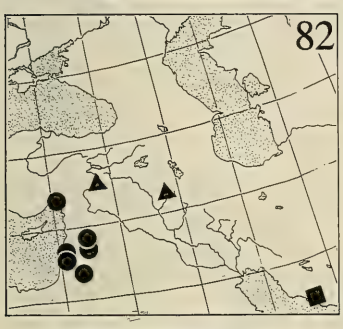
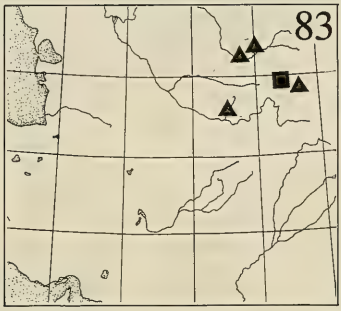
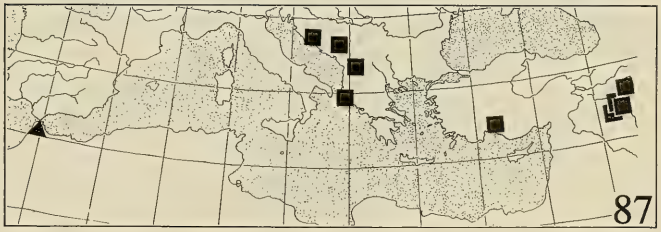
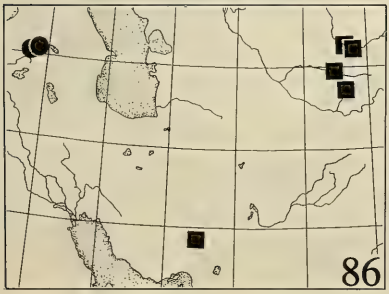










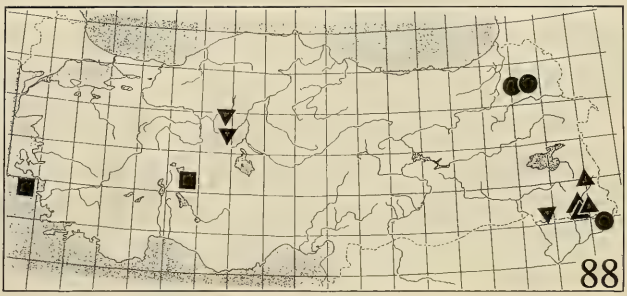
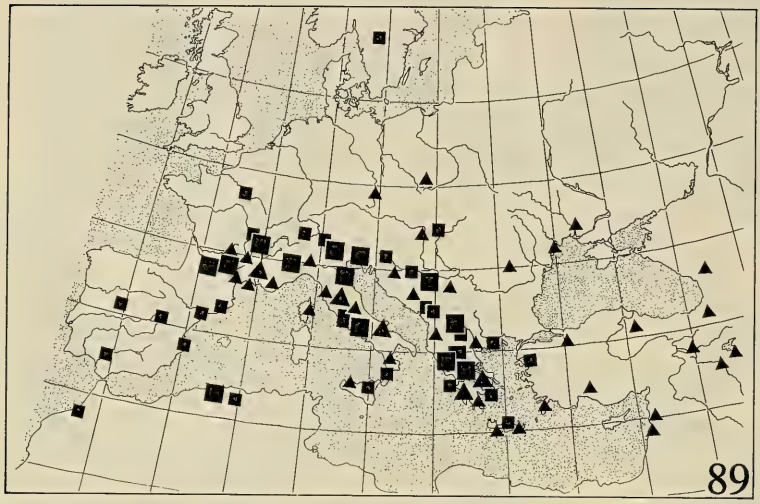
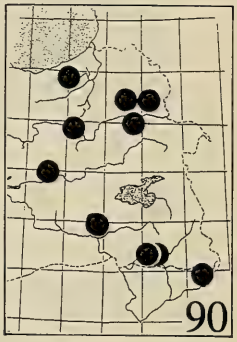
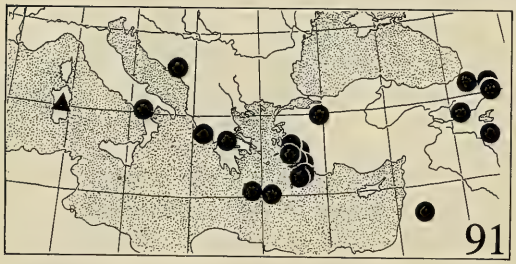
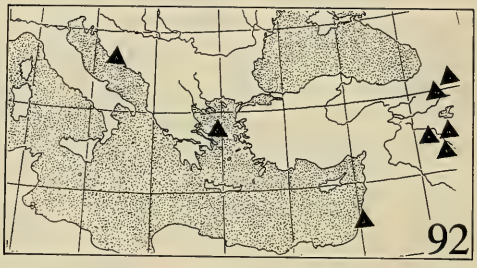


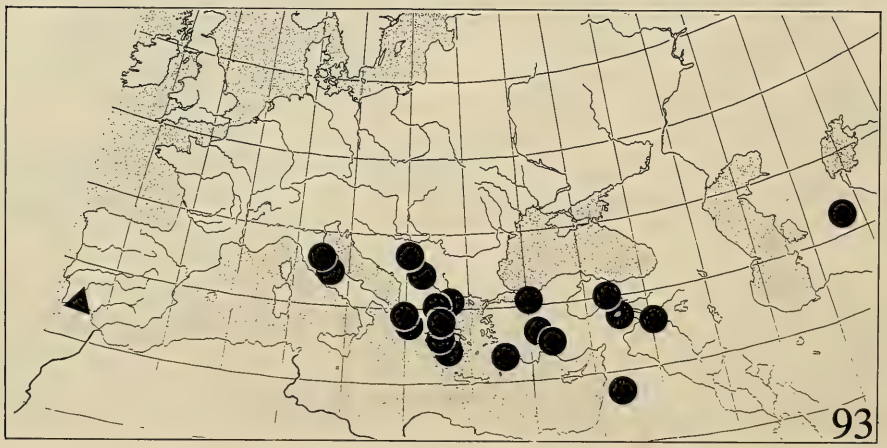
Fig. 81-88. Distribution of *Merodon*. – 81, *M. alexeji* (■), *M. sophron* (●) and *M. tener* (▲); 82, *M. hirsutus* (●), *M. hypochrysos* (▲) and *M. marginicornis* (■); 83, *M. rufitarsis* (■) and *M. tarsatus* (▲); 84, *M. ankylogaster* (■), *M. auronitens* (▼), *M. caudatus* (●) and *M. oidipous* (▲); 85, *M. persicus* (●), *M. quadrinotatus* (▲) and *M. xanthipous* (■); 86, *M. brevis* (●) and *M. turkestanicus* (■); 87, *M. kaloceros* (■) and *M. tangerensis* (▲); 88, *M. cupreus* (●), *M. hamifer* (■), *M. vandergooti* (▼) and *M. warnckei* (▲).











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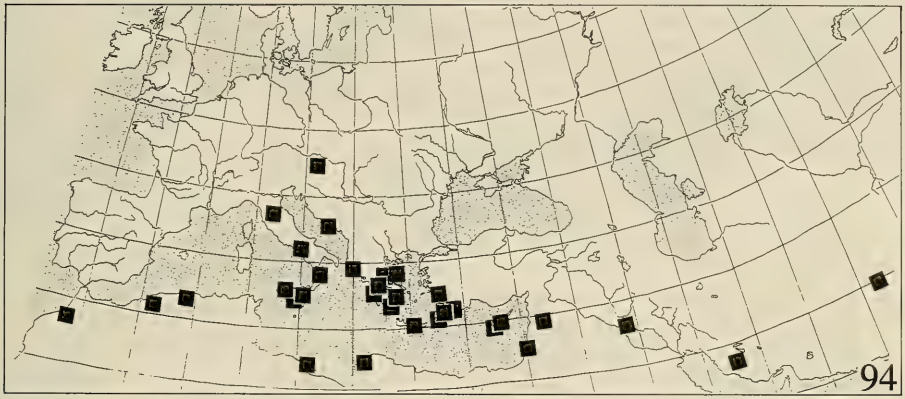

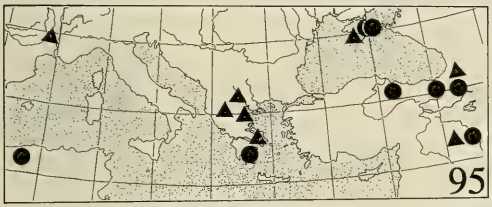

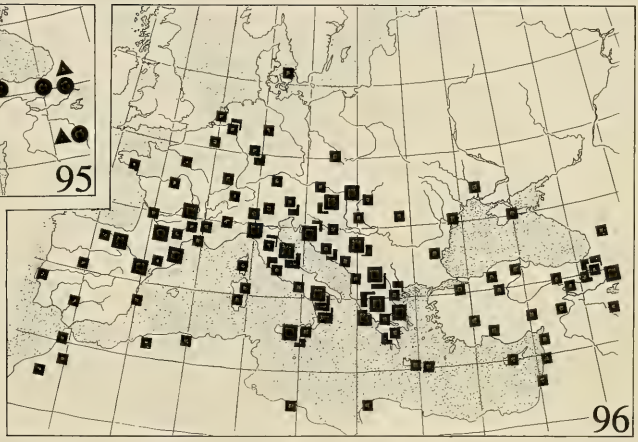

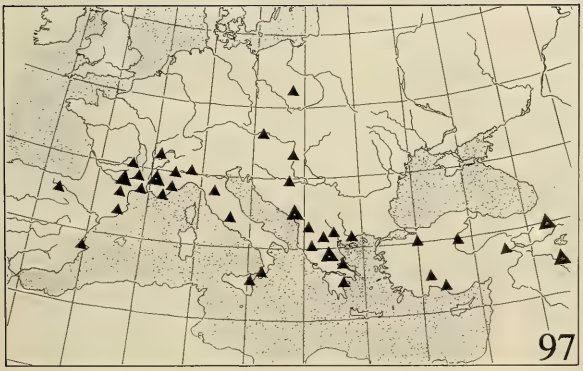

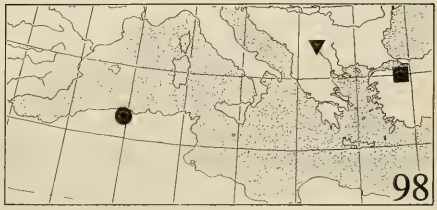

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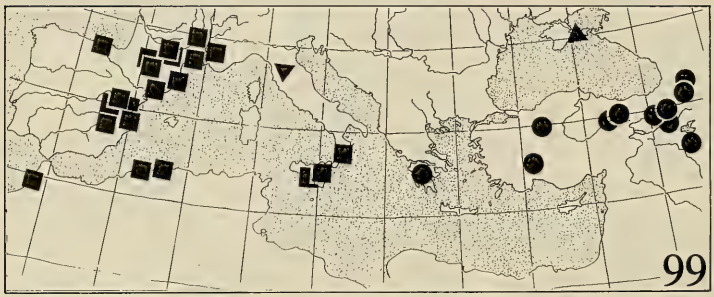

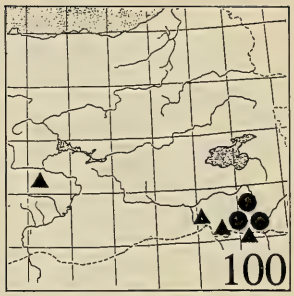

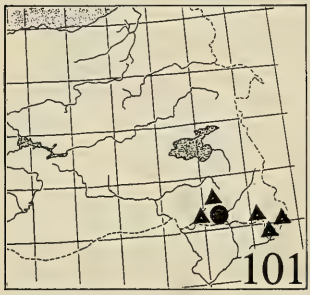

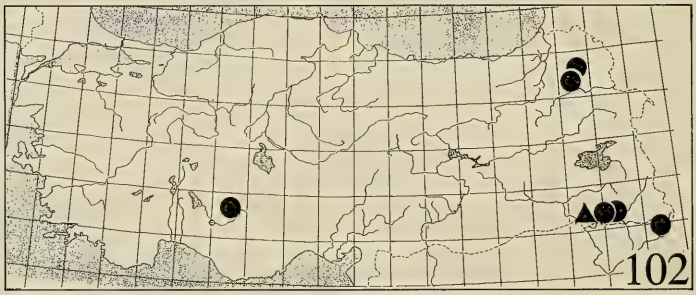

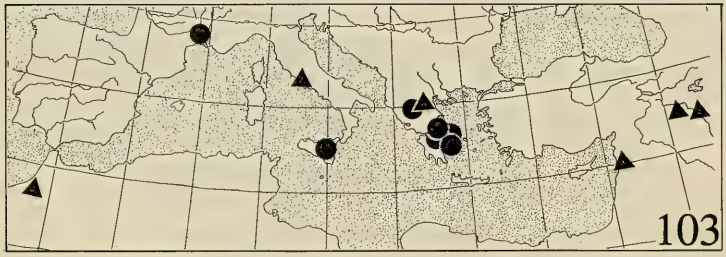

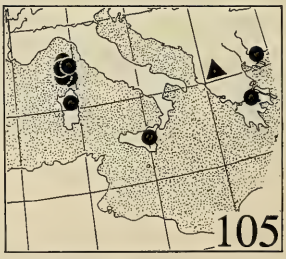

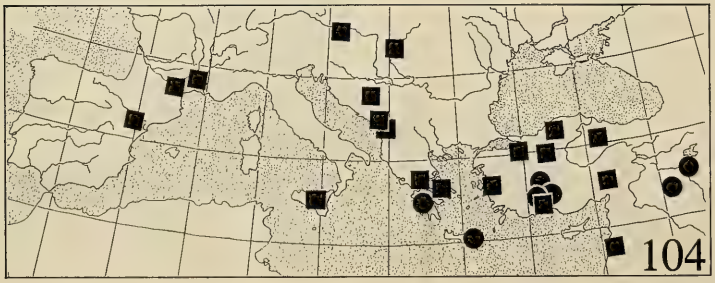

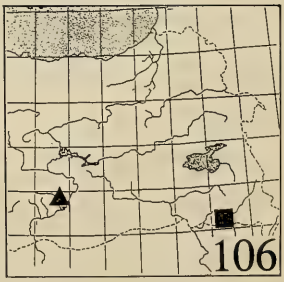

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THE PHYLOGENY OF THE *NEPHROTOMA FLAVESCENS* SPECIES GROUP (DIPTERA: TIPULIDAE)

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The phylogeny of the currently recognized 22 species and subspecies of the west Palaearctic *Nephrotoma flavescens* species group (Diptera, Tipulidae) is analysed on the basis of 50 morphological characters. The results of the present study are compared with the phylogeny of the *flavescens* group published by Oosterbroek (1980). A synopsis of the distribution of the species and subspecies is given.
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In this paper I will discuss the phylogenetic relationships of the 22 species and subspecies of the *Nephrotoma flavescens* species group sensu Oosterbroek (1980).

The concept of the *flavescens* group adopted here is in accordance with the views of Oosterbroek (1980, 1982). A list of the 22 species and subspecies of the *flavescens* group as recognized in the present paper is given in table 1. A systematic revision of the twenty species and subspecies of the *flavescens* group known at that time was incorporated in Oosterbroek (1978). Subsequently, Oosterbroek (1982) introduced *N. cretensis* and *N. guestfalica hartigiana* as new members of the group. Oosterbroek (1985a) furthermore included the Japanese species *N. subpallida* Alexander in the *flavescens* group. For reasons explained below (section 'Discussion of adopted phylogeny'), I do not accept this combination. An as yet unnamed species, known of female specimens originating from northern Algeria and northern Tunisia, awaits description until the male sex becomes available. It is not included in the phylogenetic analysis of the present paper.

The phylogeny of the *flavescens* group is analysed as part of a research project on the historical biogeography of the western Mediterranean (see De Jong in press). Previously, Oosterbroek (1980) presented a phylogenetic analysis of this species group, but additional information on the distribution of certain characters within *Nephrotoma* prompted a reconsideration of Oosterbroek's conclusions. In the section 'Discussion of adopted phylogeny', I will compare the results of the present study with Oosterbroek's phylogenetic analysis of the *flavescens* group.

The *flavescens* group has an essentially west Palaearctic distribution, with most of its species and subspecies being confined to the Mediterranean sub-

Table 1. The species and subspecies of the *Nephrotoma flavescens* species group as recognized in this paper. + = examined; - = not examined. Females of an as yet undescribed species are known from north Algeria and north Tunisia.

	♂	♀
appendiculata appendiculata Pierre, 1919	+	+
appendiculata pertenua Oosterbroek, 1978	+	+
astigma Pierre, 1925	+	+
beckeri Mannheims, 1951	+	+
cretensis Oosterbroek, 1982	+	+
exastigma Oosterbroek, 1978	+	+
flavescens Linnaeus, 1758	+	+
fontana Oosterbroek, 1978	+	+
guestfalica guestfalica Westhoff, 1879	+	+
guestfalica hartigiana Oosterbroek, 1982	+	+
guestfalica surcoufi Pierre, 1925	+	+
lempkei Oosterbroek, 1978	+	+
minuscula Mannheims, 1951	+	+
nasuta Oosterbroek, 1975	+	+
quadrifaria quadrifaria Meigen, 1804	+	+
quadrifaria farsidica Savchenko, 1957	-	+
saccai Mannheims, 1951	+	+
schaeuffelei Mannheims, 1964	+	+
spatha Oosterbroek, 1975	+	+
submaculosa Edwards, 1928	+	+
sullingtonensis Edwards, 1938	+	+
theowaldi Oosterbroek, 1978	+	+

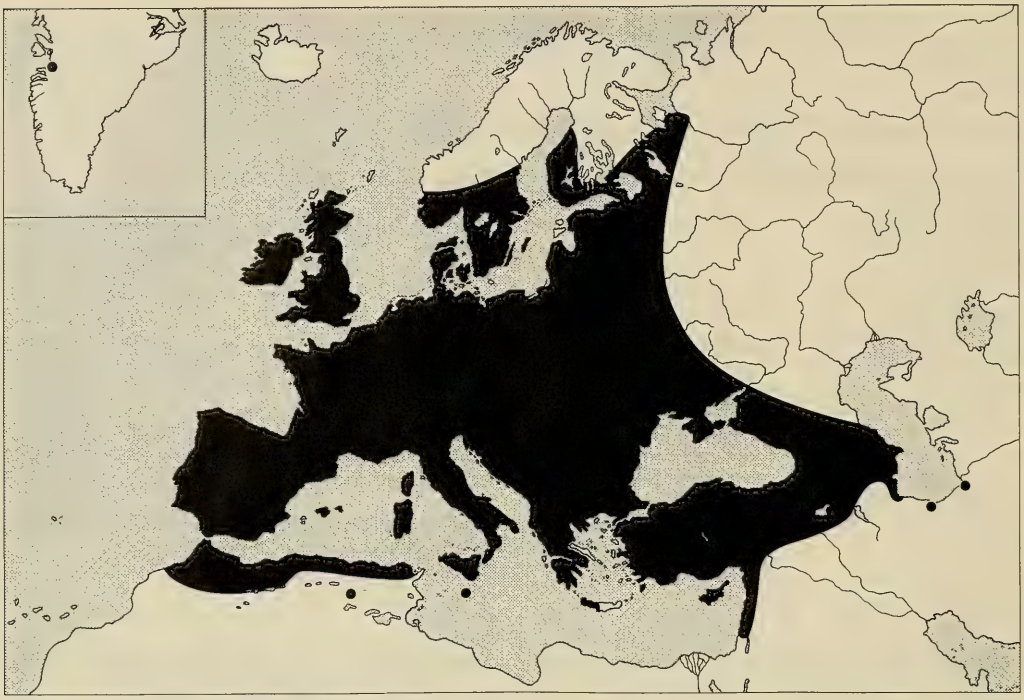


Fig. 1. Distribution of the *Nephrotoma flavescens* species group.

region (fig. 1). The distribution range of six representatives of the *flavescens* group extends towards northwest Europe. A single male specimen of the species *flavescens* Linnaeus has been reported from western Greenland (cf. Mannheims & Theowald 1971).

Detailed information on the distribution of the species and subspecies of the *flavescens* group can be found in Oosterbroek (1978: distribution maps of the species and subspecies discussed therein) and Oosterbroek (1982, 1985b: additional distributional data). Oosterbroek & Theowald (1992) summarized the ranges of the Palaearctic Tipulidae, including the members of the *flavescens* group. Distribution maps of each of the species and subspecies of the *flavescens* group will be included in a forthcoming paper dealing with the historical biogeography of the western Mediterranean. A synopsis of the distribution of the members of the *flavescens* group is given at the end of the present paper.

A key to the identification of the species and subspecies of the *flavescens* group (as well as all other western Palaearctic members of *Nephrotoma* known at the time) can be found in Oosterbroek (1979c). The more recently described *N. cretensis* and *N. guestfalica hartigiana* will key out under couplet 13 and couplet 3 respectively. Oosterbroek (1982) listed distinguishing characters for both taxa.

Material, methods and terminology

The majority of specimens used for the present study are preserved in the collection of the Department of Entomology of the Institute for Taxonomic Zoology (Zoological Museum), Amsterdam. Additional material was kindly lent by Dr. Eulalia Eiroa (Department of Animal Biology, University of Santiago de Compostela, Spain). Specimens were usually dry pinned, occasionally material was preserved in alcohol.

As most characters used for the phylogenetic analysis pertain to structures of the terminalia of both sexes, preparations of these parts were made. To this end the specimen was relaxed for a few hours in a humifier, after which the (end of the) abdomen was detached. The removed parts were macerated for about three to five minutes in a nearly boiling 10% KOH solution in a bain-marie. The macerated structures were rinsed with water (several times) and 70% alcohol, upon which they were transferred to a watchglass filled with glycerol. Examination of the terminalia was carried out using a Wild stereomicroscope

with a magnification up to 100×. The drawings were made with the aid of a drawing tube on the microscope. For lasting preservation the terminalia were stored in glycerol in a microvial pinned under the pertaining specimen.

The programs HENNIG86, version 1.5 (Farris 1988) and PAUP, version 3.1.1 (Swofford 1993) were used to analyse the phylogeny. For details on the computational methods employed, see the section 'Discussion of adopted phylogeny'.

The terminology used is largely in accordance with McAlpine (1981). I employ some additional terms to denote details of the male and female terminalia. Tangelder (1985) published a review of the morphology of the terminalia of the Tipulidae, and for further details I refer the reader to her paper. The terms used in the present text are explained in figures 3-10, 13, 14, 30 and 50.

Biology

The species of the *flavescens* group occur in a variety of habitats, ranging from grassland, gardens, scrubs, deciduous as well as coniferous forests to dry sandy places. Adults are usually on the wing in spring and early summer, although *minuscula* Mannheims (Cyprus and the Levant) flies as early as the middle of January and records of *flavescens* Linnaeus (central and western Europe) are known from as late as September. The species of the *flavescens* group can be found from sea-level up to 2400 m, the highest altitude recorded for *flavescens* in the Alps.

Several authors described immature stages of members of the group, viz. of *appendiculata appendiculata* Pierre, *flavescens, guestfalica guestfalica* Westhoff, *quadrifaria quadrifaria* Meigen, and *submaculosa* Edwards (cf. Brindle 1960, Chiswell 1956, Hemmingsen & Jensen 1972, Theowald 1957, 1967). Oosterbroek (1978) presented details on the biology of each of the then recognized members of the *flavescens* group.

Systematic position

Mannheims (1951) separated the west Palaearctic species of *Nephrotoma* with acutely pointed cerci in the female from the remaining species of the genus. Savchenko (1973), largely adopting this major division, included most of the species involved in his *cornicina* species group. The *cornicina* group sensu Savchenko contains the species of *Nephrotoma* that in the male carry an extension on the posterior margin

Table 2. Character state matrix of the species and subspecies of the *Nephrotoma flavescens* species group.

(Sub)species	Character									
	5	10	15	20	25	30	35	40	45	50
appendiculata	00010	11000	11011	00100	01000	11011	10111	00000	00011	00000
a. pertenua	00010	11000	11011	00100	01000	11011	10111	00000	00011	00000
astigma	10010	00010	10111	10100	01110	01111	11000	10000	00011	01000
beckeri	00110	00000	10001	01110	01000	01010	00010	00000	00011	00010
cretensis	00110	00000	10001	01110	01000	01010	00000	00000	00011	00010
exastigma	10010	00000	10000	00100	01000	01111	00000	00000	00011	01000
flavescens	10010	00010	10111	10100	01110	01011	11000	10000	00011	01000
fontana	00010	00010	11011	00100	01100	01011	10000	00000	00011	00000
guestfalica	00011	00000	10001	10101	00001	01111	00000	01010	00011	10000
g. hartigiana	00011	00000	10001	10101	10001	01111	00000	01010	00011	10000
g. surcoufi	00011	00000	10001	10101	10001	01111	00000	01010	00011	10000
lempkei	10010	00011	10111	10100	01110	01111	11000	10000	00011	01100
minuscula	10010	10100	10011	00100	01000	01011	10111	00000	11011	00001
nasuta	00000	00000	10101	00100	01000	01010	00000	00000	00000	00000
quadrifaria	01000	00000	11011	01100	01000	01111	10010	00101	00101	00000
q. farsidica	01000	00000	11011	01100	01000	01111	10010	00101	00101	00000
saccai	00000	00000	1-001	00100	01000	01010	00010	00000	00010	00000
schaeuffelei	00000	00000	10000	00000	01000	00010	00000	00000	00100	00000
spatha	-0010	00000	10001	10000	01000	01011	00000	00000	00100	00000
submaculosa	10010	00011	10111	10100	01110	01011	11000	10000	00011	01100
sullingtonensis	00010	00010	11011	00100	01000	01011	10000	00000	00011	00000
theowaldi	00010	10100	10011	10100	01000	01011	10111	00000	11011	00001

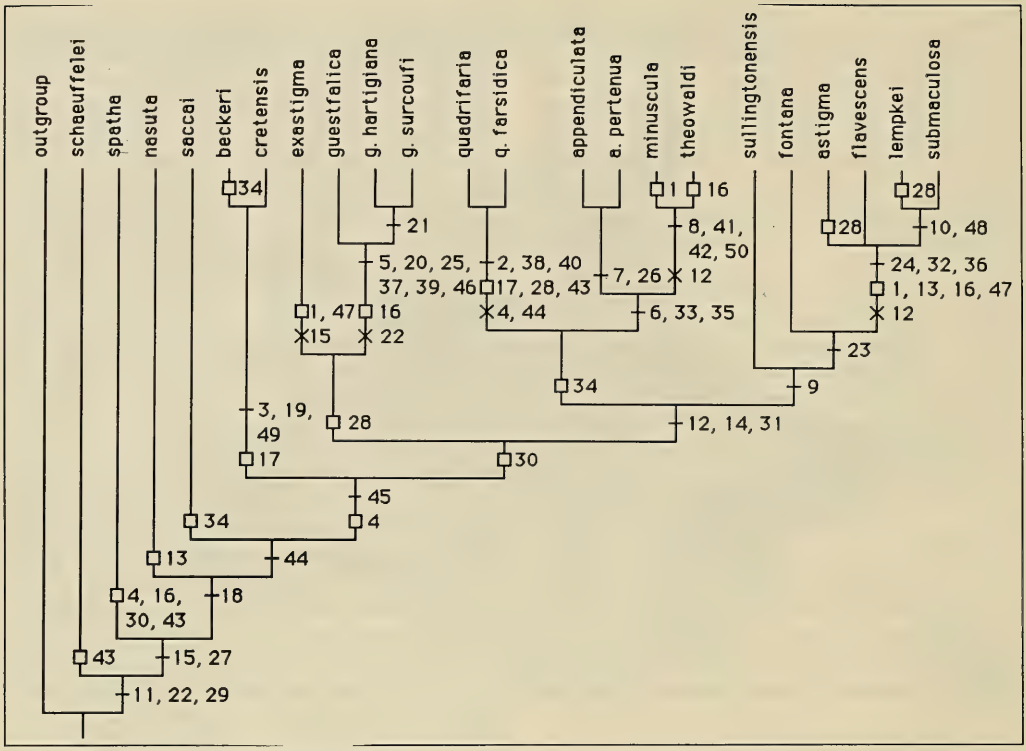


Fig. 2. Consensus tree of two equally parsimonious trees with length 73, consistency index 68 and retention index 84 for the species and subspecies of the *Nephrotoma flavescens* species group. –: synapomorphy; □: homoplasy; ×: reversal.

of sternite eight and that are devoid of bristles on the alar squama. Thus Savchenko excluded the species *guestfalica* Westhoff from his *cornicina* group, meanwhile adding several central and east Palaearctic as well as Oriental species to the group.

Based on three presumed synapomorphies, the *flavescens* species group was first recognized by Oosterbroek (1980) as a subgroup of the *cornicina* group. The monophyly of the *flavescens* group will be further discussed below.

The exact position of the *flavescens* group within the *cornicina* group is not yet established. Oosterbroek (1980) presented a phylogeny of the *cornicina* group, but restricted his analysis to the western Palaearctic species. This approach, for obvious reasons, led to the conclusion that the *flavescens* group is closely related to western Palaearctic species of the *cornicina* group. I have made a preliminary analysis of the phylogeny of the *cornicina* group with the inclusion of some of its east Palaearctic and Oriental members. Results of this investigation show that the *flavescens* group is probably more closely related with east Palaearctic species of the *cornicina* group. An exhaustive analysis of the *cornicina* group, however, was beyond the scope of the present paper.

In the phylogenetic analysis of the *flavescens* group I employed the non-*flavescens* group members of the *cornicina* group as the first level outgroup, and the remaining species of *Nephrotoma* as the second level outgroup.

Phylogenetic analysis

In this section I will discuss the characters used in the phylogenetic analysis of the *flavescens* group. Each character dealt with contains a brief description of its presumed plesiomorphous and apomorphous states, accompanied by their respective codings (0: plesiomorphous, 1: apomorphous). The character state matrix is given in table 2. The resulting cladogram for the *flavescens* group is shown in figure 2 and is discussed in the next section. Autapomorphies of the species and subspecies of the *flavescens* group are given in the appendix to this paper.

Legs

1. – Tarsal claws of male: (0) medial tooth present (fig.

11, arrowed); (1) medial tooth absent (fig. 12) (cf. Oosterbroek 1980: 337, character 24).

The male claws lack the medial tooth in the species *exastigma*, *minuscula* and the members of the clade *astigma* to *submaculosa*. In the species *spatha* the male claws usually bear this tooth, but there are specimens with some or all of the claws toothless. Absence of the medial tooth on the male claw is due to reduction. Females of *Nephrotoma* always have the tarsal claws devoid of teeth.

Species with toothless claws in the male occur frequently in other groups of *Nephrotoma*. According to Oosterbroek (1980: 337) and Tangelder (1985: 160), this character state is usually restricted to smaller monophyletic groups. Referring, among other things, to this character state, Oosterbroek (1980) united the species *exastigma* and *spatha* with the members of the clade *astigma* to *submaculosa*, an interpretation not followed in the present paper.

Wing

2. – Wing-membrane: (0) unmarked; (1) dark crossband running from pterostigma over base of discal cell, crossvein m-cu and apical portion of vein Cu; wing-tip darkened (fig. 13).

The subspecies *quadrifaria quadrifaria* and *quadrifaria farsidica* are distinguished among the members of the *flavescens* group by dark shades below the pterostigma and on the wing-tip. Other species of *Nephrotoma* with similarly marked wings, e.g. *atrostyla* Alexander, *bifusca* Alexander, *gaganboi* Tangelder, and *neopratensis* Alexander, are not closely related with *quadrifaria*.

Male terminalia

3. – Aedeagal guide, apex: (0) gradually tapering towards tip (figs. 5, 14-17, 19-26, 28); (1) with knob-like enlargement at tip (fig. 18).

The species *beckeri* and *cretensis* are sister species that, among other things, are characterized by the shape of the aedeagal guide that terminates in an enlarged tip. Oosterbroek (1982) distinguished this shared derived character state in his discussion on *cretensis* (as 'shape of central part of adminiculum').

4. – Aedeagal guide, gonapophysis: (0) dorsal extension elongate (figs. 14, 16, 17); (1) reduced in length (figs. 5, 15, 18-20, 22-26, 28).

The species *spatha* and the majority of species and subspecies of the clade *beckeri* to *submaculosa* either have a relatively short or completely reduced dorsal extension of the gonapophysis. Contrary to this, both subspecies of *quadrifaria* possess a relatively long dorsal extension (fig. 21). I interpret the character state in *quadrifaria* as a reversal of character state 4(1).

The majority of species of the *cornicina* group have relatively long dorsal extensions of the gonapophyses. Outside the *cornicina* group long dorsal extensions are known in species of the *analis*, *brevipennis*, *dorsalis*, and *pedunculata* species groups of *Nephrotoma* (cf. Oosterbroek 1979b, 1984, 1985a; Tangelder 1983, 1984).

5. – Aedeagal guide, gonapophysis: (0) posterior extension apically rounded (figs. 14-19, 21, 23-26, 28); (1) dorsoventrally flattened and with upcurved acute tip (fig. 20).

The three subspecies of *guestfalica* show the apomorphous state of this character. Within the *flavescens* group, the only other taxa with an acute dorsal tip of the posterior extension of the gonapophysis are both subspecies of *appendiculata* (fig. 22). In the latter two subspecies the posterior extension is mediolaterally flattened (see character 7).

6. – Aedeagal guide, gonapophysis: (0) posterior extension parallel sided or tapering towards tip (figs. 5, 14-17, 19-21, 24-26, 28); (1) spatulate at tip (figs. 22, 23).

The members of the clade *appendiculata* to *theowaldi* have the tip of the posterior extension of the gonapophysis dilated and laterally flattened, the posterior extension thus appearing as a spatulate structure. In both subspecies of *appendiculata* the spatulate part has an acute dorsal tip (fig. 22; see next character), in *minuscula* and *theowaldi* it is rounded off and somewhat downcurved (fig. 23; see character 8).

7. – Aedeagal guide, gonapophysis: (0) tip of posterior extension rounded off when seen in profile (figs. 14-17, 19, 21, 24-26, 28); (1) dorsally with acute tip (fig. 22).

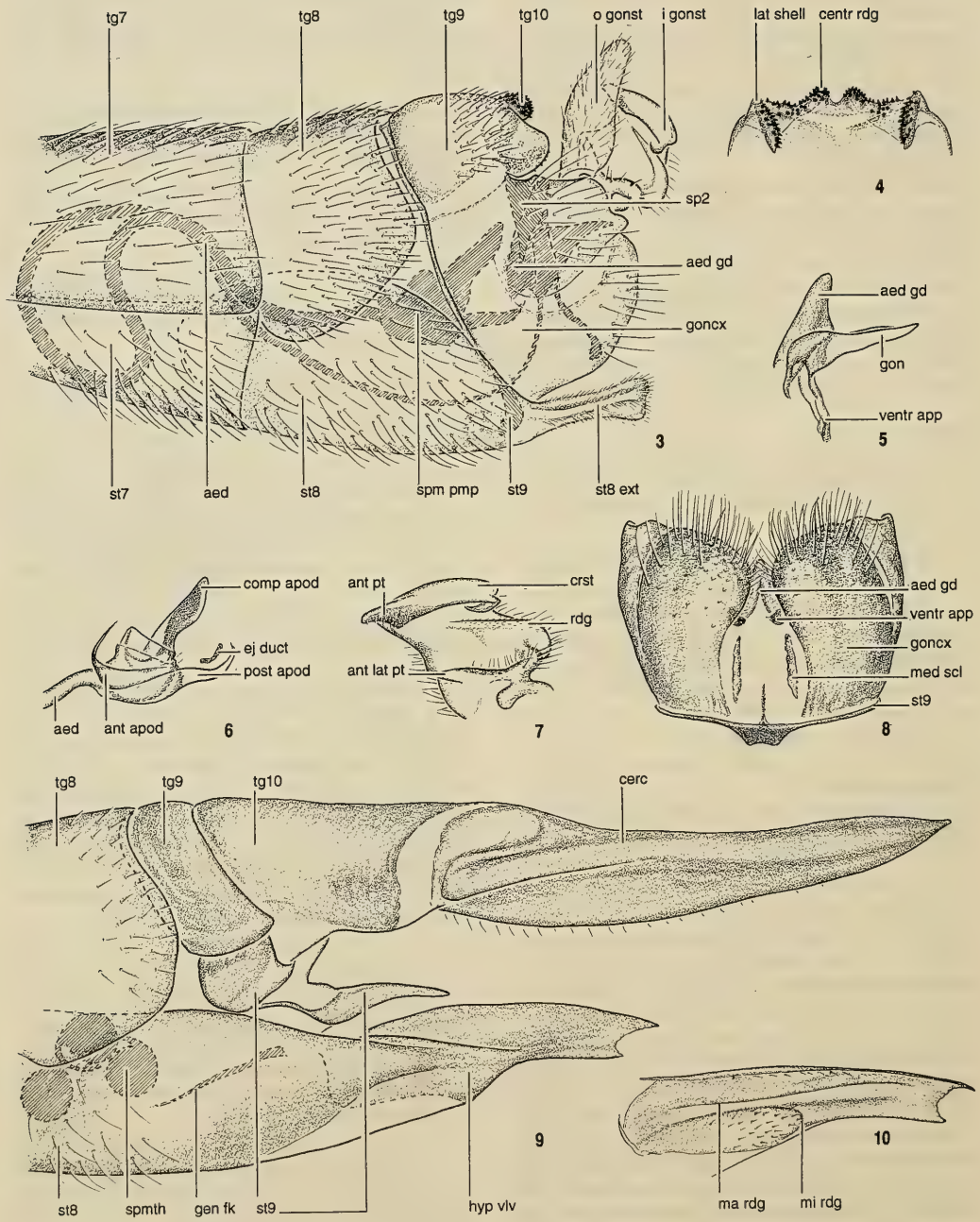
The two subspecies of *appendiculata* show the apomorphous state of this character. The only other members of the *flavescens* group with a dorsally acute posterior extension of the gonapophysis are the three subspecies of *guestfalica* (fig. 20). Here the extension is dorsoventrally flattened and thus of an overall different structure (see character 5).

8. – Aedeagal guide, gonapophysis: (0) ventral margin of posterior extension almost straight when seen in profile (figs. 5, 14-22, 24-26, 28); (1) downcurved at tip (fig. 23) (cf. Oosterbroek 1980: 337, character 25).

The tip of the posterior extension of the gonapophysis is somewhat downcurved in the species *minuscula* and *theowaldi*.

9. – Aedeagal guide, gonapophysis: (0) variously shaped (figs. 14-23); (1) consisting of a mediolaterally flattened and relatively high anterodorsal part and an elongate posterior projection which gradually tapers towards its tip (figs. 5, 24-26, 28).

The species of the clade *sullingtonensis* to *submaculosa* all have a similarly built aedeagal guide plus ap-


tg7
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o gonst
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centr rdg
sp2
aed gd
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st8
spm pmp
st9
st8 ext
3
4
aed gd
gon
ventr app
5
comp apod
ej duct
post apod
aed
ant apod
6
ant pt
crst
rdg
ant lat pt
7
aed gd
ventr app
goncx
med scl
st9
8
tg8
tg9
tg10
cerc
st8
spmth
gen fk
st9
hyp vlv
9
10
ma rdg
mi rdg

pendages, which I interpret as a synapomorphy.

10. – Aedeagal guide, gonapophysis: (0) anterodorsal margin rounded (figs. 26, 27); (1) anterodorsal margin incurved and acutely tipped (fig. 28, 29, arrowed) (cf. Oosterbroek 1980: 337, character 28).

The apomorphous character state separates the species *lempkei* and *submaculosa* from the remainder of the *flavescens* group.

11. – Aedeagal guide, rod: (0) rod present ventral of sperm pump (fig. 30); (1) absent (fig. 31) (cf. Oosterbroek 1980: 332, character 12, as 'adminicular rods').

The species of the *flavescens* group are devoid of rods of the aedeagal guide, although slight vestiges of these structures can be found in individual specimens of the species *beckeri* and *saccai*. Rods of the aedeagal guide are usually present in other species of *Nephrotoma*, including the species of the *cornicina* group outside the *flavescens* group. Reduction of the rods occurs throughout *Nephrotoma* (cf. Oosterbroek 1980: 349, character 5).

12. – Aedeagus: (0) basal, tubular section about 0.50 of total length or longer (figs. 32-35, 37, 39, junction of tubular and branched sections of aedeagus arrowed); (1) basal, tubular section about 0.40 to 0.20 of total length (figs. 36, 38, junction of tubular and branched sections of aedeagus arrowed).

Half of the species and subspecies of the clade *quadrifaria* to *submaculosa* have the branching point of the aedeagus situated before its midlength. Reversal of this state seems to have occurred twice within this clade, once in the ancestor of both *minuscula* and *theowaldi* (cf. fig. 37) and once in the ancestor of the clade *astigma* to *submaculosa* (cf. fig. 39). In the latter clade reversal of character 12(1) coincided with shortening of the aedeagus (see next character).

The presumed plesiomorphous situation of character 12 can be found in non-*flavescens* group members of *Nephrotoma* with a partly tripartite aedeagus, e.g. *alticrista* Alexander, *integra* Alexander, *medioproducta* Alexander, *nigrohalterata* Edwards, and *subpallida* Alexander.

13. – Aedeagus: (0) relatively long and slender (figs. 32, 33, 35-38); (1) short and thick (figs. 34, 39).

The species *nasuta* (fig. 34) and the members of the clade *astigma* to *submaculosa* (cf. fig. 39) have a relatively short aedeagus. Oosterbroek (1980: 336, character 23) also mentioned the species *exastigma* and *spatha* as having a short aedeagus (as 'intromittent organ'). Oosterbroek (1980: 350-351, diagram 1; 391-393, appendix 2B) related the length of the aedeagus with the length of the second abdominal tergite. Contrary to this, the relative proportions of the aedeagus are perhaps better expressed by comparing the length of the aedeagus with its diameter. When the latter procedure is followed and the - arbitrary - limit between relatively long and short is appointed to a quotient of 100 for the total length of the aedeagus and its diameter just after the sperm pump, the aedeagus of both *exastigma* (fig. 35) and *spatha* (fig. 33) turns out to be relatively long (cf. measurements in Oosterbroek 1980, appendix 2A).

In the species of the *cornicina* group outside the *flavescens* group, the aedeagus is a relatively long structure.

14. – Gonocoxite: (0) dorsomedially fused with base of aedeagal guide (fig. 40); (1) separate (fig. 41, gap arrowed).

The species of the clade *quadrifaria* to *submaculosa* show a membranous gap between the base of the aedeagal guide and the adjacent dorsomedial corner of the gonocoxite. In the remaining species of the *flavescens* group both structures are fused, as they are in the other members of the *cornicina* group. Oosterbroek (1980: 337, character 26, as separation of ventral appendages of adminiculum and sternite nine) distinguished the same character state but recognized it in the species of the clade *astigma* to *submaculosa* only. Oosterbroek noted that the gap between both structures can be narrow in other species of *Nephrotoma*. Several species of the *flavescens* group show this latter state, e.g. *fontana*.

15. – Gonocoxite, medisternal sclerotization: (0) fused with ventral appendage of aedeagal guide (fig. 42, connexion arrowed); (1) structures separate from each other (fig. 43, gap arrowed; figs. 8, 47-49).

Figs. 3-10. *Nephrotoma flavescens*, 3-8, male; 9, 10, female. – 3, terminalia, lateral view; 4, tergite 10, ventral view; 5, aedeagal guide, lateral view; 6, sperm pump, lateral view; 7, inner gonostylus, lateral view; 8, sternite 9 and gonocoxites, ventral view; 9, terminalia, lateral view; 10, hypogynial valve, medial view.
Abbreviations: aed: aedeagus; aed gd: aedeagal guide; ant apod: anterior apodeme of sperm pump; ant lat pt: anterolateral part of inner gonostylus; ant pt: anterior part of inner gonostylus; centr rdg: central ridge of tergite 10; cerc: cercus; comp apod: compressor apodeme of sperm pump; crst: crest of inner gonostylus; ej duct: ejaculatory duct; gen fk: genital fork; gon: gonapophysis of aedeagal guide; goncx: gonocoxite; hyp vlv: hypogynial valve; i gonst: inner gonostylus; lat shell: lateral shell of tergite 10; ma rdg: major ridge of hypogynial valve; med scl: medisternal sclerotization; mi rdg: minor ridge of hypogynial valve; o gonst: outer gonostylus; post apod: posterior apodeme of sperm pump; rdg: ridge of inner gonostylus; sp2: lateral remnant of genital bridge; spmth: spermatheca; st7 etc.: sternite 7 etc.; st8 ext: extension of sternite 8; tg7 etc.: tergite 7 etc.; ventr app: ventral appendage of aedeagal guide.

Within the *flavescens* group, *schaeuffelei* and *exastigma* are the only species which have the ventral appendages of the aedeagal guide fused with the medisternal sclerotizations. In all other members of the group these structures are separated by a membranous gap. When the medisternal sclerotizations are well developed, they are united with the appendages of the aedeagal guide in the non-*flavescens* group members of the *cornicina* group.

16. – Gonocoxite, medisternal sclerotization: (0) well developed, large (fig. 42, 44, 46-48); (1) reduced in size, small or absent (figs. 8, 43, 45, 49).

It is assumed that the presence of medisternal sclerotizations is a plesiomorphy within the genus *Nephrotoma* (Oosterbroek 1980: 321; Tangelder 1985: 144). Reduced medisternal sclerotizations occur within the *flavescens* group in the species *spatha* (fig. 43), the three subspecies of *guestfalica* (cf. fig. 45), the species *theowaldi*, and the members of the clade *astigma* to *submaculosa* (figs. 8, 49). The shape of the reduced medisternal sclerotizations varies among these taxa.

17. – Gonocoxite, medisternal sclerotization: (0) not in contact with ventromedial margin of gonocoxite or only so along a relatively short zone (figs. 8, 42, 43, 45, 47-49); (1) fused for more than half its length with gonocoxite (figs. 44, 46).

When in contact with the gonocoxites, the medisternal sclerotizations are usually only fused with these structures near their anterior margins (cf. fig. 47). The sister species *beckeri* (fig. 44) and *cretensis*, and both subspecies of *quadrifaria* (cf. fig. 46) are characterized by a more complete fusion of both structures. I assume that fusion evolved independently in both pairs of taxa.

18. – Inner gonostylus: (0) a projecting posterolateral part present (figs. 50-52, structure arrowed in figs. 51 and 52); (1) posterolateral part reduced (figs. 7, 53-66).

Within the *flavescens* group, the species *schaeuffelei* and *spatha* have a projecting structure placed posterolaterally on the inner gonostylus. I interpret this structure as the homologue of the posterolateral part of the inner gonostylus of other genera and subgenera of Tipulidae. As such it is a plesiomorphy in *Nephrotoma*. In several species of the *flavescens* group its remnant is readily identifiable in the low protuberance covered with long hairs on the posterolateral margin of the inner gonostylus (e.g. *nasuta*, fig. 53; *exastigma*, fig. 57; *appendiculata*, fig. 62; *minuscula*, fig. 63; *sullingtonensis*, fig. 64).

Several members of the *cornicina* group outside the *flavescens* group have a distinct projecting posterolateral extension on the inner gonostylus (fig. 50; cf. Oosterbroek 1980: 330, character 5). Oosterbroek interpreted this character state as an apomorphy of his *cornicina* subgroup, but considering its occurrence outside and within *Nephrotoma*, it is probably better regarded as a plesiomorphy on this level of analysis.

19. – Inner gonostylus: (0) general shape various, seen in lateral view with relatively short and high anterior part (figs. 7, 50-53, 57-66); (1) general shape similar, in lateral view anterior part and crest appearing in line, elongate and slender (fig. 54).

The inner gonostyli of the species *beckeri* and *cretensis* show a number of features that can be interpreted as apomorphies: the anterior part is acutely bent over laterally (fig. 55; less so in the other members of the *flavescens* group), the anterolateral part is smoothly curved when seen in dorsal aspect (fig. 56; acute in the other species of the *flavescens* group) and the crest is posteriorly produced into an acute tip (fig. 54; the only other representative of the *flavescens* group with an acute crest is the subspecies *guestfalica guestfalica*, fig. 58). Oosterbroek (1982) mentioned the synapomorphous resemblance of the shape of the inner gonostyli of *beckeri* and *cretensis* in his discussion on the latter species.

20. – Inner gonostylus: (0) general shape various, lateral edge toothless (figs. 7, 50-57, 61-66); (1) general shape similar, laterally with edge toothed (figs. 58-60).

The three subspecies of *guestfalica* share some apomorphous peculiarities in the structure of the inner gonostylus: the anterior part is large and produced, while the lateral margin is present as a rim carrying blackish sclerotized points. The inner gonostyli of the subspecies differ in degree of reduction of the dorsal crest (see next character).

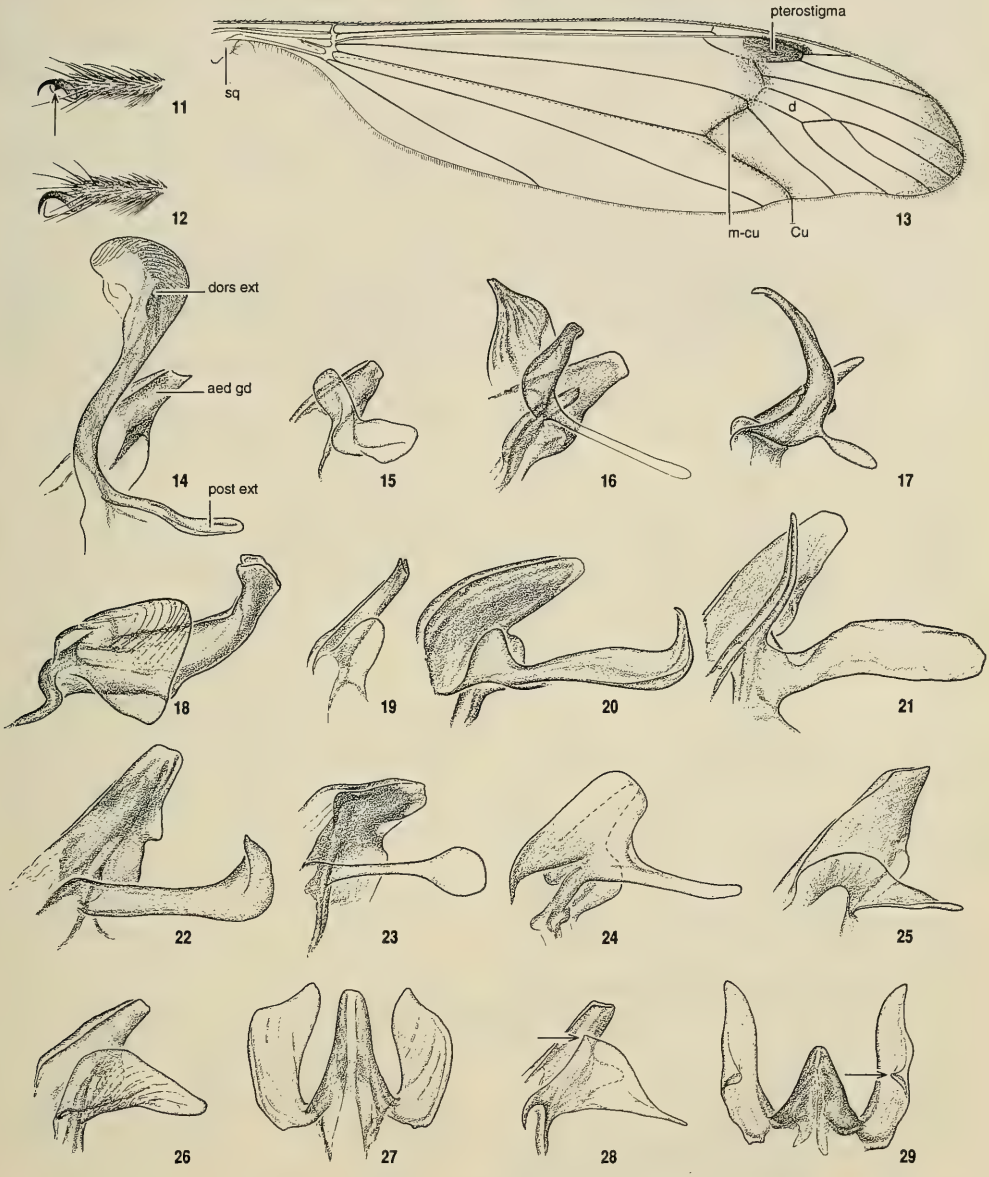
21. – Inner gonostylus: (0) crest on anterior part well developed, posteriorly extending (fig. 58); (1) crest reduced in length (figs. 59, 60).

Oosterbroek (1980: 326, character 12) considered a posteriorly produced crest a synapomorphy of the species of the *cornicina* group. A posteriorly produced crest can therefore be interpreted as a plesiomorphy within the *flavescens* group. Reduction of the posterior extension of the crest is found in the subspecies *guestfalica hartigiana* and *guestfalica surcoufi*. In *guestfalica hartigiana* the crest is shortened (fig. 59), in *guestfalica surcoufi* it is completely absent (fig. 60).

The members of the clade *fontana* to *submaculosa* also show reduction of the posterior extension of the crest. Reduction in this clade resulted in a distinct situation and is treated under character 23.

22. – Inner gonostylus: (0) without ridge (fig. 50); (1) with ridge on its lateral side (figs. 7, 51-57, 61-66) (cf. Oosterbroek 1980: 332, character 11).

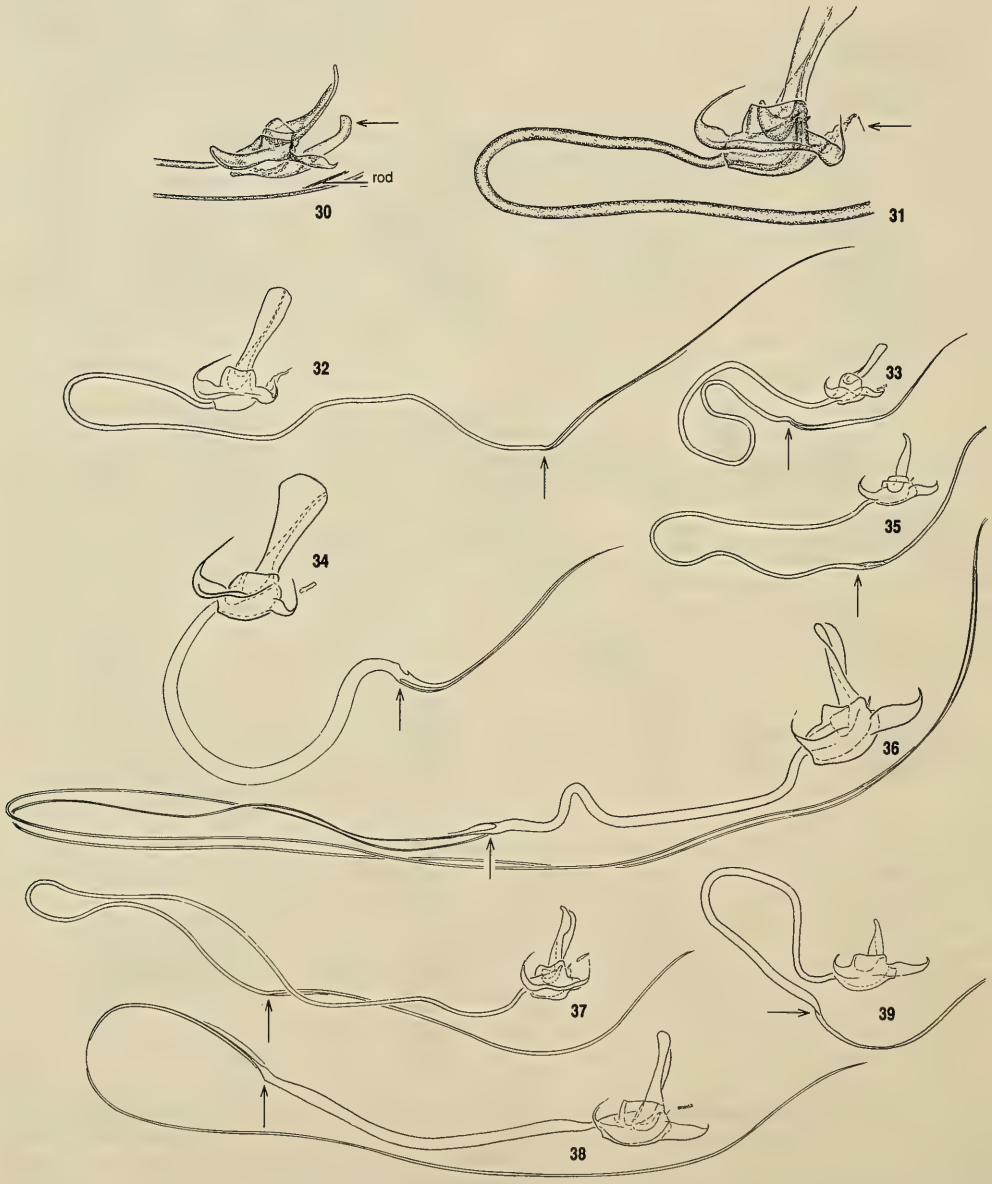
All members of the *flavescens* group, with the ex-



Figs. 11-29. – 11, 12, *Nephrotoma spatha,* male last tarsal segment; 13, *N. quadrifaria,* wing; 14, *N. schaeuffelei,* aedeagal guide and gonapophysis, lateral view; 15, *N. spatha,* idem; 16, *N. nasuta,* idem; 17, *N. saccai,* idem; 18, *N. beckeri,* idem; 19, *N. exastigma,* idem; 20, *N. guestfalica guestfalica,* idem; 21, *N. quadrifaria quadrifaria,* idem; 22, *N. appendiculata appendiculata,* idem; 23, *N. minuscula,* idem; 24, *N. sullingtonensis,* idem; 25, *N. fontana,* idem; 26, 27, *N. astigma,* 26, idem; 27, aedeagal guide and gonapophysis, dorsal view; 28, 29, *N. lempkei,* 28, aedeagal guide and gonapophysis, lateral view; 29, aedeagal guide and gonapophysis, dorsal view.
Abbreviations: aed gd: aedeagal guide; Cu: cubital vein; d: discal cell; dors ext: dorsal extension of gonapophysis; m-cu: medio-cubital crossvein; post ext: posterior extension of gonapophysis; sq: squama.

ception of the three subspecies of *guestfalica*, are characterized by the presence of a ridge on the posterior part of the inner gonostylus. (Contrary to Oosterbroek's assertion, *nasuta* does have a ridge underneath the crest; cf. fig. 53, arrowed).

Most other species of the *cornicina* group, and all other *Nephrotoma* examined, lack this feature. The only representatives of the *cornicina* group with a ridge-like structure are *cornicina cornicina* Linnaeus, *cornicina sardiniensis* Oosterbroek, and *moravica*



Figs. 30-39. – 30, *Nephrotoma ligulata*, sperm pump and part of aedeagus, lateral view; 31, 32, *N. schaeuffelei*, 31, idem; 32, sperm pump and aedeagus, lateral view; 33, *N. spatha*, idem; 34, *N. nasuta*, idem; 35, *N. exastigma*, idem; 36, *N. quadrifaria quadrifaria*, idem; 37, *N. minuscula*, idem; 38, *N. fontana*, idem; 39, *N. astigma*, idem.
Abbreviation: rod: rod of aedeagal guide.

Martinovský. These three taxa together form a monophyletic group within the *cornicina* group (cf. Oosterbroek 1980). Here the ridge-like structure probably evolved independently of that of the *flavescens* group.

23. – Inner gonostylus: (0) crest on anterior part well developed, posteriorly extending (figs. 52-58, 61-64); (1) crest reduced in length, posteriorly laterally downcurved (figs. 7, 65, 66).

In the clade *fontana* to *submaculosa*, the apomorphous state of this character can be found. Oosterbroek (1980: 337, character 27) recognized this apomorphy for the species of the clade *astigma* to *submaculosa*. I claim that it also applies to the species *fontana* (fig. 65).

24. – Inner gonostylus: (0) ridge without pubescence (figs. 51-57, 61-65); (1) ridge covered with dense pubescence (fig. 7, 66) (cf. Oosterbroek 1980: 332, character 11X).

The species of the clade *astigma* to *submaculosa* are distinguished from the remainder of species and subspecies of the *flavescens* group, by the presence of pubescence on the ridge of the inner gonostylus.

25. – Outer gonostylus: (0) at base with anteromedially directed extension (figs. 67, 69); (1) with elongate ventrolateral extension (fig. 68).

The outer gonostylus of the majority of species of *Nephrotoma* is provided with a more or less well developed anteromedially directed extension at its base. In the three subspecies of *guestfalica* the outer gonostylus basally bears a long ventrolaterally directed extension.

26. – Outer gonostylus: (0) elongate, without strikingly long hairs (figs. 67, 68); (1) broad, long haired along posterior margin, with longest hairs about as long as width of outer gonostylus (fig. 69).

The outer gonostylus of the majority of species of *Nephrotoma* is a rather slender structure when seen in lateral view, covered with moderately long hairs. In the two subspecies of *appendiculata*, the outer gonostylus is relatively broad and bears long hairs along its posterior margin.

27. – Sperm pump: (0) sclerotized part of ejaculatory duct attached to sperm pump (figs. 30, 31, 70, ejaculatory duct arrowed); (1) membranous gap between sperm pump and sclerotized part of ejaculatory duct (figs. 6, 71-73, 75) (cf. Oosterbroek 1980: 332, character 14).

In the *flavescens* group the sclerotized part of the ejaculatory duct is attached to the sperm pump in the species *schaeuffelei* only (figs. 31, 70). In the other species and subspecies of the group there either is a membranous gap between the body of the sperm pump and the sclerotized part of the ejaculatory duct or the ejaculatory duct is not sclerotized at all (see next character). The gap between the sperm pump and the sclerotized part of the duct is narrow in the species *beckeri* (fig. 73), in the other relevant species and subspecies of the *flavescens* group it is wider (figs. 6, 71, 72, 75).

Oosterbroek (1980: 326, character 11) recognized the presence of a midposterior appendage to the sperm pump (as 'aedeagus') as a synapomorphy for the *cornicina* group. I interpret the midposterior appendage as a sclerotization of the wall of the ejaculatory duct (seminal duct of Byers 1961). The species of the *cornicina* group outside the *flavescens* group have this sclerotized structure well developed, being attached to the sperm pump (fig. 30).

28. – Sperm pump: (0) vestige of sclerotized portion of ejaculatory duct present (figs. 6, 71-73, 75); (1) absent (fig. 74).

As mentioned under the preceding character, some members of the *flavescens* group do not show a trace of sclerotization of the ejaculatory duct. The species and subspecies involved are *exastigma* (fig. 74), the subspecies of *guestfalica* and *quadrifaria*, and *astigma* and *lempkei*. It seems that reduction of the sclerotization of the ejaculatory duct evolved along several lineages and to various degrees within the *flavescens* group.

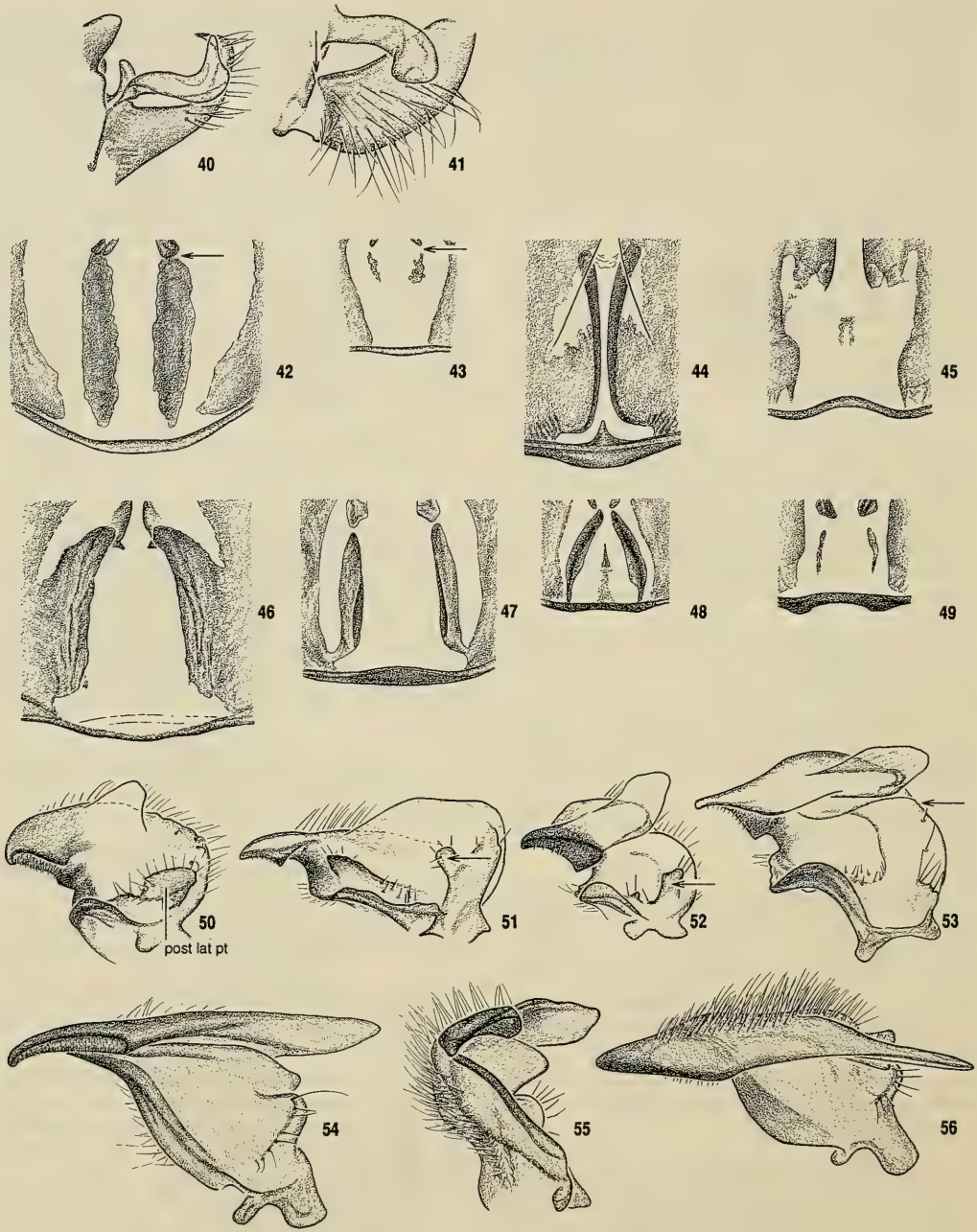
29. – Sperm pump, anterior apodemes: (0) without long membranous extensions at tip (fig. 30); (1) with long membranous extensions at tip (fig. 6, 31, 71).

All members of the *flavescens* group are characterized by the possession of long translucent extensions at the tips of the anterior apodemes of the sperm pump. I did not find such extensions in species of *Nephrotoma* outside the *flavescens* group.

30. – Sperm pump, anterior apodeme: (0) broad, bulging in dorsal view (figs. 70, 73); (1) reduced to narrow strip (figs. 72, 74, 75).

The anterior apodemes of the sperm pump are usually well developed in *Nephrotoma*. Within the *flavescens* group, reduced anterior apodemes are present in the species *spatha* (fig. 72) and the members of the clade *exastigma* to *submaculosa* (figs. 74, 75).

Oosterbroek (1980: 333, character 15) also recognized a reduction of the anterior apodemes (as 'lateral appendages of the aedeagus') as an apomorphy in the *flavescens* group. The largest anterior apodemes in the *flavescens* group are found in the species *nasuta* and *saccai*. Oosterbroek distinguished a monophyletic group composed of the remainder of species and subspecies of the *flavescens* group on account of this feature. As relatively large anterior apodemes are also



Figs. 40-56. – 40, *Nephrotoma guestfalica guestfalica,* base of aedeagal guide in part plus right gonocoxite, posterolateral view; 41, *N. quadrifaria quadrifaria,* idem; 42, *N. schaeuffelei,* male sternite 9, gonocoxites and medisternal sclerotizations, ventral view; 43, *N. spatha,* idem; 44, *N. beckeri,* idem; 45, *N. guestfalica guestfalica,* idem; 46, *N. quadrifaria quadrifaria,* idem; 47, *N. appendiculata appendiculata,* idem; 48, *N. minuscula,* idem; 49, *N. astigma,* idem; 50, *N. ligulata,* inner gonostylus, lateral view; 51, *N. schaeuffelei,* idem; 52, *N. spatha,* idem; 53, *N. nasuta,* idem; 54-56, *N. beckeri,* inner gonostylus, 54, lateral view; 55, anterior view; 56, dorsal view.
Abbreviation: post lat pt: posterolateral part of inner gonostylus.

present in *schaeuffelei*, *beckeri*, and *cretensis*, I do not adopt this interpretation.

31. – Sperm pump, compressor apodeme: (0) deeply incised (fig. 76); (1) almost entire, dorsal margin either slightly concave or entirely convex (fig. 77).

Within the *flavescens* group, the species and subspecies of the clade *quadrifaria* to *submaculosa* have a compressor apodeme which consists of an undivided structure.

32. – Sperm pump, compressor apodeme: (0) entire, with midposterior keel; (1) without midposterior keel.

The more basal species and subspecies of the clade *quadrifaria* to *submaculosa* have the compressor apodeme provided with a well developed midposterior keel. The keel is completely reduced in the species of the clade *astigma* to *submaculosa*.

33. – Sperm pump, posterior apodeme: (0) yellowish coloured, elongate (figs. 6, 30, 31, 70-72, 74); (1) dark coloured and short (fig. 75).

Dark sclerotized, short posterior apodemes occur in the species of the clade *appendiculata* to *theowaldi* of the *flavescens* group. The remainder of species of the group have the posterior apodemes less heavily sclerotized.

In the clade *appendiculata* to *theowaldi* sclerotization of the posterior apodemes coincides with reduction of these structures. Oosterbroek (1980: 336, character 22) recognized short posterior apodemes (as 'posterior appendages of the aedeagus') as an apomorphy of the clade *appendiculata* to *theowaldi*. However, reduced posterior apodemes are also known in the species *nasuta* and *beckeri* (fig. 73). The apodomes in the two latter species are not blackish sclerotized.

34. – Sp2: (0) haired (figs. 78, 83, arrowed); (1) bare (figs. 79-82).

As in the majority of other species of the *cornicina* group, most members of the *flavescens* group have the posteromedial margin of sp2 near midlength provided with a concentration of hairs. Within the *flavescens* group, these hairs are absent in the species *saccai* (fig. 79), *beckeri* (fig. 80) and in the clade *quadrifaria* to *theowaldi* (cf. figs. 81, 82).

35. – Sp2: (0) variously shaped (figs. 78-81, 83); (1) similar (fig. 82).

The species of the clade *appendiculata* to *theowaldi* possess a similarly built sp2. The bare structure has the dorsal part well developed and anteriorly protruding, while the ventral part is present as a straight ventromedially directed appendix.

36. – Sp2: (0) variously shaped (figs. 78-82); (1) similar (fig. 83).

In the clade *astigma* to *submaculosa* the sp2 structure has a small and protruding dorsal part, while it is slightly produced posteriorly near midlength at the point of insertion of the hairs. The ventral part is straight and gradually tapers towards its tip.

37. – Sternite 8: (0) with posterior extension (figs. 3, 84, 86); (1) without (fig. 85).

The only members of the *flavescens* group without an extension on the posterior margin of sternite 8 are the three subspecies of *guestfalica*. All other species of the *cornicina* group have a well-developed posterior extension of sternite 8.

38. – Sternite 8: (0) posterior extension dorsoventrally compressed (fig. 84); (1) laterally compressed (fig. 86).

The extension of sternite 8 is short and laterally compressed in both subspecies of *quadrifaria*. The majority of species of the *cornicina* group have the extension either dorsoventrally flattened or rounded in cross-section. Only *cornicina cornicina*, *cornicina sardiniensis* and *moravica* have the extreme apex of the extension laterally compressed. However, in these taxa the posterior extension of sternite 8 is dorsoventrally flattened at its base and elongate.

39. – Tergite 10: (0) variously shaped (figs. 3, 4, 89-94); (1) consisting of two cup-shaped structures provided with black spines along their anteromedial and posterior margins, each carrying an acute lateral extension (figs. 87, 88).

The three subspecies of *guestfalica* are characterized by their uniquely shaped tergite 10. Oosterbroek (1980: 336, character 17P) considered *guestfalica* and *quadrifaria* sister taxa, a relationship presumed, among other things, to be supported by similarities in the structure of tergite 10 (as 'extension of tergite 9'). In my opinion the shape of tergite 10 in *quadrifaria* (figs. 89, 90) has no apomorphy in common with that of *guestfalica* (figs. 87, 88).

40. – Tergite 10: (0) variously shaped, with relatively narrow medial incision, caudally directed (figs. 3, 4, 87, 88, 91-94); (1) posteriorly widely emarginate, caudodorsally directed (figs. 89, 90).

The two subspecies of *quadrifaria* are characterized by their peculiarly shaped tergite 10.

41. – Tergite 10: (0) central ridges posteriorly not or only slightly produced (fig. 91); (1) central ridges posteriorly produced (fig. 93) (cf. Oosterbroek 1980: 336, character 17S; tergite 10 as 'extension of tergite 9').

The central part of tergite 10 protrudes only moderately in most species of the *flavescens* group. Only

minuscula and *theowaldi* show a posterior elongation of this part of tergite 10.

42. – Tergite 10: (0) lateral shells rounded along ventral margin when seen in lateral view (fig. 92); (1) ventral margin truncate (fig. 94).

The species *minuscula* and *theowaldi* are the only members of the *flavescens* group which have the ventral margin of the lateral shells of tergite 10 straight. In the other members of the group, as well as in most other species of *Nephrotoma*, this margin is rounded.

Female terminalia

43. – Cercus: (0) long, well-developed, gradually tapering towards tip (fig. 99); (1) reduced in length, tip rounded off (figs. 95, 97, 106).

Within the *flavescens* group a shortened, blunt-tipped cercus is known in the species *schaeuffelei* (fig. 95), *spatha* (fig. 97), and the two subspecies of *quadrifaria* (fig. 106). Besides being reduced in length, the cercus of both subspecies of *quadrifaria* is also reduced in height. In the remainder of species and subspecies of the *flavescens* group the cercus is long and either gradually tapers towards the tip (fig. 99), or is produced into a nipple-like extension (see next character).

Oosterbroek (1980: 326, character 14 and page 328, character 1) listed the presence of pointed cerci in the female as one of the synapomorphies of the *cornicina* group. The cerci in this group are also more robust than is usual in *Nephrotoma* (cf. Savchenko 1973: 35, 119). The plesiomorphous form of the cercus in the *cornicina* group can be found in supposedly basal species like *forcipata* Pierre and *ligulata* Alexander. Here the well-developed cercus gradually tapers towards its tip. In the *flavescens* group a similarly shaped cercus is found in the species *nasuta* (fig. 99) and in the as yet undescribed species from Algeria and Tunisia. The cercus of *nasuta* and the north-west African species probably represents the plesiomorphous form in the *flavescens* group.

44. – Cercus: (0) gradually tapering towards tip (fig. 99); (1) tip produced into a nipple-like extension (figs. 9, 101).

With the exception of both subspecies of *quadrifaria*, the species and subspecies of the clade *saccai* to *submaculosa* are characterized by the possession of a nipple-like projection of the tip of the cerci. (The nipple-like projection is frequently worn off in older specimens).

As stated under the preceding character, the plesiomorphous condition of the female cercus in the *flavescens* group is probably represented by a moderately pointed structure as found in *nasuta* (fig. 99).

45. – Hypogynial valve: (0) tip entire, with ventral margin evenly convex (figs. 96, 98, 100, 102); (1) tip irregular, appearing to be broken off (figs. 9, 10, 103-105, 108-110) (cf. Oosterbroek 1980: 333, character 16).

The species of the clade *beckeri* to *submaculosa* show the apomorphous condition of this character. Within the *cornicina* group a similar situation is known in the non-*flavescens* group species *saghaliensis* Alexander, where it apparently evolved independently (cf. fig. 6 of Oosterbroek 1985a. Fig. 13 of Oosterbroek 1985a, depicts a damaged specimen of *esakii* Alexander in which the tip of the hypogynial valve is actually broken off; in intact specimens of this species the hypogynial valve terminates in an acute tip).

The basal species of the *flavescens* group, as well as the other members of the *cornicina* group, have slender, reduced hypogynial valves of which the ventral margin of the tip is entire (cf. figs. 96, 98, 100, 102).

46. – Hypogynial valve: (0) dorsal margin continuous (figs. 9, 10, 96, 98, 100, 102-104, 107-110); (1) dorsal margin with posteriorly directed point at about two-thirds of its length (fig. 105).

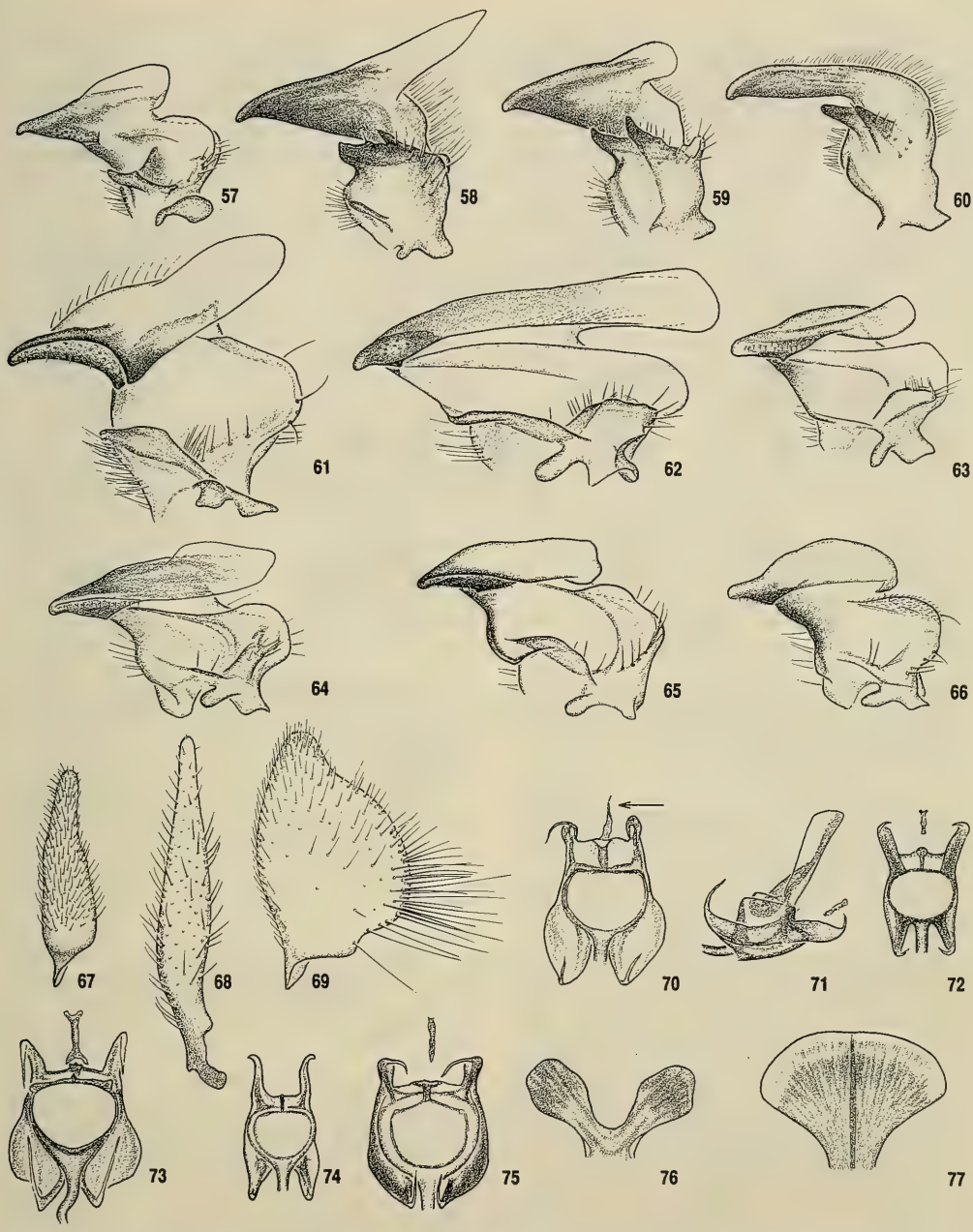
The three subspecies of *guestfalica* are, among other things, characterized by their apomorphously shaped hypogynial valves.

47. – Hypogynial valve: (0) major and minor ridges basally in contact with each other (figs. 102, 103, 108); (1) separate (figs. 10, 109, 110).

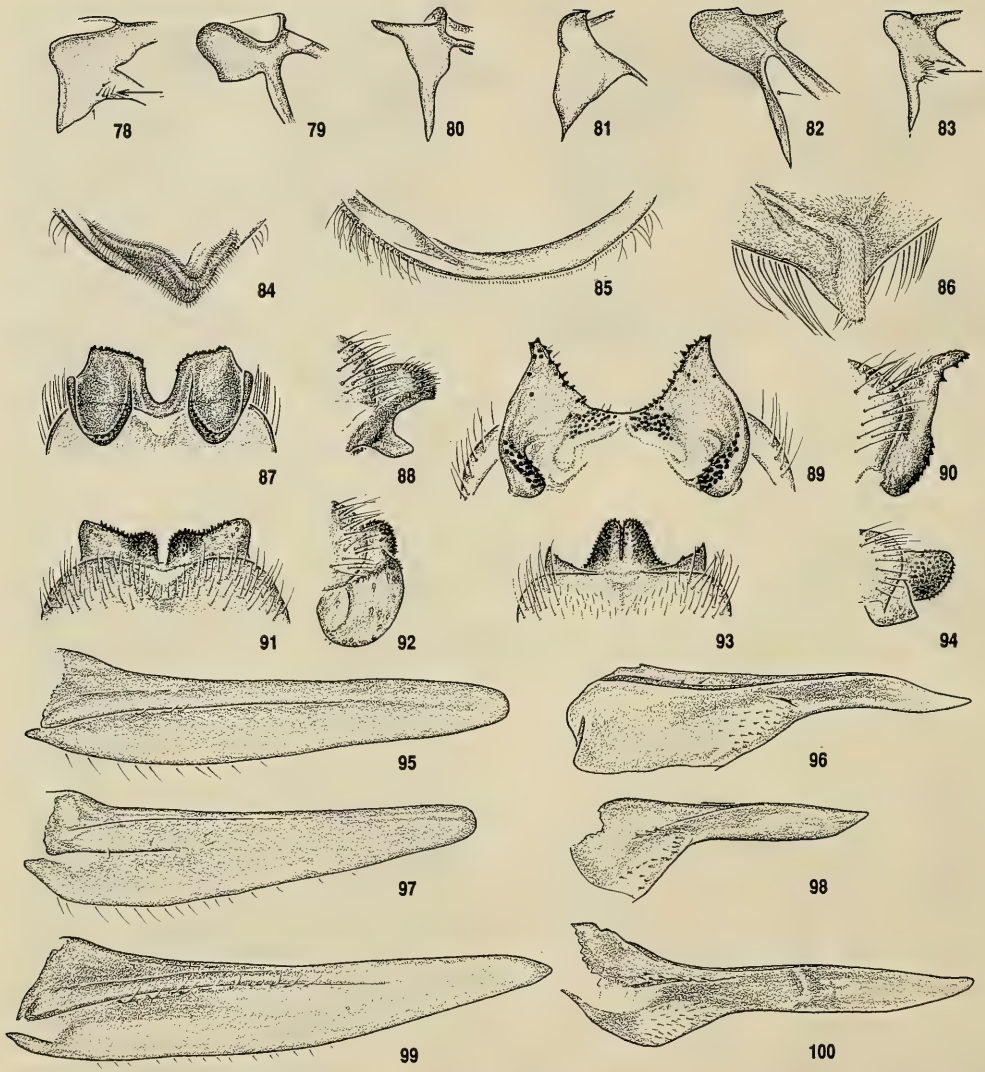
In the Tipulidae there are usually two ridges on the medial side of the hypogynial valve, a major (dorsal) and a minor (ventral) one (cf. fig. 10). As this situation is found also in the majority of species of *Nephrotoma*, I agree with Oosterbroek (1980: 326), who interpreted the presence of two ridges as a plesiomorphy for the genus. Tangelder (1985: 151), however, considered the same character state an apomorphy within *Nephrotoma*.

When present, both ridges are usually separate, like they are in the species *schaeuffelei* of the *flavescens* group (fig. 96). A partly or entirely reduced minor ridge is frequently found in the *flavescens* group, e.g. in *schaeuffelei* (fig. 96), *spatha* (fig. 98), *nasuta* (fig. 100) and the subspecies of *guestfalica* (fig. 105). In other species of the group the minor ridge is well developed and both major and minor ridges are fused at their base, e.g. in *saccai* (fig. 102), *beckeri* (fig. 103), *cretensis*, the subspecies of *appendiculata* and in *fontana* (fig. 108).

In the sistergroup of *fontana*, viz. the clade *astigma* to *submaculosa*, both ridges are separate. Judged by the situation in the nearest outgroups of this clade, this trait can be interpreted as an apomorphy (cf. figs. 109, 110). The species *exastigma* (fig. 104) also has the ridges separate, probably as the result of a secon-



Figs. 57-77. – 57, *Nephrotoma exastigma,* inner gonostylus, lateral view; 58, *N. guestfalica guestfalica,* idem; 59, *N. guestfalica hartigiana,* idem; 60, *N. guestfalica surcoufi,* idem; 61, *N. quadrifaria quadrifaria,* idem; 62, *N. appendiculata appendiculata,* idem; 63, *N. minuscula,* idem; 64, *N. sullingtonensis,* idem; 65, *N. fontana,* idem; 66, *N. astigma,* idem; 67, *N. exastigma,* outer gonostylus, lateral view; 68, *N. guestfalica guestfalica,* idem; 69, *N. appendiculata appendiculata,* idem; 70, *N. schaeuffelei,* sperm pump, dorsal view, compressor apodeme omitted; 71, 72, *N. spatha,* 71, sperm pump, lateral view; 72, sperm pump, dorsal view, compressor apodeme omitted; 73, *N. beckeri,* idem; 74, *N. exastigma,* idem; 75, *N. appendiculata appendiculata,* idem; 76, *N. guestfalica guestfalica,* compressor apodeme, anterior view; 77, *N. quadrifaria quadrifaria,* idem.



Figs. 78-100. – 78, *Nephrotoma nasuta,* sp2, medial view; 79, *N. saccai,* idem; 80, *N. beckeri,* idem; 81, *N. quadrifaria quadrifaria,* idem; 82, *N. appendiculata appendiculata,* idem; 83, *N. astigma,* idem; 84, *N. exastigma,* posterior margin of male sternite 8, posterolateral view; 85, *N. guestfalica guestfalica,* idem; 86, *N. quadrifaria quadrifaria,* idem; 87, 88, *N. guestfalica guestfalica.* 87, male tergite 10, ventral view; 88, male tergite 10, lateral view; 89, 90, *N. quadrifaria quadrifaria,* 89, male tergite 10, ventral view; 90, male tergite 10, lateral view; 91, 92, *N. appendiculata appendiculata,* 91, male tergite 10, dorsal view; 92, male tergite 10, lateral view; 93, 94, *N. minuscula,* 93, male tergite 10, dorsal view; 94, male tergite 10, lateral view; 95, 96, *N. schaeuffelei,* 95, cercus, lateral view; 96, hypogynial valve, medial view; 97, 98, *N. spatha,* 97, cercus, lateral view; 98, hypogynial valve, medial view; 99, 100, *N. nasuta,* 99, cercus, lateral view; 100, hypogynial valve, medial view.

dary development. (There is in my opinion no compelling reason to consider the dorsal ridge in *exastigma* and in the clade *astigma* to *submaculosa* a new structure, non-homologous with the major ridge of the other members of the *flavescens* group; cf. Oosterbroek 1980: 336, character 19A and B).

48. – Hypogynial valve: (0) minor ridge short (fig. 109); (1) posteriorly extended (fig. 110).

The minor ridge is elongate in the species *lempkei* and *submaculosa,* reaching towards the tip of the hypogynial valve.

49. – Sternite 9: (0) entire (fig. 112); (1) with break be-

tween its midposterior and anterolateral parts (fig. 111, arrowed).

The species *beckeri* and *cretensis* are the only representatives of the *flavescens* group that have a membranous interruption in between the broad anterolateral portion of sternite 9 and its slender posterior projection.

50. – Sternite 9: (0) yellowish coloured (fig. 111); (1) anteriorly blackish coloured, i.e. heavily sclerotized (fig. 112, arrowed).

Contrary to the other members of the group, the anterior margin of sternite 9 is blackish coloured in the species *minuscula* and *theowaldi*.

Discussion of adopted phylogeny

Phylogenetic analysis of the character state matrix given in table 2, with a zero-vector as outgroup, resulted in two most parsimonious trees with length 73, consistency index 68, and retention index 84. I used exact tree-calculating methods with both computer programs employed, viz. the 'ie' (implicit enumeration) command of HENNIG86 and the branch-and-bound algorithm of PAUP. The binary coded characters had the default weight 1. No a priori or a posteriori adaptations of the data were introduced to adjust the results of the analysis. Both programs produced the same pair of equally parsimonious trees.

The two trees obtained differ in the position of the species *flavescens*. It either is the sister species of a clade (*astigma* (*lempkei*, *submaculosa*)) or constitutes a trichotomy with *astigma* and the clade (*lempkei*, *submaculosa*). In the first tree character state 28(1) is considered an apomorphy for the clade (*astigma* (*lempkei*, *submaculosa*)), with subsequent reversal to the plesiomorphous state in *submaculosa*. The second tree depicts character state 28(1) as a homoplasy in the species *astigma* and *lempkei*. The second tree is topologically identical with the strict consensus tree which is shown in fig. 2.

The four most basal species in the cladogram split off consecutively. Next in the transition series follows the pair of sister species *beckeri* and *cretensis*.

The remainder of the cladogram contains several lineages of which the monophyly is only weakly corroborated.

The clade *exastigma* to *submaculosa* is substantiated by a single homoplasy, viz. the narrow anterior apodemes of the sperm pump, which are also found in the species *spatha* (character 30). The clade containing the species *exastigma* and the three subspecies of *guestfalica* is also relatively weakly supported by one homoplasy only (character 28). The character state involved, viz. the complete reduction of the sclerotized part of the ejaculatory duct, also occurs in the two subspecies of *quadrifaria*, as well as in *astigma* and *lempkei*.

The clade *quadrifaria* to *theowaldi* is the third lineage within the cladogram of which the monophyly is demonstrated by a single homoplasy, in this case the bare sp2 (character 34). Within the *flavescens* group the same character state is known in the species *saccai* and *beckeri*.

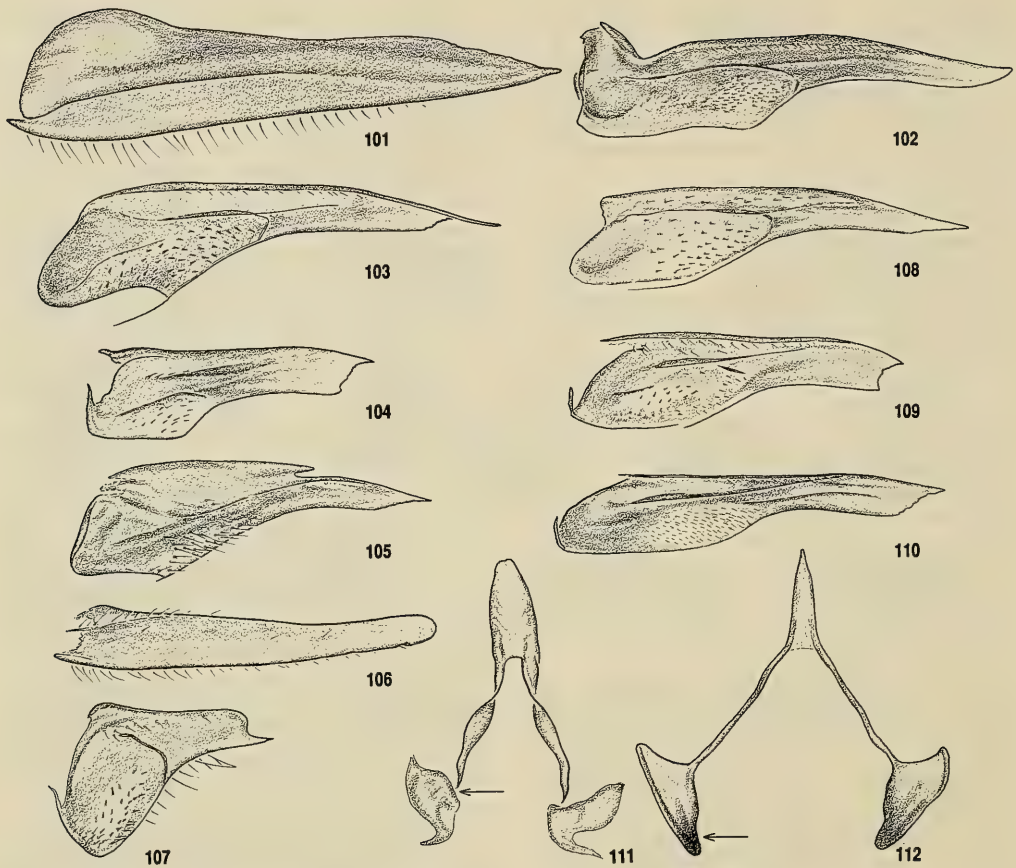
In certain aspects the results of the phylogenetic analysis of the present paper differ considerably from those presented by Oosterbroek (1980: 333, cladogram 2B; see also Oosterbroek & Arntzen 1992). Fig. 113 shows the topology of Oosterbroek's cladogram of the *flavescens* group. For ease of comparison, the topology of the consensus tree of the present paper is given in fig. 114.

Oosterbroek (1980: 332) listed three synapomorphies in support of the monophyly of the *flavescens* group, two of which he considered weak and one strong. According to his views, the members of the *flavescens* group should be distinguished by a straightened dorsal margin of the gonocoxite ('dorsal margin of the male sternite nine is flattened'; Oosterbroek 1980: 332, character 10; considered weak). Oosterbroek noted that this character state is absent in the species *nasuta* and *spatha*. My observations demonstrate that the posterodorsal edge of the gonocoxite is curved also in *exastigma*, the three subspecies of *guestfalica* (cf. fig. 38) and in *schaeuffelei*. I therefore do not accept the straightened dorsal margin of the gonocoxite as a synapomorphy of the *flavescens* group.

The other two synapomorphies of the *flavescens* group distinguished by Oosterbroek are also used in the present paper. They are the presence of the membranous ridge underneath the free part of the crest (Oosterbroek 1980: 332, character 11; considered weak because of its presumed absence in *nasuta* and *guestfalica*, but see character 22 of the present paper) and the absence of the rods of the aedeagal guide (Oosterbroek 1980: 332, character 12; considered strong; cf. character 11 of the present paper).

Oosterbroek (1980: 332, characters 13 and 14; 346, character 2) distinguished *saccai* as the sister species of a clade containing the remainder of species and subspecies of the *flavescens* group. The monophyly of this latter clade was substantiated by the presence of a partly trifid aedeagus and the reduction of the sclerotized part of the ejaculatory duct.

However, contrary to Oosterbroek's (1980, 1985a) assertion, non-*flavescens* group species with a partly trifid aedeagus are known within *Nephrotoma*. East Palaearctic and Oriental *Nephrotoma* species showing this feature include *alticrista* Alexander, *dodabettae* Alexander, *inorata* Alexander, *integra* Alexander, *medioproducta* Alexander, *nigrohalterata* Edwards, *rajah* Alexander, and *subpallida* Alexander. These species



Figs. 101-112. – 101, 102, *N. saccai,* 101, cercus, lateral view; 102, hypogynial valve, medial view; 103, *N. beckeri,* hypogynial valve, medial view; 104, *N. exastigma,* idem; 105, *N. guestfalica guestfalica,* idem; 106, 107, *N. quadrifaria quadrifaria,* 106, cercus, lateral view; 107, hypogynial valve, medial view; 108, *N. fontana,* idem; 109, *N. astigma,* idem; 110, *N. lempkei,* idem; 111, *N. beckeri,* female sternite 9, dorsal view; 112, *N. minuscula,* idem.

do not belong to the *cornicina* group in its current conception. It should be noted, moreover, that the majority of the Afrotropical species of *Nephrotoma* have the apical section of the aedeagus modified. The apical portion in these species looks like a ribbon or a flattened tube with sclerotized lateral margins, much as in the east Palaearctic and Oriental species with a trifid aedeagus, but then without the medial filament. A partly trifid aedeagus, which is also known in species of the tipulid subgenera *Tipula* (*Acutipula* Alexander), *T.* (*Lunatipula* Edwards), *T.* (*Odonatisca* Savchenko), *T.* (*Papuatipula* Alexander), and *T.* (*Pterelachisus* Rondani) could well represent a plesiomorphy in *Nephrotoma.* I therefore assume that the structure of the aedeagus in *saccai,* which is tubular throughout, represents an autapomorphy of the species (cf. appendix). Likewise, the reduction of the sclerotized part of the ejaculatory apodeme is evaluated differently in the present study (cf. characters 27 and 28).

In this context it should be noted that Oosterbroek (1985a: 247) assigned the Japanese species *subpallida* Alexander to the *flavescens* group on account of its partly trifid aedeagus. When a trifid aedeagus is regarded a plesiomorphy on this level of analysis, the feature - of course - advances no argument to incorporate any species in the *flavescens* group. Moreover, the male of *subpallida* has well developed rods of the aedeagal guide, a plesiomorphous character state not found in the *flavescens* group (cf. character 11 of the present paper). The ovipositor of *subpallida* has blunt-tipped, well-developed cerci and large hypogynial valves, both structures thus being of a different, presumably plesiomorphous, type compared with the cerci and hypogynial valves of the members of the *flavescens* group (cf. characters 43 and 45 of the present

text). For these reasons I do not include *subpallida* in the *flavescens* group.

Next in Oosterbroek's transition series is the species *nasuta*, which was considered the sister species of the remainder of the *flavescens* group on account of the plesiomorphously large anterior apodemes of the sperm pump (cf. Oosterbroek 1980: 333, character 15). Reduction of the size of the anterior apodemes is employed in a slightly different manner and at another branching point in the present paper (cf. character 30).

The sister group of *schaeuffelei* in Oosterbroek's phylogeny is characterized by the serrate hypogynial valves (cf. Oosterbroek 1980: 333, character 16). However, incorporated in this clade is the species *spatha*, a species of which the female sex was unknown to Oosterbroek in 1980. The female of *spatha* was described by Eiroa & Novoa (1987) based on material collected in Galicia, Spain. It has the ventral margin of the tip of the hypogynial valve smoothly curved (fig. 98) and can therefore not be placed in the clade distinguished by the serrate hypogynial valve (cf. character 45 of the present paper). [Oosterbroek & Artzen (1992) excluded *spatha* from their cladogram of the *flavescens* group].

Figures 113 and 114 both depict the species pair *beckeri* and *cretensis* as the sister group of the remainder of species and subspecies of the *flavescens* group.

According to Oosterbroek's views, *guestfalica* and *quadrifaria* should be considered sister taxa. This relationship was postulated on account of the reduction of the hypogynial valves (Oosterbroek 1980: 334, character 16B), the shape of tergite 10 in the male (loc. cit.: 336, character 17P) and the presence of bristles on the alar squama (as 'neala'; loc. cit.: 336, character 18). The shape of the hypogynial valves of both species is very different (cf. figs. 105, 107). The same holds for the shape of male tergite 10 (cf. figs. 87-90, and characters 37 and 38 of the present paper). Although probably a plesiomorphy in the family Tipulidae, the presence of bristles on the squama is quite unique in the genus *Nephrotoma*. I have to assume that these bristles developed independently in both *guestfalica* and *quadrifaria*.

The position of the species *fontana* in the cladogram of Oosterbroek differs noticably from its allotted place in the consensus tree of the present text. The sister group of *fontana* is, according to Oosterbroek, characterized by the absence of the downcurved part of the minor ridge of the hypogynial valve (Oosterbroek 1980: 336, character 19). However, not all members of this 'sister group' lack the downcurved part of the minor ridge, viz. both subspecies of *appendiculata* and *flavescens* (fig. 10). My interpretation of the position and state of development of the ridges of the hypogynial valve, which deviates from Oosterbroek's views, is explained under characters 47 and 48 of the present text.

The clade *appendiculata* to *theowaldi* of Oosterbroek fully concords with my ideas on the relationships of the species involved.

The exact phylogenetic relationship of the species *sullingtonensis* was left unresolved by Oosterbroek. On account of the shape of the gonapophysis of the aedeagal guide it can be considered to be more closely related with the species of the clade *astigma* to *submaculosa* (cf. character 9 of the present paper).

According to Oosterbroek, *exastigma* is closely related with the species of the clade *astigma* to *submaculosa*. He corroborated this postulate by the presence of both minor and major ridges of the hypogynial valves (Oosterbroek 1980: 336, character 19A, with the major ridge assumed to represent a newly developed structure), the short aedeagus (loc. cit.: 336, character 23), and the toothless claws in the male (loc. cit.: 337, character 24). The three characters are discussed under the respective characters 47, 13 and 1 of the present text. My argumentation results in a more basal position of *exastigma* in the *flavescens* group.

Oosterbroek's clade *astigma* to *submaculosa* is identical to the clade *astigma* to *submaculosa* presented here, inclusive of the trichotomy I was unable to resolve.

In summary, both our cladograms (figs. 113, 114) recognize the same basal species in the *flavescens* group, with the exception of the species *spatha*. In Oosterbroek's solution *spatha* occupies a more derived position. The same applies to *exastigma*, which is placed next to *spatha* in Oosterbroek's phylogeny. A sister group relationship of *guestfalica* and *quadrifaria*, as suggested by Oosterbroek, was not substantiated in the present study. The species *fontana* has a more derived position in my consensus tree. The trichotomy of which *sullingtonensis* forms part in fig. 113 is resolved in fig. 114. Here *sullingtonensis* is depicted as the sister species of the clade *fontana* to *submaculosa*. Both Oosterbroek's and my solutions agree on the composition of the clades *appendiculata* to *theowaldi* and *astigma* to *submaculosa*. Differences between figs. 113 and 114 are the result of selection and interpretation of characters. They do not represent artefacts of the analytical methods employed, viz. the 'manual' approach of Oosterbroek versus the computational procedure of the present study.

Distribution

In this section I will give a synopsis of the distribution of the species and subspecies of the *flavescens* group. For the time being, more detailed information can be found in Oosterbroek (1978, 1982, 1985b) and in Oosterbroek & Theowald (1992).

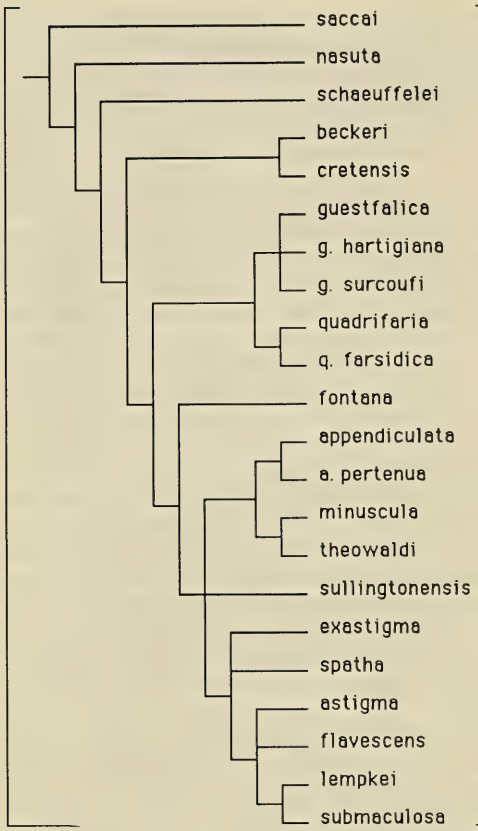


Fig. 113. (Left) Topology of the phylogeny of the *Nephrotoma flavescens* species group according to Oosterbroek (1980) and Oosterbroek & Arntzen (1992).

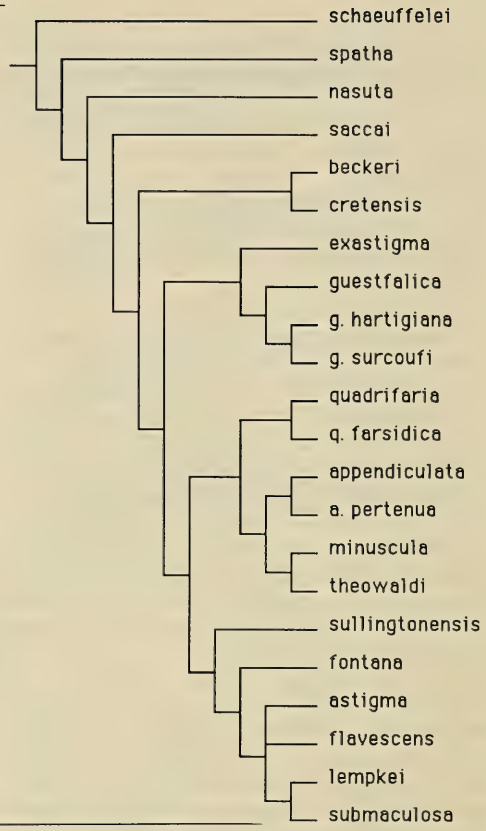


Fig. 114. (Right) Topology of the consensus tree of the *Nephrotoma flavescens* species group of the present paper.

The most basal species in the phylogeny of the *flavescens* group, *schaeuffelei*, is known from the Elburz mountains (Iran) and the Talysch mountains (Azerbaydzhan) to the south-west of the Caspian Sea.

The species *spatha* is endemic to north-west Spain. The species *nasuta* is known from a few localites in western, central and eastern Turkey, while *saccai* occurs in south-west Italy and northern Sicily.

The species pair *beckeri* and *cretensis* has an eastern Mediterranean distribution, with *beckeri* being distributed in Cyprus and the adjacent mainland of Turkey, as well as Lebanon and Israel. Its sister species is endemic to Crete.

The species *exastigma* is confined to northern Algeria and Tunesia.

The three subspecies of *guestfalica* are essentially west Mediterranean, with the nominate subspecies having the largest range of the three, extending from England and south Sweden in the northwest, Spain in the south-west to western Turkey in the east. The subspecies *guestfalica hartigiana* is endemic to Sardinia, while the subspecies *guestfalica surcoufi* is distributed in Morocco, Algeria and Tunesia.

The nominate subspecies of *quadrifaria* is distributed over west and central Europe with its range extending towards the east over the Crimea peninsula and the Caucasus mountain range. The subspecies *quadrifaria farsidica* is known from north-west Iran in the area adjacent to the Caspian Sea.

The nominate subspecies of *appendiculata* is largely distributed over west and central Europe, eastwards reaching towards the westcoast of the Caspian Sea and southwards to Anatolia. It is absent from south-west Europe (Spain, Italy) where it is replaced by the subspecies *appendiculata pertenua*. In this context the occurrence of *appendiculata* sensu stricto on Sardinia is remarkable. The subspecies *appendiculata pertenua* is known from north-west Morocco and south-west Europe, including Corsica, Sicily and Malta. In its turn, this subspecies is absent from Sardinia. The species *minuscula* is known from Cyprus and the Levant, *theowaldi* occurs in south and south-west Turkey and

in the Greek island Rhodos.

The species *sullingtonensis* is distributed from northern Morocco through Spain and France to southernmost England. The species *fontana* is endemic to Algeria, while *astigma* is confined to the north of Algeria and Tunesia. Both *flavescens* and *submaculosa* are widespread throughout western and central Europe, with *submaculosa* occurring in Corsica, Sardinia, Sicily and the mainland of Italy. The species *flavescens* is absent in the four last mentioned areas. The species *lempkei* is at present known only from the islands Mallorca and Menorca.

Acknowledgements

For the loan of material of both sexes of the species *Nephrotoma spatha* I would like to thank Eulalia Eiroa (Santiago de Compostella, Spain).

Pjotr Oosterbroek and Frederick Schram, and an anonymous referee, read and commented upon an earlier draft of this paper. Although I did not follow all of their suggestions for adjustment of the text, I greatly appreciate their willingness to review the paper. The investigations were supported by the Foundation for Biological Research (BION), which is subsidized by the Netherlands Organization for Scientific Research (NWO).

References

Brindle, A., 1960. The larvae and pupae of the British Tipulinae (Diptera: Tipulidae). – Transactions of the Society for British Entomology 14: 64-114.

Byers, G. W., 1961. The crane fly genus *Dolichopeza* in North America. – University of Kansas Science Bulletin 42: 665-924.

Chiswell, J. R., 1956. A taxonomic account of the last instar larvae of some British Tipulinae (Diptera: Tipulidae). – Transactions of the Royal Entomological Society of London 108: 409-484.

Eiroa, M. E. & F. Novoa, 1987. Descripción de la hembra de *Nephrotoma spatha* (Diptera, Tipulidae). – Eos 63: 19-20.

Farris, J. S., 1988. Hennig86, version 1.5 + reference. – Port Jefferson Station, New York.

Hemmingsen, A. M. & B. Jensen, 1972. Egg characteristics and body size in crane-flies (Diptera: Tipulidae) with comparative notes on birds and other organisms. – Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening 135: 85-127.

Jong, H. de, in press. The phylogeny of the *Tipula* (*Acutipula*) *maxima* species group, with notes on its distribution (Diptera, Tipulidae). – Entomologica Scandinavica 24.

McAlpine, J. F., 1981. Morphology and terminology - adults. – In: McAlpine, J. F. et al. Manual of Nearctic Diptera. Volume 1. Research Branch, Agriculture Canada, Monograph 27: 9-63.

Mannheims, B., 1951. Tipulidae. – Fliegen der palaearktischen Region 15, Lieferung 167: 1-64, pls. I-VII.

Mannheims, B. & B. Theowald, 1971. Die Tipuliden von Grönland (Diptera, Tipulidae). – Bonner zoologische Beiträge 22: 332-342.

Oosterbroek, P., 1978. The western palaearctic species of *Nephrotoma* Meigen, 1803, (Diptera, Tipulidae) Part 1. – Beaufortia 27: 1-137.

Oosterbroek, P., 1979a. The western palaearctic species of *Nephrotoma* Meigen, 1803, (Diptera, Tipulidae) Part 2. – Beaufortia 28: 57-111.

Oosterbroek, P., 1979b. The western palaearctic species of *Nephrotoma* Meigen, 1803 (Diptera, Tipulidae) Part 3. – Beaufortia 28: 157-203.

Oosterbroek, P., 1979c. The western palaearctic species of *Nephrotoma* Meigen, 1803 (Diptera, Tipulidae) Part 4, including a key to the species. – Beaufortia 29: 129-197.

Oosterbroek, P., 1980. The western palaearctic species of *Nephrotoma* Meigen, 1803 (Diptera, Tipulidae), Part 5, Phylogeny and Biogeography. – Beaufortia 29: 311-393.

Oosterbroek, P., 1982. New taxa and data of western Palaearctic *Nephrotoma* (Diptera: Tipulidae). – Entomologische Berichten, Amsterdam 42: 41-44.

Oosterbroek, 1984. A revision of the crane-fly genus *Nephrotoma* Meigen, 1803, in North America (Diptera, Tipulidae). Part II: non-*dorsalis* species-groups. – Beaufortia 34: 117-180.

Oosterbroek, P., 1985a. The *Nephrotoma* species of Japan (Diptera, Tipulidae). – Tijdschrift voor Entomologie 127: 235-278.

Oosterbroek, P., 1985b. Some Tipulidae new for Corsica and Sardinia (Diptera). – Entomologische Berichten, Amsterdam 45: 121-122.

Oosterbroek, P. & J. W. Arntzen, 1992. Area-cladograms of Circum-Mediterranean taxa in relation to Mediterranean palaeogeography. – Journal of Biogeography 19: 3-20.

Oosterbroek, P. & B. Theowald, 1992. Family Tipulidae. – Catalogue of Palaearctic Diptera 1: 56-178.

Savchenko, E. N., 1973. Crane flies (fam. Tipulidae), subfam. Tipulinae (conclusion) and Flabelliferinae. – Fauna SSSR (N.S. 105) Two-winged insects II (5): 1-281. (In Russian).

Swofford, D. L., 1993. PAUP, Phylogenetic Analysis Using Parsimony, version 3.1. – Illinois Natural History Survey, Champaign, Illinois.

Tangelder, I. R. M., 1983. A revision of the crane fly genus *Nephrotoma* Meigen, 1803, in North America (Diptera, Tipulidae). Part I: the *dorsalis* species-group. – Beaufortia 33: 111-205.

Tangelder, I. R. M., 1984. The species of the *Nephrotoma dorsalis*-group in the Palaearctic (Diptera, Tipulidae). – Beaufortia 34: 15-92.

Tangelder, I. R. M., 1985. Phylogeny of the *Nephrotoma dorsalis* species-group (Diptera, Tipulidae), mainly based on genital characters. – Beaufortia 35: 135-174.

Theowald, B., 1957. Die Entwicklungsstadien der Tipuliden (Diptera, Nematocera), insbesondere der westpalaearktischen Arten. – Tijdschrift voor Entomologie 100: 195-308.

Theowald, B., 1967. Familie Tipulidae. (Diptera, Nematocera). Larven und Puppen. – Bestimmungsbücher zur Bodenfauna Europas 7: 1-100.

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Appendix

In this section the recognized autapomorphies of the species and subspecies of the *Nephrotoma flavescens* group are listed.

appendiculata appendiculata: no autapomorphies recognized.
appendiculata pertenua: differing from nominal subspecies in details of male tergite 10 only.
astigma: shape of lateral shells of male tergite 10 in lateral view.
beckeri: shape of male tergite 10; shape of inner gonostylus.
cretensis: shape of compressor apodeme of sperm pump.
exastigma: lateral prescutal stripes straight; inner gonostylus with sclerotized ridge from anterior to lateral part.
flavescens: medial prescutal stripes with dull lateral margins, downcurved part of lateral prescutal stripes dull.
fontana: shape of extension of male sternite eight; shape of gonapophysis of aedeagal guide.
guestfalica guestfalica: position and shape of crest of inner gonostylus.
guestfalica hartigiana: crest of inner gonostylus partly reduced.
guestfalica surcoufi: crest of inner gonostylus entirely reduced.
lempkei: medial projection on male sternite eight slender, somewhat tapering towards tip.
minuscula: aedeagal guide with dorsolaterally extending ridges; form and length of central ridges of male tergite 10.
nasuta: nasus long; shape of male tergite 10; shape of aedeagus, particularly at branching point.
quadrifaria quadrifaria: shape of inner gonostylus; shape of male tergite 10.
quadrifaria farsidica: medial projection of male sternite eight directed dorsally.
saccai: shape of male tergite 10; shape of gonapophysis of aedeagal guide; sperm pump posteriorly with upcurved plate; aedeagus single throughout; genital fork reduced.
schaeuffelei: shape of inner gonostylus; outer gonostylus anteriorly with pubescent incurved swelling; shape of sp2.
spatha: hairs on vertex short; shape of male tergite 10.
submaculosa: no autapomorphies recognized.
sullingtonensis: prescutal stripes partly confluent.
theowaldi: aedeagus near branching point with pair of lateral extensions; crest of inner gonostylus twisted along its longitudinal axis.

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NEW SPECIES OF THE GENUS *MOLANNA* CURTIS FROM SULAWESI (TRICHOPTERA: MOLANNIDAE)

Neboiss, A., 1993. New species of the genus *Molanna* Curtis from Sulawesi (Trichoptera: Molannidae). – Tijdschrift voor Entomologie 136: 257-258, figs. 1-4 [ISSN 0040-7496]. Published 10 December 1993.
The description and figures of *Molanna jolandae* sp. n. are given. This is the second species recorded from Sulawesi, and extends the range of generic distribution to southern Sulawesi Tenggara.
A. Neboiss, Department of Entomology, Museum of Victoria, 71 Victoria Crescent, Abbotsford 3067, Victoria, Australia.
Key words. – Trichoptera; Molannidae; *Molanna*; Sulawesi; taxonomy.

The present paper is based on material recently collected in Sulawesi. Among the numerous specimens from a number of localities, members of the family Molannidae are scarce and have been collected at only one location. There is only one previous Sulawesi record, a single specimen on which the description of *Molanna cupripennis* Ulmer (1906) is based. The type locality 'Bonthain Peak' is in southwestern Sulawesi (Sulawesi Selatan). The present material is from the southeastern part of the island (Sulawesi Tenggara) near Moramo (4°09'S 122°38'E). It may be noted, that the extensive collection from Dumoga Bone National Park in the north of the island (Sulawesi Utara), accumulated by the Wallace Expedition 1985, did not contain any specimens of *Molanna*.

Material and methods

Specimens were prepared by clearing the abdomen in cold KOH solution, then transferring to glycerol for drawing and later storage in microvial. Drawings of genitalia were made with the assistance of a camera lucida on a Wild M20 compound microscope. The wings, prepared as temporary microscope mounts in glycerol, were examined and drawn using a Wild M8 dissecting microscope also equipped with camera lucida. All dissected and figured specimens are identified by the author's notebook number with prefix 'PT-...'. All specimens have been deposited in the National Museum of Natural History, Leiden, The Netherlands (RMNH).

Taxonomic part

Molanna jolandae sp.n.
(figs. 1-3)

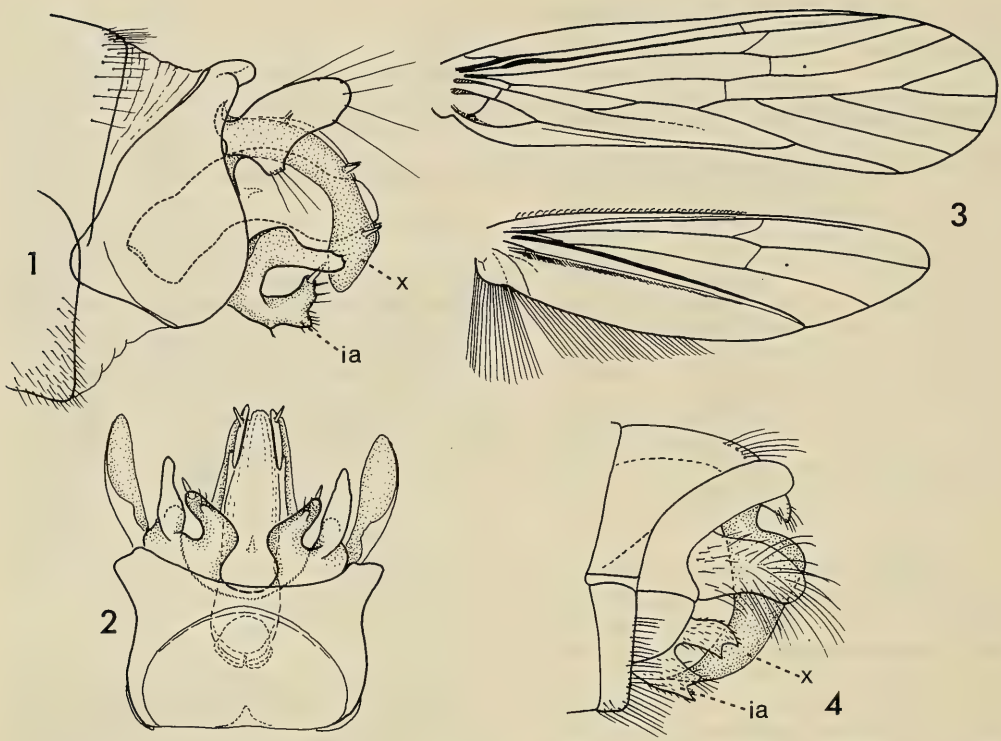
Type material. – Holotype ♂: Sulawesi Tenggara, Moramo (4°09'S 122°38'E), Sungai Sena, 50 m asl, 15 Nov 1989, R. de Jong and J. Huisman (site S 8946: mixed forest, dense undergrowth) in RMNH [Genitalia prep. PT-1968 figured, specimen dry mounted]. – Paratypes: Sulawesi Tenggara, Moramo, Sungai Moramo, 200 m asl, 16 Nov. 1989, at light, R. de Jong and J. Huisman, 2♂ (site S 8947: mixed forest, dense undergrowth) in RMNH [wing prep. PT-1969 figured; both specimens in alcohol].

Description

Wings slender, rounded apically (fig. 3), length ♂ 8.6-9.0 mm, densely covered with short, dark brown pubescence, hind wing anal margin with long, dark brown fringe, venation similar to that of *Molanna cupripennis* Ulmer.

Male. – Dark, blackish brown, antennae, maxillary and labial palpi as well as fore legs densely covered with coarse blackish brown hairs, mid- and hind-tarsi also covered with dark hairs, whereas femora and tibiae are pale yellow with scattered small, dark blackish semi-erect spines, apical spurs covered with dark hairs, preapical spurs with paler hairs.

Genitalia (figs. 1, 2) with abdominal segment IX in lateral view broadly rounded ventrally, mid-dorsal margin broad with slight mesal depression, anterolateral angles may be more or less produced. Superior appendages elongate ovoid, flattened, lower basal margin produced into an incurved lobe. Segment X large, extended and strongly curved ventrad, dorsomesally separated almost to the base, usually with three strong spines on dorsal margin on either side. Inferior



Figs. 1-4. *Molanna* species. – 1, *M. jolandae* sp. n., male genitalia (holotype), lateral; 2, ventral; 3, wing venation (paratype); 4, *M. cupripennis* Ulmer, male genitalia lateral (from Ulmer 1951).

appendages short, two branched, lower branch with terminal half curved dorsad, a distinct spine apically, upper branch directed posteriorly, slightly concave, apex rounded. Phallus short, rather robust, strongly curved, membranous, small chitinous spine internally.

Female unknown.

Remarks

This species is very similar to *Molanna cupripennis* Ulmer, but, besides being smaller (length of forewing 9 mm instead of 14 mm), differs by the presence of spines on segment X, and the shape of the inferior appendages, the branches of which are not incised apically. The figures by Ulmer (1906, 1951) (here reproduced as fig. 4) also show notable differences in shape and position of segment IX and the superior appendages.

Etymology. – The species is named after Jolanda Huisman in recognition of her efforts gathering extensive material of Trichoptera from many localities in Sulawesi.

ACKNOWLEDGEMENT

I wish to express my sincere thanks to Jan van Tol of RMNH Leiden for access to this most interesting material.

REFERENCES

Ulmer, G., 1906. Neuer Beitrag zur Kenntnis aussereuropäische Trichopteren. – Notes from the Leyden Museum 28: 1-116.

Ulmer, G., 1951. Köcherfliegen (Trichopteren) von den Sunda-Inseln (Teil 1). – Archiv für Hydrobiologie (Supplement) 19: 1-528 + plate 1-28.

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THE *RHAGOVELIA* (HETEROPTERA: VELIIDAE) OF SULAWESI (INDONESIA)

Notes on Malesian aquatic and semiaquatic bugs (Heteroptera), IV.

Nieser, N. & P. P. Chen, 1993. The *Rhagovelia* (Heteroptera: Veliidae) of Sulawesi (Indonesia). Notes on Malesian aquatic and semiaquatic bugs (Heteroptera), IV. – Tijdschrift voor Entomologie 136:259-281, figs. 1-84 [ISSN 0040-7496]. Published 10 December 1993.
Apart from additional records for several species for Sulawesi, ten new species are described: *Rhagovelia blagiokommena* sp. n., *Rhagovelia chrysomalla* sp. n., *R. daktylophora* sp. n., *R. horaia* sp. n., *R. pseudocelebensis* sp. n., *R. robina* sp. n., *R. trichota* sp. n., *R. tropidata* sp. n. from Sulawesi, *R. kastanoparuphe* sp. n. from Sulawesi and Buton and *R. kalami* sp. n. from Buton. A revised key to species from Sulawesi and Buton is given. Additional records for *Rhagovelia* from Sabah are given in an appendix.
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Key words. – Sulawesi (= Celebes); Buton; Sabah; Veliidae; *Rhagovelia*; key; new species.

As our contribution to the Fauna Malesiana program, we are working on the Nepomorpha and Gerromorpha mainly collected by staff members of the Zoological Museum Amsterdam and the National Museum of Natural History Leiden. The present one is the fourth in the series, the first dealt with Naucoridae, Nepidae and Notonectidae (Nieser & Chen 1991), while the second and third treated the Gerridae (Nieser & Chen 1992, Chen & Nieser 1992)

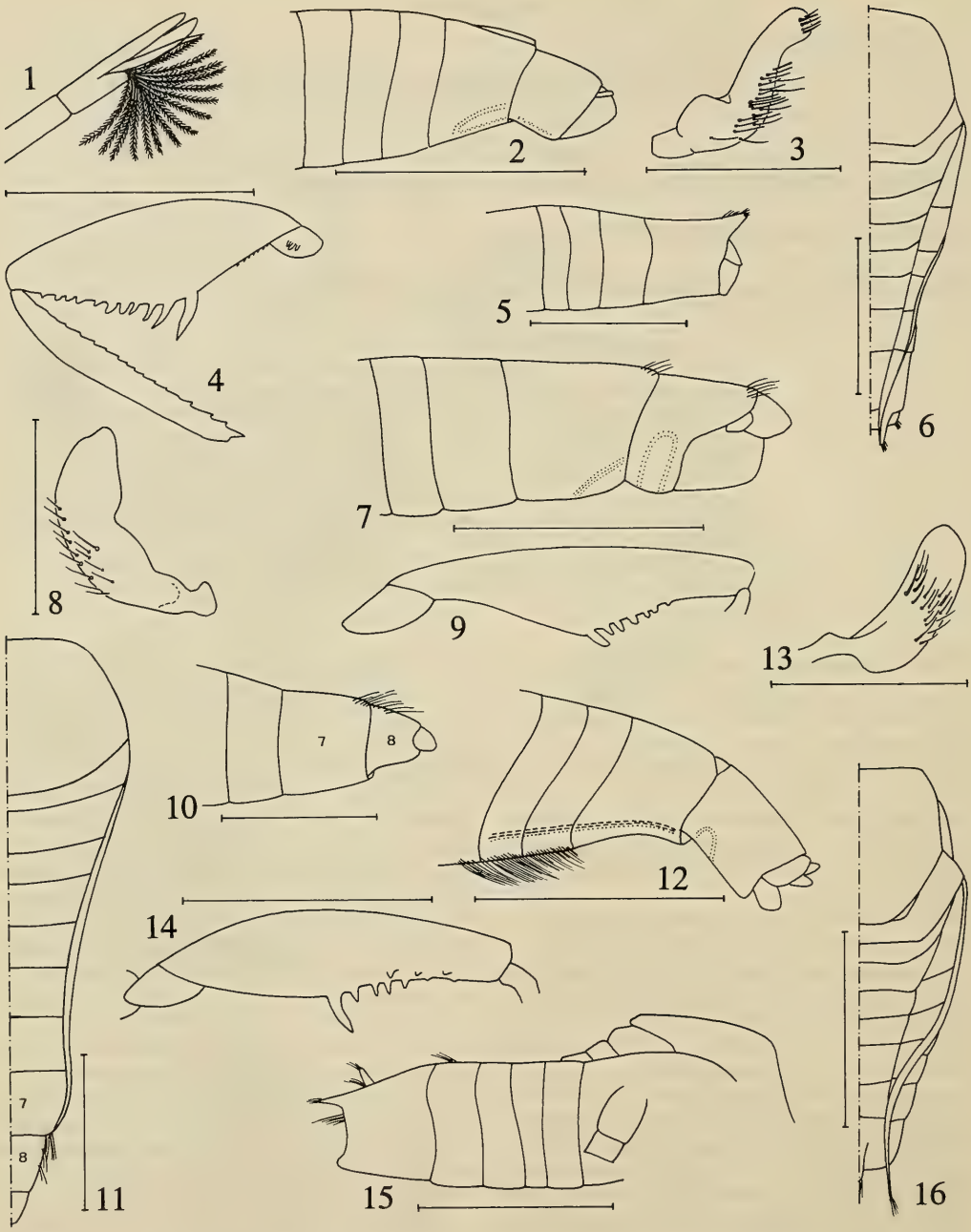
Rhagovelia is a large tropicopolitan genus of small, stream inhabiting, Veliidae. About 150 species have been described so far, but the number of extant species is probably twice as high. The subfamily Rhagoveliinae is characterized by a large, deeply cleft, apical segment of the middle tarsus with a fan-like structure (fig. 1). This is considered an adaption to living on waters with a strong current. Two Oriental genera are included in the subfamily, viz. *Tetraripis*, with both middle and hind tarsi with cleft apical segment provided with a fan-like structure, and *Rhagovelia*, with only middle tarsi modified in this way. *Tetraripis* is only known from Sri Lanka and western Malaysia.

Formerly, it was thought that tropical America would be much richer in species of *Rhagovelia* than Asia (Bacon 1956, Hungerford & Matsuda 1961, Lundblad 1936, 1937). In a recent revision, however, Polhemus & Polhemus (1988) described 26 new species from Borneo, Sulawesi and Maluku (the Moluccas). Only two species were previously known from this area. They stated, moreover, that they had many more undescribed Indo-Australian species in their collection. Thus the apparent paucity of species in tropical Asia is at least partly due to insufficient knowledge of the fauna.

Although a complete survey of the *Rhagovelia* of Sulawesi was included in the revision by Polhemus & Polhemus (1988), we recognised again ten new species in the collections we studied, thus doubling the number of known species. As very probably more species are still to be discovered, the key to species from Sulawesi and Buton presented here is to be used with care. New records of this genus for Sabah are presented in appendix 1.

Measurements are in millimetres, length has been measured in dorsal view from the anterior margin of the head along the central axis to the posterior margin of the last visible abdominal tergite in apterous, and to the apex of the hemielytra in macropterous specimens. 'Width' has been measured at the base of the connexiva in dorsal view. The first two segments of the fore tarsi have not been measured, as they are small (0.02-0.03), usually partly hidden in an excavation of the fore tibia and thus difficult to measure precisely. Moreover, they do not provide specific characters. For the same reason the measurements of the first two segments of the hind tarsi have been omitted.

The seventh abdominal segment, on which the connexiva end, is the last before the modified genital segments. In females the eighth tergite is sometimes



Figs. 1-16. – 1, diagrammatical drawing of the fan like structure in the cleft apical segment of intermediate tarsi of Rhagoveliinae. – 2-6. *R. blogiokommena* paratypes, 2-4 male, 2 apex of abdomen, lateral view, 3 paramere, 4 hind femur; 5–6 female, 5 apex of abdomen, lateral view, 6 right half of thorax and abdomen in dorsal view. Scales 2,4–6 1 mm, 3 0.25 mm. – 7-11. *R. chrysomalla* paratypes; 7-9 male, 7 apex of abdomen, lateral view, 8 paramere, 9 hind femur; 10-11 female, 10 apex of abdomen, lateral view, '7' and '8' indicate 7th and 8th (gonocoxa) segment, 11 right half of thorax and abdomen in dorsal view, '7' and '8' indicate tergites 7 and 8. Scales 7,9–11 1 mm, 8 0.25 mm. – 12-16. *R. daktylophora* paratypes; 12-14 male, 12 apex of abdomen, lateral view, 13 paramere, 14 hind femur; 15-16 female, 15 thorax and abdomen, lateral view, 16 right half of thorax and abdomen in dorsal view. Scales 12,14-16 1 mm, 13 0.25 mm.

more or less horizontal (fig. 11) in which cases the eighth tergite is the last visible in dorsal view. In other species the eighth tergite is pointing downward (fig. 34), in which case the seventh tergite is the last one fully visible in dorsal view. Another character that may give some trouble is the presence of minute denticles on the body, especially in greyish black species. Good optics with a magnification of at least 30× and a good light source is needed to study this character. These denticles are more difficult to distinguish in wet than in dry specimens. They are often most distinct on the proepisterna, which are the sclerites anterodorsally of the anterior coxae, on both sides of the rostrum.

The species dealt with in this paper were mainly collected by J. P. Duffels (ZMA), N. Nieser (NC), J. van Tol (RMNH) and G. Zimmermann (NC/ZC) on several expeditions to Sulawesi, Buton and Sabah (Eastern Malaysia). Unless otherwise indicated specimens are deposited in the collections mentioned in brackets after the collectors. Some reference specimens have been sent to the additional collections mentioned in following list: Museum Zoologi Bogor, Bogor, Jawa (MBBJ); Bagian Pertanian, Universitas Haluoleo, Kendari, Sulawesi (BPUH); J. T. Polhemus collection (University of Colorado Museum), Englewood, Co. U. S. A. (JTPC); Nieser collection, Tiel, The Netherlands (NC); Chen collection, Beijing, P. R. China (PCHC); National Museum of Natural History, Leiden, The Netherlands (RMNH); G. Zimmerman collection, Marburg, B. R. D. (ZC); Zoölogisch Museum, afd. Entomologie, Amsterdam, The Netherlands (ZMA) and Zoological Museum, Copenhagen, Denmark (ZMC). Some additional information on localities can be found in Nieser & Chen (1991).

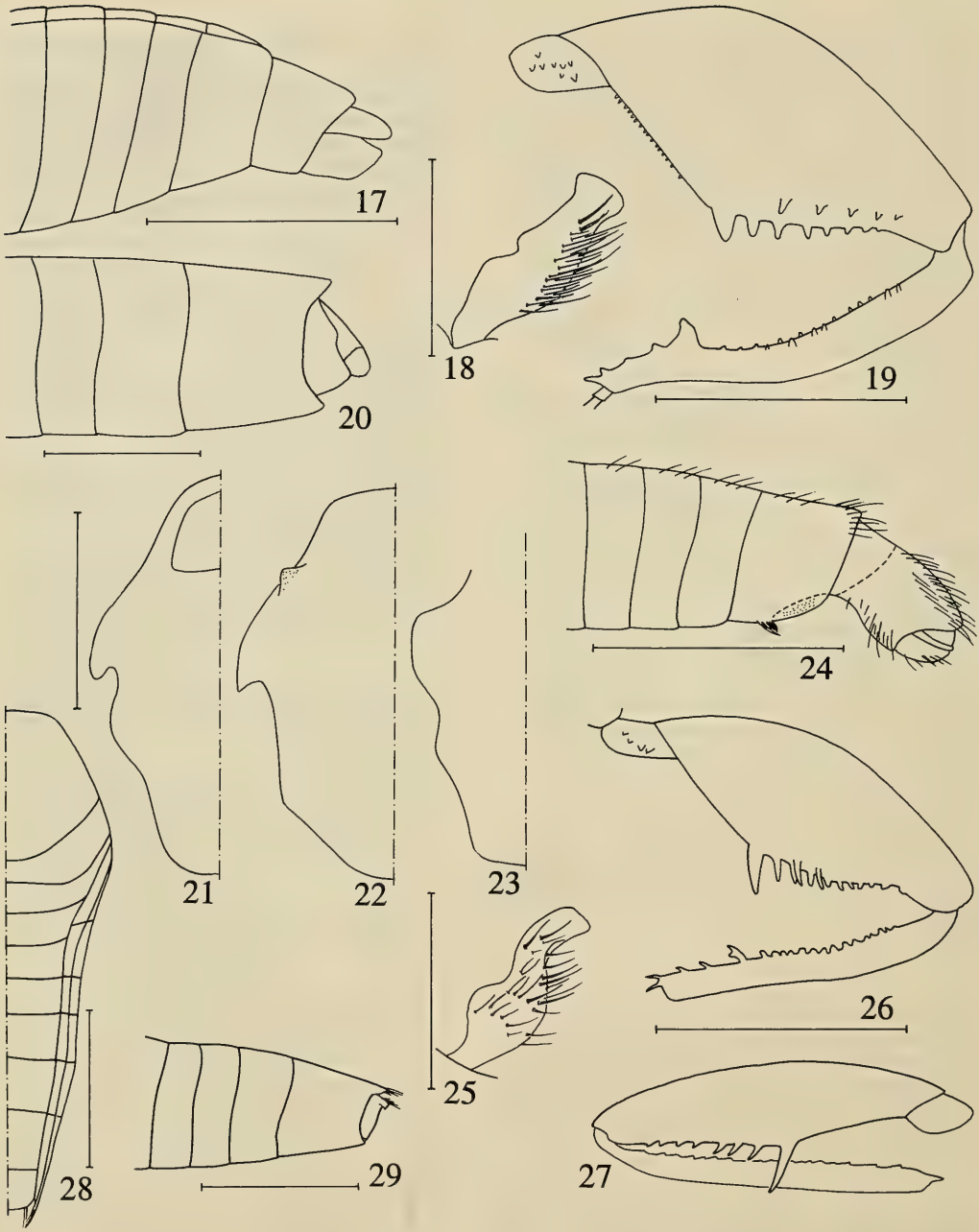
Acknowledgements

Thanks are due to Drs J. P. Duffels, J. van Tol and G. Zimmermann for putting specimens in their care at our disposal and to Dr. J. T. Polhemus for making paratypes of most of the species described by Polhemus & Polhemus (1988) available for study.

Systematic part

Key to *Rhagovelia* of Sulawesi (apterous specimens)

1. Pronotum short, its length much shorter than length of eye ..... *R. samarinda* Polhemus & Polhemus
   [Described from E Kalimantan and Sarawak, one macropterous female has been reported from Lore Lindu N. P. If a species with short pronotum is found, it may well represent a new species]
- Pronotum long, covering, all or nearly all of mesonotum 2
2. Dorsum of pronotum and abdomen covered by striking appressed golden pubescence. Transverse yellowish-orange band anteriorly on pronotum separated from yellowish prosternum by variable and sometimes indistinct dark brown spots behind the eyes. [Large species, length 3.8-4.3 mm] ..... *R. chrysomalla* sp. n.
- Dorsum of pronotum and abdomen not covered by striking appressed golden pubescence 3
3. Transverse yellowish-orange band anteriorly on pronotum narrow, laterally at most reaching halfway the eyes 4
- Transverse yellowish-orange band anteriorly on pronotum wide, reaching laterally of eyes 20
4. Males 5
- Females 12
5. Abdominal sternite 7 (sixth visible ventrally) not longitudinally carinate (fig. 56) 6
- Abdominal sternite 7 longitudinally carinate 7
6. Dorsum of abdomen hirsute; apex of paramere truncate (fig. 57) ..... *R. trichota*
- Dorsum of abdomen with normal pubescence, not hirsute; apex of paramere pointed (fig. 75) ... . *R. hamjadi*
  [Only known by the type series from Lore Lindu N. P. Polhemus & Polhemus 1988: 194-195, figs. 134-140]
7. Abdominal sternite 7 with a sharply pointed tuft of stiff setae, looking at first sight like a short stout peg, at basal third of longitudinal median carina (fig. 68). Hind femur inflated to a variable extend, at least twice as wide as middle femur ... . *R. pruinosa*
- Abdominal sternite 7 without peg like tuft of setae, hind femur 1.5 times or less as wide as middle femur 8
8. Abdominal sternites 4-6 with thick long golden yellowish pilosity (fig. 35) 9
- Abdominal sternites 4-6 with normal inconspicuous pubescence ..... *R. kastanoparuphe* sp. n.
9. Abdominal tergite 7 about as long as its basal width 10
- Abdominal tergite 7 longer (about 1.4x) than its basal width 11
10. Paramere apically broad, leaf-like (fig. 36, 43-44) ..... *R. pseudocelebensis* sp. n.
- Paramere apically less broad (fig. 41-42) .... *R. celebensis*
11. Sternites 5-7 with ventrolateral impressions resulting in a broad median keel longitudinally on these sternites (fig. 12) ..... *R. daktylophora*
- Ventrolateral impressions and keel restricted to sternite 7 (fig. 69) ..... *R. sulawesiana*
12. Hind femur dorsoventrally flattened, lower mar-



Figs. 17-29. – 17-20. *R. horaia*; 17-19 male, 17 apex of abdomen of holotype, lateral view, 18 paramere of paratype, 19 hind trochanter, femur and tibia of holotype; 20 female paratype, apex of abdomen, lateral view. Scales 17, 19, 20 1 mm, 18 0.25 mm. – 21-23. Right half of proctiger of males; 21 *R. horaia* paratype, scale 0.25 mm, 22 *R. grayi*, 23 *R. lorelinduana*, 22 & 23 drawn after J. & D. Polhemus (1988). – 24-29. *R. kalami* paratypes; 24-26 male, 24 apex of abdomen, lateral view, 25 paramere, 26 hind trochanter, femur and tibia; 27-29 female, 27 hind trochanter, femur and tibia, 28 right half of thorax and abdomen, dorsal view, 29 apex of abdomen, lateral view. Scales 24, 26–29 1 mm, 25 0.25 mm.

gin more or less straight (fig. 78) .....*R. hamjadi*
– Hind femur not flattened dorsoventrally, with a convex lower margin (fig. 77) 13
13. Connexiva margined with yellowish brown and set with long setae (longer than width of hind tibia) along entire length, converging caudally but not folded over tergite 7 .....*R. unica*
[Known only by the unique holotype female from Dumoga Bone N. P., Polhemus & Polhemus 1988: 195, figs. 43-45]
– Combination of characters not as above 14
14. Tergite 8 more or less horizontal, in the same plane as tergite 7 .....*R. pruinosa*
– Abdominal tergite 8 distinctly directed ventrad... 15
15. Caudal part of connexiva folded over abdominal tergite(s), at least covering most of tergite 7 ...16
– Connexiva not folded over abdominal tergites . .. .17
16. Connexiva strongly constricted on segments 4 and 5, more or less parallel and nearly meeting on segments 6 and 7 (fig. 61). Tergite 7 with a mediocaudal finger-like process .....*R. sulawesiana*
– Connexiva constricted on segment 4, convergent caudally and meeting dorsally over posterior part of tergite 7 which lacks a mediocaudal finger-like process (fig. 60) .....*R. trichota*
17. Connexiva converging caudally in a straight or softly sinuate line 18
– Connexiva distinctly constricted at the suture between segment 6 and 7, tergite 7 with a distinct mediocaudal upwardly directed finger-like process (figs. 15, 16) .....*R. daktylophora*
18. Upper margin of connexiva brownish, their caudal apices long, tergite 7 with a more or less triangular hind margin (figs. 33, 34) ....*R. kastanoparuphe*
– Upper margin of connexiva blackish, caudal apices short, hind margin of tergite 7 either truncate or with a mediocaudal finger-like projection (figs. 39, 40) 19
19. Hind margin of tergite 7 truncate, straight ....*R. celebensis*
– Hind margin of tergite 7 with a mediocaudal finger-like projection .....*R. pseudocelebensis*
20. Males 21
– Females 29
21. Posterior tibia straight or softly curved, without larger subapical tooth in inner row (fig. 64) 22
– Posterior tibia curved, usually distinctly, with one or more larger teeth subapically in inner row (figs. 19, 26) 26
22. Metanotum and first abdominal tergite orange-like to light reddish brown. Posterior femur relatively slender, about 3.5 times as long as wide ....*R. robina*
– Metanotum and first abdominal tergite dark. Posterior femur more inflated, three times or slightly less as long as wide 23
23. Sternite 7 laterally compressed, resulting in a strongly developed ventral keel, which is accentuated by a well-developed fringe of cilia (fig. 62) .. ..*R. tropidata*
– Sternite 7 ventrally flattened, with a low median keel 24
24. Abdominal sternites 5-6 with postero-ventrally directed tufts of stiff setae (fig 71), paramere as in fig. 76 .....*R. wallacei*
– Abdominal sternites 5-6 with normal pubescence only, without postero-ventrally directed tufts of stiff setae (fig 69), parameres as in figs. 3, 75 ...25
25. Minute black denticles present on pro- and mesopleura, mesopleura without coarse punctation ....*R. minahasa*
– Minute black denticles absent on pro- and mesopleura, mesopleura with coarse punctation ....*R. blogiokommena*
26. About 30 minute teeth in row proximal to large spine on posterior femur .....*R. grayi*
[Only known by the type series from Sulawesi Utara, Lake Mala near Mokabang, Polhemus & Polhemus 1988: 207-208, figs. 208-215]
– About 20 minute teeth in row proximal to large spine on posterior femur 27
27. Sternite 7 ventrally halfway with a tuft of caudally directed setae (fig. 24) .....*R. kalami*
– Sternite 7 ventrally halfway without a tuft of caudally directed setae 28
28. Posterior femur nearly three times as long as wide, proctiger as in fig. 23 .....*R. lorelinduana*
[Only known by the type series from Lore Lindu N. P. in Sulawesi Tengah, Polhemus & Polhemus 1988: 208, figs. 141-148]
– Posterior femur about 2.5 times as long as wide, proctiger as in fig. 21 .....*R. horaia*
29. Connexiva caudally folded over abdomen at least on tergite 7 30
– Connexiva convergent posteriorly but not folded over tergite 7 32
30. Minute black denticles distinctly and abundantly extending onto thoracic pleura. Connexiva strongly constricted on segment 5 and converging in a more or less straight line caudally of constriction. Caudal apices of connexiva small, triangular .....*R. minahasa*
– Minute black denticles not distinctly extending onto thoracic pleura. Caudal apices of connexiva large, triangular (fig. 72) 31
31. Connexiva only slightly constricted on segments 4/5, more or less straightly convergent caudally. Middle femur not dorsoventrally flattened ....*R. grayi*

– Connexiva strongly constricted on segment 5, curved outward again on segment 6. Middle femur dorsoventrally flattened .....*R. lorelinduana*
32. Outer lateral margin of connexiva distinctly constricted on segment 4 (figs. 52, 67) 33
– Outer lateral margin of connexiva more or less straight 35
33. Meso- and meta-thoracic pleura yellow to pale orange-like, densely set with minute black denticles. Metanotum caudolaterally with small swellings (fig. 52) .....*R. robina*
- Meso- and meta-thoracic pleura largely dark with at most a few minute black denticles. Metanotum without a pair of caudolateral swellings (fig. 67) 34
34. Length over 3 mm, connexiva swollen and slightly curved inward on segments 4-5 but not sinuate (fig. 67), mesopleuron without coarse punctation .....*R. tropidata*
– Length just under 3 mm, connexiva slightly sinuate and hardly swollen on segments 4-5 (fig. 6), mesopleuron with coarse punctation ....*R. blogiokommena*
35. Connexiva in dorsal view slightly thickened on segment 4. Abdominal tergite 7 only slightly longer than basal width .....*R. kalami*
– Connexiva not thickened on segment 4. Abdominal tergite 7 over 1.25 times as long as its basal width 36
36. Generally a dark grey brown species, yellow transverse band on pronotum on median line less than one fifth the median length of pronotum. Length of body about 3.2, ratio length to maximum width 1.6 .....*R. wallacei*
– Generally a reddish brown species, yellow transverse band on pronotum on median line more than one fifth the median length of pronotum. Length of body about 3.4, ratio length to maximum width 1.7 .....*R. horaia*

Rhagovelia celebensis Polhemus & Polhemus
(figs. 41-42, 81)

Rhagovelia celebensis Polhemus & Polhemus, 1988: 199-200, figs. 179-186, 229.

Material. – Sulawesi Utara: Dumoga Bone N.P., Base Camp, bridge, 16.x.1985 103♂ 72♀ (5♂ 1♀ macr.); same, flussabw. Brücke (downstream bridge), 22.x.1985, 2♂ 3♀; same, Base Camp, Stausee ('barrage lake'), 22.x.1985, 6♂ 10♀ (1♀ macr.); same, Tumpah R.(type locality), Staustufe (barrage dam) 23.x.1985, 17♂ 18♀ (3♂ macr.); same, Tumpah R., quiet part, 28.x.1985, 3♂ 3♀; Tumpah R. beach, 19.x.1985, 36♂ 36♀ (1♂ macr.); Tumpah, Waterfall oberh. Seitenbach (upstream tributary), 21.xi.1985, 1♂ 1♀; Südküste, Strasse, Bach, (South coast, road, stream), 18.xi.1985, 8♂ 13♀; all leg. G. Zimmermann; Dumoga Bone N. P. Tumpah river near confluence Toraut, UTM-XL00631, 210 asl., 18.v.1985, 2♂ 2♀, same, 23.v.1985, 10♂ 4♀ (1♀ macr.); Dumoga Bone N. P., waterfall creek, tributary of Tumpah, UTM-XL0064, c. 225m asl., 24.v.1985, 2♀; same, hygropetric zone of Waterfall Creek, 22.iv.1985, 1♂ 1♀; Dumoga Bone N.P., Edward's subcamp, UTM-WL9365, 664m asl., 3.vi.1985, 5♀ (1 macr.); all leg. J. van Tol; 20 km E of Kotamobagu, Mt Ambang, alt. 1210 m, 8.xi.1985, multistr. evergreen forest, soil litter sifted, 1♀, leg. J. Krikken. – Sulawesi Tengah, 50 km SE of Palu, Lore Lindu N. P., sur. Dongi Dongi shelter, 1°13'S 120°11'E, tributary of Sopu river, edge of multistr. evergreen forest, 950 m, 4.xii.1985-C, 1♂ 1♀; Palu, Sopu river nr. Dongi Dongi, SJ 85, 950m, 5.xii.1985, 5♀; same, 8.xii.1985, 1♂, J. van Tol. – Sulawesi Selatan, c. 10 km NW Palopo (km 15 along road Palopo-Rantepao), Salo Tandung, 2°58'S 120°07'E, 300-400 m asl., width 10m, boulders, torrents and seepage areas, open sec. forest, 27.iv.1991, 3♂ 10♀, leg. S. Kofman, 91JvT15; Mamasa, 2°56'S 119°22'E, 1050m, cultivated area, river flowing through village, rather fast flowing, bottom with boulders and some coarse sand, 8. IV. 1991, leg. J. van Tol, 2♂ 2♀.

Distribution. – This species is widespread in Sulawesi (fig. 81). Its type locality is Dumoga National Park, Tumpah River.

Rhagovelia minahasa Polhemus & Polhemus
(figs. 70, 73-74, 84)

Rhagovelia minahasa Polhemus & Polhemus 1988: 205-206, figs. 216-222, 228.

Material. – Sulawesi Utara: Lakes, Bach unter Sulphur spr., Z. Dorf, 21.xi.1985, 48♂ 45♀ (5♂ 6♀ macr.), many larvae; Dumoga Bone N. P., Tumpah River, 19. X. 1985, 1♀, leg. G. Zimmermann. Apterous, unless otherwise indicated.

Distribution. – Only known from the eastern part of North Sulawesi (fig. 84).

Rhagovelia pruinosa Polhemus & Polhemus
(figs. 68, 77, 83)

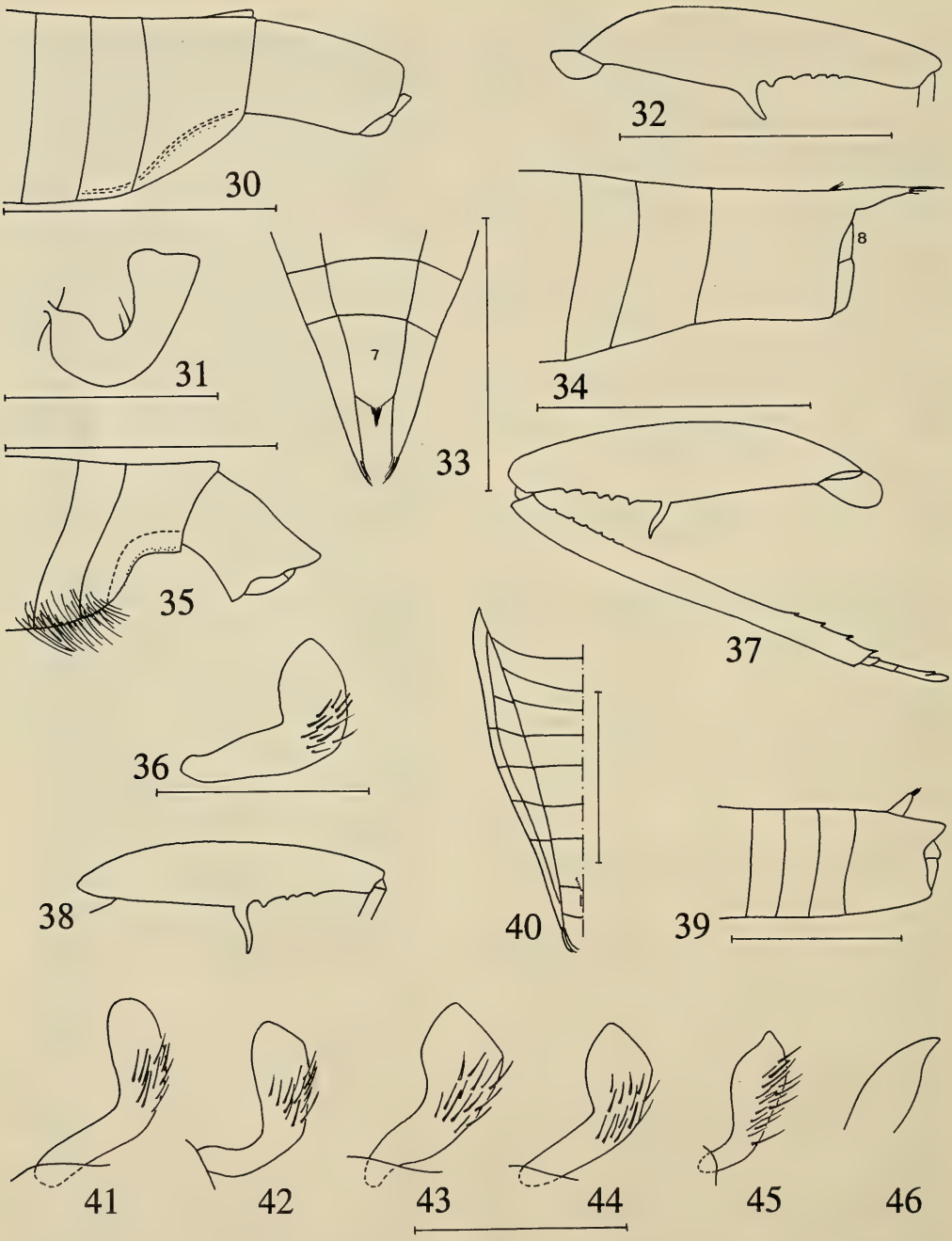
Rhagovelia pruinosa Polhemus & Polhemus, 1988: 195-196, figs. 149-157, 229.

Material. - Sulawesi Selatan: E of Maros, Bantimurung Area, Sg. Pattunuang Asue (type locality), 5°03'S 119°41'E, fast flowing stream, ponded areas, through disturbed forest on limestone, 23.iv.1991, J. van Tol, 6♂ 8♀ (2♂ 2♀ macr.). – Sulawesi Tengah: Luwuk area, Sungai Batui, Singsing Camp, 19.x.1989, 1♂ macr.; Sungai Biak, 22.x. 1989, J. van Tol, 2♂. – Sulawesi Tenggara: Sungai Mowewe, 28.ii.1989, N8922, 3♂; marsh S of Pomalaa, 2.iii.1989, N8930 3♂ 11♀; 20 km E Kolaka, mountain stream, 3.iii.1989, N8934 1♂, leg. N. Nieser; Konaweha R. near Sanggona, 7.xi.1989, J. van Tol, 4♂ 10♀. – Buton. Stream N of Baubau, 8.iii.1989, N8935 4♂ 6♀, leg. N. Nieser. Apterous unless otherwise indicated.

Distribution. – Southern and eastern parts of Sulawesi, Buton (fig. 83).

Table 1. Measurements of leg segments in *Rhagovelia*
Tarsal segments 1 and 2 of fore and hind legs have not been measured for most species. When not given, they measure together 0.05-0.07 and 0.12-0.15 respectively and do not seem to provide specific characters.

	femur	tibia	tars1	tars2	tars3
R. blogiokommena ♂					
fore leg	0.80	0.82	–	–	0.22
middle leg	1.30	1.05	0.06	0.40	0.62
hind leg	1.20	1.06	–	–	0.23
R. blogiokommena ♀					
fore leg	0.81	0.82	–	–	0.22
middle leg	1.29	1.01	0.07	0.40	0.61
hind leg	1.11	1.10	–	–	0.23
R. chrysomalla ♂					
fore leg	1.23	1.28	–	–	0.30
middle leg	2.00	1.62	0.07	0.72	0.81
hind leg	1.44	1.72	–	–	0.38
R. chrysomalla ♀					
fore leg	1.21	1.25	–	–	0.29
middle leg	1.86	1.60	0.08	0.75	0.85
hind leg	1.41	1.73	–	–	0.36
R. daktylophora ♂					
fore leg	0.93	1.01	–	–	0.25
middle leg	1.58	1.26	0.07	0.57	0.71
hind leg	1.32	1.41	–	–	0.30
R. daktylophora ♀					
fore leg	0.87	0.98	–	–	0.27
middle leg	1.49	1.16	0.07	0.50	0.71
hind leg	1.22	1.39	–	–	0.31
R. horaia ♂					
fore leg	1.04	1.09	–	–	0.30
middle leg	1.60	1.37	0.08	0.49	0.69
hind leg	1.67	1.49	–	–	0.40
R. horaia ♀					
fore leg	1.00	1.03	–	–	0.28
middle leg	1.55	1.26	0.007	0.47	0.70
hind leg	1.37	1.43	–	–	0.40
R. kalami ♂					
fore leg	0.94	0.97	–	–	0.22
middle leg	1.52	1.20	0.08	0.50	0.69
hind leg	1.39	1.20	–	–	0.30
R. kalami ♀					
fore leg	0.93	0.95	–	–	0.22
middle leg	1.51	1.18	0.08	0.53	0.69
hind leg	1.31	1.23	–	–	0.31
R. kastanoparuphe ♂					
fore leg	0.93	1.02	–	–	0.26
middle leg	1.63	1.28	0.08	0.56	0.70
hind leg	1.47	1.39	–	–	0.35
R. kastanoparuphe ♀					
fore leg	0.95	1.03	–	–	0.25
middle leg	1.58	1.23	0.08	0.54	0.70
hind leg	1.32	1.45	–	–	0.32



Figs. 30-46. – 30-34. *R. kastanoparuphe* paratypes; 30-32 male, 30 apex of abdomen, lateral view, 31 paramere, 32 hind femur; 33–34 female apex of abdomen, 33 dorsal view '7' and '8' abdominal tergites 7 and 8 respectively; 34 lateral view. Scales 30, 32–34 1 mm, 31 0.25 mm. – 35-40. *R. pseudocelebensis* paratypes; 35-37 male, 35 apex of abdomen, lateral view, 36 paramere, 37 hind leg; 38–40 female, 38 hind femur, 39 apex of abdomen lateral view, 40 left half of abdomen, dorsal view. Scales 35, 37–40 1 mm, 36 0.25 mm. – 41-46, parameres of 41-42, *R. celebensis* (Dumoga Bone N. P.), 43-44, *R. pseudocelebensis* (Kolaka and Buton respectively), and 45-46, *R. sulawesiana* (paratype); 45, lateral view, 46, medial view. Scale 0.25 mm.

R. pseudocelebensis ♂					
fore leg	0.96	0.99	–	–	0.28
middle leg	1.48	1.17	0.07	0.53	0.70
hind leg	1.26	1.35	–	–	0.31
R. pseudocelebensis ♀					
fore leg	1.00	0.95	–	–	0.23
middle leg	1.41	1.11	0.08	0.50	0.69
hind leg	1.23	1.35	–	–	0.29
R. robina ♂					
fore leg	0.91	0.93	–	–	0.24
middle leg	1.47	1.11	0.08	0.52	0.66
hind leg	1.37	1.14	–	–	0.30
R. robina ♀					
fore leg	0.90	0.93	–	–	0.23
middle leg	1.44	1.08	0.08	0.51	0.66
hind leg	1.29	1.28	–	–	0.31
R. trichota ♂					
fore leg	0.89	0.91	–	–	0.20
middle leg	1.41	1.13	0.06	0.43	0.65
hind leg	1.20	1.24	–	–	0.30
R. trichota ♀					
fore leg	0.96	0.96	–	–	0.22
middle leg	1.43	1.17	0.08	0.47	0.70
hind leg	1.22	1.31	–	–	0.32
R.tropidata ♂					
fore leg	0.92	0.96	–	–	0.22
middle leg	1.52	1.23	0.09	0.48	0.68
hind leg	1.40	1.22	–	–	0.32
R.tropidata ♀					
fore leg	0.90	0.93	–	–	0.22
middle leg	1.42	1.11	0.08	0.41	0.64
hind leg	1.23	1.23	–	–	0.36

Rhagovelia sulawesiana Polhemus & Polhemus (figs. 61, 69, 81)

Rhagovelia sulawesiana Polhemus & Polhemus, 1988: 198-199, figs. 158-164, 230.

Material. – SULAWESI SELATAN: E of Maros, Bantimurung Area, Sg. Pattunuang Asue [type locality], 5°03'S 119°41'E, fast flowing stream, ponded areas, through disturbed forest on limestone, 23.iv.1991, J. van Tol, 3♂ 5♀; SE of Malino, rivulet at N side of Lompobattang, cultivated area, 20.vi.1985-A, J. van Tol 2♂. All apterous.

Distribution. – S Sulawesi (fig. 81).

Rhagovelia wallacei Polhemus & Polhemus (figs. 71, 76, 82)

Rhagovelia wallacei Polhemus & Polhemus, 1988: 203-205, figs. 187-193, 230.

Material. – SULAWESI UTARA: Kotamobagu, Caves, 26.x.1985, 11♂ 7♀; Dumoga Bone N. P., Base Camp, Toraut R., maze, 7.xi.1985, 7♂ 15♀; Tumpah R., beach, 19.x.1985, 1♂ 4♀ (1♀ macr.); Tumpah R., Waterfall oberh. Seitenbach, 21.xi.1985, 2♂; Malibagu Z., 8.xi.1985, 1♀ macr.; Lakes, Kleine See, Abfluss des Flusses (small lake, drainage of stream), 16.xi.1985, 6♂ 11♀ (2♀ macr.); Lakes, kleiner See, Fischteich, 16.xi.1985, 2♂ 4♀; Südküste, Strasse, Bach, 18.xi.1985, 2♂ 9♀; all leg. G. Zimmermann; Dumoga Bone N. P., waterfall creek (type locality), 24.v.1985, 1♂; Tumpah river near confluence Toraut, UTM-XL00631, 210 asl., 21.v.1985, 1♂, both J. van Tol; 20 km E of Kotamobagu, Mt Ambang, alt. 1210 m, 8.xi.1985, multistr. evergreen forest, soil litter sifted, 1♂ 1♀, leg. J. Krikken. – SULAWESI TENGAH, 50 km SE of: Lore Lindu N. P., sur. Dongi Dongi shelter, 1°13'S 120°11'E, tributary of Sopu river, edge of multistr. evergreen forest, 950 m, 4.xii.1985-C, 1♀. Apterous, unless otherwise indicated.

Distribution. – Northern and eastern parts of Sulawesi (fig. 82)

Rhagovelia blogiokommena **sp. n.**
(figs. 2-6, 82)

Type material. – Holotype ♂: Sulawesi Tenggara, mountain stream between Tamborasi and Wolo, 1 mar. 1989, leg. N. Nieser, N8926 (ZMA). – Paratypes, same data as holotype, 7♂ 9♀ (1♀ allotype ZMA, 3♂ 3♀ NC, 1♂ 1♀ PCHC, 1♂ 1♀ JTPC, 1♂ 1♀ MBBJ, 1♂ 1♀ RMNH, 1♀ ZMC). All apterous (fig. 82).

Description. – Apterous form. Dimensions. Length ♂ 2.80-2.92, ♀ 2.85-3.00; width ♂ 1.0-1.1, ♀ 1.1-1.2; width of head ♂ 0.70-0.73, ♀ 0.72-0.74; width of pronotum ♂ 0.90-0.95, ♀ 0.95-1.02.

Colour, generally dark grey to blackish, anterior quarter of pronotum orange-yellow, connected with yellowish propleura, and prosternum. Dorsal half (males) to two thirds (females) of connexivum orange. Venter dark, juga, prosternum and abdominal sternite 7 yellowish, genital segments of male yellowish. Basal half of first antennal segment, basal part of rostrum, basal three quarters of fore femur, basal third of hind femur, acetabula, coxae and trochanters pale; hind femur in ventral view medium brown.

Minute black denticles virtually restricted to posterior half of jugum of head and propleura on both sides of rostrum. Mesopleuron in front of acetabulum with a group of 11-16 coarse punctures. Dorsum rather bare, abdominal tergites pruinose laterally. Vertex, interoculus, sides of thorax and abdomen, antennae and legs with the usual pubescence and setae. Punctures on disk of pronotum indistinct except for a row at posterior margin of transverse orange-yellow part.

Length of antennal segments I-IV ♂ 0.70 : 0.37 : 0.47 : 0.41, ♀ 0.68 : 0.35 : 0.45 : 0.41. Pronotum long, covering mesonotum, length: width 0.75 : 0.92. Length of metanotum on midline, 0.10. Abdominal tergites 1-5 subequal in length (0.15), tergite 6 slightly longer (0.20), tergite 7 0.30 in male, 0.35 in female.

Male. Posterior trochanter with 1-3 small but distinct blunt teeth. Posterior femur slightly less than four times as long as wide (1.20/0.32), on ventral margin proximally with about 10 minute and closely set teeth, followed about halfway by a large spine about as long as half the width of femur, with a row of about 11 spines of decreasing length distally (fig. 4). Anteroventrally a row of 5 smaller spines located in distal part. Larger spines black tipped, smaller spines and teeth entirely black or nearly so. Posterior tibia virtually straight, armed beneath with a row of about 15 rather coarse pegs, a few proximally paired. Connexiva more or less horizontal, gradually converging posteriad. Basal width of abdominal tergite 7 subequal to its median length. Abdominal sternite 7 with a pair of shallow impressions separated by a narrow and low keel, sternite 8 with an indistinct ventral keel (fig. 2). Parameres as in fig. 3.

Female. Posterior trochanter without small teeth. Posterior femur slightly less than four times as long as wide (1.1/0.3), row of minute teeth absent, row of larger spines essentially as in male. Posterior tibia with small and less distinct pegs as in male. Connexiva more or less vertical, on tergites 5 and 6 somewhat sinuate, otherwise gradually converging caudally, with the pointed apices of connexiva touching, or nearly so (fig. 6). One female has the connexiva nearly horizontal. Tergite 8 slanting ventrad at an angle of about 45°, proctiger pointing ventrad. Sternite 7 about half as long as remaining abdominal sternites (0.5/1.0). Gonocoxa hidden in segment 7.

Etymology. – *Blogiokommenos*, greek adjective meaning pockmarked, referring to the coarse punctation on mesopleura.

Comparative notes. – Similar to *R. tropidata*, *R. wallacei* and, in males, *R. minahasa*, all of which have distinct minute black denticles on pro- and mesopleura. *R. minahasa* lacks mesothoracic punctures, *R. tropidata* has fewer (4-9) and indistinct punctures in front of mesoacetabula, *R. wallacei* has slightly less (about 10) and less coarse punctures there. Male sternite 7 and female connexiva are also different (figs. 2, 62, 70-71, 6, 67)

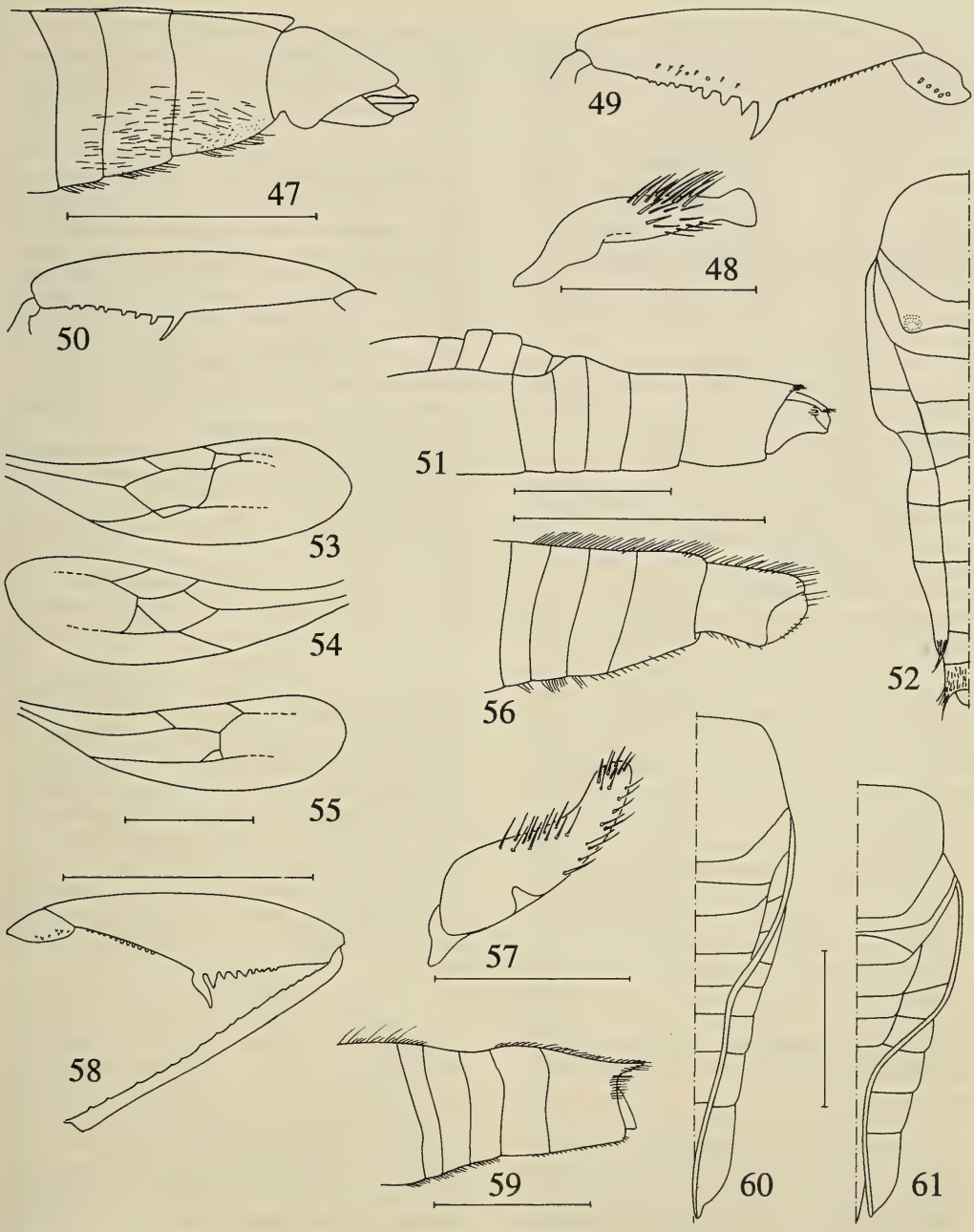
Rhagovelia chrysomalla **sp. n.**
(figs. 7-11, 83)

Type material. – Holotype ♂: Sulawesi Tengah, 60 km SE of Palu: Lore Lindu N. P., UTM-SJ95, Danau Tambing and brooklets, 1600 m asl., *Pandanus*, 7 Dec. 1985-A, leg. J. van Tol (RMNH). – Paratypes 4♂ 8♀, same data as holotype (2♂ 3♀, including allotype RMNH, 2♂ 3♀ NC, 1♀ MBBJ, 1♀ JTPC). All apterous (fig. 83).

Description. – Apterous form. Dimensions. Length ♂ 3.80-3.90, ♀ 4.10-4.33; width ♂ 1.3-1.4, ♀ 1.4-1.6; width of head ♂ 0.88-0.90, ♀ 0.90-0.92; width of pronotum ♂ 1.20-1.28, ♀ 1.22-1.40.

Colour, dark grey brown to blackish, eyes castaneous. Anterior fifth of pronotum orange-yellow. Propleura, pro- and mesosterna, first antennal segment except apex, acetabula, coxae and trochanters anterior femur except apex yellowish. Middle and hind femur variably yellowish and brown, connexiva entirely in female, distal two thirds in male orange yellow. Sternites 7 and 8 in male, tergite 8, proctiger and gonocoxa in female yellowish. The orange-yellow anterior transverse band of pronotum tends to be separated from the yellow area of the propleura by a dark spot behind the eyes which is quite variable and may be absent.

Thoracic venter with minute black denticles, ex-



Figs. 47-61. – 47-55. *R. robina* paratypes; 47 apex of abdomen, lateral view, 48 paramere, 49 hind trochanter and femur; 50-52 female, 50 hind femur, 51 dorsal part of thorax and abdomen lateral view, 52 left half of thorax and abdomen, dorsal view; 53-55 hemielytra of males (54-55 of same specimen). Scales 47, 49-55 1mm, 48 0.25 mm. – 56-60. *R. trichota* paratypes; 56-58 male, 56 apex of abdomen lateral view, 57 paramere, 58 hind trochanter, femur and tibia; 59-60 female, 59 apex of abdomen, lateral view, 60 right half of thorax and abdomen, dorsal view. Scales 56, 58-60 1 mm, 57 0.25 mm. – 61, *R. sulawesiana* paratype female, right half of thorax and abdomen, dorsal view. Scale 1 mm.

tending onto pleura, most distinctly on jugum and proepisternum. Interoculus, thoracic and abdominal tergites clothed with dense, appressed golden-yellow pilosity. (This golden pilosity is also present in larva V). In addition dorsum of thorax and abdomen with sparse long erect dark cilia. Vertex sides of thorax antennae and legs with the usual pubescence and setae.

Length of antennal segments I-IV ♂ 0.95 : 0.44 : 0.69 : 0.67, ♀ 0.99 : 0.47 : 0.68 : 0.59. Pronotum long, covering mesonotum. Disk of pronotum with some indistinct punctures, obscured by pilosity. Length: width of pronotum male 0.93 : 1.22, female 1.18 : 1.32. Length of metanotum on midline, 0.20. Abdominal tergites 1-5 subequal in length (0.20 in male, 0.25 in female), tergite 6 subequal in male, slightly longer (0.30) in female, tergite 7 distinctly longer (0.43 in male, 0.50 in female).

Male. Posterior trochanter length: width 0.40 : 0.21, without teeth or warts. Posterior femur slender, slightly less than four and a half times as long as wide (1.44/0.33), on ventroposterior margin about halfway with a rather small brown spine, its length somewhat less than one thirds the width of femur, with a row of about 7 spines of decreasing length distally (fig. 9). Posterior tibia straight, armed beneath with a row of about 20 small teeth. Connexiva slanting upward about 45°, convex on segments 3-5 strongly converging posteriad on segment 7, no caudal points. Basal width of abdominal tergite 7 1.5 times its median length (0.6/0.4). Abdominal sternite 7 comparatively short, about 1.5 times as long as tergite 6 (0.3/0.2), somewhat flattened medially, without a carina. Genital segments prominent (fig. 7), fusiform, tergite 8 slightly longer than tergite 7 (0.45/0.40). Sternite 8 laterally compressed at base, resulting in a low blunt carina. Median length of pygophore distinctly longer than median length of sternite 8 (0.4/0.3). Parameres as in fig. 8.

Female. Posterior femur about five times as long as wide (1.4/0.23). Posterior femur and tibia without teeth or spines. Connexiva vertical, sinuate, slightly curved inward on segments 4-5 and curved outward on segments 6-7, in some specimens nearly straight (fig. 11). In lateral view connexiva slightly convex dorsally on segments 4-6, caudal apex truncate with a tuft of pilosity at the tip (fig. 10). Basal width of tergite 7 slightly larger than its median length (0.55/0.50). Tergite 8 nearly horizontal, with caudolateral tufts of bristles. Sternite 7 large, about one third as long as the remaining abdominal sternites together (0.6/1.8). Gonocoxa clearly visible, about half the length of sternite 7, ventro-laterally slightly compressed. Proctiger distinctly visible.

Etymology. – *Chrysomallos*, greek adjective meaning 'with a golden fleece', refers to the golden pubescence on dorsum of this species.

Comparative notes. – The size combined with striking golden pubescence dorsally set this species apart from its Sulawesi congeners.

Rhagovelia daktylophora sp. n.
(figs. 12-16, 79, 81)

Type material. – Holotype ♂: Sulawesi Tengah, SW Luwuk, Toptop Camp along Batui River, 1°09'S, 122°31'30"E, 120 m, lowland rainforest, 19-21 Oct 1989, leg. J. P. Duffels, sample Sul. 18 (ZMA). – Paratypes (including allotype ♀) same data as holotype 14♂ 7♀ (ZMA, 2♂ 2♀ NC, 1♂ 1♀ MBBJ); Batui River at Singsing Camp, SW of Luwuk, c. 1°09'S 122°31'E, 90m, middle sized stream in lowland rainforest, 14-17 Oct 1989, sample Sul.14, J. P.Duffels, 3♂ (1♂ RMNH, 2♂ ZMA); NE Luwuk, Sungai Bantayan, near road Kayutanyo to Siuna, 0°47'S 123°00'E, 50-100 m, medium sized river in slightly disturbed lowland rainforest, 7.x.1989, leg. J. P. Duffels, sample Sul. 2, 10♂ 30♀ (ZMA, 3♂ 7♀ NC, 1♀ PCHC, 1♀ JTPC, 1♀ ZMC); Luwuk area, Sg. Batui and tributaries at Singsing Camp, 17.x.1989, J. van Tol 23♂ 11♀ (4♂ 2♀ macr., RMNH, 1♂ apt., 2♂ 1♀ macr. NC, 2♂ 2♀ apt. JTPC, 1♂ 1♀ apt. SNOW); Luwuk area, Sg. Biak, 21.x.1989, leg. J. van Tol, 8♂ 9♀ (1♀ macr.). Apterous unless otherwise indicated (fig. 81).

Description. – Apterous form. Dimensions. Length ♂ 3.04-3.25, ♀ 3.05-3.28; width ♂ 1.2-1.3, ♀ 1.3-1.4; width of head ♂ 0.80-0.84, ♀ 0.80-0.83; width of pronotum ♂ 1.02-1.13, ♀ 1.10-1.20.

Colour, black, pronotum with anterior transverse orange band usually slightly narrower than interocular space. Basal third of first antennal segment, acetabula, fore and hind coxae and trochanters and basal part of anterior femur ventrally pale yellowish. In some specimens middle coxa medium to light brown, but in most blackish. Venter largely pruinose ash grey.

Venter with minute black denticles, which are difficult to see due to pruinose dark grey background, extending onto episterna. Dorsum with a few short golden-yellow setae, longer and denser on genital segments of male. Vertex sides of thorax antennae and legs with the usual pubescence and setae.

Length of antennal segments I-IV ♂ 0.80 : 0.40 : 0.44 : 0.43, ♀ 0.80 : 0.39 : 0.43 : 0.42. Pronotum long, covering mesonotum, usually laterocaudal angles of mesonotum narrowly visible. Disk of pronotum with comparatively fine punctures, about 30/0.25mm^2. Length: width of pronotum 0.85 : 1.10. Length of metanotum on midline, 0.15. Abdominal tergites 1-5 subequal in length (0.12 in male, 0.15 in female), tergite 6 slightly longer (0.20 in male, 0.30 in female), tergite 7 distinctly longer (0.40).

Male. Posterior trochanter length: width 0.32:

0.18, pilose but without teeth or warts. Posterior femur slender, nearly five times as long as wide (1.4/0.3), on ventroposterior margin about halfway with a large black spine its length two thirds the width of femur, with a row of 6 black spines of decreasing length distally and three very small spines proximally of large spine (fig. 14). Posterior tibia straight, armed beneath with a row of about 16 small teeth, proximally three or four extra teeth forming pairs. Connexiva more or less horizontal gradually converging posteriad, no caudal points. Basal width of abdominal tergite 7 equal to its median length. Abdominal venter with long, quite dense, golden yellow setae on sternites 3-6 and the base of sternite 7. Sternite 7 in lateral view distinctly compressed dorsoventrally in posterior three fourths. Apical part of sternite 7 without pubescence, shining black, with a pair of sublateral impressions, separated by a low, narrow median carina (fig. 12). Segment 8 prominent, elongate, in dorsal view, length 0.55, basal width 0.37, sternite 8 shining black. Parameres relatively large, as in fig. 13.

Female. Generally with a more compact build as compared to male, due to compressed genital segments. Posterior femur nearly five times as long as wide (1.18/0.27). Spines on posterior femur and tibia essentially as in male. Connexiva vertical, strongly curved inward on segment 5-6; ending in narrow caudal points with a tuft of pilosity at the tip (fig. 16). Another tuft of bristles just ventral of apices of connexiva and a smaller group of somewhat more scattered bristles on dorsal margin of connexiva at segment 6, best visible in lateral view (Fig. 15). Tergite 7 with a well developed mediocaudal projection on hind margin, with a short tuft of setae apically. Tergite 8 nearly vertical, genital segments retracted into segment 7. Sternite 7 large, shining black under quite dense ash white pubescence, slightly over half as long as the remaining abdominal sternites together (0.67/1.2), sides of segment 7 pruinose grey.

Macropterous form. – Mostly as apterous except for development of pronotum and hemielytra. Length ♂ 3.5-3.7, ♀ 3.7-3.8; humeral width of pronotum of both sexes 1.37-1.45. Submedial carinae at base of abdomen just not reaching the hind margin of first abdominal tergite. Female without the finger-like projection on caudal margin of tergite 7 and the constriction of connexiva on segments 5-6 less pronounced.

Etymology. – *Daktylophora*, Greek adjective meaning 'bearing a finger' refers to the finger-like projection on tergite 7 in apterous female.

Comparative notes. – Very similar to *R. celebensis* and *R. pseudocelebensis*, but the connexiva of apterous females curved inward on segments 5-6 in combination with a well developed finger-like projection on the caudal margin of abdominal tergite 7 (figs. 15-16, 39-40) and the parameres of males, with the broad apical part longer (figs. 13, 36, 41-44), are distinctive.

***Rhagovelia horaia* sp. n.**
(figs. 17-20, 84)

Type material. – Holotype ♂: Sulawesi Tenggara, Centipede Camp, 3.xi.1989, J. van Tol (RMNH). – Paratypes 2♂ 6♀ (including allotype), same data as holotype (RMNH, 1♂ 2♀ NC, 1♀ MBBJ); S. Mokowu, 5.xi.1989, J. van Tol, 1♀, all apterous (fig. 84).

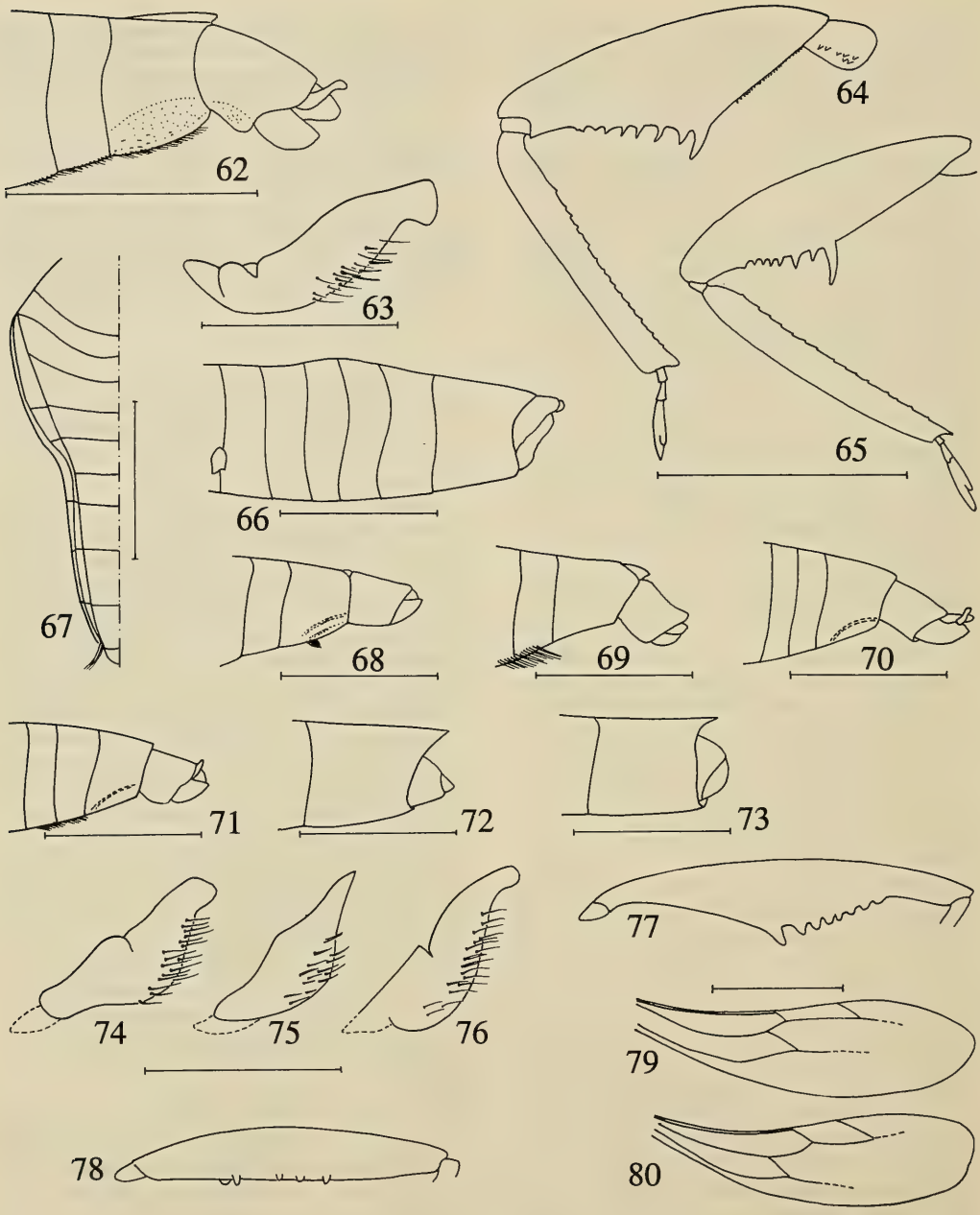
Description. – Apterous form. Dimensions. Length ♂ 3.4-3.7, ♀ 3.5-3.8, width of head ♂ 0.78-0.81, ♀ 0.78-0.83; width of pronotum ♂ 1.07-1.12, ♀ 1.08-1.12; thoracic width ♂ 1.12-1.23, ♀ 1.20-1.23.

Colour, reddish brown, eyes dark castaneous to blackish, anterior quarter of pronotum and entire propleura pale yellow. Basal two thirds of first antennal segment, basal two thirds of fore femur, coxae and trochanters, basal half of hind femur especially in female, distal margin of connexiva more distinctly dorsally than ventrally, pale.

Venter with minute black denticles extending onto thoracic pleura, distinctly on propleura only a few on meso- and metapleura. Dorsum with normal pubescence and bristles, rather dense yellowish setae on genital segments of male. Vertex, head, sides of thorax and apex of abdomen, antennae and legs with the usual pubescence and setae.

Length of antennal segments I-IV ♂ 0.81 : 0.40 : 0.49 : 0.46, ♀ 0.80: 0.40: 0.47: 0.43. Pronotum long, covering mesonotum, length: width of pronotum 0.85 : 1.1, length of metanotum on midline ♂ ♀ 0.12. Posterior three quarters of disk with coarse punctures, about 50/0.25 mm^2. Abdominal tergites 1-6 in male and 1-5 in female, subequal in length (0.20-0.22), tergite 7 in male longer (0.42), tergite 6 in female slightly longer (0.30), tergite 7 distinctly so (0.55).

Male. Posterior trochanter length : width 0.40 : 0.25, with 7-8 well developed teeth. Posterior femur strongly inflated, about two and a half times as long as wide (1.73/0.78 to 1.57/0.60), on posteroventral margin proximally a row of about 15 minute teeth, about halfway a large spine about a quarter as long as the width of femur, with a row of 7 spines of decreasing length distally. Anterior to the distal row a row of 4-5 smaller teeth. Posterior tibia curved (fig. 19), armed on inner side with a proximal row of about 13 teeth, then a larger tooth, followed by four distal teeth. In addition a more posterior row of about 12 smaller teeth. Connexiva horizontal slightly convex



Figs. 62-80. – 62-67, *R. tropidata* paratypes; 62-64 male, 62 apex of abdomen, lateral view, 63 paramere, 64 hind leg; 65-67 female, 65 hind leg; 66 abdomen in lateral view, 67 left half of thorax and abdomen dorsal view. Scales 62, 64-67 1 mm, 63 0.25 mm. – 68-73, Apex of abdomen, lateral view. 68, *R. pruinosa* male, 69 *R. sulawesiana* male, 70 *R. minahasa* male, 71 *R. wallacei* male, 72 *R. grayi* female, 73 *R. minahasa* female. Scale 1 mm. – 74-76. Paramere (75-76 redrawn after Polhemus & Polhemus 1988); 74 *R. minahasa*, 75 *R. hamjadi*, 76 *R. wallacei*. Scale 0.25 mm. – 77-78, hind femur of female;77 *R. pruinosa*, 78 *R. hamjadi* (redrawn after Polhemus & Polhemus 1988); 79-80. Right hemielytron; 79 *R. daktylophora*, 80 *R. pseudocelebensis*. Scale 1 mm.

on segment 4-6, otherwise gradually converging toward tergite 7, without apical points. Basal width of abdominal tergite 7 subequal to its median length (0.4), centrally more or less bare and somewhat shining. Abdominal sternite 2 with a well defined median keel, sternite 7 flattened medially, nearly bare, shining, without median keel, its median length one third of median length of remaining sternites together (fig. 17). Sternites 8 and 9 of subequal length, somewhat shorter (0.25/0.35) than sternite 7. Paramere as in fig. 18.

Female. Posterior trochanter with three or four small teeth. Posterior femur four and a half times as long as wide (1.35/0.31). Posterior femur on ventral margin proximally with 0-3 small minute teeth, large spine halfway three fifth the width of femur, followed by 4-6 smaller spines, hind tibia straight, with a, distally double, row of about 18 teeth on inner surface. Connexiva slanting 45° upwards, slightly convex on segments 3-5, converging caudally with short, narrowly triangular, caudal points. Abdominal tergite 7 distinctly longer than its basal width (0.55/0.30). Tergite 8 slanting 45° downward, proctiger visible in dorsal view. Abdominal sternite 7 half as long as preceding ones together, bare, shining, no minute black denticles, gonocoxa short but well visible (fig. 20). Macropterous form, unknown.

Etymology. – *Horaios*, a greek adverb meaning e. g. youthfully beautiful.

Comparative notes. – The male is nearly identical to *R. grayi* Polhemus & Polhemus, except for the proctiger which lacks a pair of proximal tubercles (figs. 21, 22). Females of *R. grayi* have connexiva upturned, expanded and incurvate along tergites 4 and 5 and apically folded over abdomen, whereas in *R. horaia* the connexiva of female are simple. Another similar species is *R. lorelinduana* which has in male a quite different proctiger (figs. 21, 23) and in female curved and folded connexiva much as in *R. grayi*.

Rhagovelia kalami sp. n.
(figs. 24-29, 82)

Type material. - Holotype ♂: Pulau Buton, first stream along road from Baubau to the North, 8 Mar. 1989, N8935, leg. N. Nieser (RMNH). – Paratypes, same data as holotype, 6♂ 17♀ (2♀ including allotype RMNH, ZMA 1♂ 2♀, ZMC 1♂ 2♀, rest NC); Buton, small stream near sea, 9.iii.1989, N8941, 14♂ 18♀ (4♂ 4♀ PCHC, 1♂ 1♀ BPUH, 1♂ 1♀ MBBJ, 2♂ 3♀ JTPC, 1♂ 1♀ ZC); Buton, small stream 16 km E Baubau, 10.iii.1989, N8944, 6♂ 9♀. All apterous (fig. 82).

Description. – Apterous form. Dimensions. Length ♂ 3.08-3.28, ♀ 3.20-3.50; width ♂ 1.15-1.19, ♀ 1.30-1.42; width of head ♂ 0.72-0.80, ♀ 0.78-0.80; width of pronotum ♂ 0.98-1.08, ♀ 1.10-1.18.

Colour, dark greyish. Eyes dark castaneous to black, interoculus black, pronotum and dorsum of abdomen largely black with a greyish pruinose bloom. Anterior quarter of pronotum, propleura and prosternum yellowish orange. Connexiva light orange brown, proximally blackish. First antennal segment, acetabula, coxae trochanters, anterior femur except for distal apex, base of posterior surface and most of anterior surface of hind femur, variable part of anterior surface of middle femur, mesosternum and mediocaudal part of abdominal venter including genital segments pale yellow orange. Venter with minute black denticles which extend onto jugum, proepisternum and dorsal sides of acetabula. Dorsum of abdomen of male with golden-yellow setae. Vertex sides of thorax antennae and legs with the usual pubescence and setae, except for hind tibia of male which is more hairy than in most other species.

Length of antennal segments I-IV ♂ 0.78 : 0.39 : 0.47 : 0.44, ♀ 0.77 : 0.38 : 0.47 : 0.42. Pronotum long, covering mesonotum, in some specimens laterocaudal angles of mesonotum narrowly visible. Disk of pronotum with coarse punctures, about 40/0.25mm^2. Length : width of pronotum 0.80 : 1.05. Length of metanotum on midline, 0.12. Abdominal tergites 1-6 in male and 1-5 in female subequal in length (0.2)

Male. Posterior trochanter length: width 0.3: 0.2, with 5-6 small teeth of which 2 twice as large as the others. Posterior femur strongly inflated, less than three times as long as wide (1.4/0.5), on ventral margin distally with about 20 minute teeth, about halfway a large spine its length about one fourth the width of femur, with a double row of 6-7 spines of decreasing length distally, the larger spines pale, with blackish tip. Posterior tibia slightly curved armed beneath with a row of about 17 short blunt teeth of which the apical one and the fourth or fifth from apex are larger (fig. 26), anterior to row a few extra teeth. Connexiva more or less horizontal, distal margin straight to slightly convex on segments 4-6, converging posteriad, no caudal points. Basal width of abdominal tergite 7 three quarters its median length (0.32/0.40). Sternite 7 in lateral view laterally compressed in posterior three fourths, with a low median carina marked at its base by a small but dense tuft of setae resembling a spine (fig. 24). Genital segments hirsute, tergite 8 as long as wide (0.32/0.33). Parameres as in fig. 25.

Female. Posterior femur four times as long as wide (1.3/0.32). Spines on posterior femur essentially as in male. Posterior tibia straight, armed beneath with a row of about 17 short blunt teeth all of subequal size. Connexiva slanting about 45° upwards, distal margin slightly sinuate, thickened on segment 4, where there

is a patch of short dense pubescence. Apex of connexiva triangularly produced caudally, accentuated by a tuft of bristles (fig. 29). Tergite 7 slightly longer than its basal width (0.40/0.35). Tergite 8 nearly horizontal, with laterocaudal tufts of pilosity, basal width equal to its median length (0.32), apical margin truncate. Sternite 7 large, shining, half as long as the remaining abdominal sternites together (0.6/1.2). Gonocoxa not distinctly visible.

Macropterous form, unknown.

Etymology. – *Kalami*, greek noun, meaning shin, referring to the modified tibia of male.

Comparative notes. – *R. kalami* is not very similar to other species in the region, those with a similar male tibia (*R. grayi, R. horaia*) are more slender and longer. *R. tropidata* and *R. wallacei* are of similar shape, but have the male hind leg less modified. See also key to species.

***Rhagovelia kastanoparuphe* sp. n.**
(figs. 30-34, 84)

Type material. – Holotype ♂ (ZMA): Sulawesi Tenggara, NE Kolaka, Mokowu Camp, along Mokowu River, nr. Gng. Watuwila, c. 3°49'S 121°40'E, 200m, 29-31 Oct. 1989, disturbed lowland rainforest, J. P. Duffels, sample Sulawesi 24 (ZMA). – Paratypes: same data as holotype, 14♂ 26♀ (7♂ 18♀ including allotype ♀ ZMA, 1♂ 1♀ BPUH, 1♀ JTPC, 1♂ 1♀ MBBJ, 3♂ 3♀ NC, 1♂ 1♀ PCHC, 1♂ 1♀ RMNH); Sungai Mokowu, 30.x.1989, J. van Tol, 2♀; Rd. Kendari-Lalimboe, 21.ii.1989, N8903, 2♀; tributary Sg. Mowewe, 28.ii.1989, N8923, 1♂ 4♀. – P. Buton, stream N of Baubau, 8.iii.1989, N8935, 10♂ 19♀ (6♂ 10♀ NC, 1♂ 1♀ BPUH, 1♂ 3♀ JTPC, 1♂ 2♀ PCHC, 2♀ RMNH, 2♀ ZMA, 1♂ 1♀ ZMC); P. Buton, Sg. Labuhan Tobelo at Jismil camp, 18.xi.1989, leg. J. van Tol 9♂ 32♀ (1♀ macr., 5♂ 24♀, incl. 1 macr., RMNH, 4♂ 8♀ NC). Apterous, unless otherwise indicated (fig. 84).

Description. – Apterous form. Dimensions. Length ♂ 3.0-3.3, ♀ 3.0-3.2; width ♂ 1.0-1.1, ♀ 1.1-1.2; width of head ♂ 0.79-0.82, ♀ 0.82-0.83; width of pronotum ♂ 0.92-1.01, ♀ 1.0-1.08.

Colour, black with a greyish tinge. Orange transverse band anteriorly on pronotum only slightly wider than interoculus. Propleurae orange, separated from pronotal transverse band by a narrow black mark behind eyes. Distal margin of connexiva orange brown, more distinctly so in females than in males, without obvious pilosity. Basal half of first antennal segment, acetabula, coxae, trochanters, basal half of fore femur, basal quarter of hind femur pale yellow. Rostrum castaneous except for darker apex. Abdominal sternites 7 and 8 in male and sternite 7 in female, castaneous.

Venter with minute black denticles, which do not extend onto pleura except for a few on metapleuron. Dorsum mostly with a greyish pruinose cover, sparse pilosity except for some shiny yellowish setae on genital segments of male and a tuft of long dark setae at caudal apex of connexiva. Vertex anteriorly with short dark setae, sparse long dark setae on head, sides of thorax and apex of abdomen. Antennae and legs with the usual pubescence and setae.

Length of antennal segments I-IV ♂ 0.81 : 0.40 : 0.49 : 0.46, ♀ 0.80 : 0.40 : 0.47 : 0.43. Pronotum long, covering mesonotum. Length: width of pronotum 0.85: 1.4. Disk of pronotum with about 60 punctures/mm^2. Length of metanotum on midline, 0.12. Abdominal tergites 1-5 subequal in length (0.14), tergite 6 slightly longer (0.25), tergite 7 distinctly longer (0.45).

Male. Posterior trochanter length: width 0.30: 0.18, without teeth or warts. Posterior femur rather slender, four and a half times as long as wide (1.3/0.28), on ventral margin about halfway with a large spine about 0.6 as long as the width of femur, with a row of 5-7 spines of decreasing length distally (fig. 32). Posterior tibia straight, armed beneath with small blunt teeth proximally shorter and more densely placed. Connexiva slanting up- and outward, about 45°, gradually tapering downward on tergite 7, without apical points. Basal width of abdominal tergite 7 0.30, its median length 0.45; sternites 6-8 with a well defined median keel. Segment 8 prominent (fig. 30), elongate, in dorsal view, length 0.4 width 0.30. Parameres as in fig. 31.

Female. Generally with a more compact build as compared to male, due to compressed genital segments. Posterior femur five times as long as wide (1.3/0.27). Length of large spine on posterior femur three quarters the width of femur, followed by 3-5 smaller spines, hind tibia essentially as in male. Connexiva variable more or less horizontal to vertical, dorsal margin straight to very slightly convex, apex of connexiva narrowly triangularly produced dorsocaudally, accentuated by a tuft of setae (fig. 34). Posterior margin of tergite 7 bluntly triangular with a short mediocaudal tuft of setae, often suggesting a spine (fig. 33). Tergite 8 nearly vertical, gonocoxa mostly hidden within segment 7. Sternite 7 large, shining, half as long as the remaining abdominal sternites together.

Macropterous form. The single macropterous female, which has its wings torn off, is identical to the apterous form except for stronger development of pronotum, humeral width 1.40, and for stronger development of pronotum, humeral width 1.40, and absence of the mediocaudal tuft of setae on abdominal tergite 7.

Etymology. – *Kastanoparuphe*, greek noun meaning brown band or brown rim, referring to the upper margin of connexiva.

Comparative notes. – At first sight similar to *R. celebensis* and related forms, the lack of long pilosity on abdominal venter in male and the brownish upper rim of connexiva in female separate this species easily. The paramere (fig. 31) and the apex of abdomen of female (fig. 33, 34) are also characteristic.

***Rhagovelia pseudocelebensis* sp. n.**
(figs. 35-40, 80-81)

Type material. - Holotype ♂, SULAWESI TENGGARA: Tamborasi-Wolo, mountain stream, 1 Mar. 1989, N8926, leg. N. Nieser (RMNH). Paratypes: same data as holotype, 13♂ 4♀ (incl. allotype) (1♀ macropterous) (allotype RMNH); Sungai Kolaka, upstream of Kolaka, 27 Feb. 1989, N8921A, 16♂ 18♀ apt., 16♂ 20♀ macr.(3♀ apt. PCHC); same, N8921B, 2♂ (macr.) 3♀ (2♀ apt., 1♀ macr. JTPC); Tamborasi, mouth of subterranean stream, 1.iii.1989, N8925 81♂ 21♀ (4♂ PCHC, 4♂ JTPC); 20 km E of Kolaka, mountain stream, 3 Mar. 1989, N8934 2♀ (all leg. N. Nieser). – PULAU BUTON, 1st stream road N of Bau-Bau, 8.iii.1989, N8935 4♂ 4♀, leg. N. Nieser. All apterous unless otherwise indicated (fig. 81). The following museums received 1♂ 1♀ paratypes each: BPUH, CHC, JTPC, MBBJ, ZMA; ZMC received a single ♀, remaining paratypes in NC.

Description. – Apterous form. Dimensions. Length ♂ 2.98-3.80, ♀ 2.78-3.10; width ♂ 1.1-1.2, ♀ 1.3-1.4; width of head ♂ 0.76-0.82, ♀ 0.80-0.83; width of pronotum ♂ 1.00-1.03, ♀ 1.02-1.13.

Colour, black, pronotum with anterior transverse orange band only slightly broader than interocular space, laterally obscured by pale grey pruinose pilosity. Basal third of first antennal segment, acetabula, fore and hind coxae and trochanters and basal third of anterior femur pale yellowish. Ventral pilosity of abdomen in male yellowish.

Venter with minute black denticles, which are difficult to see due to pruinose dark grey background, extending onto episterna and head. Dorsum with a few short golden-yellow setae, longer and denser on genital segments of male. Vertex anteriorly with short dark setae, sparse long dark setae on head, sides of thorax and apex of abdomen. Antennae and legs with the usual pubescence and setae.

Length of antennal segments I-IV ♂ 0.83 : 0.42 : 0.46 : 0.48, ♀ 0.81 : 0.38 : 0.42 : 0.45. Pronotum long, covering mesonotum, in some specimens is the posterior margin of mesonotum narrowly visible. Length: width of pronotum 0.75 : 1.0. Length of metanotum on midline, 0.12. Abdominal tergites 1-5 subequal in length (0.12), tergite 6 slightly longer (0.17), tergite 7 distinctly longer (0.55).

Male. Posterior trochanter length: width 0.30 : 0.17, without teeth or warts. Posterior femur rather slender, four times as long as wide (1.2/0.3), on ventroposterior margin about halfway with a large spine about 0.6 as long as the width of femur, with a row of 5-6 spines of decreasing length distally (fig. 37). Posterior tibia straight, armed beneath with five small blunt teeth proximally and three slightly larger sharper teeth apically. Connexiva more or less horizontal or slightly slanting upward, gradually converging posteriad. Basal width of abdominal tergite 7 0.38, its median length 0.40. Abdominal venter with long, quite dense, golden yellow pilosity. Sternite 7 in lateral view distinctly compressed dorsoventrally in posterior three fourths (fig. 35). Apical part of sternite 7 without pubescence, shining black, flattened with a low, narrow median carina. Segment 8 prominent (fig. 35), elongate, in dorsal view, length 0.50 width 0.30. Parameres as in fig. 36.

Female. Generally with a more compact build as compared to male, due to compressed genital segments. Posterior femur five times as long as wide (1.3/0.25). Spines on posterior femur and tibia essentially as in male. Connexiva more or less vertical, apex of connexiva triangularly produced caudally, with a long tuft of medially curved pilosity (figs. 39, 40). Tergite 7 with a short mediocaudal projection on hind margin, with a short tuft of setae apically, this character is, however, quite variable. Especially in some females from N8921A the projection is hardly recognizable. Tergite 8 distinctly (about 60°) slanting ventrad, proctiger pointing ventrad and somewhat retracted into segment 7 in most specimens. Sternite 7 large, shining, half as long as the remaining abdominal sternites together (1.0/1.8). Gonocoxa not distinctly visible.

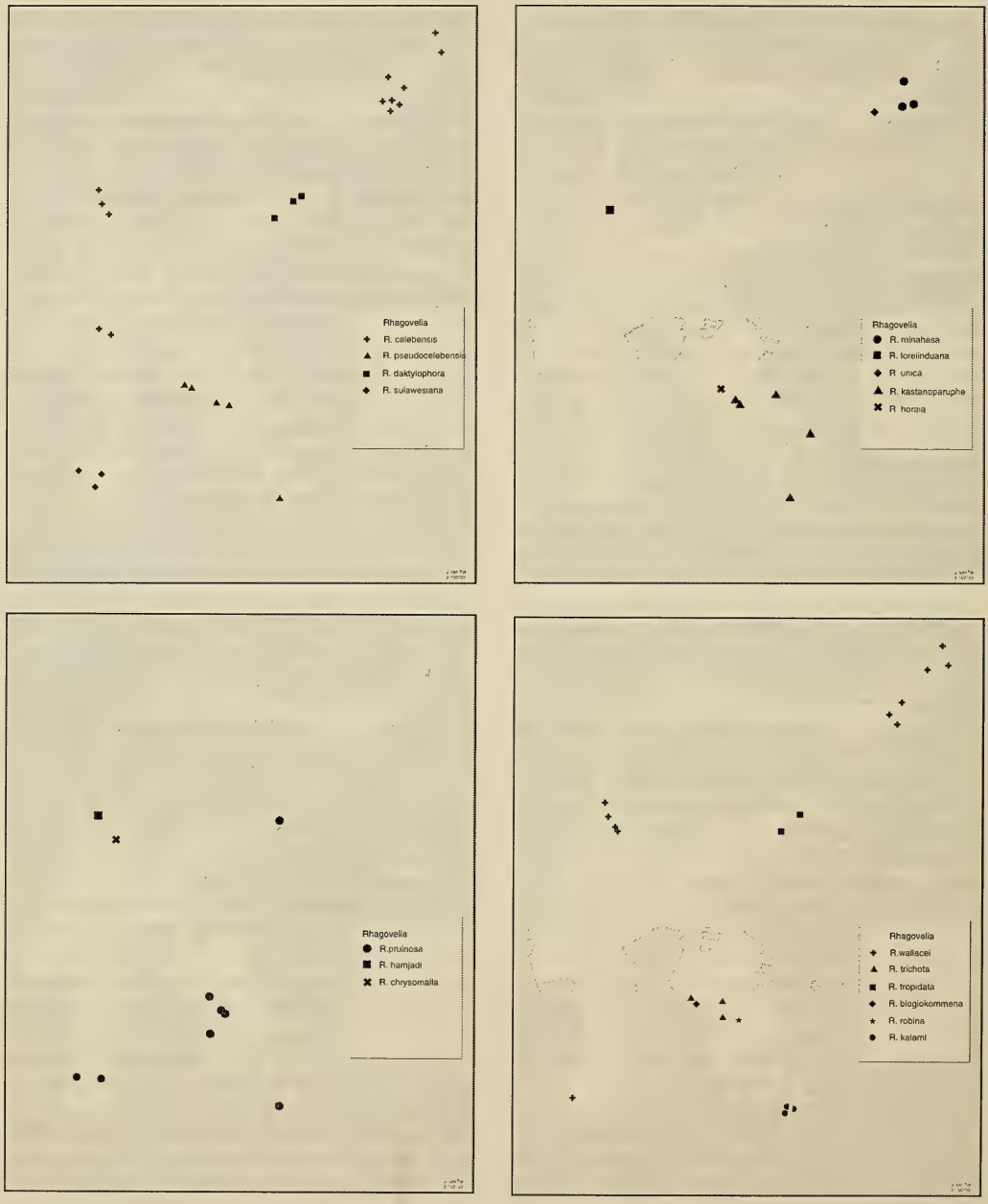
Macropterous form, as apterous except for full development of pronotum and wings. Dimensions, length ♂ 3.5-3.8, ♀ 3.5-3.7, width of head 0.80-0.82, humeral width of pronotum ♂ 1.40-1.43, ♀ 1.37-1.42. Pronotum broadly rounded posteriorly. Hemielytra dark brown with darker veins, three closed cells, two basal, reaching about one third the length of hemielytron, the distal costal cell reaching well into distal half (fig. 80). Submedial carinae on base of abdomen reaching to hind margin of tergite 2.

Etymology. – *Pseudocelebensis*, greek adjective meaning looking like *celebensis*, refers to the similarity between *R. celebensis* and *R. pseudocelebensis*.

Comparative notes. – Very similar to *R. celebensis* but the female has a small caudal projection on tergite 7, the male paramere is different (figs. 36, 41-44). In *R. sulawesiana* which is also very similar, the female has the connexiva folded over the tergites apically, the paramere of male is different (fig. 45-46). See also comparative notes under *R. daktylophora*.

***Rhagovelia robina* sp. n.**
(figs. 47-55, 82)

Type material. – Holotype ♂: Sulawesi Tenggara: Road



Figs. 81-84. Distribution of *Rhagovelia* species in Sulawesi. – 81, *R. celebensis*, *R. daktylophora*, *R. pseudocelebensis*, *R. sulawesiana*; 82, *R. wallacei*, *R. tropidata*, *R. blogiokommena*, *R. trichota*, *R. robina*, *R. kalami*; 83, *R. pruinosa*, *R. hamjadi*, *R. chrysomalla*; 84 *R. minahasa*, *R. unica*, *R. kastanoparuphe*, *R. lorelinduana*, *R. horaia*.

Kolaka Kendari, 20 km E Kolaka, stream in hilly forest, 3 mar. 1989, N8934, leg. N. Nieser (RMNH). – Paratypes 6♂ 4♀ apterous, 2♂ macropterous, same data as holotype (1♀ allotype RMNH, 5♂ 2♀ NC, 1♂ 1♀ MBBJ, 1♂ PCHC, 1♂ JTPC, 1♂ 1♀ ZMA) (fig. 82).

Dimensions. Length ♂ 3.38-3.50, ♀ 3.58-3.67; width of head ♂ 0.80-0.81, ♀ 0.82-0.87; width ♂ 1.18-1.20, ♀ 1.27-1.32, width of pronotum ♂ 1.07-1.10, ♀ 1.10-1.12.

Colour, yellow to orange reddish. Eyes dark castaneous. Interoculus, posterior three quarters of pronotum, abdominal tergites 2-6, proximal and lateral margins of tergite 7 in male, mesonotum and abdominal tergites except for central spot on tergite 6 in female, distal half of antennal segment 1 and remaining antennal segments, apical segment of rostrum, apex of fore femur, most of fore tibia and tarsus, middle leg except for coxa and trochanter, dorsoapical streak on hind femur, hind tibia and tarsus dark brown to blackish.

Body ventrally and dorsally densely covered with small black denticles. Dorsum without longer pilosity except on genital segments of male and posterior margin of abdominal tergite 8 and connexiva in female. Head, sides of thorax, antennae and legs with the usual setae. Disk of pronotum without coarse punctures. Length of antennal segments I-IV ♂ 0.70 : 0.40 : 0.49 : 0.41, ♀ 0.72 : 0.39 : 0.50 : 0.42. Pronotum long, covering mesonotum, length: width 1.1 : 0.85. Length of metanotum on midline, 0.12. Abdominal tergites 1-5 subequal in length (0.15-0.20), tergite 6 slightly (0.22) longer in male more distinctly so(0.30) in female, tergite 7 longer (0.40-0.45).

Male. Posterior trochanter one and a half times as long as wide, with one small teeth and a about four minute teeth or warts. Posterior femur three and a half times as long as wide (1.37/0.40), on ventral margin about halfway a large spine with a length just over half the width of femur, with a row of 8-10 spines of rapidly decreasing length distally and a row of 16 very small warts proximally (fig. 49). Anteriorly in distal half a row of 4-8 small warts. Larger spines black tipped, smaller spines and teeth entirely black or nearly so. Posterior tibia straight, armed beneath with a double row of about 20 pairs of warts of which the posterior ones are largest. Connexiva more or less horizontal, gradually converging to caudal margin of tergite 7, connexival points absent. Basal width of tergite 7 0.5, diverging caudally, caudal width 0.6. Segment 8 prominent in dorsal view, length and width about 0.6, sides slightly convex. Abdominal sternite 2 bluntly keeled in midline, length of sternites 2-5 subequal (about 0.20), length of sternite 6 0.28, and of sternite 7 0.45. Abdominal sternite 7 laterally compressed resulting in a broad median keel (fig. 47). This keel accentuated by a fringe of long pilosity which runs over the midline of all abdominal sternites. Sternite 8 lateroproximally compressed. Parameres fig. 48.

Female. Posterior trochanter without small teeth. Posterior femur four and a half times as long as wide (1.28/0.28), proximal row of 0-2 minute teeth, row of larger spines essentially as in male, posteroventral row of 0-2 smaller spines. Posterior tibia as in male. Metanotum with a pair of caudolateral broad blunt tooth-like swellings. Abdominal tergites 1 and 2 swollen, in lateral view distinctly rising above the dorsal margin of connexiva. Tergites 4 and 5 with a broad blunt median keel. Connexiva (fig. 52) constricted on segments 4 and 5, caudally ending in blunt triangular apices fringed with black setae. Tergite 8 only horizontal in basal part, slightly curved ventrad apically, proctiger well visible. Gonocoxa 1 well visible (fig. 51).

Macropterous form as apterous except for development of pronotum, hemielytra and dorsal abdominal carinae. Pronotum with coarse ill defined pits in posterior part, about 20/0.25 mm^2. Humeral width of pronotum 1.35, median length 1.40. Hemielytra with 4 cells and one or two variable adventitious cells (figs. 53-55). Dorsal abdominal carinae long, reaching to caudal margin of tergite 4.

Etymology. – *Robinos*, a greek adjective meaning rose-coloured, refers to the reddish colour of the species.

Comparative notes. – Similar to *R. tropidata* and *R. wallacei* but differing by the orange-like to pale reddish metanotum and first abdominal tergite in *R. robina*, which are dark in the other species.

Rhagovelia trichota sp. n.
(figs. 56-60, 82)

Type material. – Holotype ♂, Sulawesi Tenggara, Tamborasi, creek of subterraneous stream, 1 Mar. 1989, N8925 (ZMA). – Paratypes: same data as holotype, 50♂ 32♀ (1♂ 2♀ incl. allotype ZMA; 1♂ 1♀ PCHC, 1♂ 1♀ BPUH; 1♂ 1♀ MBBJ, 1♂ 1♀ JTPC; 2♂ 2♀ RMNH, remaining specimens NC); Sg. Kolaka, 27.ii.1989, 2♂; Sg. Konaweha at Sanggona, 7.xi.1989, J. van Tol, 3♂ 3♀ (RMNH, 1♂ 1♀ NC). All apterous (fig. 82).

Description. – Apterous form. Dimensions. Length ♂ 3.10-3.17, ♀ 3.30-3.40; width ♂ 1.07-1.14, ♀ 1.18-1.36; width of head ♂ 0.78-0.80, ♀ 0.80-0.83; width of pronotum ♂ 0.99-1.02, ♀ 1.10-1.18.

Colour, dull black, orange yellow transverse band on anterior margin of pronotum laterally reaching halfway the eyes. Basal half of first antennal segment, coxae, trochanters and basal half of anterior femur yellowish. Distal margin of connexiva, brownish

orange distinct in female, often indistinct in males. Abdominal venter with variable area along median line and on posterior sternites medium brown.

Minute black denticles difficult to distinguish, on the propleura they are, however, usually quite distinct. Dorsal side of male, except on head, with loosely set long erect setae. Dorsal side of female bare except on connexiva, abdominal dorsum especially on tergites 1-4 with a grey pruinose bloom. Thoracic pleura with grey pruinose bloom best developed in females. Vertex, sides of thorax, antennae and legs with the usual pubescence and setae.

Length of antennal segments I-IV ♂ 0.80 : 0.41 : 0.48 : 0.49, ♀ 0.80 : 0.43 : 0.49 : 0.49. Pronotum long, covering mesonotum. Central part of pronotum smooth, lateral and hind margins with comparatively fine punctures, along hind margin of orange yellow transverse band a row of coarser punctures. Length: width of pronotum 0.8 : 1.0. Length of metanotum on midline, 0.12. Abdominal tergites 1-5 subequal in length (0.20-0.22), tergite 6 subequal (0.22) in male, slightly longer (0.30) in female, tergite 7 distinctly longer (0.40 in male, 0.50 in female).

Male. Posterior trochanter length : width 0.30 : 0.15, with about 5 small teeth. Posterior femur rather slender, slightly less than four times as long as wide (1.20/0.33), on ventroposterior margin about halfway with a large, yellowish to blackish, usually medium brown, spine, its length (0.17) half the width of femur, with a row of 12-13 very small black teeth proximally and a row of 5-7 black spines of decreasing length distally (fig. 58). Posterior tibia straight, armed beneath with an irregular row of about 20 small teeth. Connexiva more or less horizontal gradually converging posteriad, no caudal points. Basal width of abdominal tergite 7 about three quarters its median length (0.28/0.40). Abdominal sternites 2-5 with a low broad ridge, accentuated by a band of long pilosity (fig. 56). Sternite 7 slightly less than half as long as the remaining ones (0.4/1.0), without median keel. Genital segments relatively small, tergite 8 about three quarters the length of 7 (0.3/0.4). Sternite 8 flattened with a low broad carina. Parameres as in fig. 57.

Female. Posterior femur nearly five times as long as wide (1.20/0.25). One or two small teeth proximally of large spine, which is about half as long as width of femur, on hind femur, distal decreasing row of about six spines. Teeth on posterior tibia essentially as in male. Connexiva more or less vertical, distal ('dorsal') rim pubescent except on segments 3 and 4 where it is bare and strongly shiny. Connexiva curved inward on segments 3 and 4, folded and dorsocaudally touching; ending in narrowly triangular points (fig. 60). Tergite 7 mostly hidden from view. Tergite 8 and proctiger nearly vertical, genital segments retracted into segment 7 (fig. 59). Sternite 7 large, shining, half as long as the remaining abdominal sternites together (0.6/1.2).

Macropterous form, unknown.

Etymology. – *Trichotos*, greek adjective meaning hairy, refers to the hairy aspect of dorsal surface of male.

Comparative notes. – The long and relatively dense dorsal pilosity distinguishes males from its Sulawesi congeners. Females are similar to those of *R. sulawesiana* but a caudal finger like process is lacking and the connexiva are different (figs. 60, 61).

Rhagovelia tropidata sp. n.
(figs. 62-67, 82)

Type material. – Holotype ♂: Sulawesi Tengah, between Desa Seseba and Singsing Camp, SW of Luwuk, c. 1°09'S 122°31'E, 80m, narrow stream in lowland rainforest, 14.Oct.1989, sample Sul.12, J. P.Duffels (ZMA). – Paratypes: same data as holotype 7♂ 6♀ (4♂ 4♀, including allotype ♀ ZMA, 2♂ 2♀ NC, 1♂ PCHC); Batui River at Singsing Camp, SW of Luwuk, c. 1°09'S 122°31'E, 90m, middle sized stream in lowland rainforest, 14-17 Oct. 1989, sample Sul. 14, J. P. Duffels, 3♂ 2♀ (ZMA, 1♂ NC); SW Luwuk, Toptop Camp along Batui River, 1°09'S, 122°31'30"E, 120 m, lowland rainforest, 19-21 Oct 1989, leg. J. P. Duffels, sample Sul. 18, 1♂; Luwuk area, S. Biak, 21 Oct. 1989, J. van Tol, 3♂ 2♀ (1♂ 1♀ NC); Batui River at Singsing camp, 15 Oct. 1989, J. van Tol, 1♂ 1♀ (RMNH). All apterous (fig. 82).

Description. – Apterous form. Dimensions. Length ♂ 3.20-3.32, ♀ 3.22-3.35; width ♂ 1.2-1.3, ♀ 1.2-1.3; width of head ♂ 0.76-0.80, ♀ 0.77-0.80; width of pronotum ♂ 1.18-1.30, ♀ 1.26-1.32.

Colour, dorsally dark brown, broad orange yellow band anteriorly on pronotum extending to propleura, covering anterior quarter of pronotum. Dorsal two thirds of connexivum orange yellow, in male caudal half of abdominal tergite 7 and posterior segments orange yellow. Venter brownish, laterally (including acetabula) and caudally orange yellow. First antennal segment pale yellow, other segments brown. Legs basally (up to halfway femur) yellowish, apically castaneous.

Posterior half of jugum of head, anterior half of propleura, thoracic sternum, dorsal margin of acetabula and abdominal sternites 1-6 with small black denticles. On darker parts of venter difficult to see because of lack of contrast. Dorsum rather sparsely clothed with golden pubescence, longer and thicker towards apex of abdomen, especially in male. Vertex anteriorly with short dark setae, sparse long dark setae on head, sides of thorax and apex of abdomen. Disk of pronotum with large impressed pits, about 25/0.25 mm^2. Antennae and legs with the usual pubescence and setae.

Length of antennal segments I-IV ♂ 0.74 : 0.40 : 0.49 : 0.41, ♀ 0.70 : 0.39 : 0.49 : 0.41. Pronotum long, covering mesonotum, length : width 0.8 : 1.1. Length of metanotum on midline, 0.12. Abdominal tergites 1-6 subequal in length (0.15-0.20), tergite 7 longer (0.35-0.40).

Male. Posterior trochanter with one larger, two small teeth and a group of about five small warts. Posterior femur three times as long as wide (1.35/0.45), on ventral margin proximally with about 20 minute and closely set teeth, followed about halfway by a large spine about as long as half the width of femur, with a row of 9-10 spines of decreasing length distally. Anteroventrally a row of 5 smaller spines located in distal part. Larger spines black tipped, smaller spines and teeth entirely black or nearly so (fig. 64). Posterior tibia virtually straight, armed beneath with a double row of about (2x) 15 pegs. Connexiva more or less horizontal, gradually converging posteriad. Abdominal sternite 7 laterally compressed in posterior two thirds, resulting in a broad distinct medioventral keel in posterior part. Keel accentuated by a dense fringe of long pilosity (fig. 62). Genital segments prominent, 1.5 times as long as sternite 7, sternite 8 with an indistinct ventral keel. Parameres long (fig. 63), apically curved mediad.

Female. Posterior trochanter without small teeth. Posterior femur four times as long as wide (1.30/0.30), row of minute teeth absent, row of larger spines essentially as in male, anteroventral row of 2-4 smaller spines located in basal part. Posterior tibia as in male. Connexiva more or less vertical, on tergites 4 and 5 slightly curved inward, thickened and beset with dense pilosity. Apex of connexiva truncate, dorsoapically with a small tuft of pilosity (figs. 66-67). Tergite 8 only slightly slanting ventrad, proctiger pointing ventrad in most specimens. Gonocoxa 1 well visible, laterally somewhat compressed.

Macropterous form, unknown.

Etymology. – Tropidatos, greek adjective meaning 'provided with a keel', referring to the well developed keel on abdominal sternite 7 of male.

Comparative notes. – Similar to *R. wallacei* Polhemus & Polhemus which differs in the male by a less well developed keel on sternite 7 and shorter parameres (fig. 76) and in the female by connexiva not thickened on segments 4 and 5 and apical segments (8 and 9) hardly visible, withdrawn into segment 7. Abdominal segment 8 and the long paramere remind somewhat of *R. meikdelyi* Polhemus & Polhemus from Ambon but in detail there are many differences of which the more strongly inflated posterior femur (only slightly over twice as long as wide in males, three times as long as wide in females) is one of the most distinct. Finally *R. lorelinduana* Polhemus & Polhemus has a strongly developed keel on sternite 7 of male but this species has an aberrant paramere and proctiger (fig. 23) in male and a posteriorly prolonged abdomen with the connexiva bent over its apex in female.

Discussion

Polhemus & Polhemus (1988) distinguished several groups within the genus, of which three occur in Sulawesi. The *sarawakensis*-group, however, has been recorded by a single macropterous specimen of *R. samarinda* only. So we will restrict our discussion to the *orientalis*- and *papuensis*- group.

The *orientalis*-group is a small group of about eight species distributed in the Philippines and Sulawesi. The main synapomorphy for this group is the hemielytral venation, three cells, of which the apical one reaches into the apical quarter of hemielytron (figs. 79-80). This seems a rather fickle character in view of the variability of hemielytral venation in some species and even between hemielytra of a specimen (figs. 53-55). As the general appearance of at least the Sulawesi species of this group is homogeneous and, apart from males of *R. sulawesiana*, distinct from the species of the other group, it seems, nonetheless, justified. In Sulawesi this group is represented by three species: *R. celebensis*, *R. daktylophora* and *R. pseudocelebensis*.

The remaining Sulawesi species belong to the *papuensis*-group, a large group with a wide distribution: India and Sri Lanka through Taiwan, the Philippines, Northern Borneo, Sulawesi and Maluku (the Moluccas) to New Guinea, Solomons and Australia. According to Polhemus & Polhemus (1988) this group is probably polyphyletic. A more restricted *papuensis*-group is characterized by a strongly inflated hind femur, a curved hind tibia with one or more larger subapical teeth and a comparatively long third antennal segment. *R. papuensis* Lundblad (Papua New Guinea), *R. kawakamii* (Matsumura) (Northern Borneo), *R. grayi*, *R. horaia* and *R. lorelinduana* (Sulawesi) and *R. kalami* (Buton) are all representatives of this group. But as many species of this group (s. l.) are still to be described and the Sulawesi fauna constitutes only a fraction of it an analysis of this group here would be premature.

The distribution of most species seems to be rather restricted, although one should not forget, looking at these small maps, that the distance between the northern and southern points of the main island of Sulawesi is over 1000 km and the west-east length of the northern peninsula c. 600 km. Secondly, more or less extensive collecting has been done in a rather small number of restricted areas only. The maps are based on the data from Polhemus & Polhemus (1988) and our own.

The three species of the *orientalis*-group have, so far, neatly separated distributions (fig. 81). The most widely distributed species seem to be *R. pruinosa* and *R. wallacei* (figs. 83, 82). *R. kastanoparuphe* and *R. pseudocelebensis* are interesting as they occur with *R. pruinosa* both on the main island and on Buton (figs. 81, 83-84), *R. trichota* has been found on both sides of Pegunungan Mengkoka. The remaining species are as yet only known from restricted areas. Nearly all specimens have been collected by experienced collectors. So we may assume that having been collected only on one or very few close localities of these local species indeed reflects restricted distribution rather than more cryptic habits. Available data suggest that the widely distributed species tend to be lowland species, and most, but not all, of the restricted species live on higher ground. A definite conclusion in this respect has to wait until more data become available. Likewise our data are not sufficient to establish altitudinal separation between species occurring geographically at the same 'points'.

Polhemus & Polhemus (1990) have postulated 'centres of species endemism' in Sulawesi. As average areas of distribution of species of various genera of Gerromorpha and Nepomorpha in Malesia are not yet known, we prefer to avoid the predicates endeme and endemism for the present. Although their centres look somewhat like areas in which more intensive collecting has been done compared to the remaining of Sulawesi, our results with *Rhagovelia* and *Enithares* (Nieser & Chen 1991) coincide with the regions with different faunal elements of water bugs in Sulawesi they postulated. Our present data also support their supposition that Sulawesi Tenggara (apparently including Buton) and the eastern peninsula of Sulawesi Tengah probably are such regions. It should, however, been pointed out that our results with the gerrine genus *Limnometra* (Nieser & Chen 1992), which also contains mostly stream inhabiting species, do not strongly support this pattern. In *Limnometra* there are fewer species of which relatively more occur at least in two of these regions.

References

Bacon, J. A., 1956. A taxonomic study of the genus *Rhagovelia* of the Western Hemisphere. – Kansas University Science Bulletin 38:695-913.

Chen, P. P. & N. Nieser, 1992. Gerridae, mainly from Sulawesi and Pulau Buton (Indonesia). – Tijdschrift voor Entomologie 135: 145-162.

Hungerford, H. B. & R. Matsuda, 1961. Some new species of *Rhagovelia* from the Philippines. – University of Kansas Scientific Bulletin 42: 257-279.

Lundblad, O., 1936. Die altweltlichen Arten der Veliidengattungen *Rhagovelia* und *Tetraripis*. – Arkiv för Zoologi 28A(21): 1-21, 13 pls.

Lundblad, O., 1937. Einige neue oder wenig bekannte ostasiatische *Rhagovelia*-Arten. – Entomologisk Tidskrift 58: 1-9.

Nieser, N., & P. Chen, 1991. Naucoridae, Nepidae and Notonectidae, mainly from Sulawesi and Pulau Buton (Indonesia). – Tijdschrift voor Entomologie 134: 47-67.

Nieser, N., & P. Chen, 1992. Revision of *Limnometra* Mayr (Gerridae) in the Malay Archipelago. – Tijdschrift voor Entomologie 135: 11-26.

Polhemus, J. T., & D. A. Polhemus, 1988. Zoogeography, ecology, and systematics of the genus *Rhagovelia* Mayr (Heteroptera: Veliidae) in Borneo, Celebes, and the Moluccas. – Insecta Mundi 2: 161-230.

Polhemus, J. T., & D.A. Polhemus 1990. Zoogeography of the aquatic Heteroptera of Celebes: regional relationships versus insular endemism. – In: Knight, W. J. & J. D. Holloway (Eds.), Insects and the rain forests of South East Asia (Wallacea). Royal Entomological Society of London.

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Appendix 1

Rhagovelia species collected in Sabah

Rhagovelia kawakamii (Matsumura)

Kotovelia kawakamii Matsumura, 1913: 99.
Rhagovelia kawakamii; Polhemus & Polhemus 1988: 206-207, figs. 74-80, 227 (redescription, synonymy).

Material. – EAST MALAYSIA: Sabah, Pulau Ranggi, logging camp, 7.10N 117.10E, 23. IV. 1987, leg. J. Huisman 2♂ 1♀ apterous (1♂ 1♀ RMNH, 1♂ NC).

Distribution. – Taiwan, Philippines, N. Borneo.

Rhagovelia samardaca Polhemus & Polhemus

Rhagovelia samardaca Polhemus & Polhemus, 1988: 200-201, figs. 194-200, 226.

Material. – EAST MALAYSIA: Sabah, Lahad Datu, 60 km W of Danum Valley field Centre at junction of Sg. Segama and Sg. Palum Tambun, 4°58'N 117°48'E, 150m, bridge of Segama, 26. IV. 1987, 18.30-21.00h, clearing edge of untouched evergr. lowl. rainforest, leg. van Tol & Huisman, 4♂ 2♀ apterous (RMNH, 1♂ 1♀ NC).

Distribution. – Sabah.

Rhagovelia silau Polhemus & Polhemus

Rhagovelia silau Polhemus & Polhemus, 1988: 184-186, figs. 99-105, 227.

Material. – EAST MALAYSIA: Sabah, 105 km S of Beaufort: Long Pa Sia area, Sg. Ritan, 4°24'N 115°42'E, 1160m, undisturbed evergreen tropical forest, 8.iv.1987, J. van Tol & J. Huisman, 1♂ 3♀ (1♂ 1♀ apt., 1♀ macr. RMNH, 1♀ apt. NC).

Distribution. – Previously recorded from Sabah in mountainous terrain, localities 900-2100m asl.

Rhagovelia tawau Polhemus & Polhemus

Rhagovelia tawau Polhemus & Polhemus, 1988: 187-188, figs. 15-22, 224.

Material. – EAST MALAYSIA: Sabah, 70 km West of Lahad Datu, Main Trail West 12, 180m, narrow creek, 2.xii.1989, M. J. & J. P. Duffels, sample Sab. 52, 5♂ 1♀; same, 4 km S Main Trail West 5, near Sungai Segama, 150m, middle sized stream and waterfall, 3.xii.1989, M. J. & J. P. Duffels, sample Sab. 54, 5♂ 2♀ (ZMA, 3♂ 1♀ NC); 60 km W Lahad Datu, Danum Valley Field Centre, road DVFC-Kg Silam nr km 68.3, 4°58'N 117°48'E, at junction of Sg. Sagama and Sg. Palum Tambun, 150m, disturbed evergreen lowland rainforest, 26.iii.1987, leg. van Tol & Huisman, 1♂. All apterous.

Distribution. – So far only known by the type series from Tawau (near Kalabakan) which is also in the eastern coastal region of Sabah, close to the border with Kalimantan Timur.

BOOK REVIEW

Kuchlein, J. H. (with collaboration of J. H. Donner), 1993. De Kleine Vlinders. Handboek voor de Faunistiek van de Nederlandse Microlepidoptera. – PUDOC, Wageningen. 715 pp., 1372 maps, 8 colour plates, textfigs. [ISBN 90-220-1038-4] [The small moths. Manual for the Faunistics of Netherlands Microlepidoptera, in Dutch, with 5 pp. English summary]. Price Hfl. 150.- (ca US $ 80).

This book deals with the Microlepidoptera of the Netherlands, the main body being distribution maps of all 1372 species (4 missing maps are provided on a separate erratum sheet).

The first 170 pages contain lengthy general chapters, dealing respectively with Morphology of adult, larva, feeding traces (mines), Ecology, Taxonomy and zoogeography, Human influence, Faunistics, and a key to families based on adults with a bibliography of key-works.

Apart from the maps, the main part of the book contains a checklist with annotations about faunistic status (incorrectly referred to as ecological status), indication of occurrence in the periods 1850-1900, 1900-1950 and later than 1950, number of provinces, number of grid squares, indication of abundance and codenumbers for hostplants. Further there are annotations for part of the species, usually explaining past identification problems, or indication of first findings.

A final chapter contains some general results and conclusions. Finally there is a long English summary, making the book also accessible for foreign readers.

The book is attractively made, well printed, and the colour plates, with mounted moths, mostly from the collection of J. C. Koster, are well made, although the black background sometimes tends to make the colours of the moth too dark. One colour plate depicts leaf-mines.

The book contains a wealth of interesting information, and there lies in my opinion the main problem of the book: it is as if the author could not make a choice whether to write a general manual about microlepidopteran studies or to present the results of faunistic research on the species in the Netherlands. The book would have been much nicer and easier to use if a choice had been made before writing. The general introduction chapters are really more a student textbook, certainly with interesting information, but to be found in many other textbooks as well, albeit with fewer examples from the Lepidoptera. The connection between the lengthy introduction to ecology for instance and the individual species is difficult to find. In fact there are hardly any notes about the habitats and ecology of individual species. The only ecology found is a list of hostplant species (and then with numbers, which have to be searched in the appendix for the correct name), without any details.

The most interesting and original part of the introductory chapters is in my opinion the historical chapter on Dutch Microlepidopterists. The key to families could be useful, and the colour plates certainly are helpful. It is a pity that the family names are not given in the captions for the plates. One photograph has mistakenly been used twice: plate 5: 4 (*Mompha epilobiella*) shows the photograph of *Bucculatrix ulmella*, the same as plate 3: 1.

The bibliography of key works is very long, for new workers disappointingly long. Nowhere a choice has been made, nor annotations given about the usefulness of a book or article. Some references seem completely misplaced, like keys for New Zealand species for groups where recent European keys are available as well. On the other hand some important titles are missing.

The checklist is an important summary of present knowledge of Dutch faunistics: it is therefore to be regretted that here and in the species annotations there are many mistakes or inaccuracies. Despite a well written introduction to zoological nomenclature, the author nowhere indicates his source for the nomenclature used. Several recently proposed changes are not incorporated, but some are (like the generic name *Luquetia* Leraut). Notable mistakes are the use of *Episcardia* for *Haplotinea*, shown to be incorrect by Robinson in 1984, the use of the generic name *Glyphipteryx* Curtis, rejected by the ICZN in 1986 and the use of the replacement name *Nemophora violaria* (Razowski), which is only needed (because of secondary homonymy) when used in the genus *Adela*. Such mistakes could easily have been avoided by closer contact with specialists.

The maps show the distribution in 5 × 5 km grid cells with a single symbol. Although the databank used contains information about the date of the records, all records have the same symbol, so a well dotted map may also show the distribution of about 100 years ago. It would have been better to indicate periods, using different symbols as is general practice in similar atlasses. Some rapidly declining species can not be identified from these maps, nor from the text. In some cases there is considerable doubt about the correctness of some dots: the large number of dots in the species *Stigmella samiatella* and *S. ruficapitella* could only be explained by the inclusion of records based on mines. However, there are no reliable characters separating these mines, nor the larvae. In some cases I am missing previously published records, in others there are dots for records which have been shown to be incorrect in literature.

The presentation chosen is partly impractical because in order to find all information about a species, one needs to switch from the map to the list, for which one needs the appendix to understand the hostcodes, and the introduction to understand the other codes. The list also indicates whether there is an annotation for the species, but the caption to the map does not give this reference.

Finally, I would like to comment on the choice of the species treated: it is unfortunate that this book chooses to include only the Microlepidoptera in the old sense and excluding such related groups as Psychidae or Sesiidae. On the other hand one could wonder about the inclusion of single import events of species found on Bonsai trees imported from Japan and China. These species have been found by the Plant Protection Service, and the trees were destroyed subsequently. Such species do not belong on the list of species occurring in The Netherlands, otherwise all species introduced alive in our country could be listed as well with the same argumentation, including those introduced on purpose by scientists or breeders! The maps of such species do not give any information (some of the maps even do not contain any dot, yet they are printed).

In conclusion: a book with much faunistic information, useful for Microlepidopterists in Europe, but to be used with care. The long introduction is only of use for readers with knowledge of Dutch. In my opinion too expensive despite the excellent printing.

[E. J. van Nieukerken]

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LOBOSMITTIA, A NEW GENUS OF ORTHOCLADS FROM TANZANIA AND TURKEY (DIPTERA: CHIRONOMIDAE)

Sæther, O. A. & T. Andersen, 1993. *Lobosmittia*, a new genus of orthoclads from Tanzania and Turkey (Diptera: Chironomidae). – Tijdschrift voor Entomologie 136: 283-287, figs. 1-10. [ISSN 0040-7496]. Published 10 December 1993.
The genus *Lobosmittia* is erected for a new species from the West Usambara Mts in NE Tanzania, *L. basilobata* and for *Pseudosmittia invaginata* Caspers & Reiss, 1989 from Turkey. The genus differs from other orthoclads with bare eyes, wings and squama; by completely lacking acrostichals, median microtrichial tuft or less sclerotized median area on scutum; by having costa not or only slightly extended; fine, triangular, strongly pointed anal point bare of microtrichia; and gonostylus with either a basal or preapical lobe. The *Parakiefferiella* group of genera or *Acamptocladius* Brundin and related genera are the most likely closest relatives.
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Key words. – Chironomidae, Orthocladiinae, new genus, Tanzania, Turkey.

Introduction

During an expedition by the Museum of Zoology, University of Bergen, to the montane evergreen forests in the West Usambara Mountains, NE Tanzania in the autumn of 1990, several interesting new genera and species of chironomids were collected together with a few genera new to the African continent (Andersen & Sæther 1993, in press a, b, Sæther & Wang 1992). One of the new genera had what in some specimens looked like a double gonostylus. However, other views showed that it was a basal lobe. Other characteristics made it clear that the species could not be placed in any presently recognized genus. The senior author, together with L. C. Ferrington jr., Lawrence, Kansas, presently is revising the genus *Pseudosmittia* Goetghebuer. Many species in that genus are tentatively placed since the genus has not been well defined. When examining types it was found that *Pseudosmittia invaginata* described by Caspers & Reiss (1989) could be placed in the same genus as the species from Tanzania.

The field work, which included an extensive use of Malaise traps and sweep nets, was mainly conducted in the Mazumbai Forest Reserve in the eastern part of the West Usambara Mts. A thorough description of the vegetation in these mountains is given by Iversen (1991). Our Malaise trap localities along the Kaputu Stream near Mazumbai are described in Andersen & Johanson (in press).

Methods and terminology

The material examined was mounted on slides following the procedure outlined by Sæther (1969). The general terminology follows Sæther (1980). The measurements are given as ranges followed by mean and the number measured (n) in parentheses.

The types of *Lobosmittia basilobata* sp. n. are deposited in the Museum of Zoology, University of Bergen, Norway (ZMBN).

Lobosmittia gen. n.

Type species. – *Lobosmittia basilobata* sp. n. by present designation. Other included species: *Lobosmittia invaginata* (Caspers & Reiss, 1989: 123, Figs. 11-13, as *Pseudosmittia invaginata*), **comb. n.**

Diagnostic characters. – The bare eyes, wing membrane and squama, combined with complete lack of acrostichals, microtrichial tuft on median hump or sclerotized area on scutum, not or only moderately extended costa, and pointed, triangular anal point, free of microtrichia will separate the genus from other orthoclads.

Etymology. – From the Greek *lobos*, a lobe, and *Smittia*, a related genus of Orthocladiinae and a common ending among orthoclads, referring to the basal or subapical lobes of the gonostyli of the two included species.

Description

Small species with wing length 0.7 - 1.1 mm.

Eyes bare, without dorsomedial elongation. Coronal suture well developed ending in frontal projection. Temporal setae consisting of weak inner verticals and strong outer verticals. Tentorium and stipes normal. Antennae of male with 13 flagellomeres; antennal groove starting on flagellomere 3; sensilla chaetica on flagellomeres 2, 3 and 13; apex without apical setae.

Antepronotum with median lobes narrowed medially and slightly separated, with 1 lateral seta. Dorsocentrals several; acrostichals, microtrichial tuft, hump or unsclerotized median area of scutum absent; prealars few, in one or two groups; supraalars present or absent. Scutellum with few setae. Humeral pit not distinctive.

Wing membrane bare, with very fine punctuation of microtrichia; veins brown. Anal lobe weak or absent. Costa not to moderately extended; R_{2+3} running in the middle between R_1 and R_{4+5}, ending close to R_{4+5}; R_{4+5} ending clearly proximally of end of M_{3+4}; Cu_1 sinuate; FCu far distally of RM; postcubitus extending beyond FCu; anal vein not reaching FCu. Brachiolum with 1 seta, other veins bare. Squama bare. Sensilla campaniformia about 8-10 on base of brachiolum, 3 below seta, and about 8-10 at apex of brachiolum; 1 at base of subcosta, 1 on FR and 1 at base of R_1.

Tibial spurs and tibial comb normal. Pulvilli absent, at least in *L. invaginata*.

Tergite IX with few to several setae at base of triangular, sharply pointed anal point which is bare of setae and microtrichia. Sternapodeme with weak or no oral projections. Phallapodeme normal. Virga well developed, consisting of few needle-like spines. Gonocoxite with long, relatively low inferior volsella. Gonostylus either with a basal crista dorsalis appearing as a basal appendage in some views or with a long apically angled crista dorsalis making the gonostylus appear to have a deep apical invagination.

Female, pupae and larvae unknown.

Systematics

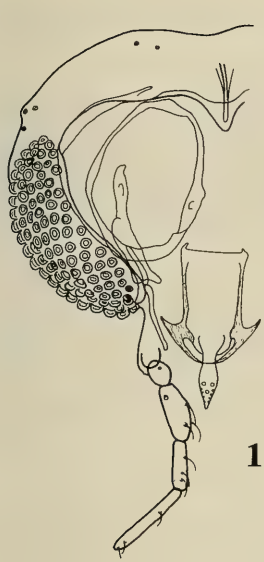
In the key to adult males of Orthocladiinae by Cranston *et al.* (1989) *Lobosmittia* will key to couplet 98. It will not key further since the pulvilli apparently are absent or vestigial, while the anal point extends from the posterior margin of tergite IX. Caspers & Reiss (1989: 12) discussed the placement of their species as *Pseudosmittia invaginata* on the base of the similarity of *Pseudosmittia* Goetghebuer and *Prosmittia* Brundin. Cranston & Oliver (1988) even synonymized the two genera based on the fact that *Prosmittia nanseni* Kieffer (Kieffer 1926: 82) is a good *Pseudosmittia*. Oliver (1963: 177) first placed *nanseni* in the genus *Prosmittia* apparently based on the similarities in the hypopygia between *nanseni* and *Prosmittia jemtlandica* (Brundin, 1947). Reexamination of the type of *P. nanseni* by Sæther *et al.* (1984: 270) did not change the placement of the species. However, the wing venation could not be discerned on the damaged male. The senior author together with Dr. L. C. Ferrington jr., Lawrence, Kansas, presently is revising the genus *Pseudosmittia* and we have examined *P. jemtlandica* as well as a large amount of *P. nanseni* and most types of *Pseudosmittia*. All species of *Pseudosmittia* have 2 or occasionally 4-11 (as in *P. nanseni*) short, but relatively strong acrostichals, with distinct sockets, in a pale, less sclerotised median area on the scutum. There is never a median microtrichial tuft as in *Parakiefferiella* Thienemann, and no median tubercle, but occasionally there is a hump in some teneral specimens. On the wing, vein R_{4+5} may end slightly distal to end of M_{3+4}, but mostly ends well proximal of the end of M_{3+4}. In *Prosmittia jemtlandica* there is no sign of acrostichals, microtrichal tuft, hump or pale area on scutum, and R_{4+5} ends far distally of the end of M_{3+4} almost reaching the wing apex. The illustration by Brundin (1947: fig. 16) of *Prosmittia jemtlandica* (as *Pseudosmittia jemtlandica*) is correct and not erroneous as previously presumed. The genus *Prosmittia* Brundin (1956: 58, 165) clearly has to be resurrected. The wing venation, however, appears to place it close to *Unniella* Sæther, but not to *Pseudosmittia* nor to *Lobosmittia*.

Lobosmittia, however, has an anal point placed on the posterior margin of tergite IX and does not appear closely related to any of the above mentioned genera. *Boreosmittia* Tuiskunen appears to be the most similar genus. However, without knowledge of the immatures a more definite placement is as yet not possible.

Lobosmittia basilobata sp. n.
(figs. 1-10)

Type material. – Holotype ♂, Tanzania, Tanga region, West Usambara Mts, Mazumbai, Kaputu Stream, 1640 m a. s. l., sweep net at waterfall, 28.x.1990, ZMB's Tanzania Expedition (ZMBN No. 156).– Paratypes: 4♂, as holotype; 1♂ as holotype except Malaise trap loc. 2, 1650 m a. s. l., 2.-6.xi.1990; 2♂ as holotype except Malaise trap loc. 10, 1420 m a. s. l., xii.1990.

Figs. 1-10. Male imago of *Lobosmittia basilobata* gen. n., sp. n. – 1, head; 2, thorax; 3, third palpal segment; 4, tentorium and stipes; 5, wing; 6, hypopygium, with dorsal aspect to the left, ventral to the right; 7, anal point, lateral view; 8-10, gonostylus, different views.



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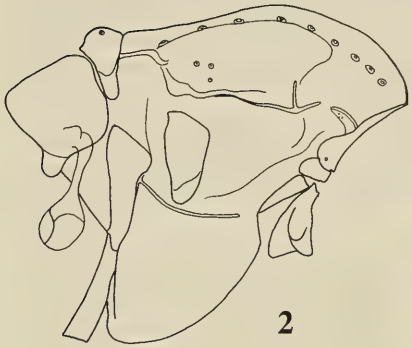

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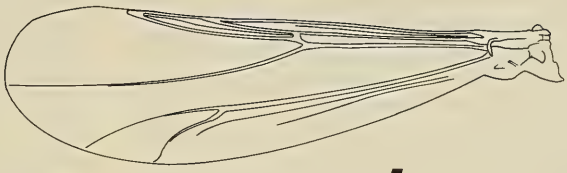

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Diagnostic characters. – The basal lobe of the gonostylus easily separates *L. basilobata* from *L. invaginata*. Other characteristics of *L. basilobata* include absence of supraalars, fewer prealars and inner verticals and more numerous sensilla clavata at apex of the third palpal segment.

Etymology. – From the Latin *basis*, base, pedestal, and New Latin, *lobatus*, lobed, referring to the shape of the gonostylus.

Description

Male imago (n = 7-8, except when otherwise stated). – Total length 1.34-1.46, 1.40 mm (6). Wing length 0.75-0.83, 0.81 mm. Total length / wing length 1.57-1.87, 1.73 (6). Wing length / length of profemur 2.73-3.08, 2.88. Coloration brownish black with yellowish shoulders and anepisternum. Legs yellowish brown.

Head (Fig. 1). AR 0.39-0.49, 0.42. Ultimate flagellomere 123-171, 141 µm long. One specimen with division between flagellomere 12 and 13 indistinct, if antenna regarded as 12-segmented AR 0.56. Temporal setae consisting of 2-3, 2 mostly widely separated, weak inner verticals; and 3 strong outer verticals. Clypeus with 4-6, 5 setae. Tentorium (Fig. 4) 80-94, 85 µm long, 13-18, 15 µm wide. Stipes (Fig. 4) 57-66, 62 µm long, 21-27, 25 µm wide. Palp segments lengths in µm: 14-18, 15; 18-23, 21; 27-39, 34; 32-41, 38; 46-66, 59. Third palpal segment (Fig. 3) with 6-7, 6 (6) sensilla clavata. Coronal suture ending in frontal projection.

Thorax (fig. 2). Antepronotum with 1 lateral seta. Dorsocentrals 8-11, 9; prealars 3; supraalars absent. Scutellum with 2 setae.

Wing (fig. 5). VR 1.31-1.45, 1.40. Costal extension 23 -62, 35 mm long.

Legs. Spur of front tibia 29-39, 34 µm long; spurs of middle tibia 14-18, 16 µm (6) and 13-18, 15 µm long; of hind tibia 32-39, 35 µm and 11-16, 14 µm. Width at apex of front tibia 16-18, 17 µm; of middle tibia 16-21, 19 µm; of hind tibia 25-34, 30 µm. Hind tibial comb of 13-15, 14 setae; shortest setae 18-25, 21 µm long; longest setae 26-34, 31 µm long. Lengths of front, middle and hind femora (in µm) as: 252-306, 282; 279-315, 306; 288-324, 308; of tibiae: 266-315, 293; 288-360, 325; 315-360, 339. Tarsomeres 1 and 2 of hind legs 171 µm (1) and 90 µm (1) long, other tarsomeres lost.

Hypopygium (fig. 6). Anal point 18-27, 21 µm long; with 9-14, 10 setae at base (fig. 7); laterosternite IX with 3 setae. Phallapodeme 39-48, 45 µm long, transverse sternapodeme 34-43, 41 µm long. Virga 14-19, 16 µm long. Gonocoxite 91-101, 97 µm long; with long inferior volsella apically hooked in some views. Gonostylus 39-45, 42 µm long; basal lobe ending 21-27, 24 µm from base (figs. 8-10); megaseta 9-14, 10 µm long.

Lobosmittia invaginata (Caspers & Reiss) comb. n.

Pseudosmittia invaginata Caspers & Reiss, 1989: 123, figs. 11-13. – Holotype ♂, Turkey: Kars province, W. Sarikamis, Soganli railway station, 2100 m a. s. l., 5.vii. 1985, W. Schacht (Zoologischen Staatssammlung, München). [examined]

Diagnostic characters. – The subapical invagination of the gonostylus easily separates *L. invaginata* from *L. basilobata*. Other characteristics of *L. invaginata* includes the presence of 1 supraalar, 6 inner verticals and 1 sensillum clavatum at the apex of the third palpal segment.

Description

The species is well described by Caspers & Reiss (1989: 123, figs. 11-13). However, this description contains a few mistakes. There are 6 weak inner verticals reaching from near the middle of the head to the position of the outer verticals. There also are 3 stronger outer verticals, apparently 8 setae on the clypeus, 1 lateral antepronotal and 1 supraalar. The first palp segment is shorter than the second, our measurements are 23 µm and 30 µm. The leg segments lengths appear to have been measured as total lengths, not following Schlee (1966), as especially the femora and ta_5 are about 15% too long compared with our measurements, while ta_1 to ta_4 are quite close.

Acknowledgements

The expedition to Tanzania was funded by The Norwegian Council for Science and the Humanities (NAVF). Financial support was also given by Nansenfondet. Thanks are also due to the staff at the Department for Forest Biology, Sokoine University of Agriculture (SUA), Morogoro, Tanzania and to the Norwegian Agency for Development (NORAD), Dar es Salam, Tanzania, for their cooperation and support. Gladys Ramirez made the slide preparations of *Lobosmittia basilobata*.

References

Andersen, T. & K. A. Johanson, (in press). Caddis flies (Trichoptera) from a mountain rain forest in NE Tanzania. – In: Otto, C. Proceedings of the 7th International Symposium on Trichoptera. – Universal Book Services, The Netherlands.

Andersen, T. & O. A. Sæther, 1993. *Lerheimia*, a new genus of Orthocladiinae from Africa (Diptera, Chironomidae). – Spixiana 16: 105-112.

Andersen, T. & O. A. Sæther, (in press a). *Usambaromyia*

nigrala gen. n., sp. n., and Usambaromyiinae, a new subfamily among the Chironomidae (Diptera). – Aquatic Insects 15.

Andersen, T. & O. A. Sæther, (in press b). *Colosmittia clavata* gen. n., sp. n., a new orthoclad from the Usambara Mts, Tanzania (Diptera: Chironomidae). – Journal of the Kansas Entomological Society 66.

Brundin, L., 1947. Zur Kenntnis der schwedishen Chironomiden. – Arkiv för Zoologi 39A (3): 1-95.

Brundin, L., 1956. Zur Systematik der Orthocladiinae (Dipt. Chironomidae). – Report, Institute of Freshwater Research, Drottningholm 37: 5-185.

Caspers, N. & F. Reiss, 1989. Die Chironomidae der Türkei. Teil I: Podonominae, Diamesinae, Prodiamesinae, Orthocladiinae (Diptera, Nematocera, Chironomidae).– Entomofauna 10 (8/1): 105-160.

Cranston, P. S. & D. R. Oliver, 1988. Additions and corrections to the Nearctic Orthocladiinae (Diptera: Chironomidae). – Canadian Entomologist 120: 425-462.

Cranston, P. S., D. R. Oliver, & O. A. Sæther, 1989. 9. The adult males of Orthocladiinae (Diptera: Chironomidae) of the Holarctic region - Keys and diagnoses. – In: Wiederholm, T. Chironomidae of the Holarctic region. Keys and diagnoses. Part 3. Adult males. – Entomologica scandinavica Supplement 34: 165-352.

Iversen, S. T., 1991. The Usambara Mountains, NE Tanzania: Phytogeography of vascular plant flora. – Acta Universitatis Upsalensis, Symbolae Botanicae Upsaliensis 29 (3): 1-234.

Kieffer, J. J., 1926. Chironomiden der 2. Fram - Expedition (1898-1902). – Norsk entomologisk Tidsskrift 2: 78-89.

Oliver, D. R., 1963. Entomological studies in the Lake Hazen Area, Ellesmere Island, including lists of species of Arachnida, Collembola and Insecta. – Arctic 16: 175-180.

Sæther, O. A., 1969. Some Nearctic Podonominae, Diamesinae, and Orthocladiinae (Diptera: Chironomidae). – Bulletin of the Fisheries Research Board of Canada 107: 1-154.

Sæther, O. A., 1980. Glossary of chironomid morphology terminology (Diptera: Chironomidae). – Entomologica scandinavica Supplement 14: 1-51.

Sæther, O. A., J. E. Sublette & E. Willassen, 1984. Chironomidae (Diptera) from the 2nd Fram Expedition (1898-1902) to Arctic North America described by J. J. Kieffer. – Entomologica scandinavica 15: 245-275.

Sæther, O. A. & X. Wang, 1992. *Euryhapsis fusciprope*s sp. n. from China and *Tokyobrillia anderseni* sp. n. from Tanzania, with a review of genera near *Irisobrillia* Oliver (Diptera: Chironomidae). – Annales de limnologie 28: 209-223.

Schlee, D., 1966. Präparation und Ermittlung von Messwerten an Chironomiden (Diptera). – Gewässer und Abwässer 41/42: 169-193.

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BERNHARD J. van VONDEL

Natuurmuseum Rotterdam

REVISION OF THE *LIAPHLUS* SPECIES OF THE ORIENTAL REGION EXCLUDING CHINA (COLEOPTERA: HALIPLIDAE)

Vondel, B. J. van, 1993. Revision of the *Liaphlus* species of the Oriental region excluding China (Coleoptera: Haliplidae). – Tijdschrift voor Entomologie 136: 289-316, figs 1-130. [ISSN 0040-7496]. Published 10 December 1993.
The Oriental species of the Haliplidae are discussed. The species of the subgenus *Liaphlus* Guignot are revised, while the few remaining species of the subgenus *Haliplus* s. str. (in revision by Holmen) and the genus *Peltodytes* Régimbart (already revised by Vondel 1992) are only discussed in general. Twenty-six species of Haliplidae are known from the Oriental region. *H. shanicus* Guignot is established as a junior synonym of *H. angustifrons* Régimbart. Four new species are described: *Haliplus javanicus, H. nedungaduensis, H. samosirensis* and *H. srilankanus.* Most primary types have been studied. Lectotypes are designated for *H. angustifrons* Régimbart, *H. oceanicus* Régimbart, *H. pulchellus* Clark and *H. pulchellus* var. *indicus* Régimbart. The latter is raised to specific rank. A check-list of all Oriental Haliplidae is provided, as well as a key to the *Liaphlus* species in the Oriental region excluding China, and distribution maps of most species.
B. J. van Vondel, Roestuin 78, 3343 CV Hendrik-Ido-Ambacht, The Netherlands.
Key words. – Haliplidae, *Haliplus, Liaphlus,* Oriental region, new species.

Since Zimmermann (1924) published his key to the Haliplidae of the world, no revisional work has been done regarding the Oriental species. The status of the species described since is not always clear, so a revision is necessary. The type material of most species was studied, except for the three species described by Vazirani, whose types appear to be completely unavailable for examination.

Female genitalia are not described, because they usually are very uniform. Further research is necessary to check if there are characters sufficiently reliable to separate the species.

Material

About 280 specimens, including type-material, were studied from the following collections: Natural History Museum, London, UK (BMNH); B. P. Bishop Museum, Honolulu, Hawaii, USA (BPBM); Canadian National Collection, Ottawa, Canada (CNCI); Institut Royal des Sciences Naturelles, Brussels, Belgium (ISNB); Museum of Comparative Zoology, Cambridge, Massachusetts, USA (MCZC); Muséum National d'Histoire Naturelle, Paris, France (MNHN); Museum of Zoology, Lund, Sweden (MZLU); Naturhistorisches Museum Wien, Vienna, Austria (NHMV); Naturhistoriska Riksmuseet, Stockholm, Sweden (NHRS); Nationaal Natuurhistorisch Museum (Rijksmuseum van Natuurlijke Historie), Leiden, Netherlands (RMNH); United States National Museum of Natural History, Washington D.C., USA (USNM); Instituut voor Taxonomische Zoölogie (Zoologisch Museum), Amsterdam, Netherlands (ZMAN); Zoologisk Museum, Copenhagen, Denmark (ZMUC); Zoologische Staatssammlung, Munich, Germany (ZSMC).

Private collections: L. Hendrich, Berlin, Germany; P. Mazzoldi, Brescia, Italy; B. J. van Vondel, Hendrik-Ido-Ambacht, The Netherlands.

Methods

Dissecting, preparing and drawing the aedaegi as well as the use of morphological terms follows the methods described by Vondel (1991: 76).

Locality names are given, as far as possible, according to the Times Atlas of the World (Comprehensive edition 1983), but when different from original labels, the modern name is given in parentheses. Names of countries are used with their present-day boundaries. Distribution maps are based on material examined. Literature records are included using different symbols.

Systematic section

Checklist of Oriental Haliplidae, including Taiwan and China south of the river Chiang Jiang

Haliplus Latreille
subgenus Haliplus s.str.
japonicus Sharp, 1873 (*)
sauteri Zimmermann, 1924 (*)

subgenus *Liaphlus* Guignot
angustifrons Régimbart, 1892
  shanicus Guignot, 1956 **syn.n.**
arrowi Guignot, 1936
chinensis Falkenström, 1932 (**)
diopus Guignot, 1955
diruptus Balfour-Browne, 1946
eximius Clark, 1863
  modestus Zimmermann, 1924
  emmerichi Falkenström, 1936
holmeni Vondel, 1991 (**)
indicus Régimbart, 1899 **stat. n.**
javanicus **sp. n.**
kapuri Vazirani, 1975
kotoshonis Kano & Kamiya, 1931 (**)
manipurensis Vazirani, 1966
nedungaduensis **sp. n.**
perroti Guignot, 1950
philippinus Chapin, 1930
pruthii Vazirani, 1966
pulchellus Clark, 1863
  oceanicus Régimbart, 1886
samosirensis **sp. n.**
sharpi Wehncke, 1880 (**)
srilankanus **sp. n.**

Peltodytes Régimbart
coomani Peschet, 1923 (***)
  wui Gschwendtner, 1934
intermedius (Sharp, 1873) (***)
sinensis (Hope, 1845) (***)
  variabilis (Clark, 1863)
  koreanus Takizawa, 1931
sumatrensis Régimbart, 1885 (***)

The Oriental region as defined in this revision is according to fig. 122. Species of the subgenus *Liaphlus*, which are present in the south of China or in Taiwan and not further in the Oriental region (marked ** in the species-list) are already revised by Vondel (1991) and not included in the following key. The Oriental species of the genus *Peltodytes* (marked *** in the species-list) were revised together with the Palaearctic species (Vondel 1992). The few species of the subgenus *Haliplus* s. str. (marked with * in the species-list), which are present in the southwest of China (*H. japonicus* Sharp) and in Taiwan (*H. sauteri* Zimmermann) are subject of a revision of that subgenus by Holmen (in prep.) and not further treated here. Some species are present both in the Oriental and Palaearctic regions. These species are included in the following key, but only treated here in a general way, except *H. pulchellus* Clark, which is fully treated.

Key to the genera of Oriental Haliplidae

1. Elytra with sutural stripe on about apical half. Last segment of maxillair and labial palpi longer than penultimate segments ..... genus *Peltodytes* Régimbart
- Elytra without sutural stripe or at most a weak trace at the apex. Last segments of maxillair and labial palpi much shorter than penultimate segments ..... genus *Haliplus* Latreille

Remark. – Species of the genus *Peltodytes* are already revised (Vondel 1992) and are only mentioned in the species-list.

Key to the subgenera of *Haliplus*

1. Hind tibia with setiferous striole on dorsal face. Pronotum without basal plicae .... subg. *Liaphlus*
– Hind tibia without setiferous striole on dorsal face. Pronotum with basal plicae ..... subg. *Haliplus* s.str.

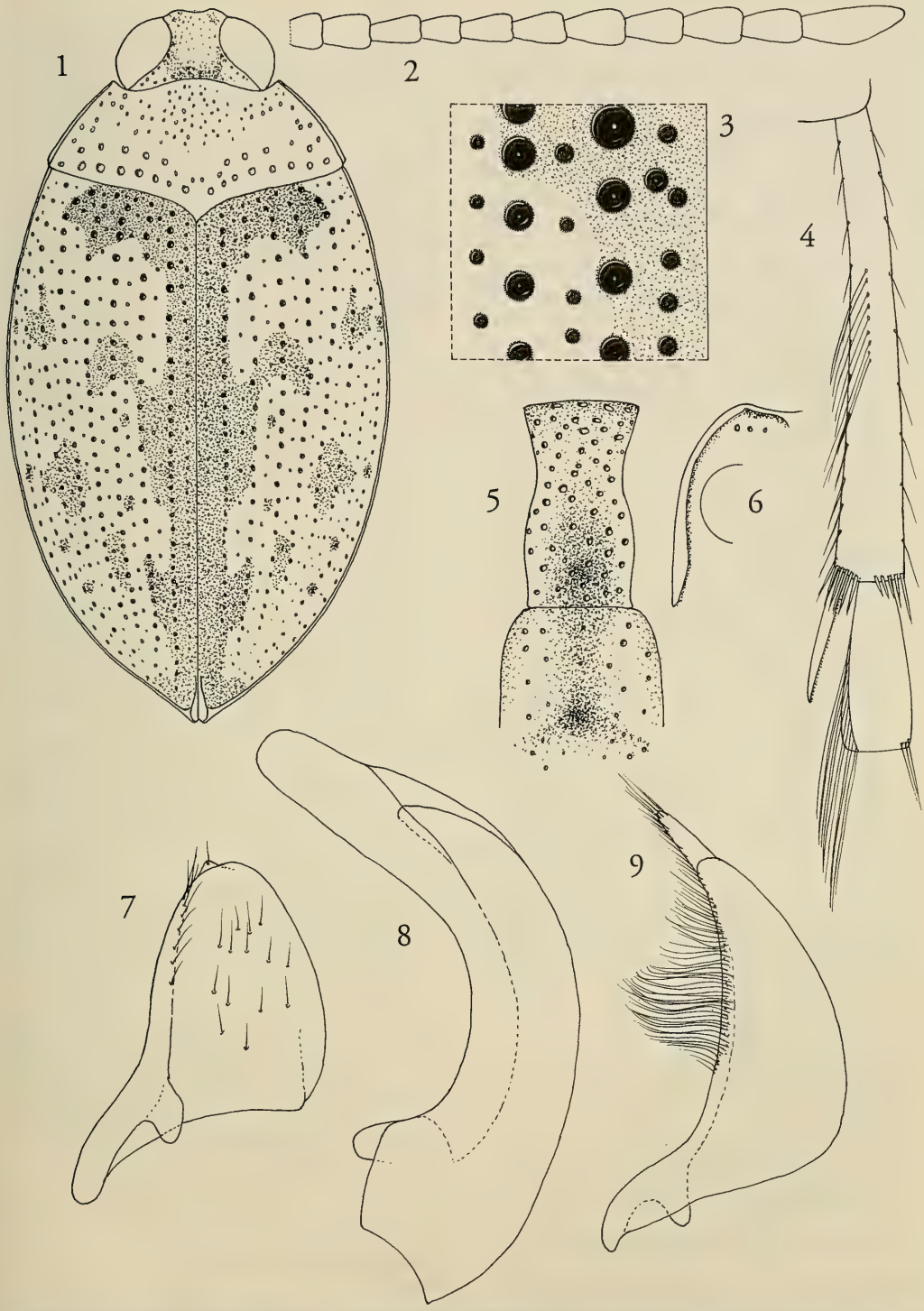
Remarks. – Species of the subgenus *Haliplus* s.str. are in the Oriental region present in the southwest of China: Yunnan (*H. japonicus*) and in Taiwan (*H. sauteri*). The species concerned are only mentioned in the species-list, because they are subject of a revision by Holmen.

Guignot (1955b) proposed a division of the subgenus *Liaphlus* into species-groups. In some cases I do not agree with his interpretation of species. As far as Oriental species are concerned the following notes can be made. *Haliplus diopus* and *H. pulchellus* are closely related, but placed by Guignot in different groups. The latter, however, is placed by him with the clearly different *H. testudo* (from Australia) in one group.

H. arrowi and *H. angustifrons* are closely related, but, again, placed by him in different groups.

Key to the Oriental species of the subgenus *Liaphlus:*

Species known only from China or Taiwan are not included in the key, but can be identified with Vondel (1991).



Figs. 1-9. *Haliplus angustifrons*, lectotype. – 1, dorsal view; 2, antenna; 3, punctures near elytral base and suture; 4, dorsal side of hind tibia; 5, prosternal process; 6, lateral view of prosternal process; 7, left paramere; 8, penis; 9, right paramere.

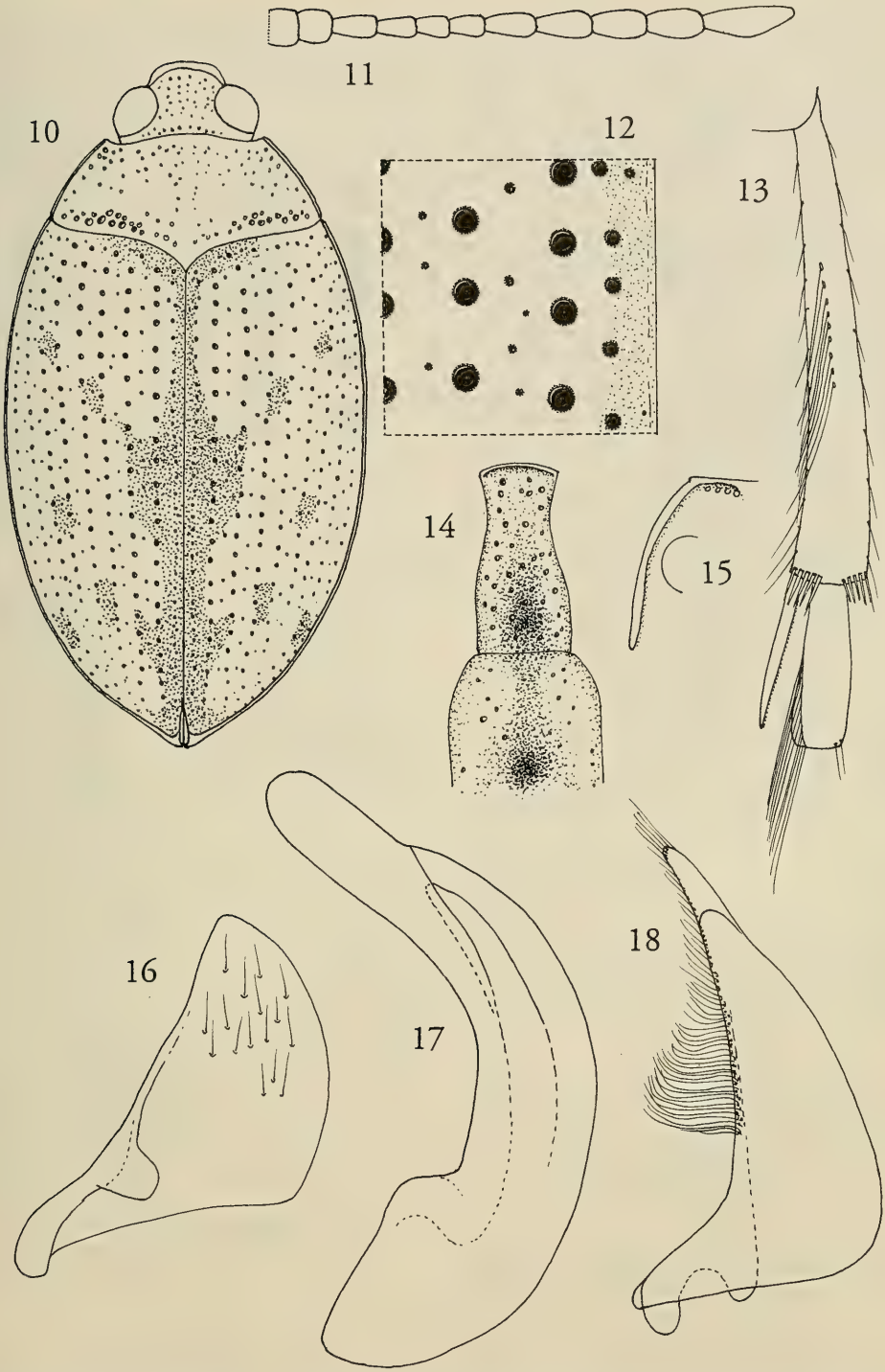
1. Prosternal process with two longitudinal grooves (fig. 23) 2
- Prosternal process flat or impressed in the middle (fig. 5, 41) 9
2. Elytra maculate (fig. 19) 3
- Elytra only narrowly darkened along suture (fig. 68) .....*H. nedungaduensis*
3. Margins of elytra serrate in basal part (fig. 46) .4
- Margins of elytra not clearly serrate in basal part 6
4. Distance between eyes 0.9-1.0× width of one eye .....specimens of *H. pulchellus*
- Distance between eyes 1.1-1.5× width of one eye 5
5. Metasternal process with transverse impression, in which two pits can be recognised (fig. 50) ....*H. indicus*
- Metasternal process with two separated pits (fig. 23) .....*H. diopus*
6. Mesepimeron with about 4 strong punctures (fig. 92). Length less than 2.6 mm .....*H. philippinus*
- Mesepimeron without or rarely with one or two punctures. Length more than 2.6 mm 7
7. Pronotum usually not continuously margined, sometimes traces of a margin in posterior part, posterior corners usually clearly protruding. Basal black band on elytra reaching fifth primary puncture-row (fig. 98) .....specimens of *H. pulchellus*
- Pronotum usually finely margined except near anterior corner, posterior corners not or hardly protruding. Basal dark band on elytra reaching at least sixth primary puncture row 8
8. Elytral basal band brown, reaching margins when seen from above, black marks very irregular. Pronotum slightly darker in the middle (fig. 107). Length 3.3-3.5 mm ....*H. samosirensis*
- Elytral basal band black, reaching sixth primary puncture-row, black marks well defined. Pronotum clearly darkened in the middle (fig. 55). Length 2.8-3.0 mm ....*H. javanicus*
9. Elytra without any markings 10
- Elytra with markings 11
10. Prosternal process broad and flat, narrowed beteen procoxae, not narrowed between mesocoxae (fig. 41) .....*H. eximius*
- Prosternal process narrowed between pro- and mesocoxae (see remarks below) .....*H. kapuri*
11. Prosternal process without anterior margin (fig. 5) 12
– Prosternal process margined anteriorly (fig. 14) 13
12. Prosternal process pitted posteriorly (fig. 5) ....specimens of *H. angustifrons*
– Prosternal process canaliculate (see remarks below) .....*H. manipurensis*
13. Two longitudinal markings on disc of pronotum (see remarks below) .....*H. pruthii*
– At most small markings on disc of pronotum 14
14. Elytral markings not connected with darkened suture (fig. 77) .....*H. perroti*
– Elytral markings connected with darkened suture (fig. 1) 15
15. Prosternal process strongly grooved and with a deep pit in apical part (fig. 5), elytral base usually darkened 16
– Prosternal process flat or weakly impressed in apical part (fig. 32), elytral base usually not darkened (fig. 28) .....*H. diruptus*
16. Distance between eyes 0.8-0.9× width of one eye. Base of pronotum usually wider than elytral base, posterior corners rounded. Pronotum short, width at base 2.1-2.3 × length in the middle, strong and in basal corners coarse punctures. Margins thicker than elytral margin near shoulders. Basal dark band usually reaching to fifth puncture-row (fig. 1). Anterior edge of prosternum only margined near prosternal process. About 38 sutural punctures, about 32 punctures in first primary row .....*H. angustifrons*
– Distance between eyes 1.0-1.1× width of one eye. Width of pronotum at base about 2.0× length in the middle, margins about as thick as elytral margins near shoulders 17
17. Pronotal posterior corners clearly protruding (fig. 113). Anterior edge of prosternum completely margined. About 33 punctures in first primary row. Suture darkened to first primary puncture-row (fig. 113) .....*H. srilankanus*
– Pronotal posterior corners not protruding. Anterior edge of prosternum only margined near prosternal process. About 24 punctures in first primary row. Suture darkened to first secondary puncture-row (fig. 10) .....*H. arrowi*

Remarks. – The species described by Vazirani (*H. kapuri*, *H. manipurensis* and *H. pruthii*) are only known to me by the original description. As I do not always know how to interpret some parts of these descriptions, especially concerning the shape of the prosternal process, some uncertainty remains regarding Vazirani's species.

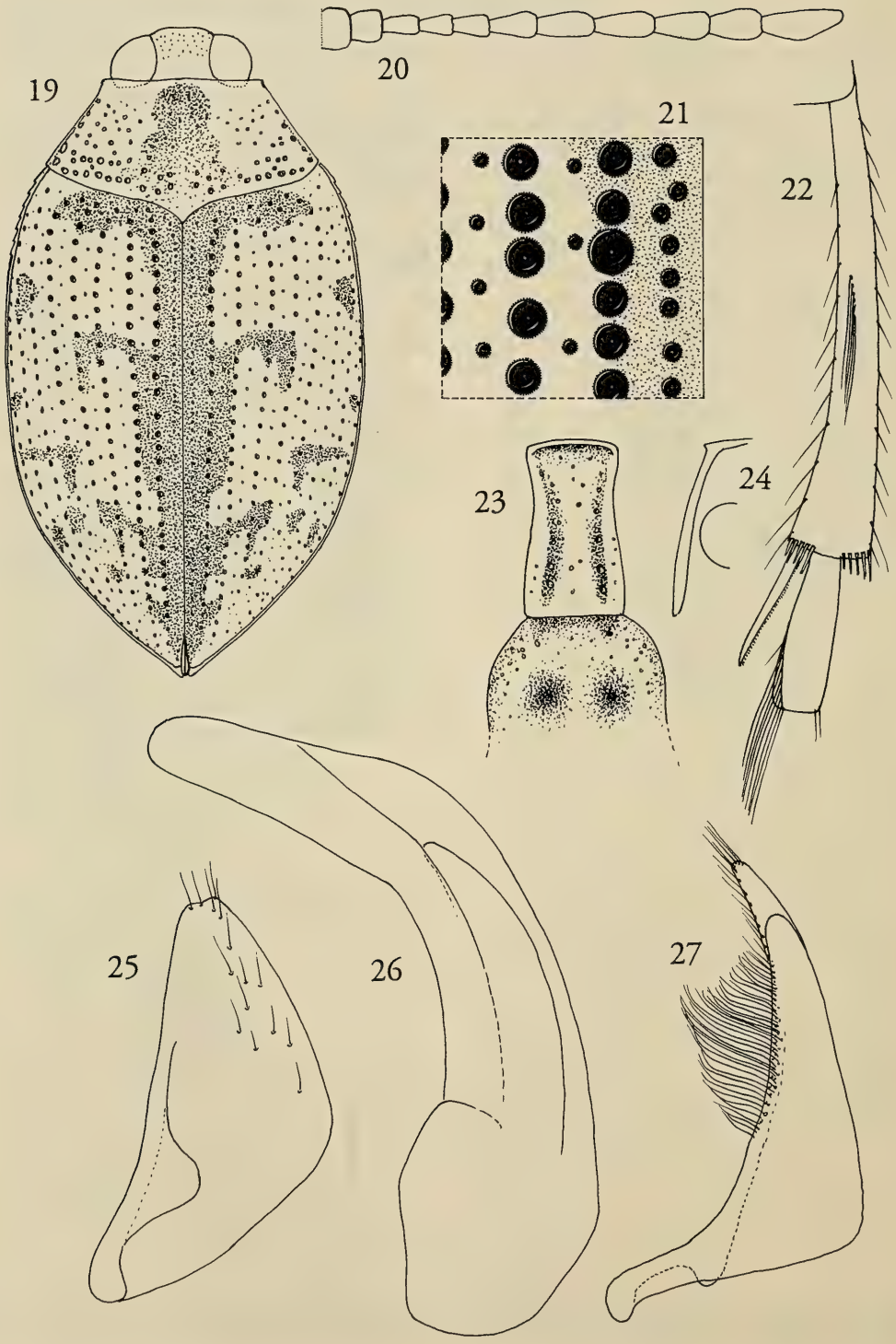
Description of the Oriental Liaphlus

Haliplus angustifrons Régimbart
(figs. 1-9)

Haliplus angustifrons Régimbart, 1892: 112. Lectotype ♂, 'Konbir [Konbira, Ranchi distr., Bihar, India], P.



Figs. 10-18. *Haliplus arrowi*, holotype. – 10, dorsal view; 11, antenna; 12, punctures near elytral base and suture; 13, dorsal side of hind tibia; 14, prosternal process; 15, lateral view of prosternal process; 16, left paramere; 17, penis; 18, right paramere.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Cardon; Museum Paris, Coll. Maurice Régimbart, 1908; type' (MNHN) [examined].

Haliplus shanicus Guignot, 1956: 477. Holotype ♂, 'S. Shan States, Road 40 km E. of Taunggyi, 25.IX-13.X.[19]34, Malaise' (NHRS) [examined]. **syn. n.**

Haliplus angustifrons; Régimbart 1899: 187, Zimmermann 1920: 303, 1924: 140, Guignot 1936: 117, 1954: 563, 1955b: 295, Vazirani 1966: 128.

Haliplus shanicus; Vazirani 1966: 133.

Diagnosis

This species can be distinguished from the other species with a posteriorly well impressed prosternal process by the characters mentioned in the key.

Description

Length 2.9-3.8 mm, width 1.6-2.0 mm. Body oval, widest in the middle (fig. 1).

Head: Yellow-brown to dark brown, vertex sometimes darkened, moderately strongly punctured. Distance between eyes 0.8-1.0 × width of one eye. Antennae yellow-red (fig. 2), palpi yellow-red.

Pronotum: Yellow-red to rust-coloured. Lateral borders straight to slightly concave in posterior half and convex in anterior half, strongly margined. Posterior corners clearly protruding. Moderately strongly, in anterior corners and along base strongly punctured. Impressed along base.

Elytra: Yellow-red to brown-red with extensive brown markings (fig. 1). Primary puncture-rows moderately strong, 25-33 punctures in first row. Secondary punctures relatively strong. All punctures darkened with yellow centre (fig. 3). Completely margined.

Ventral side: Body yellow-brown to rust-coloured or brown, elytral epipleura yellow-brown, legs yellow-red to brown. Prosternal process strongly impressed in posterior part, anterior edge usually not clearly margined, strongly punctured, narrowed near coxae, anteriorly about as wide as posteriorly (fig. 5), lateral plicae complete (fig. 6). Metasternal process widely and strongly impressed in the middle, moderately strongly to weakly punctured (fig. 5). Metacoxal plates strongly punctured, along suture with a weakly punctured area. Setiferous striole on dorsal side of hind tibia about 1/5 × length of tibia, longest of the two tibial spurs about 2/3 × length of first tarsal segment (fig. 4).

Male: First three tarsal segments of fore- and mid-legs widened, scaly hairs on ventral side. Penis and parameres as in figs. 7-9.

Biology and distribution (fig. 123)

In rivers. In mixed primary forest. In watertank. Up to an altitude of 1500 m.

India: Armachal Pradesh, Bihar, Karnataka, Madhya Pradesh, Maharashtra, Uttar Pradesh, West Bengal; Vazirani (1966) also gives Himachal Pradesh and Orissa. Sri Lanka. Nepal. Burma.

Material examined. – India: Armachal Pradesh: 1 ex., Assam, Patkai Mts, Doherty (BMNH); Bihar: 1♂, Lectotype; 1♂, 1♀, Konbir [Konbira], P. Cardon, paralectotype (MNHN); 1♂, 1♀, Konbir [Konbira, Ranchi distr.], P. Cardon, *Haliplus pulchellus* Régimbart det. 1890 (ISNB); 42 ex., Chota-Nagpore [Chota Nagpur], Nowatoli, R. P. Cardon, viii-ix.1896, ix-x.1896, iv-v.1897 (MNHN, RMNH); Karnataka: 1♂, 1♀, Shimoga, Maïssour, vi-vii.1897 (MNHN); Madhya Pradesh: 1 ex., Barway [Barwah?], P. Cardon (BMNH); Maharashtra: 1 ex., Lonaula, 80 km E. Bombay, 13.ix.1991, R. Schuh (NHMV); Uttar Pradesh: 1♂, O, Almora Dn., Kumaun, vii.1920, H.G.C (BMNH); West Bengal: 1♀, Sarda, F.W.C. (BMNH); no province known: 1♂, Indes Or., 22-53 (MNHN). – Nepal: 2♀, Kathmandu Valley, 7.ii.1981, M. Jäch (NHMV, Vondel); 2♀, Kathmandu Distr., Gokarna, 1.viii.1983, M.G. Allen, 4500', mixed primary forest (BMNH); 1♀, Ktmd [Kathmandu], Godavari [?], 15.viii.1967, 5000'; 2♂, 2♀, nr Birganj, Lothar, 12.ix.1967, 450 Ft. (CNCI); 8 ex., Godawari, 15 km S. Kathmandu, 1500 m, 29.iv.1984, Wewalka (Mazzoldi). – Sri Lanka: 1♂, Inginiyagala, 14.xii.1979, V. Mahler Jensen (ZMUC). – Burma: Holotype ♂, *H. shanicus*; 1♀ allotype, 1♂ paratype, data as holotype (NHRS); paratypes of *H. shanicus*, 1♂, 2♀, data as holotype (MNHN); 1♂, 1♀, Shan States, road 40 km E. of Taung-gyi, 25.ix-13.x.1934; 1♂, Shan States, Namhkok [?], 20. viii.1934, Malaise, 900 m.; 1♂, Shan States, Taung-gyi, 25.x.1934, Malaise, 1500 m, watertank (MNHN).

Haliplus arrowi Guignot
(figs. 10-18)

Haliplus arrowi Guignot, 1936: 117. – Holotype ♂, 'Type, ♂, Calcutta, Atkinson 92-3., Det. Dr. Guignot *Haliplus Arrowi* Guign., Type' (BMNH) [examined].

Haliplus arrowi; Guignot 1955b: 294, Vazirani 1966: 131, 1975: 317.

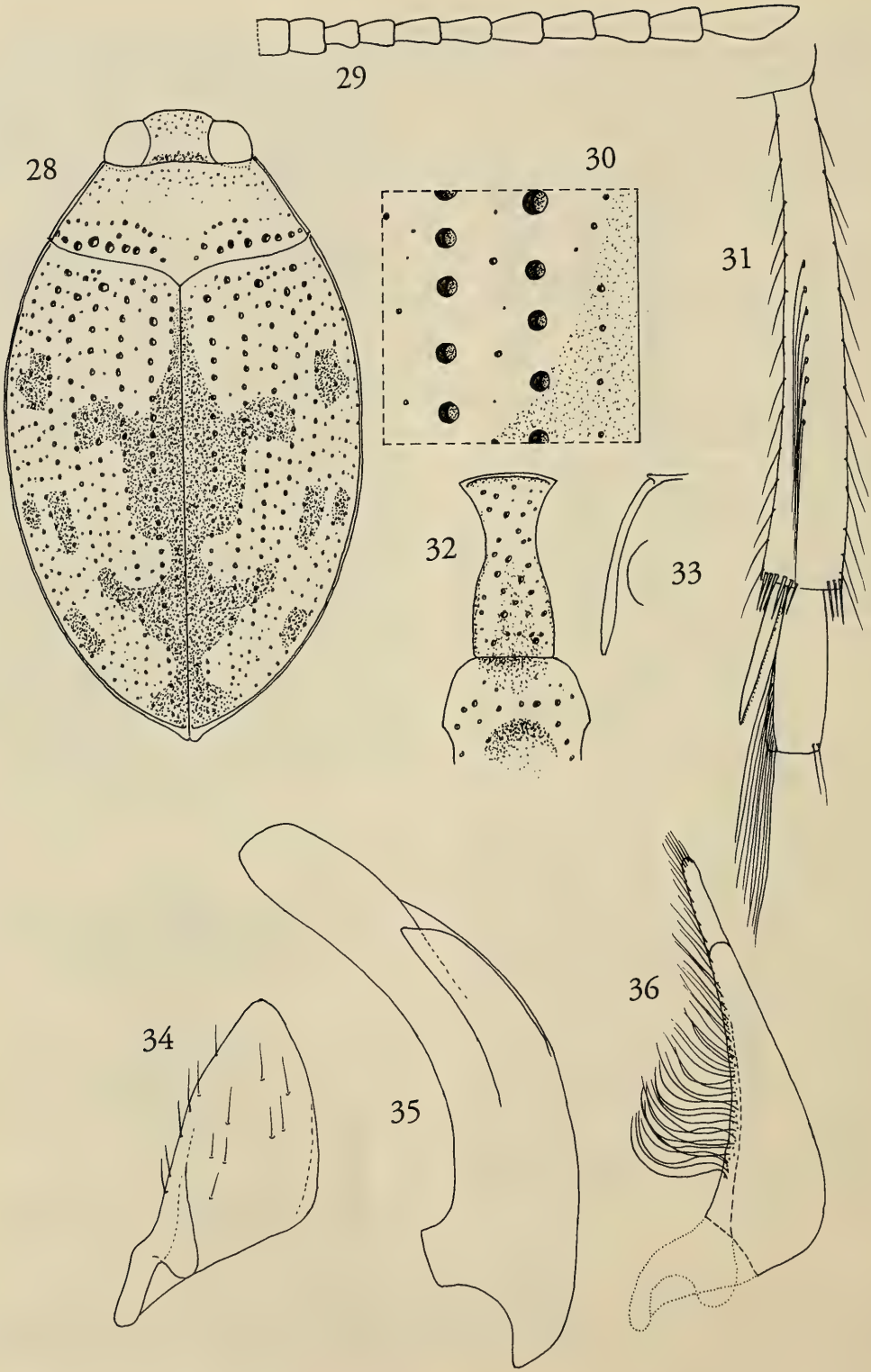
Diagnosis

This species is very closely related to *Haliplus angustifrons*, but has sparser elytral puncture-rows, the eyes less close to each other, the posterior corners of the pronotum less protruding and some other slight differences, mentioned in the key.

Description

Length 2.8-3.1 mm, width 1.5-1.6 mm. Body oval, widest in the middle (fig. 10).

Figs. 19-27. *Haliplus diopus*, holotype. – 19, dorsal view; 22, antenna; 21, punctures near elytral base and suture; 22, dorsal side of hind tibia; 23, prosternal process; 24, lateral view of prosternal process; 25, left paramere; 26, penis; 27, right paramere.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Head: Brown, moderately punctured. Distance between eyes 1.1-1.2× width of one eye. Antenna (fig. 11) and palpi yellow to yellow-brown.

Pronotum: Yellow-brown. Lateral borders convex, very finely margined, posterior corners not protruding. Width at base about 2.0× length in the middle. Fairly strongly, along the base very strongly and densely punctured, punctures not darkened. In the midddle a transverse somewhat elevated unpunctured band.

Elytra: Yellow-brown, brown marking along suture and part of base and on disc, marks in even intervals (fig. 10). Primary puncture-rows sparse and moderately strong, about 25 punctures in first row. Secondary punctures moderately strong along suture and rather weak in intervals. All punctures darkened with a yellow centre.

Ventral side: Yellow-brown to brown, elytral epipleura yellow, legs yellow-brown, femora brown to dark-brown near coxae. Prosternal process strongly impressed in posterior part and less impressed in anterior part, slightly narrowed near coxae, moderately strongly and densely punctured (fig. 14), lateral plicae complete (fig. 15). Anterior border of prosternum not completely margined, margin near prosternal process accompanied by four punctures in a row. Metasternal process with a wide and very deep pit, weakly punctured (fig. 14). Coxal plates densely punctured, except near suture, posterior part of plates dilated. Setiferous striole on dorsal side of hind tibia about 1/3× length of tibia and with about 8 punctures, longest of the two tibial spurs almost as long as first tarsal segment (fig. 13).

Male: First three tarsal segments of fore and midlegs slightly widened, scaly hairs on ventral side. Penis and parameres as in figs. 16-18.

Biology and distribution (fig. 124)

Biology unknown.

India: Bihar, Madras, Uttar Pradesh, West Bengal. Burma. Laos.

Material examined. – India: Bihar: 1♂, Lectotype (BMNH); 2♂, Calcutta, Atkinson, paratype (BMNH, MNHN); 2 ex., Pusa, Andrewes (BMNH); Uttar Pradesh: 1 ex., Sirampur [Sitapur?], Elberling (ZMUC); West Bengal: 1♂, Calcutta, *Haliplus pulchellus* det. dr Guignot (BMNH). – Burma: 1 ex., Maymyo, H.I. Andrewes (BMNH). – Laos: 1 ex., betw. Vientiane and Luang Prabang, end of 1919, R. V. de Salvara (BMNH). – Unlabelled: 3 ex. (BMNH).

***Haliplus chinensis* Falkenström**

Haliplus chinensis Falkenström, 1932: 191.

Fully redescribed by Vondel (1991). In the Oriental region only known from China.

***Haliplus diopus* Guignot**

(figs. 19-27)

Haliplus diopus Guignot, 1955a: 270. Holotype ♂, 'Tonkin, Hoa-Binh [Vietnam], VII-1940 (Coom.)' [A. de Cooman] (MNHN) [examined].

Haliplus diopus; Guignot 1955b: 294.

Diagnosis

This species can be distinguished from *H. pulchellus* by the wider distance between the eyes and from *H. indicus* by the clearly separated pits on the metasternal process.

Description

Length 2.8-3.1 mm, width 1.6-1.7 mm. Body oval, widest in or just before the middle (fig. 19).

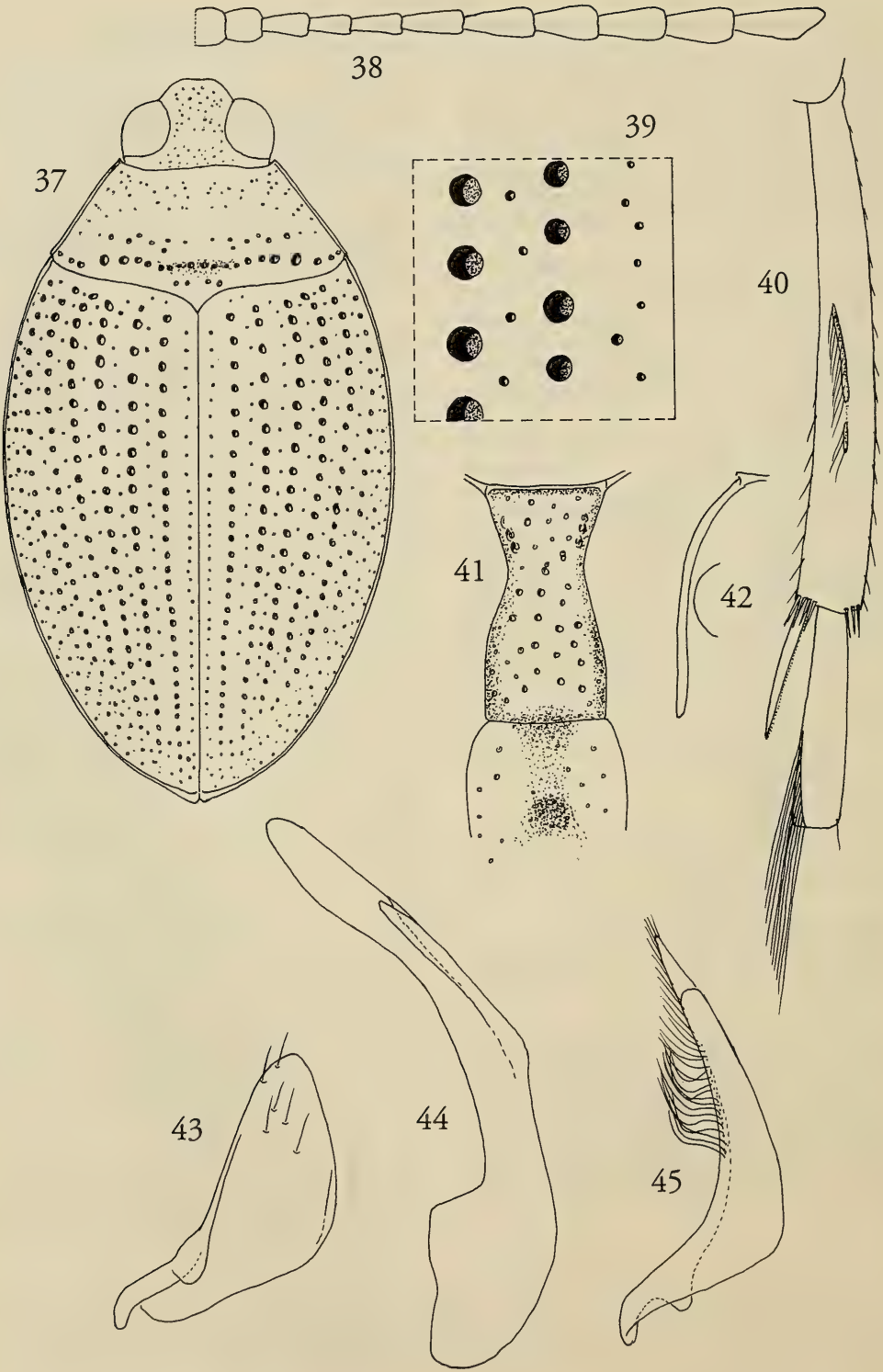
Head: Brown, sparsely and weakly punctured, between eyes partly unpunctured. Distance between eyes 1.1× width of one eye. Antennae yellow to yellow-red (fig. 20), palpi yellow-red.

Pronotum: Yellow to yellow-red, longitudinal dark blotch along the middle, this blotch can be vague or reduced to a blotch on anterior part (fig. 19). Lateral borders slightly convex, concave just behind anterior corners, weak margins not allways clearly visible because of coarse punctures. Strongly, on the disc more weakly punctured, widened punctures in rounded apical corners (fig. 19). Usually transverse impression along base. Width at base 1.8-2.1× length in the middle and 1.6-1.8× width in front.

Elytra: Yellow with an extensive dark marking along suture and along base to fifth puncture-row, central mark connected to small mark in third interval, a various number of irregular marks spread over elytra (fig. 19). Rather strong primary puncture-rows, 26-30 punctures in first row. Secondary punctures fairly strong, accompanied by some very small punctures. All punctures darkened, but distinctly yellow in centre of punctures (fig. 21). Margins of elytra slightly serrate in basal part (fig. 19).

Ventral side: Yellow-red to rust-coloured, elytral epipleura yellow-red, legs red-brown, darkened towards coxae. Prosternal process strongly grooved along margins, slightly narrowed near coxae, strongly

Figs. 28-36. *Haliplus diruptus*, holotype. – 28, dorsal view; 29, antenna; 30, punctures near elytral base and suture; 31, dorsal side of hind tibia; 32, prosternal process; 33, lateral view of prosternal process; 34, left paramere; 35, penis; 36, right paramere.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punctured in both grooves, clearly margined anteriorly (fig. 23), lateral plicae complete (fig. 24). Metasternal process flat with strong pit on both sides of the middle, between pits not or hardly impressed, sparsely, laterally densely punctured (fig. 23). Metacoxal plates strongly, along suture weakly and sparsely punctured, punctures without a hair, apical sutural corner slightly margined. Fifth and sixth abdominal segment with complete row of strong punctures. Setiferous striole on dorsal side of hind tibia very short, about 1/8× length of tibia, longest of two tibial spurs about 4/5× length of first tarsal segment (fig. 22).

Male: First three tarsal segments of fore- and mid-legs widened, scaly hairs on ventral side. Penis and parameres as in figs. 25-27.

Biology and distribution (fig. 128)

Biology unknown.

Vietnam.

Material examined. – Vietnam: Holotype ♂, ♀ allotype, 4 ♂ paratypes, 6♀ paratypes, Tonkin, Hoa Binh, viii.1940 & viii.1941, A. de Cooman, *Haliplus diopus* n. sp. dr. F. Guignot det. (ISNB, MNHN).

Haliplus diruptus Balfour-Browne
(figs. 28-36)

[*Haliplus simplex* sensu Régimbart 1899, nec Clark 1863. Misidentification].
Haliplus diruptus Balfour-Browne, 1946: 436.

This species was fully redescribed by Vondel (1991: 95).

Probably also in India: see under unnamed material. Guignot records this species from Burma (1954: 563), but later (1956) changed his view and based the new *H. shanicus* on that material. Additional material examined: 1♀, SW China, Yunnan, Western Hills nr. Kunming, 2100 Mt., 7.viii.1940, J. L. Gressitt (BPBM).

Haliplus eximius Clark
(fig. 37-45)

Haliplus eximius Clark, 1863: 418.
Haliplus modestus Zimmermann, 1924: 139.
Haliplus hiogoensis Kano & Kamiya, 1931: 1.
Haliplus emmerichi Falkenström, 1936: 79.

This species was fully redescribed by Vondel (1991: 97), but erroneously treated under the name *H. eximis.*

Additional material examined: China: 2 ex., Chusan Isl, J. J. Walker (BMNH); 1 ex., Fukien, Yungan, 5.ix.1940, T. C. Man (BPBM).

Haliplus holmeni Vondel

Haliplus holmeni Vondel, 1991: 109.

This species is only known from China: Yunnan.

Haliplus indicus Régimbart stat. n.
(figs. 46-54)

Haliplus pulchellus var. *indicus* Régimbart, 1899: 189. Lectotype ♂ (here designated), 'Chota-Nagpore [India, Ranchi Distr., Bihar], Nowatoli, R. P. Cardon, viii-ix.1896, *pulchellus* var. *indicus* Rég., Dr. Régimbart vidit 1898, Museum Paris, ex coll. R. Oberthur' (MNHN) [examined].
Haliplus pulchellus var. *indicus*; Zimmermann 1920: 314.
Haliplus pulchellus ab. *indicus*; Zimmermann 1924: 140.
Haliplus pulchellus indicus; Vazirani 1966: 133.

Diagnosis

This species, belonging to the group with double grooved prosternal process, can be distinguished from *H. pulchellus* by the wider distance between the eyes. It is here considered a distinct species.

Description

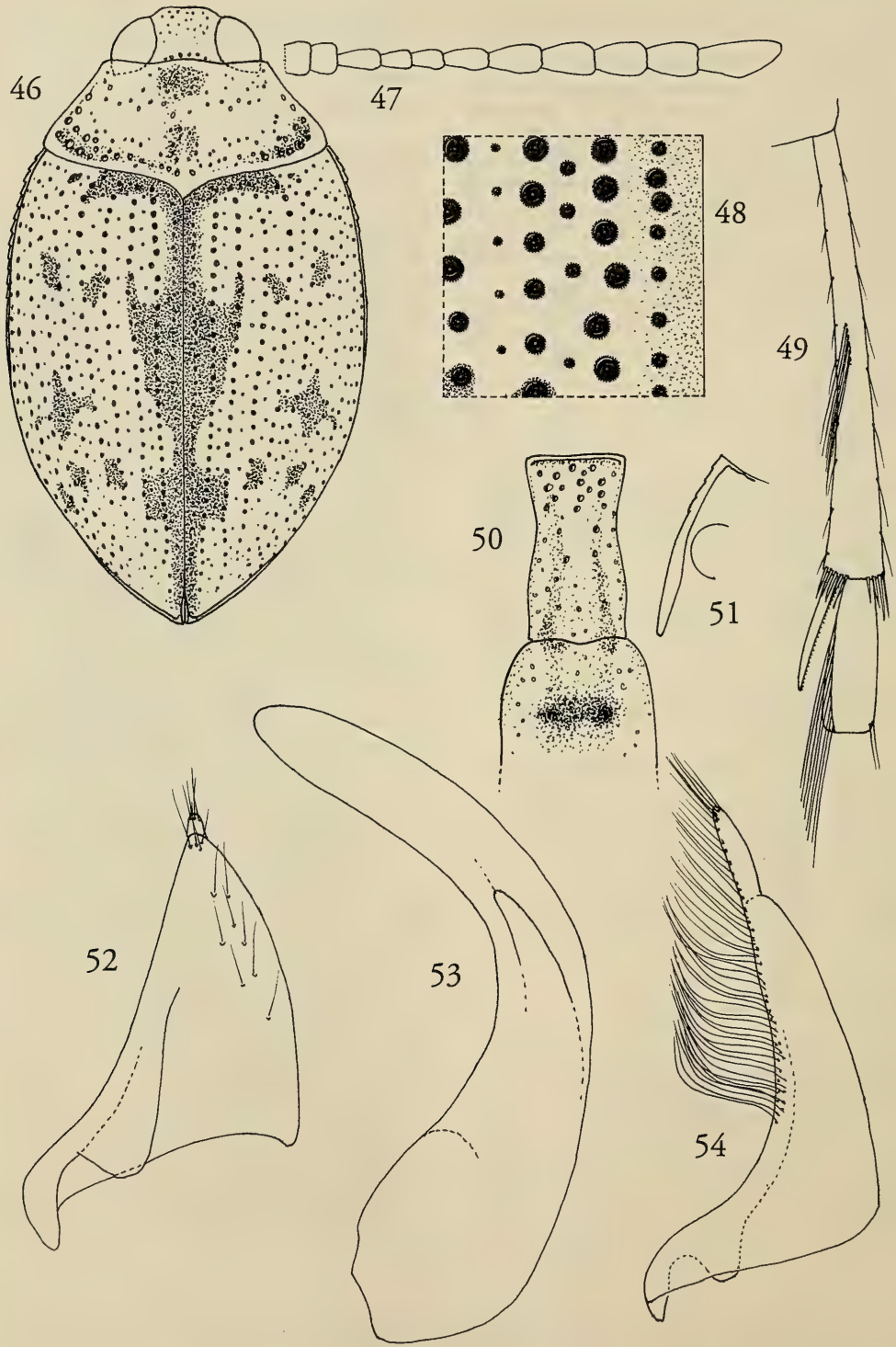
Length 2.8-3.1 mm, width 1.6-1.7 mm. Body oval, widest in or just before the middle (fig. 46).

Head: Brown, sparsely and weakly punctured, between eyes partly unpunctured. Distance between eyes 1.1-1.2× width of one eye. Antennae yellow to yellow-red (fig. 47), palpi yellow-red.

Pronotum: Yellow to yellow-red, dark mark in anterior middle, vague central mark before base can be reduced or absent (fig. 46). Lateral borders slightly convex, concave just behind anterior corners, weak margins usually not clearly visible because of coarse punctures. Strongly punctured, on disc more weakly so, with widened punctures in rounded posterior corners. Usually a transverse impression along base opposite fourth to sixth elytral puncture-row.

Elytra: Yellow with an extensive dark marking along suture and along base to fourth or fifth puncture-row, central mark connected with small mark in fourth interval, a variable number of irregular marks spread over elytra (fig. 46). Rather strong to strong primary puncture-rows, 26-35 punctures in first row. Secondary punctures fairly strong. All punctures darkened, but distinctly yellow in centre of punctures (fig. 48). Margins of elytra slightly serrate in basal part (fig. 46).

Figs. 37-45. *Haliplus eximius*, China. – 37, dorsal view; 38, antenna; 39, punctures near elytral base and suture; 40, dorsal side of hind tibia; 41, prosternal process; 42, lateral view of prosternal process; 43, left paramere; 44, penis; 45, right paramere.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Ventral side: Yellow-red to rust-coloured, elytral epipleura yellow-red, legs red-brown, darkened towards coxae. Prosternal process strongly grooved along margins, slightly narrowed near coxae, strongly punctured in both grooves, clearly margined along anterior edge (fig. 50), lateral plicae complete (fig. 51). Metasternal process with strong transverse impression, in which two pits can be recognised, sparsely punctured (fig. 50). Metacoxal plates strongly, along suture weakly and sparsely punctured. Fifth and sixth sternite with complete transverse row of strong punctures, last sternite strongly and densely punctured. Setiferous striole on dorsal side of hind tibia about 1/5 × length of tibia, longest of two tibial spurs about 4/5 × length of first tarsal segment (fig. 49).

Male: First three tarsal segments of fore- and mid-legs widened, scaly hairs on ventral side. Penis and parameres as in figs. 52-54.

Biology and distribution (fig.127)

Biology unknown.

India: Bihar, West Bengal, Tamil Nadu.

Material examined. – India: 4♂, 2♀, Chota Nagpore [Ranchi distr. Bihar], Nowatoli, R.P. Cardon, viii-ix.1896 (MNHN, RMNH); 5♂, 4♀, W. Bengal, Santiniketan, Birbhum District, x.1937, T. C. Maa; 1♀, Madras State, Coimbatore, 420 m, iv.1962, P. S. Nathan (BPBM).

Haliplus javanicus sp. n.
(fig. 55-63)

Type material. – Holotype ♂, 'Tjilatjap, Java, Drescher, 12.1915; coll. F. C. Drescher' (ZMAN). – Paratypes, 2♂: 1♂, data as holotype (coll. Vondel); 1♂, 'Java, 1915, Weltevreden, Neytzell de Wilde; coll. Dr. D. MacGillavry (ZMAN).

Diagnosis

This species can be distinguished from other species with a double grooved prosternal process by the combination of the central pronotal blotch, the smooth elytral margin near shoulders and the elytral basal darkening reaching sixth puncture-row.

Description

Length 2.8-3.0 mm, width 1.5-1.7 mm. Body oval, widest in the middle (fig. 55).

Head: Brown to dark brown, moderately strongly, on vertex stronger punctured. Distance between eyes 0.7-1.0 × width of one eye. Antennae yellow-red (fig. 56), palpi yellow-red.

Pronotum: Yellow to yellow-brown with large central longitudinal mark. Lateral borders straight and finely margined, near anterior corner concave and not margined. In posterior corners strongly and densely punctured, basally strongly punctured, on the disc more weakly and sparsely punctured. Impressed opposite fourth to sixth elytral puncture-rows (fig. 55).

Elytra: Yellow to yellow-red, dark marks along suture and along base to sixth puncture-row, various marks on intervals (fig. 55). Primary puncture-rows moderately strong, about 28 punctures in first row. Secondary punctures strong. All punctures darkened with yellow centre (fig. 57).

Ventral side: Body yellow-red to brown, elytral epipleura yellow-red, legs yellow-red to brown-red. Prosternal process with two strong grooves, margined at anterior edge, narrowed near coxae, moderately strongly and sparsely punctured (fig. 59), lateral plicae complete (fig. 60). Metasternal process with two strong pits, weakly punctured (fig. 59). Metacoxal plates strongly punctured, along suture weakly punctured. Setiferous striole on dorsal side of hind tibia very short, consisting of about 4 small punctures, longest of the two tibial spurs about 2/3 × length of first tarsal segment (fig. 58).

Male: First three tarsal segments of fore- and mid-legs widened, scaly hairs on ventral side. Penis and parameres as in figs. 61-63.

Biology and distribution (fig.130)

Biology unknown.

Indonesia: Java.

Haliplus kapuri Vazirani
(fig. 64-65)

Haliplus kapuri Vazirani, 1975: 317. Holotytpe ♂, India, Maharashtra, Fritzgerald, Satara District, 5.x.1972, A. P. Kapur (in Zoological Survey of India, Calcutta)[not examined]

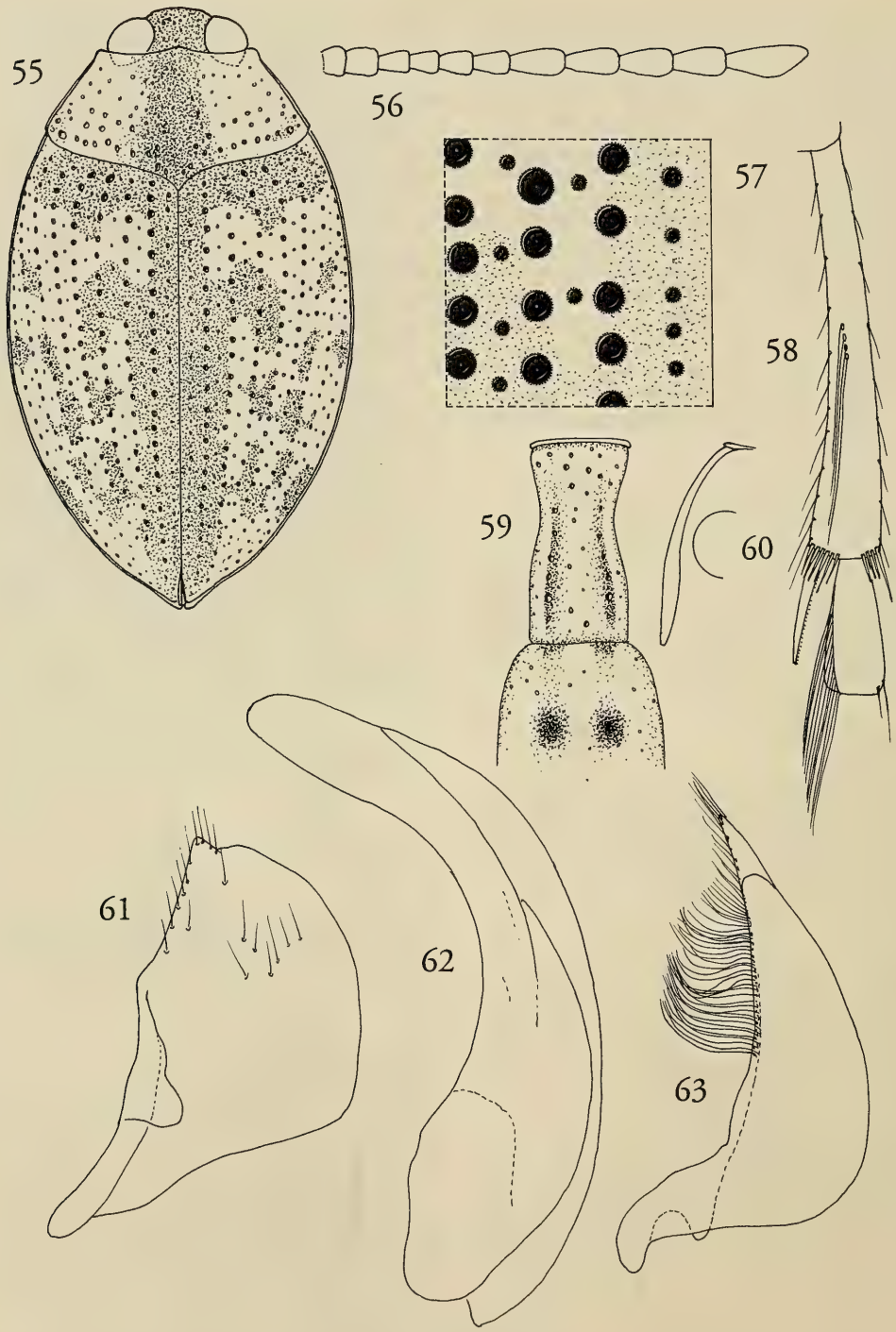
Original description

Length 3.5 mm.

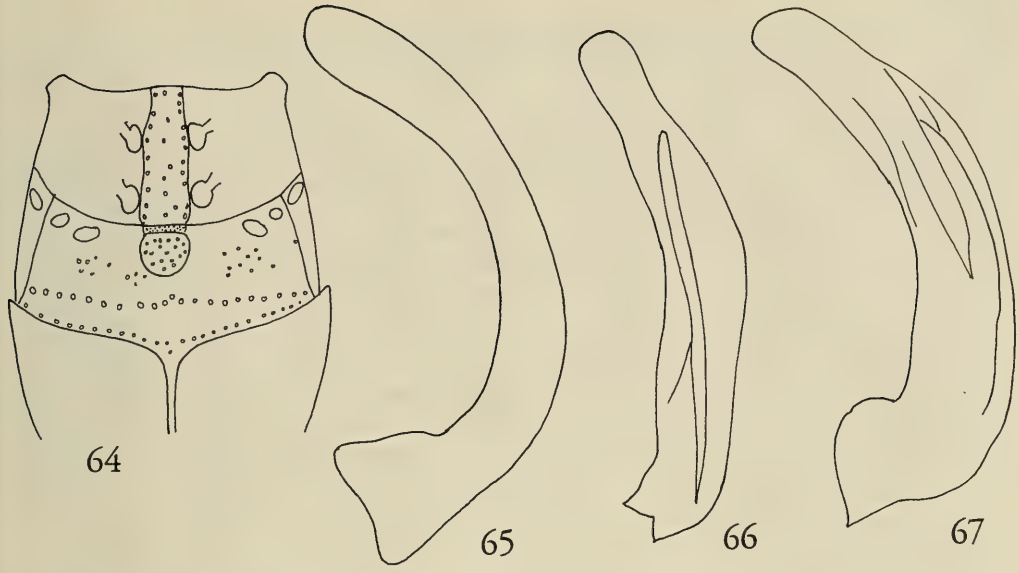
Head testaceus; punctation moderate and irregular, stronger on the vertex; antennal segments 3 and 4 rather thinner than others, 7th segment slightly longer than 8th segment.

Pronotum testaceus; punctation larger than on the head, larger and stronger anteriorly and posteriorly, less strong on the disc, generally irregular, two longitudinal rows of fine punctures discernible on the disc;

Figs. 46-54. *Haliplus indicus*, lectotype. – 46, dorsal view; 47, antenna; 48, punctures near elytral base and suture; 49, dorsal side of hind tibia; 50, prosternal process; 51, lateral view of prosternal process; 52, left paramere; 53, penis; 54, right paramere.



Figs. 55-63. *Haliplus javanicus*, holotype. – 55, dorsal view; 56, antenna; 57, punctures near elytral base and suture; 58, dorsal side of hind tibia; 59, prosternal process; 60, lateral view of prosternal process; 61, left paramere; 62, penis; 63, right paramere.



Figs. 64-65. *Haliplus kapuri*, (after Vazirani, 1975). – 64, ventral view of thorax; 65, penis.
Figs. 66. *Haliplus manipurensis*, penis (after Vazirani 1966).
Figs. 67. *Haliplus pruthii*, penis (after Vazirani 1966).

lateral margin of the pronotum rebordered.

Elytra pale testaceus without any markings; punctation quite regular except in the apical portion, both strial and interstrial punctures black; row of sutural punctures moderate, less strong but more dense than the strial punctures, interstrial punctures less strong than the strial punctures but not more numerous than them.

Ventral side testaceus with legs ferruginous, mesosternum darker, metacoxal plates and epipleurae paler. Prosternal process not rebordered laterally but canaliculate, strongly punctate more so on the lateral borders, a little narrowed in between the procoxae and the mesocoxae (fig. 64), anteriorly bordered by a fine ridge; anterior part of the metasternum (behind the prosternal process) distinctly swollen/inflated, with a large median pit behind it and two smaller pits on the anterolateral corner; punctation on the metasternum irregular except a transverse row of strong punctures behind the large median pit and a row of fine punctures along the posterior border of the metasternum; metacoxal plates moderately punctate, punctures irregular and separated by 2-3× its own diameter. Penis (fig. 65) rather strongly curved, rounded at the apex and narrowed in the middle.

Biology and distribution (fig. 129)

Biology unknown.

Only known from the type-locality.

Remarks. – As I have been unable to borrow the type for examination I only know this species from the original description. According to Vazirani it comes close to *H. arrowi*.

Haliplus kotoshonis Kano & Kamiya

Haliplus kotoshonis Kano & Kamiya, 1931: 2.

This species is fully redescribed by Vondel (1991: 113).

Probably in Laos: see under unnamed material. Additional notes: Satô (1984) recorded this species from the Ryukyu Islands.

Additional material examined. – 1♀, Ryukyu Isl., Ishigaki I., 20-30.xi.1952, G.E. Bekart (BPBM).

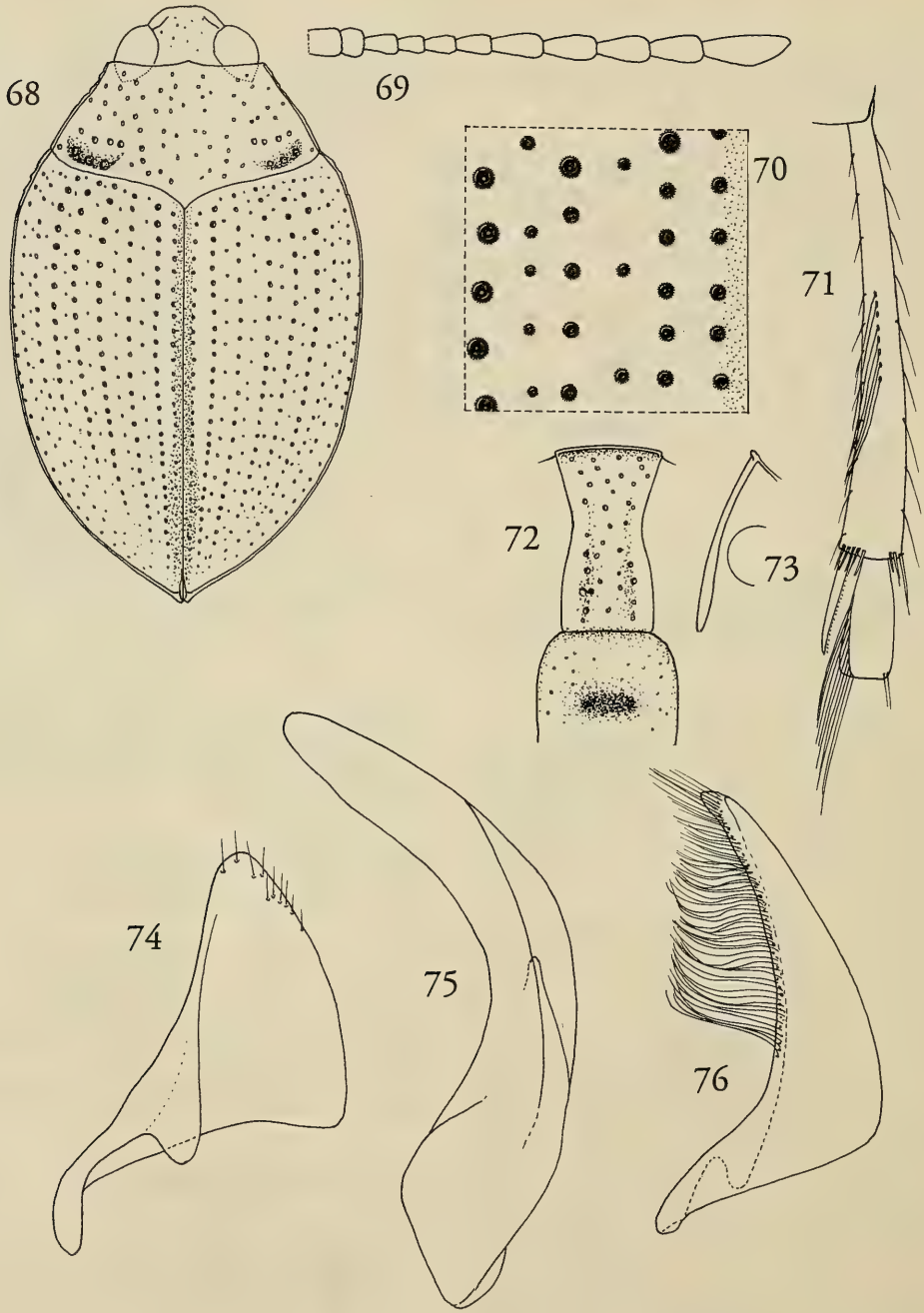
Haliplus manipurensis Vazirani
(fig. 66)

Haliplus manipurensis Vazirani, 1966: 132. Holotype ♂, [India], Manipur, Imphal, 880 m, 24°44'N, 93°58'E, 8.vii.1960, F. Schmid coll. (in Zoological Survey of India) [not examined].

Original description

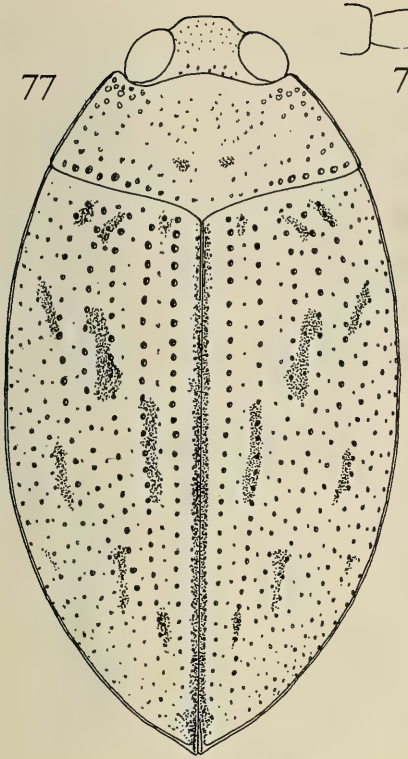
Length 3.2-3.5 mm. Form, oval, feebly attenuated posteriorly.

Head testaceus, finely and moderately punctate, punctures on the vertex separated by their own diam-



Figs. 68-76. *Haliplus nedungaduensis*, holotype. – 68, dorsal view; 69, antenna; 70, punctures near elytral base and suture; 71, dorsal side of hind tibia; 72, prosternal process; 73, lateral view of prosternal process; 74, left paramere; 75, penis; 76, right paramere.

Figs. 77-86. *Haliplus perroti*, holotype. – 77, dorsal view; 78, antenna; 79, punctures near elytral base and suture; 80, dorsal side of hind tibia; 81, prosternal process; 82, lateral view of prosternal process; 83, metacoxal plate; 84, left paramere; 85, penis; 86, right paramere.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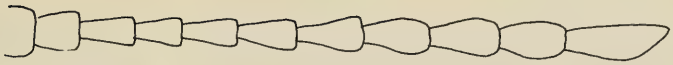
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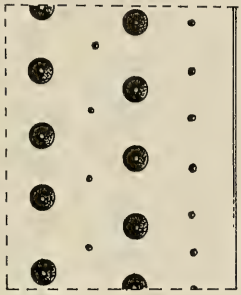
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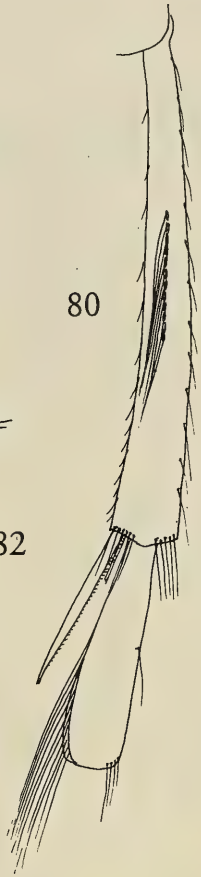
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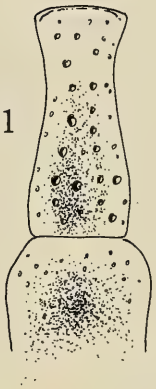
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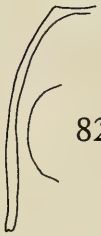
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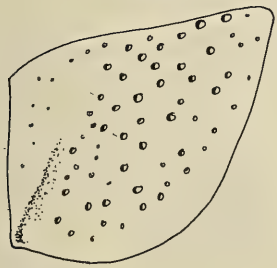
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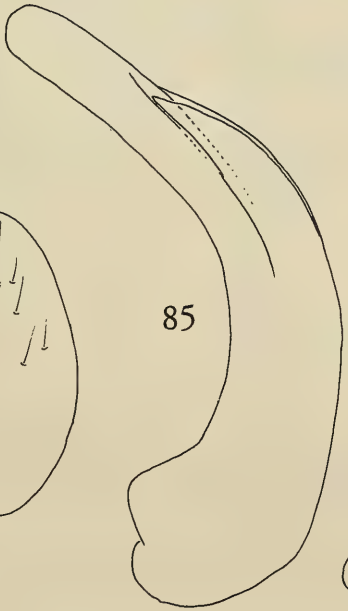
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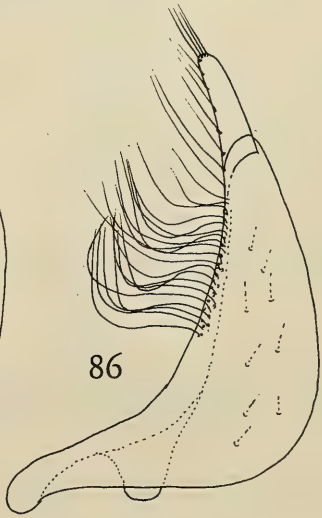
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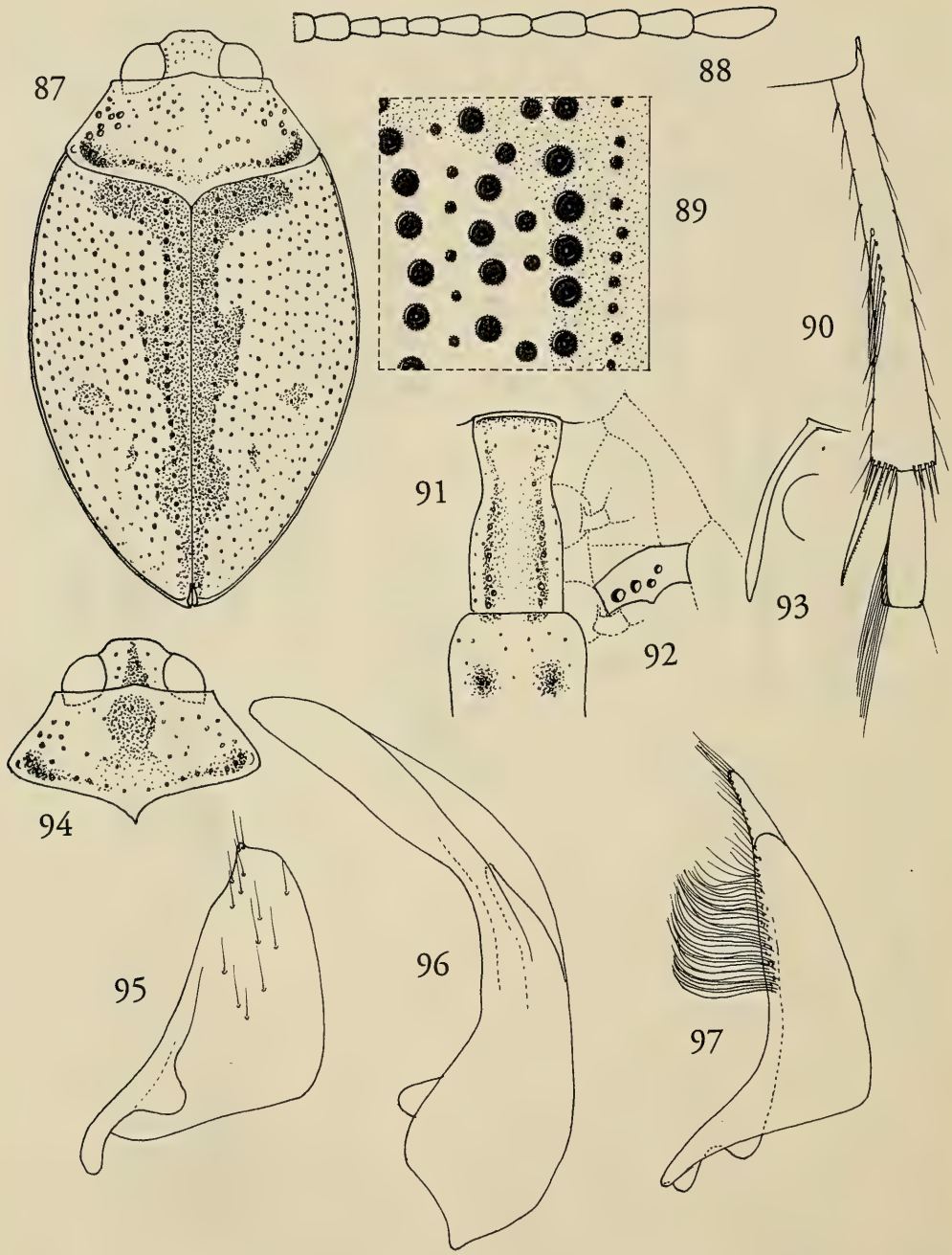


Figs. 87-97. *Haliplus philippinus* (87, 89-91, 93, 95-97, holotype; 88, 92, 94, Laos). – 87, dorsal view; 88, antenna; 89, punctures near elytral base and suture; 90, dorsal side of hind tibia; 91, prosternal process; 92, mesepimeron; 93, lateral view of prosternal process; 94, head and pronotum; 95, left paramere; 96, penis; 97, right paramere.

eter. Antennal segments 7-11 subequal and broader than the sixth.

Pronotum testaceous, paler towards sides; punctation moderate and irregular, stronger along anterior and posterior margins, sparse on the disc; a few punctures on postero-lateral margins strong and confluent. Anterior angles not projecting beyond the middle of anterior margin. Sides moderately rebordered, slightly convex, posterior angles slightly prominent, not projecting beyond the thoraco-elytral angles.

Elytra testaceous with irregular ferruginous markings, more so along the suture and extending laterally at base. Sutural line of punctation irregular, not so closely punctate; punctures separated by twice their own diameter. Strial punctures moderate, shallow, black; on the disc quite close and not separated by their own diameter. Each interstrial space with a row of much smaller and deeper, but not more numerous black punctures.

Ventral side testaceous, epipleurae paler. Prosternal process and legs darker. Prosternal process margined laterally but not anteriorly, canaliculate, slightly narrowed adjacent to the front coxae; anterior end a little wider than apex; lateral margins punctate but not roughened, punctures fine, separated by more than their own diameter. Apical part of metasternum almost flat, pitted, moderately but irregularly punctate. Metacoxal plates with moderate, shallow and dense punctures, punctures separated by half of their own diameter.

Male with anterior tarsi moderately broadened and furnished with 'ciliae' underneath; claws broken. Penis very slightly curved, rounded at the apex (fig. 66).

Biology and distribution (fig. 129)

Biology unknown.

Only known from the type-locality.

Remarks. – As I have been unable to borrow the type for examination I only know this species from the original description.

Haliplus nedungaduensis sp. n.
(figs. 68-76)

Type material. – Holotype ♂, 'South India, Nedungadu, 7.1934, Hathach [?]' (MNHN).

Diagnosis

This species can be distinguished from the other species with double grooved prosternal process by the absence of elytral markings.

Description

Length 2.7 mm, width 1.5 mm. Body oval, widest in the middle (fig. 68).

Head: Yellow-brown, vertex slightly darkened, rather weakly punctured, unpunctured band between the eyes not always present. Distance between the eyes 1.2-1.4× the width of one eye. Antennae yellow-red (fig. 69), palpi yellow-red.

Pronotum: Yellow to yellow-red. Lateral borders about straight, fine margins a little undulate. Moderately strongly and sparsely punctured. Base opposite fourth to sixth elytral puncture-row impressed and strongly punctured (fig. 68).

Elytra: Yellow to yellow-red, suture slightly darkened to secondary punctures (fig. 68). Completely margined, margin serrate in anterior part. Primary puncture-rows fairly weak, about 29 punctures in first row. Secondary punctures strong. All punctures darkened with a yellow centre (fig. 70).

Ventral side: Body yellow to yellow-red, elytral epipleura yellow, legs yellow-red to brown-red, slightly darkened towards coxae. Prosternal process with two weak grooves, margined at anterior edge, narrowed near coxae, anteriorly wider than posteriorly, moderately strongly punctured (fig. 72), lateral plicae complete (fig. 73). Metasternal process with deep transverse impression in which two pits are recognisable, weakly punctured (fig. 72). Metacoxal plates moderately strongly punctured, along suture with a weakly punctured area. Setiferous striole on dorsal side of hind tibia about 1/3 × length of tibia, longest of the two tibial spurs about 2/3 × length of first tarsal segment (fig. 71).

Male: First three tarsal segments of fore- and mid-legs widened, scaly hairs on ventral side. Penis and parameres as in figs. 74-76.

Biology and distribution (fig. 127)

Biology unknown.

Only known from the type-locality.

Haliplus perroti Guignot
(figs. 77-86)

Haliplus perroti Guignot, 1950: 25. Holotype ♂, 'Tam Dao, Tonkin, H. Perrot, ♂, Type' (MNHN) [examined].

Diagnosis

This species can be recognised by the longitudinal elytral marks, which are not connected to the darkened suture.

Description

Length 3.2-3.4 mm, width 1.7-1.9 mm. Body oblong oval, widest in the middle (fig. 77).

Head: Yellow-brown, vertex slightly darkened, rather weakly punctured, unpunctured band between eyes not always present. Distance between eyes 1.2-1.4× width of one eye. Antennae yellow-red (fig.

78), palpi yellow-red.

Pronotum: Yellow with two small marks on disc before base. Lateral borders convex, finely margined. In anterior corners strongly and densely punctured, basally with a continous row of darkened punctures getting strong towards sides, on disc more weakly and sparsely punctured. Slightly impressed in front of central base (fig. 77).

Elytra: Yellow to yellow-red, suture completely darkened to secondary punctures, oblong marks on even intervals (fig. 77). Primary puncture-rows fairly weak, 31-35 punctures in first row. Secondary punctures weak. All punctures darkened with yellow centre (fig. 79).

Ventral side: Body yellow-red to yellow-brown, elytral epipleura yellow, legs brown-red, darkened towards coxae. Prosternal process impressed in the middle, less impressed at apex, margined at anterior edge, narrowed near coxae, moderately strongly punctured (fig. 81), lateral plicae complete (fig. 82). Metasternal process widely and strongly impressed in the middle, weakly punctured (fig. 81). Metacoxal plates densely and rather strongly punctured, along suture with a wide weakly punctured area, slightly impressed towards apical point (fig. 83). Setiferous striole on dorsal side of hind tibia about 1/3 × length of tibia, consisting of about 12 small groovelike connected punctures, longest of the two tibial spurs about 2/3 × length of first tarsal segment (fig. 80).

Male: First three tarsal segments of fore- and midlegs widened, scaly hairs on ventral side. Penis and parameres as in figs. 84-86.

Biology and distribution (fig.125)

Biology unknown.

Vietnam. India: West Bengal, Rajasthan.

Material examined. – Vietnam: Holotype ♂; 1♀, allotype, 2 ♂, paratype, Tam Dao, Tonkin, H. Perrot (MNHN). – India: 1 ex., Pusa, Bengal, R. D. D., xi.1908 (BMNH); 1♀, Rajasthan, Sariaka, 16.viii.1989, A. Riedel (Hendrich).

Haliplus philippinus Chapin
(figs. 87-97)

Haliplus philippinus Chapin, 1930: 9. Holotype ♂, 'Bacoor Nov PI, P. L. Stangl Collector, Type No. 41757 U.S.N.M., Haliplus philippinus Type Chap.' (USNM) [examined].

Diagnosis

This species can be distinguished from the related *H. pulchellus* by the four punctures on the mesepimeron.

Description

Length 2.4-2.7 mm, width 1.3-1.5 mm. Body broad, more or less parallel in basal half of elytra (fig. 87).

Head: Brown-red, margins dark, weakly and sparsely punctured. Usually with dark arrowlike mark (fig. 94). Distance between eyes about 1.2 × width of one eye. Antennae yellow-red (fig. 88), palpi yellow-red.

Pronotum: Yellow-red to yellow in lateral parts. Usually with dark central mark (fig. 94). Lateral borders slightly convex, not margined. Posterior corners broadly rounded, anterior corners bent outwards. Anterior margin clearly protruding in the middle. Rather weakly punctured, two rows of strong punctures along the slightly impressed base, coarse punctures together forming a strong impression in each hind corner (fig. 87).

Elytra: Yellow-red, brown markings along base and suture and a clear mark in posterior half between fourth and sixth puncture-row, often additional marks on intervals (fig. 87). Primary punctures moderately strong, standing in irregular sometimes difficult to recognise rows. About 28 punctures in first row. Secondary punctures relatively strong, sometimes nearly as strong as primary punctures. All punctures slightly darkened with a yellow centre (fig. 89).

Ventral side: Body brown-red with several strongly darkened parts, elytral epipleura yellow-red, legs yellow-red to brown-red. Mesepimeron with about 4 strong punctures (fig. 92). Prosternal process parallel, slightly narrowed near coxae, sparsely punctured, margins ridgelike, about flat in the middle (fig. 91). Metasternal process flat, small clear pit on each side, sparsely punctured. Metacoxal plates strongly, near suture very sparsely and weakly punctured, apical corner of suture sharp. Last sternite largely covered with strong punctures, fifth and sixth sternite with a continuous row of strong punctures. Setiferous striole on dorsal face of hind tibia about ¼ × length of tibia, longest of tibial spurs about ⅘ × length of first tarsal segment (fig. 90).

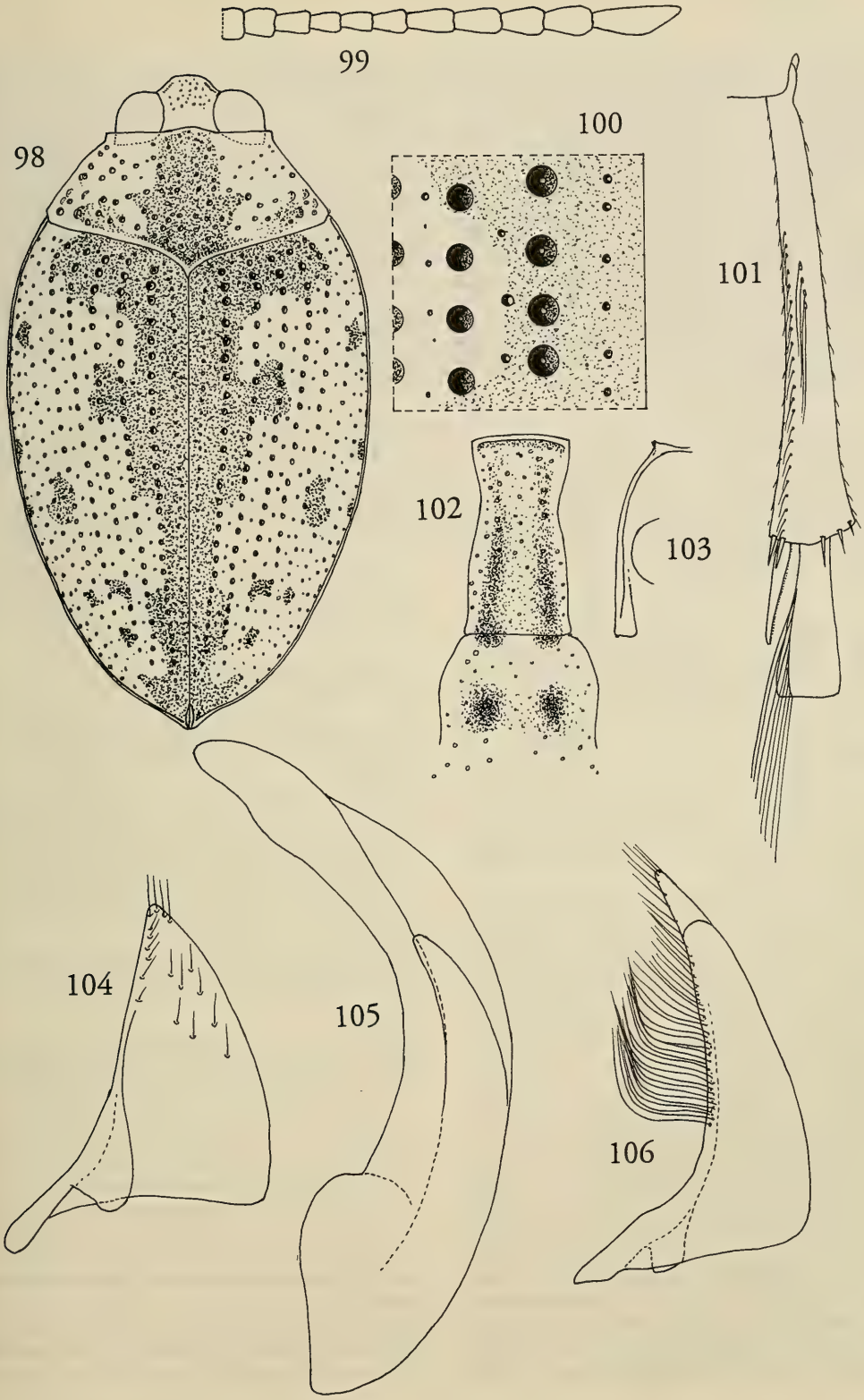
Male: First three segments of front and midlegs slightly widened, scaly hairs on ventral side. Claws of forelegs equal in shape and length. Penis and parameres as in figs. 95-97.

Biology and distribution (fig. 128)

Attracted to light. Up to an altitude of 920 m.

Philippines. Indonesia: Java. Thailand. Laos. Vietnam. Burma.

Figs. 98-106. *Haliplus pulchellus*, lectotype. – 98, dorsal view; 99, antenna; 100, punctures near elytral base and suture; 101, dorsal side of hind tibia; 102, prosternal process; 103, lateral view of prosternal process; 104, left paramere; 105, penis; 106, right paramere.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Material examined. – Philippines: Holotype ♂ (USNM). – Vietnam: 1♀, Cochin China, Travinh, Travinh Prov., vii.1932, K.M. Tsui (BPBM). – Laos: 2♂, Vientiane, 31.v-3.vi.1960, S. Quale & L. Quale, light trap; 1♂, Muong Sing, NW of Luang Prabang, 6-10.vi.1960, L.W. Quale, light trap, 650 m.; 2 ex., 39 km S. Djiring, 810 m, 29.iv.1969, J.W. Quale; 2 ex., Di Linh, Djiring, 920 m, light trap, 22-28.iv.1960, S. & J. Quale; 1 ex., Cochin China, French Indo China, Travinh, Travinh Province, vii.1932, K. H. Tsui (BPBM). – Thailand: 2♂, 1♀, Bangkok (BMNH, Vondel); 2 ex., Bangkok, Aynttaya, 28.viii.1988, S. Schödl (NHMV, Vondel); 2 ex., Bangkok (MNHN); 2 ex., 25 km NW Lan Sak, 210 km NW Bangkok, viii.1991, W. Thielen (RMNH). – Burma: 1♀, Victoria Point, Tenasserim, viii.1887, E.T. Atkinson (BMNH); 8 ex., Rangun, 16.v.1976, Wewalka (Mazzoldi). – Indonesia: 1♂, Batavia [Jakarta], ii.1949, C. v. Nidek (ZMAN).

Haliplus pruthii Vazirani
(fig. 67)

Haliplus pruthii Vazirani, 1966: 130. Holotype ♂, Madhya Pradesh (Narmada Survey); Rewa State (=Rewa District), Khetagao, stn. 45, c 880 m, 24°31'N, 81°19'E; Mar.1927, H.S. Prithi coll. (in: Zoological Survey of India) [not examined].

Diagnosis

The character of the two longitudinal marks on pronotum seems to offer a possibility to distinguish this species from related species.

Original description

Length 3.0-3.2 mm.

Head testaceus; punctation on the vertex fine, moderately close; antennal segments 7-11 subequal, segment 7 not significantly broader than preceding segment.

Pronotum testaceus, with two ferruginous longitudinal parallel lines on the disc coinciding with punctures; punctation irregular, moderate, rather effaced on the disc (excepting those coinciding with the ferruginous markings); sides narrowly rebordered, a little oblique, very slightly convex; posterior angles obtuse. Anterior angles almost in line with middle of the anterior margin.

Elytra testaceus, with irregular and indeterminate ferruginous markings, more prominent along the suture and at base. Sutural line of punctures regular, punctures almost separated by their own diameter, more numerous than the strial punctures. Strial punctures moderate, rather close and shallow, narrowly black. Each interstrial space with a row of small deep punctures not more than the strial punctures.

Ventral side testaceus; sternum and legs ferruginous. Prosternal process moderately margined laterally, narrowly margined anteriorly, moderately narrowed adjacent to the front coxae, anterior end and apical end subequal, lateral margins punctate, median area hardly inflated, punctation indistinct. Apical part of metasternum slightly inflated and pitted. Metasternum weakly and sparsely punctate. Abdominal sternites with a single transverse row of punctures. Apical abdominal sternite with a few postero-lateral punctures (less than in *angustifrons* or *arrowi*). Metacoxal plates more or less regular and finely punctate, separated by two or three times their own diameter.

Male with protarsi moderately dilated and furnished with cilia underneath. Protarsal claws thin, slightly curved and more than half the apical segments length. Penis (fig. 67) of paratype moderately curved.

Biology and distribution (fig. 129)

Up to an altitude of 880 m. Probably attracted to light.

India: Madhya Pradesh, probably also in Uttar Pradesh and Bihar (see under unnamed material).

Remarks. – As I have been unable to borrow the type for examination I only know this species from the original description.

Haliplus pulchellus Clark
(fig. 98-106)

Haliplus pulchellus Clark, 1863: 418. Lectotype ♂ (here designated), 'Browning, Siam [Thailand], Co-type' (BMNH) [examined].

Haliplus oceanicus Régimbart, 1886: 139. Lectotype ♀ (here designated), 'Ed. Everts, W. Dates, Medan, Sumatra; *Haliplus oceanicus* Régb., type; Type; Museum Leiden, *Haliplus pulchellus* det. Clark (RMNH) [examined].

Haliplus pulchellus; Régimbart 1889: 147, 1892: 112, 1899: 188, Zimmerman 1920: 314, 1924: 140, 1927: 2, Guignot 1955b: 295, Vazirani 1966: 133.

Haliplus oceanicus; Zimmermann 1927: 3.

Haliplus pulchellus var. *oceanicus*; Régimbart 1899: 189, Zimmermann 1920: 314, 1924: 140.

Diagnosis

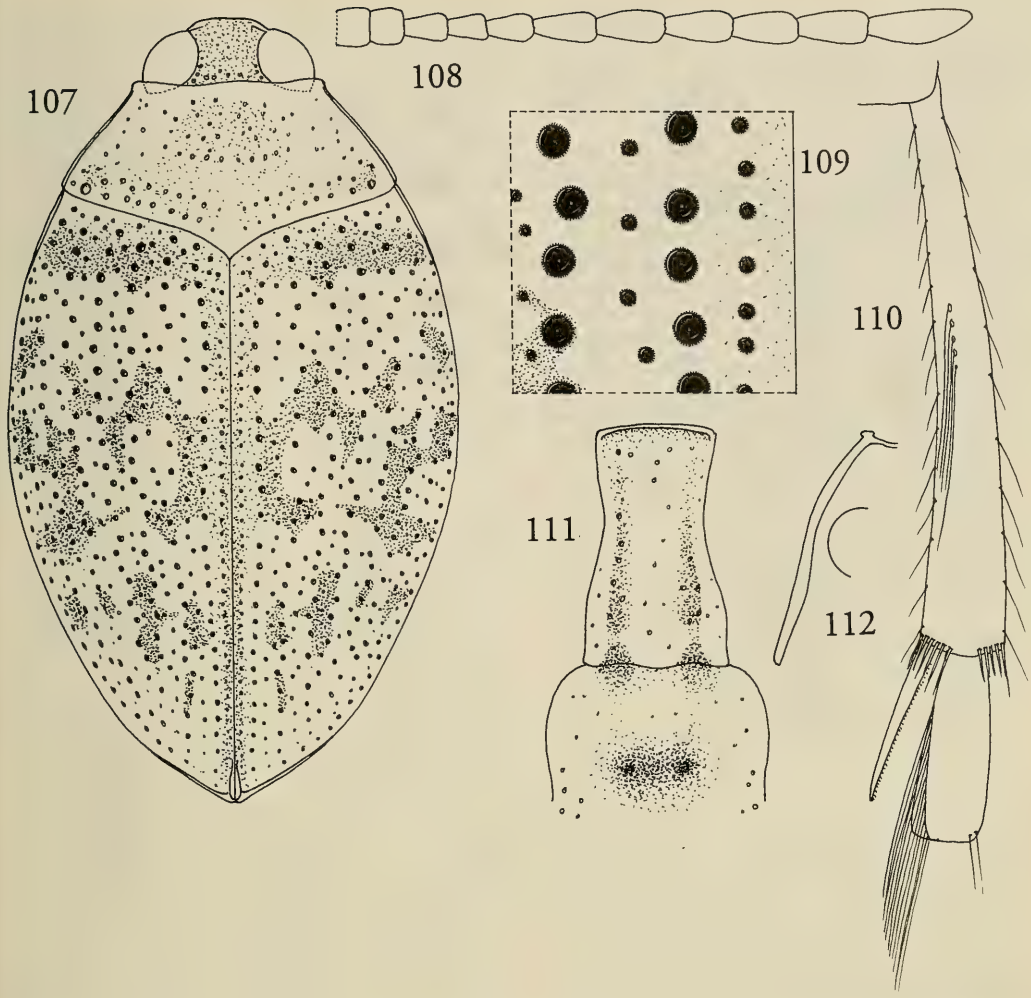
This species can be distinguished from the other species with a double grooved prosternal process by the characters mentioned in the key.

Description

Length 2.5-3.4 mm, width 1.5-2.0 mm. Body oval, widest just before the middle (fig. 98).

Head: Brown to dark brown, darkened along the eyes and near antennae, sometimes with a weak arrow-like darkening in the middle. Sparsely and weakly, behind eyes stronger punctured. Distance between eyes 0.9-1.1 × width of one eye. Antennae yellow to brown-yellow (fig. 99), palpi yellow-red to brown.

Pronotum: Yellow to yellow-red, large medial dark blotch that can be reduced to a round blotch on ante-

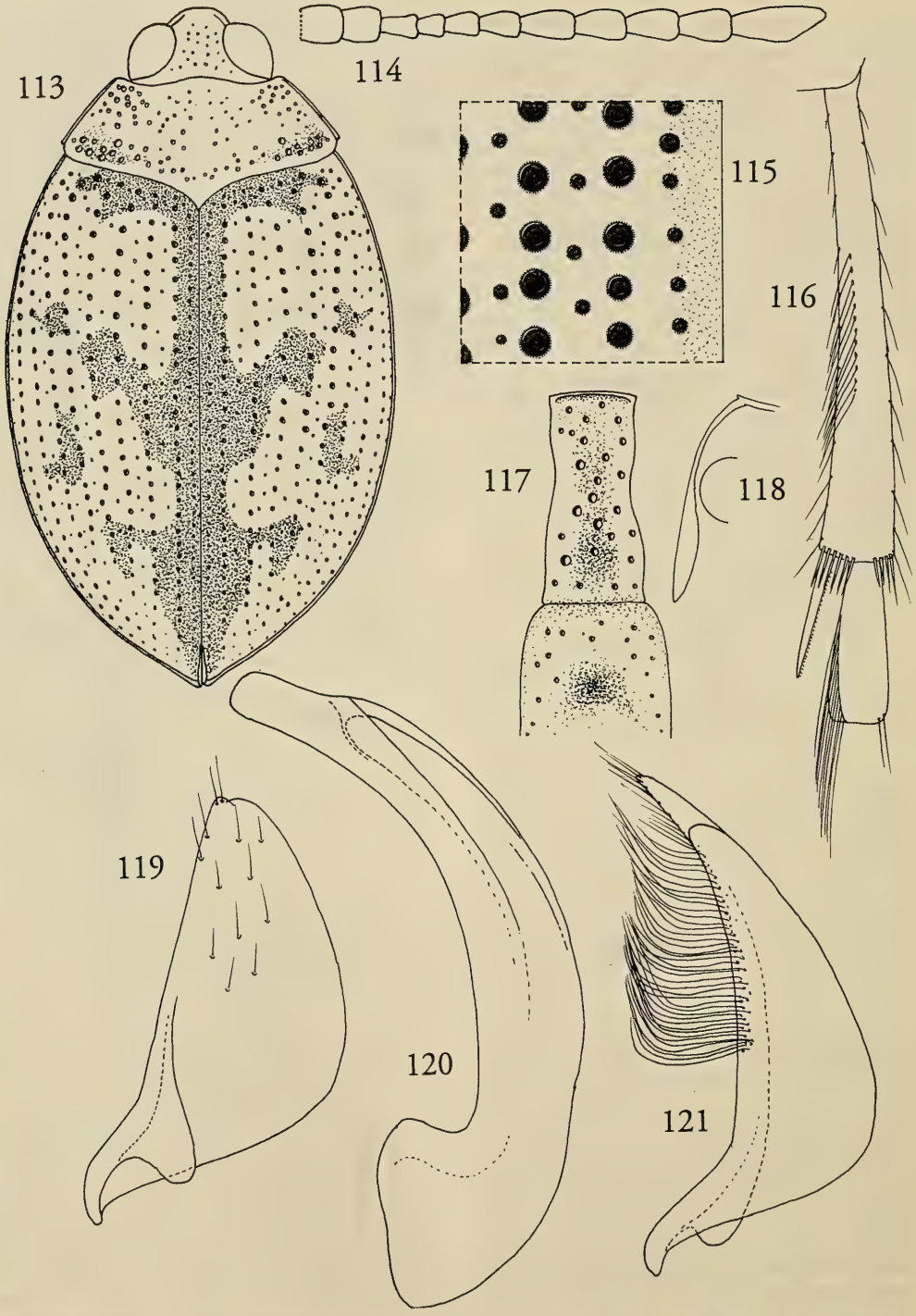


Figs. 107-112. *Haliplus samosirensis*, holotype. – 107, dorsal view; 108, antenna; 109, punctures near elytral base and suture; 110, dorsal side of hind tibia; 111, prosternal process; 112, lateral view of prosternal process.

rior half with a partly reduced or vague blotch on apical half (fig. 98). Lateral borders straight to slightly convex, anterior corners concave, clearly, vaguely or not visibly margined, margin never reaching anterior corner. Apical corners rounded, middle of base usually finely impressed. Strongly, anteriorly weaker punctured, near basal corners with one or two stronger punctures in a slight depression. Basal punctures darkened.

Elytra: Yellow to yellow-red, clear and extensive markings along suture and along base untill fifth primary puncture-row, a central mark in third interval connected to suture and various small marks in lateral part (fig. 98). Primary punctures of average strength, stronger towards base, about 30 punctures in first row. Secondary punctures relatively strong accompanied by some very small punctures. All punctures darkened except the central hole. Lateral borders sometimes slightly serrate in basal part.

Ventral side: Body yellow-brown to dark brown, elytral epipleura yellow to yellow-brown, legs yellow-brown with brown to dark-brown femora and coxae. Prosternal process with two strong grooves, anterior edge margined, punctured, sometimes strongly, especially in the grooves, weakly narrowed near coxae, sligthly diverging towards apex (fig. 102, 103). Metasternal process flat with two pits, these pits sometimes very strong and than almost forming one confluent transverse pit, sparsely punctured (fig. 102). Coxal plates rather sparsely, near suture weakly



Figs. 113-121. *Haliplus srilankanus*, holotype. – 113, dorsal view; 114, antenna; 115, punctures near elytral base and suture; 116, dorsal side of hind tibia; 117, prosternal process; 118, lateral view of prosternal process; 119, left paramere; 120, penis; 121, right paramere.

punctured, sutural corners more or less rectangular. Sternites with complete puncture-rows. Last sternite almost completely covered with strong punctures, apical point with a very short ridge. Setiferous striole on dorsal side of hind tibia very short, very close to the lateral row of setae and often hard to distinguish from it, longest of the tibial spurs about ⅔ × length of first tarsal segment (fig. 101).

Male: First three tarsal segments of fore- and mid-legs slightly widened, scaly hairs on ventral side. Penis and parameres as in figs. 104-106.

Biology and distribution (fig. 126)

Collected up to an altitude of 920 m. Attracted to light.

China along the coast north to Xiamen, Thailand, Vietnam, Indonesia: Sumatra, Java, Sulawesi, India: West Bengal, Sri Lanka.

Material examined. – China: 1 ♂, 1 ♀, Amoy [Xiamen], Galatea (ZMUC). – Thailand: 1♂, Lectotype; 1♀, Paralectotype, Browning, Siam; 1♂, Siam; 2 ex., Bangkok, Castlenau (BMNH); 1♂, Cotype, Wallace, Mal.' [Malacca], 67-56, Paralectotype (BMNH); 1 ex., Pattaya, 4.xii.1979 (MZLU); 1♂, Banna, Chawang nr. Nabon, 70 m., 5.ix.1958, J.L. Gressitt, light trap (BPBM); 6 ex., 25 km NW Lan Sak, 210 km NW Bangkok, viii.1991, W. Thielen (RMNH). – Vietnam: 1♀, Annam, Chuan-an [nr. Hue], Museum Paris, Coll. Maurice Régimbart, 1908, TYPE, *oceanicus* Rég. [not belonging to syntype-series]; 1♀, Annam, Chuan-an [nr. Hue]; 1♂, Cochin Chine, Harmand 1872; 1 m, Annam, Rég. de An-Ninh [?], R. P. M. Maunier 1903 (MNHN). – Sri Lanka: 1♂, Polonnaruwa, 28.xi.1980, M. Jäch (NHMV); 1♂, Maha-illerpulma [Madakalapuwa ?], 30.xi.1957, C. H. Fernando, light (BMNH). – India: 1♀, Calcutta, Atkinson coll. (BMNH). – Indonesia: Sumatra: 1♂, Lectotype of *H. oceanicus* (RMNH); 6 ex., Fort de Kock [Bukittinggi], 920 m, E. Jacobson, i.1922, 1924, 1925, 1926 (BMNH, RMNH, ZMAN); 1 ex., Solok, exped. Kleiweg de Zwaan 1907; 1 ex., Deli, de Bussy (ZMAN); 8 ex., Medan, vii. 1904, 1906 (-RMNH); Java: 22 ex., Weltevreden [nr. Jakarta], 1915, Neytzell de Wilde (RMNH, ZMAN); 4 ex., G. Oengaran [G. Ungaran], v.1915, xii.1907, F. C. Drescher; 39 ex., Batavia [Jakarta], C. v. Nidek, 25.ix.1947, xii.1948, ii.1949, v.1949, vi.1949, xii.1949, i.1950, v.1950; 2 ex., Tengger Mountains, Drescher; 1 ex., Tjilatjap, xii.1914, F. C. Drescher (ZMAN); 1 ex., Batavia [Jakarta], v.1913, J. B. Corporaal; 1 ex., Weltevreden [nr. Jakarta], i.1919, P. B. Buytendijk (RMNH); Sulawesi: 1♂, Makassar, I-74 [1.1874 ?], O. Beccari (Vondel); 3 ex., Makassar, L. de Vos (RMNH); 1♀, Sharp (MNHN).

Haliplus samosirensis sp. n.
(fig. 107-112)

Type material. – Holotype ♀, 'Sumatra [Indonesia], Samosir Isl., 2°28'N 98°49'E, Tuk-Tuk, L. Toba, 2800 Ft., 4.iii.1978, M. Holmen; 13.' (ZMUC). – Paratypes, 2♀: 1♀, same data as holotype (coll. Vondel); 1♀, 'J. Corporaal, Sumatra's O.K., Medan, 1.10.1921, 20 M, *Haliplus pulchellus* v. *oceanicus* det. A. Zimmermann'(ZMAN).

Diagnosis

This species can be distinguished from related species by the elytra, which are provided with a basal dark band reaching margins and very irregular dark marks.

Description

Length 3.3-3.5 mm, width 1.9-2.0 mm. Body oval, widest in the middle (fig. 107).

Head: Red-brown, frons vaguely marked, moderately strongly, on vertex stronger punctured. Distance between eyes about 1.1 × width of one eye. Antennae yellow-red (fig. 108), palpi yellow-red.

Pronotum: Yellow-brown, gradually darkening towards the middle and base. Lateral borders convex, finely margined, anterior corner not margined and bending outwards. Strongly but not very densely punctured, all punctures darkened. Impressed opposite fourth to sixth elytral puncture-row (fig. 107).

Elytra: Yellow to yellow-red, suture weakly darkened to first secondary punctures, base darkened to seventh row, darker towards shoulders, various dark marks (fig. 107). Completely margined, margin sometimes invisible from above. Primary puncture-rows strong and somewhat irregular, 22-26 punctures in first row. Secondary punctures strong, sometimes almost as strong as adjacent primary punctures. All punctures darkened with a yellow centre (fig. 109).

Ventral side: Body yellow-red to brown, elytral epipleura yellow to yellow-brown, legs brown-red, darkened towards coxae. Prosternal process with two grooves, margined at anterior edge, narrowed near coxae, weakly punctured (fig. 111), lateral plicae complete (fig. 112). Metasternal process with transverse impression, in which two pits are recognisable, weakly punctured (fig. 111). Metacoxal plates densely and rather strongly punctured, along suture with a weakly punctured area. Setiferous striole on dorsal side of hind tibia very short, longest of the two tibial spurs about ¾ × length of first tarsal segment (fig. 110). Sternites strongly punctured.

Male: Unknown.

Biology and distribution (fig. 130)

Up to an altitude of 850 m.

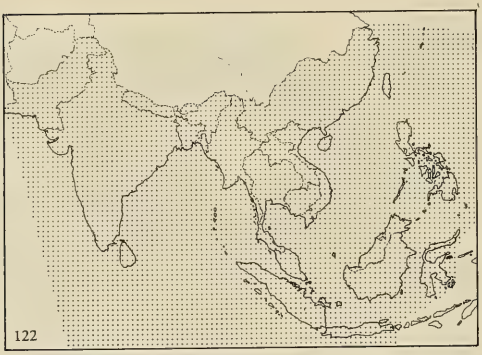
Indonesia: Sumatra.

Haliplus sharpi Wehncke

Haliplus sharpi Wehncke, 1880
Haliplus tsukushiensis Yoshimura, 1932

This species is fully redescribed by Vondel (1991: 129).

Additional notes: also recorded from Taiwan. Additional material examined: 1♂, Taiwan, Taihoku, 4.vi.1928, F. C. Hadden (BPBM).



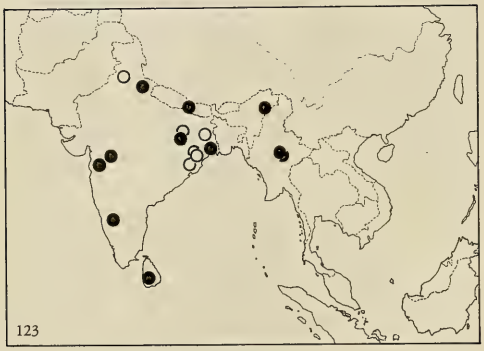


Fig. 122. Oriental region as treated in this revision.
Fig. 123. Distribution of *Haliplus angustifrons* (dots: examined, circles: literature record).

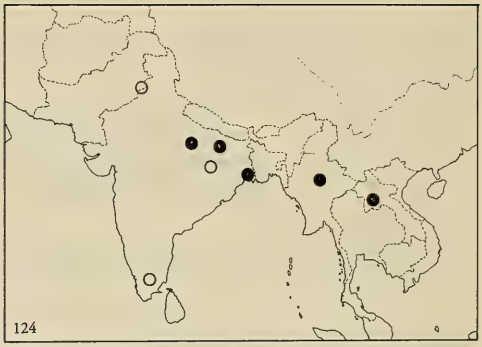
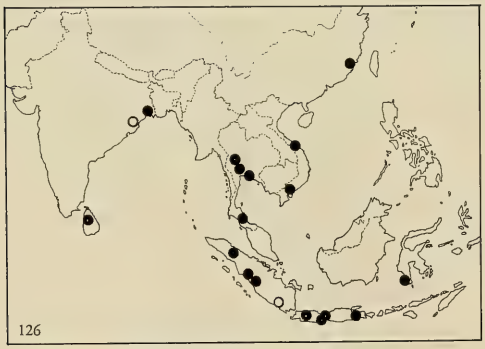


Fig. 124. Distribution of *Haliplus arrowi* (dots: examined, circles: literature record). Fig. 125. Distribution of *Haliplus perroti* (dots) and *Haliplus srilankanus* (triangles).



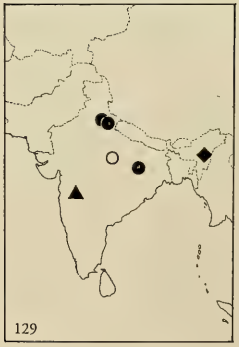


Fig. 126. Distribution of *Haliplus pulchellus* (dots: examined, circles: literature records).
Fig. 127. Distribution of *Haliplus indicus* (dot) and *Haliplus nedungaduensis* (triangle).
Fig. 128. Distribution of *Haliplus philippinus* (dots) and *Haliplus diopus* (square).
Fig. 129. Distribution of *Haliplus pruthii* (dots: examined, circle: literature record), *Haliplus kapuri* (triangle) and *Haliplus manipurensis* (square).
Fig. 130. Distribution of *Haliplus samosirensis* (dot) and *Haliplus javanicus* (triangles).

***Haliplus srilankanus* sp. n.**
(figs. 113-121)

Type material. – Holotype ♂, 'Sri Lanka, Tissawewa, 10.xii.1979, V. Mahler Jensen leg.'(ZMUC). Paratype ♂, same data as holotype (Vondel); Paratype ♀, 'Sri Lanka, Tissawewa, 10.xii.1979, V. Mahler Jensen leg., *Haliplus* (*Liaphlus*) *pulchellus* Clark det. T. G. Vazirani 1981, SL6' (ZMUC). Paratype, 2♂, 'India, Rajasthan, Bharatpur, 11. viii.1989, A. Riedel' (Hendrich, Vondel).

Diagnosis

This species is related to *H. angustifrons* and *H. arrowi*, but can be distinguished from them by the characters given in the key.

Description

Length 3.2 mm, width 1.8 mm. Body oval, widest in the middle (fig. 113).

Head: Red-brown, moderately strongly punctured. Distance between eyes about 1.1 × width of one eye. Antennae yellow-red (fig. 113), palpi yellow-red.

Pronotum: Yellow-red, slightly and vaguely darkened in the middle near anterior side and before base. Lateral borders straight, finely margined, posterior corner protruding (fig. 113). In posterior corners strongly and densely punctured, impressed along base. Strongly and except on disc densely punctured, punctures not darkened except in the darkened central areas near base and anterior edge.

Elytra: Yellow, suture completely darkened to first primary punctures, base darkened to fifth row, hooked marks on disc and in apical part connected to suture, marks in sixth interval (fig. 113). Completely margined. Primary puncture-rows moderately strong and not very dense, stronger in basal part, about 30 punctures in first row. Secondary punctures moderately strong, sparse or partly absent in even intervals. All punctures darkened with a yellow centre (fig. 115).

Ventral side: Body yellow-red to red-brown, elytral epipleura yellow, legs yellow-brown, darkened towards coxae. Prosternal process impressed in the middle, margined at anterior edge, slightly narrowed near coxae, strongly and coarsely punctured (fig. 117), lateral plicae complete (fig. 118). Metasternal process widely and strongly impressed in the middle, weakly punctured (fig. 117). Metacoxal plates moderately strongly punctured, along suture more weakly punctured. Setiferous striole on dorsal side of hind tibia about ⅓ × length of tibia, consisting of about 12 small punctures, longest of two tibial spurs about ⅔ × length of first tarsal segment (fig. 116). Sternites weakly punctured.

Male: First three tarsal segments of fore- and mid-legs widened, scaly hairs on ventral side. Penis and parameres as in figs. 119-122.

Biology and distribution (fig.125)

Biology unknown.

Sri Lanka. India: Rajasthan.

Unnamed material

The specimens I failed to determine are listed below. Some of them might belong to still undescribed species.

Species near *H. diruptus*. – 1♂, [India], Calcutta, Type, Atkinson Coll., BM 92-3, *Haliplus falsificus* n. sp. [MS-name] Type!, J. Balfour-Browne det. (BMNH)

Species near *H. kotoshonis*. – 1♀, Laos, Vientiane, 9.v.1965, P.D. Ashlock, at light (BPBM)

Species close to *H. indicus*, but with unmaculated pronotum. – 1♀, Sarda, Bengal, F. W. C. (BMNH)

Specimens probably representing *H. pruthii*. – 1♀, [India], Uttar Pradesh, Haldwani Divn., Kumaun, vii.1923, H. G. C., at light, 3956 (BMNH); 1♀, [India, Bihar], Chota-Nagpore, Nowatoli, R. P. Cardon, viii-ix.1896 (MNHN); 1♀, N. India, U.P., Rishikesh, 450 m, viii.1988, Werner (NHMV).

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REFERENCES

Balfour-Browne, J., 1946. The aquatic Coleoptera of Manchuria (Weymarn Collection). – Annals and Magazine of Natural History (11) 13: 433-460.

Chapin, E. A., 1930. New species of *Haliplus* Latr. (Col.). – Proceedings of the Biological Society of Washington 43: 9-12.

Clark, H., 1863. Descriptions of new East-Asiatic species of Haliplidae and Hydroporidae. – Transactions of the Entomological Society of London 3: 417-428.

Falkenström, G., 1932. Vorläufige Mitteilung über die neuen Halipliden und Dytisciden, von Dr. D. Hummel

in den Jahren 1927-30 während Dr. Sven Hedins China-Expedition eingesammelt. – Entomologisk Tidskrift 53: 191-192, 1 pl.

Falkenström, G., 1936. Schwedisch-chinesische wissenschaftliche Expedition nach den nordwestlichen Provinzen Chinas, unter Leitung von Dr. Sven Hedin und Prof. Sü Ping-chang. Insekten, 15, Coleoptera. 1. Haliplidae und Dytiscidae. – Arkiv för Zoologi 27A: 1-7.

Gschwendtner, L. 1934. Aquatic insects of China. Article XVI. Eine neue Art von Haliplidae aus China. – Peking Natural History Bulletin 9: 107.

Guignot, F., 1936. Description d'*Haliplus* nouveaux (Col. Haliplidae). – Bulletin de la Société entomologique de France 41: 115-118.

Guignot, F., 1950. Trente-et-unième note sur les Hydrocanthares. – Bulletin mensuel de la Société Linnéenne de Lyon 19: 25-28.

Guignot, F., 1954. Entomological results from the Swedish expedition 1934 to Burma and British India. – Arkiv för Zoologi 6: 563-567.

Guignot, F., 1955a. Quarante-deuxième note sur les Hydrocanthares. – Revue Française d'Entomologie 22: 270-276.

Guignot, F., 1955b. Sur la systématique des *Haliplus*. – Mémoires de la Société Royal Entomologique de Belgique 27: 289-296.

Guignot, F., 1956. Un nouvel *Haliplus* de Birmanie. – Arkiv för Zoologi 9: 477.

Hope, F. W., 1845. On the entomology of China, with descriptions of the new species sent to England by Dr. Cantor from Chusan and Canton. – Transactions of the Entomological Society of London 4: 4-17.

Kano, T. & K. Kamiya, 1931. Two new species of Haliplidae from Japan. – Transactions of the Kansai Entomological Society 2: 1-4, 1 pl.

Peschet, R., 1923. Dytiscidae et Haliplidae nouveaux (Col.). – Bulletin de la Société entomologique de France1923: 175-181.

Régimbart, M., 1885. Description d'une espèce nouvelle de Haliplides. – Notes from the Leyden Museum 7: 55-56.

Régimbart, M., 1886. Dytiscides et Gyrinides nouveaux de la collection du Musée de Leyde. – Notes from the Leyden Museum 8: 139-144.

Régimbart, M., 1889. Contributions à la faune Indo-Chinoise. – Annales de la Société Entomologique de France (6) 9: 147-156.

Régimbart, M., 1892. Insectes du Bengale Occidental. – Annales de la Société Entomologiques de Belgique 36: 112-121.

Régimbart, M., 1899. Révision des Dytiscidae de la région Indo-Sino-Malaise. – Annales de la Société Entomologique de France 68: 186-367.

Satô, M., 1984. Taxonomic notes on the aquatic Coleoptera of Japan I. – Coleopterists' News 65: 1-4.

Sharp, D., 1873. III. The water beetles of Japan. – Transactions of the Entomological Society of London 21: 45-67.

Takizawa, M., 1931. The Haliplidae of Japan. – Insecta Matsumarana 5: 137-143.

Vazirani, T. G., 1966. A review of the Indian Haliplidae (Insecta: Coleoptera), with descriptions of two new species. – Proceedings of the Zoological Society, Calcutta 19: 127-134.

Vazirani, T. G., 1975. A new species of Haliplidae (Insecta: Coleoptera) from India. – Oriental Insects 9: 317-318.

Vondel, B. J. van, 1991. Revision of the Palaearctic species of *Haliplus* subgenus *Liaphlus* Guignot (Coleoptera: Haliplidae). –Tijdschrift voor Entomologie 134: 75-144, figs 1-312.

Vondel, B. J. van, 1992. Revision of the Palaearctic and Oriental species of *Peltodytes* Régimbart (Coleoptera: Haliplidae). – Tijdschrift voor Entomologie 135: 275-267, figs 1-101.

Wehncke, E., 1880. Neue *Haliplus*. – Stettiner Entomologische Zeitung 41: 72-75.

Yoshimura, S., 1932. On a new species of *Haliplus* from Japan. – Mushi 5: 102-103.

Zimmermann, A., 1920. Dytiscidae, Haliplidae, Hygrobiidae, Amphizoidae. – Coleopterorum Catalogus 71: 1-325.

Zimmermann, A., 1924. Die Halipliden der Welt. – Entomologische Blätter (für Biologie und Systematik der Käfer) 20 (1): 1-16; (2): 65-80; (3): 129-144; (4): 193-213.

Zimmermann, A., 1927. Fauna sumatrensis. Beitrag Nr. 45. Revision der Haliplidae et Dytiscidae von Sumatra. – Supplementa Entomologica 16: 1-44.

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