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REVUE SUISSE DE ZOOLOGIE 108 (3): 441-453; septembre 2001

Two new species of *Lauxania* Latreille s. str. (Diptera, Lauxaniidae) from Southern Europe

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Two new species of *Lauxania* Latreille s. str. (Diptera, Lauxaniidae) from Southern Europe. - Three species of *Lauxania* s. str. are known from Europe: *L. cylindricornis* (Fabricius) and the two new species *L. bilobata* sp. n. (Southern France, Drôme) and *L. siciliana* sp. n. (Sicily, Mt. Etna). All species are described and illustrated. The two new species form a monophyletic group based on the strongly asymmetrical postgonites. They differ from each other in males in the structure of the brush of black setulae at the tip of the hind tibia ventrally and in details of the male terminalia (surstylus, hypandrium). A key to the European species of *Lauxania* s. lat. is presented.

Key-words: Diptera – Lauxaniidae – *Lauxania* s. str. – new species – Europe.

INTRODUCTION

The Lauxaniidae are among the most abundant acalyptrate Diptera in forest ecosystems in the temperate and tropical parts of the world. Their larvae are saprophagous or mycetophagous and play therefore an important role in the decomposition of leaf litter (Miller, 1977; Broadhead, 1984; Papp & Shatalkin, 1998). Nevertheless, our knowledge of this family is still rudimentary. Even in the comparatively well studied western Palaearctic region, from which some 150 species have been described, many new species are waiting to be named. In addition, Stuckenberg (1971) pointed out that many genera of Old World Lauxaniidae are insufficiently characterized, because of the lack of phylogenetic studies.

A good example for the changing history in its generic limits is demonstrated by *Lauxania* Latreille: Originally, Latreille (1804) described the genus for one species, *Musca cylindricornis* Fabricius. Later, Meigen (1826) placed in *Lauxania* all metallic shining Lauxaniids with a depression on the face and with elongated, feathery antennae, such as species now placed in *Calliopum* Strand, *Pachycerina* Macquart and *Minettia* Robineau-Desvoidy. This concept was more or less accepted by subsequent authors (Loew, 1847; Becker, 1895; Hendel, 1908). An alternative classification was first proposed by Westwood (1840), who suggested that only species with the scape distinctly longer than the pedicel, and with the transverse

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depression on the face, should be assigned to *Lauxania*. As a consequence, only *L. cylindricornis* remained in the genus. This classification was later adopted by Rondani (1877), Czerny (1932), Stuckenberg (1971) and all subsequent authors. Martinek (1974) added *L. minor*, a new species from the Czech and Slovak republics. This species was later placed by Papp (1978) in the new subgenus *Callixania*. This taxon may warrant generic rank according to Papp & Shatalkin (1998). Another seven species were described in *Lauxania* from the eastern parts of the Palaearctic region by Elberg, Remm and Shatalkin in the past 20 years (Shatalkin, 1993). In his review of the Palaearctic Lauxaniidae, Shatalkin (2000) keyed all species, synonymized some species described from the eastern Palaearctic region and described the new subgenus *Czernushka* for the transpalaearctic species *L. albomaculata* Strobl. Unfortunately, this new taxonomic proposal is not accompanied by a phylogenetic discussion. Further studies are necessary to confirm whether the three morphologically very different subgenera of *Lauxania* form indeed a monophyletic group.

Following Shatalkin (2000), *Lauxania* is characterized among the Lauxaniinae by its black body, the transverse depression on the face, the black base of the wing, the absence of intraalar and presutural dorsocentral setae, and the virtually bare anepimeron. It is separated from *Calliopum* only by the white arista and the usually black knob of the halteres. However, both characters occur in the two genera. Thus, further studies are needed to propose a more convincing classification (Merz, in preparation).

In contrast to the genus, the subgenus *Lauxania* s. str. is well defined. It has elongated antennal segments, distinct rays on the arista, and a unique shape of the transverse depression on the head. A habitus drawing was given by Papp (1979). It has a Holarctic distribution, with five species in the Nearctic region (Pérusse & Wheeler, 2000) and six species in the Palaearctic region (Shatalkin, 2000) one of which, *L. cylindricornis*, occurs in Europe.

In the present paper, two new species of *Lauxania* s. str. are described from the Mediterranean region. They differ from each other mainly in the structure of the male terminalia. The material for this study is deposited in the following institutions and private collections: Hungarian Natural History Museum (HNHM), Muséum d'histoire naturelle, Genève (MHNG), Zoological Museum University Copenhagen (ZMUC), the private collections V. Korneyev, Kiev (CVK), V. Martinek, Dobruska (CVM) and the author's collection (CBM). Terminology in the descriptions follows Papp & Darvas (2000).

SYSTEMATIC PART

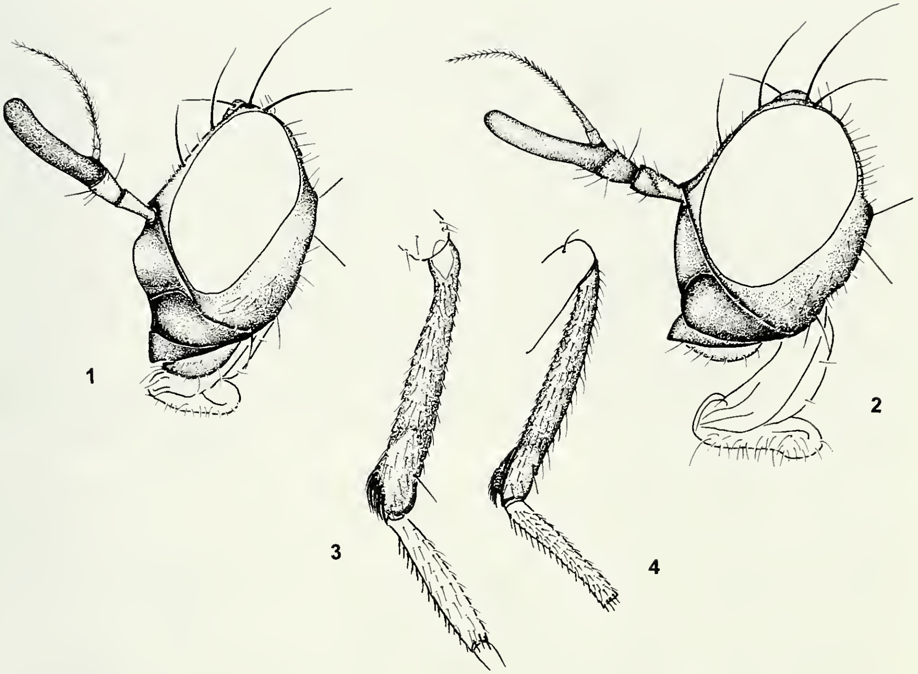
***Lauxania* (s. str.) *bilobata* sp. n.** Figs 1, 3, 10-13

MATERIAL

Holotype ♂: France: Drôme, 820-950m, Chalancon, Col des Roustans (D135), 11.VII. 1999, leg. B. Merz. The holotype is double mounted on a minuten pin on a polyporus strip and is in excellent condition. It is deposited in the MHNG. Paratypes: 4♂♂, same data as holotype (CBM, MHNG).

ETYMOLOGY

The two anterior lobes on the hypandrium are very conspicuous and separate this species from the similar *L. siciliana*.



FIGS 1-4

Head in profile (1-2) and hind tibia of males (3-4) of *Lauxania* s. str.: 1, *L. bilobata* sp. n.; 2, *L. cylindricornis* (Fabricius); 3, *L. bilobata* sp. n.; 4, *L. siciliana* sp. n.

DIAGNOSIS (male)

Shining black species of 3.00-3.35 mm wing length. Scape and pedicel mostly yellow; arista yellowish, its rays about twice as long as base of arista; scape and pedicel subequal in length (Fig. 1); acrostichal setulae usually in 6 more or less regular rows. Hind tibia at tip with a brush of rather long, black setulae over most of ventral surface (Fig. 3). Terminalia: surstylus slightly higher than wide in profile, without protuberance; postgonites asymmetrical: left postgonite halter-like, right postgonite rudimentary; hypandrium anteriorly with two large lobes; posteriorly truncate (Figs 10-13).

DESCRIPTION (male)

Head (Fig.1). Shining black; parafacialia, gena and postgena silvery microtrichose; interfrontal stripe, fronto-orbital plate and occiput thinly microtrichose; palpus black; scape and pedicel yellow or only indistinctly infuscated, 1st flagellomere black; arista yellowish throughout. Head in profile about 1.5 times higher than wide; gena about one quarter as high as compound eye in profile; fronto-facial angle about 150^{0}; frons and face of subequal length; distance between bases of antennae three times the diameter of the scape; dorsal half of occiput strongly convex; face with a transverse depression on ventral third, which does not reach the oral margin medially; antenna: ratio scape:pedicel:1st flagellomere = 8:9:35; pedicel dorsally at base with one seta and ventrally in distal half with few long setae; rays of arista distinct, about twice as long as diameter of base of arista; frons almost bare with only few setulae laterally. Chaetotaxy: 2 reclinate fronto-orbital setae, 1 rather short ocellar seta, 2 vertical setae, 1 postocellar seta, one row of black postocular setae.

Thorax. Subshining black, covered with very thin microtrichosity, entirely shining on a patch in anterior half of anepisternum; acrostichal setae in 6 more or less regular rows; prescutellar seta slightly shorter than anteriormost dorsocentral seta; 0+3 dorsocentral setae, increasing in size towards scutellum; 1 postpronotal seta; 2 notopleural setae; 1 presutural intraalar seta; 1 supraalar seta; 2 postalar setae; 1 proepisternal seta; 1 anepisternal seta; 2 katepisternal setae, of which the anterior is shorter and weaker; prosternum setulose; anepimeron bare; scutellum with long basal and apical setae. Calyptra black; halter black; wing yellowish tinged, but base including alula darkened.

Legs (Fig. 3). Black, but knees of anterior leg, tip of mid tibia and posterior four tarsi yellowish, the last segment of the posterior four tarsi sometimes slightly brownish; all tibiae with a dorsal preapical seta, the one on hind tibia shorter. Male: hind tibia slightly swollen apically, with a distinct, well defined brush of long black setulae on ventral half.

Preabdomen. Subshining black with very thin microtrichosity; all tergites with short setulae, those on hind margin of the tergites slightly longer.

Male terminalia (Figs 10-13). Epandrium a semicercle; surstylus compact, in profile higher than wide, with convex posterior margin and a concave medial plate; bacilliform plate large, anteriorly upcurved; hypandrium posteriorly open, anteriorly with a pair of outstanding lobes, posteriorly abruptly cut; postgonites strongly asymmetrical: left gonite halter-like, with a distinct knob distally; right gonite rudimentary; pregonites forming a closed circle, well separated from the postgonites, anteriorly produced in a large plate; phallapodeme large, spatulate; aedeagus membranous, indistinctly and weakly sclerotized near apex; ejaculatory apodeme sclerotized, bowl-shaped.

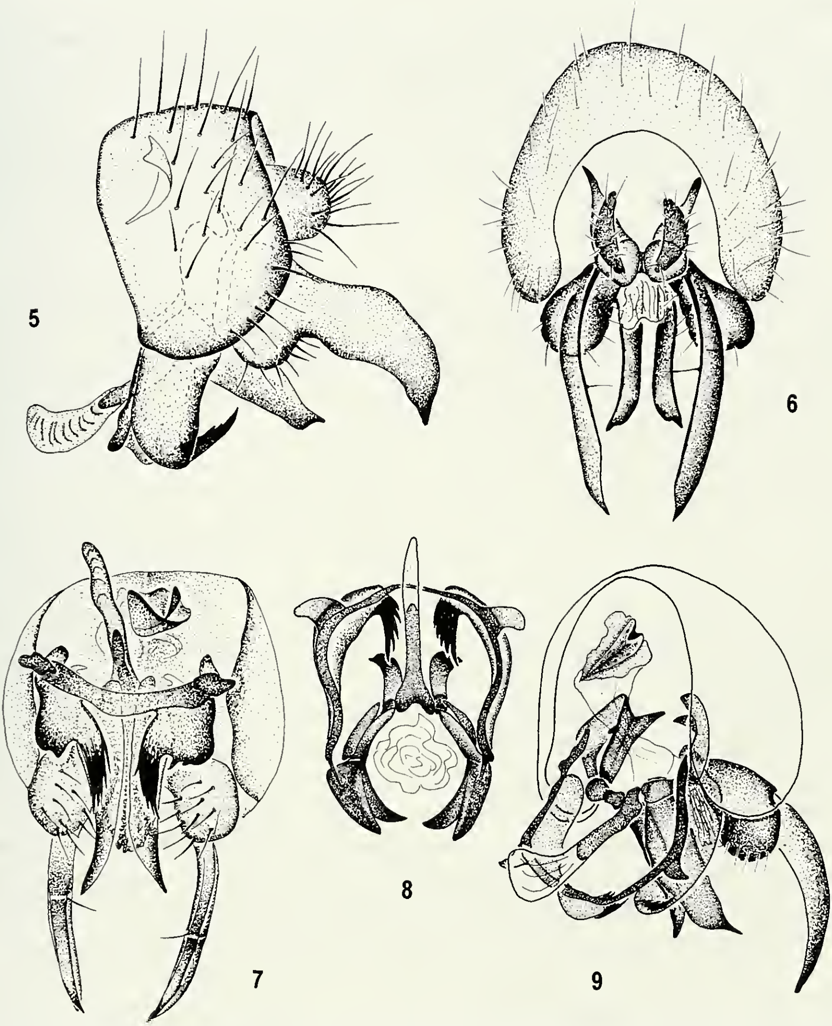
Female: unknown.

BIOLOGY

The adults were swept on shrubs and low trees (mainly *Populus* and *Alnus*) along a small stream in a small valley which opens to the south.

DISCUSSION

This species differs from *L. siciliana* only in the characters given in the key. The structure of the tip of the hind tibia in males is the only stable external difference (Figs 3-4). Two males of both species were dissected and they do not show any intraspecific variation. Therefore, it is proposed here that the two populations from Southern France and Sicily represent two distinct species. Because the Eastern Palaearctic species were not available for study, the relationships of the two species with other species of the subgenus are unknown.



FIGS 5-9: Male terminalia of *Lauxania cylindricornis* (Fabricius): 5, lateral view; 6, posterior view; 7, anterior view; 8, dorsal view, epandrium and surstylus omitted; 9, anterolateral view.

Lauxania* (s. str.) *cylindricornis (Fabricius, 1794) Figs 2, 5-9, 18-21

Musca cylindricornis Fabricius, 1794: 332. Type locality: France. Type material lost (Martinek, 1974).
Musca chrysoptera Schrank, 1803: 126. Synonymy by Meigen (1826).
Lauxania rufitarsis Latreille, 1805: 390. Synonymy by Latreille (1805).

MATERIAL

Switzerland: numerous specimens from the following cantons: GL, GR, SH ,VS, ZH (CBM, MHNG); Danmark: Lolland (ZMUC); Ukraine: Kiev region (CVK); Czech and Slovak Republics: various regions (CVM).

DIAGNOSIS

Shining black species of 2.9-3.3 mm wing length in males and 3.1-3.4 mm in females. Antennae mostly dark; arista with comparatively short rays; scape about 1.5 times as long as pedical (Fig. 2); acrostichal setulae usually in 4-5 rows. Male: hind tibia at tip with inconspicuous brush of short, black setulae ventrally; surstylus with characteristic protuberance; hypandrium with 2 lobes anteriorly carrying each some 5-7 black, ventrally directed setulae; pregonites with 2 ventrally directed processes (Figs 5-9).

DESCRIPTION

Head (Fig. 2). Shining black, but parafacialia and postgena silvery microtrichose; interfrontal stripe, fronto-orbital plate and occiput slightly microtrichose; palpus black; scape pale at base, distal half and pedicel dark brown to black, 1st flagellomere black; arista yellow in basal thickened part, remainder white. Head in profile about 1.3-1.4 times as high as wide; gena about one third as high as compound eye in profile; fronto-facial angle about 135^0; frons and face of the same length; distance between antennae at base about 3 times the diameter of the scape; face with distinct „v"-shaped depression medially reaching oral margin; antenna: ratio scape: pedicel:1st flagellomere = 13:9:40; pedical dorsally at base with one seta and ventrally in distal half with few long setulae; rays of arista distinct, about as long as diameter of base of arista; occiput in dorsal half strongly concave; frons anteriorly setulose. Chaetotaxy: 2 reclinate fronto-orbital setae, 1 rather short ocellar seta, 2 vertical setae, 1 postocellar seta, one row of black postocular setae.

Thorax. Subshining black, covered with very thin microtrichosity, only a patch in anterior half of anepisternum fully shining; acrostichal setae on level of suture in 4-5 irregular rows; prescutellar seta shorter than the anteriormost dorsocentral seta; 0+3 dorsocentral setae; 1 postpronotal seta; 2 notopleural setae; 1 presutural intraalar seta; 1 supraalar seta; 2 postalar setae; 1 proepisternal seta; 1 anepisternal seta; 2 katepisternal setae, of which the anterior is shorter and weaker; prosternum with 1-2 fine setulae; anepimeron bare; scutellum with strong basal and apical setae. Calyptra black; halter black; wing with yellowish tinge, but base including alula darkened.

Legs. Black, but anterior knees, tip of mid tibia and posterior four tarsi yellowish; last segment of posterior four tarsi usually blackish; all tibiae with a dorsal preapical seta, the one on hind tibia shorter. Male hind tibia apically with a rather indistinctly defined brush of short, black setulae on ventral side.

Preabdomen. Subshining black with very thin microtrichosity; all tergites shortly setulose, with slightly longer setulae on hind margin of tergites.

Male terminalia (Figs 5-9). Epandrium a semicercle; surstylus divided into a bulbous base and a flattened, crescent-shaped protuberance which is often curved medially; hypandrium posteriorly open, ventrobasally with a pair of large lobes which are covered with a patch of 5-7 close-set, black, ventrally directed strong setae; postgonites fused with hypandrium and pregonites; the latter separated from each other, and with a pair of sclerotized, symmetrical, ventrally directed protuberances emerging from their anterior half; phallapodeme large, spatulate; aedeagus membranous, soft; ejaculatory apodeme sclerotized, irregular in shape; bacilliform plate forming a pair of bulbous posterior knobs which are produced anteriorly into an acute tip; knobs connected by a narrow sclerotized bridge.

Female terminalia (Figs 18-21). Shape rather complex, in particular sternite 8, which has a deep, lateral depression and the ventral part distally upcurved; sub-anal plate large, densely setulose; supra-anal plate and tergite 8 obviously fused. Three spermathecae of smooth surface present; the simple spermatheca larger, egg-shaped; the paired spermatheae small, roundish.

DISTRIBUTION

A widely distributed species in the whole Palaearctic region (Papp, 1984; Shatalkin, 2000). Based on the available checklists, the species is recorded from the following countries: Mongolia, Russia, Baltic countries, Ukraine, Romania, Hungary, Poland, Czech and Slovak Republics, Germany, Denmark, Finland, Sweden, Norway, Ireland, Great Britain, Netherlands, Belgium, France, Switzerland, Italy. However, the records from the Mediterranean region need re-examination, because they may refer to the two new species described in this paper. The Nearctic records published so far under *L. cylindricornis* belong to a new species, *L. shewelli* Pérusse & Wheeler (Pérusse & Wheeler, 2000).

BIOLOGY

This species is common at low altitudes in rather hot and dry places. At locally warmer places, *L. cylindricornis* may be found up to 1600m (inner alpine valleys of Switzerland). Contrary to other Lauxaniidae this species is more common on grass and low shrubs, and may only occasionally be found in open forests. Its flight period ranges from April to July.

DISCUSSION

As indicated in key and diagnosis, this species differs considerably from the other two European species of the subgenus. The spines at the ventral base of the hypandrium are also present in some *Calliopum* (*C. simillimum* Papp, *C. elisae* Meigen), and these species may form a monophyletic group (Pérusse & Wheeler, 2000; own observations). Further studies, however, are needed to confirm this hypothesis.

***Lauxania* (s. str.) *siciliana* sp. n.** Figs 4, 14-17, 22-25

MATERIAL

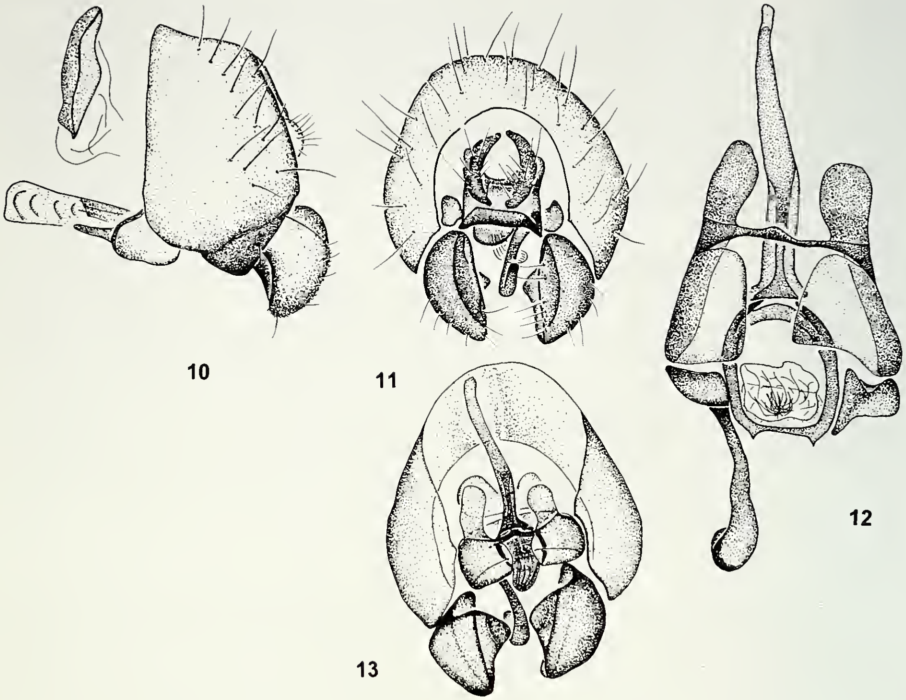
Holotype ♂: Italy: Sicily, 1450m, Etna, Piano delle Donne, 5.VI.1999, leg. B. Merz. The holotype is double mounted on a minuten pin on a polyporus strip and is in excellent condition. It is deposited in the MHNG. Paratypes: 2♂♂, 5♀♀, same data as holotype (CBM, HNHM, MHNG).

ETYMOLOGY

This species is named after the type locality.

DIAGNOSIS

This shining black species of 3.0-3.3 mm wing length in males and 3.15-3.30 mm in females differs from *L. bilobata* in the shape of the male hind tibia and details of the terminalia. Apex of hind tibia (Fig. 4) with a small plate ventrally which is



FIGS 10-13

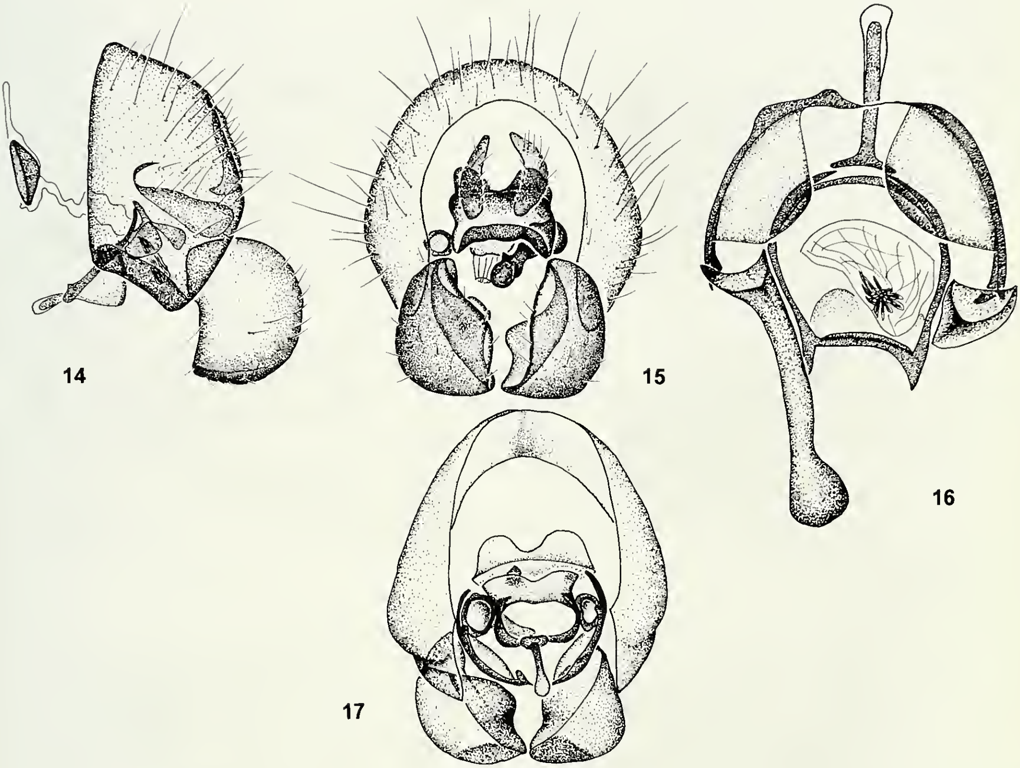
Male terminalia of *Lauxania bilobata* sp. n.: 10, lateral view; 11, posterior view; 12, ventral view, epandrium and surstylus omitted; 13, anterior view.

covered by a narrow brush of long, black setulae. Surstylus more robuste; hypandrium anteriorly evenly closed, without a pair of lobes; posteriorly ending in a short rod (Figs 14-17).

DESCRIPTION

External characters. Shape, proportions, colouration and chaetotaxy as in *L. bilobata.* Hind tibia apically thickened due to a ventrally directed flattened plate which is covered with a brush of black setulae. In *L. bilobata*, the apex of the hind tibia is evenly swollen and the brush of black setulae covers almost the entire ventral half (Figs 3-4).

Male terminalia (Figs 14-17). Epandrium as in *L. bilobata*; surstylus more robust in both specimens dissected, but further material is needed to confirm whether this is a constant difference; bacilliform plate large, as in *L. bilobata*; hypandrium differing from the latter species by the presence of a short rod posteriorly and the lack of anteriorly directed lobes (Figs 12, 16); postgonites similar, but the knob of the left postgonite in *L. siciliana* dorsally more upcurved; aedeagus and its appendages as in *L. bilobata.*



Figs 14-17
Male terminalia of *Lauxania siciliana* sp. n.: 14, lateral view; 15, posterior view; 16, ventral view, epandrium and surstylus omitted; 17, anterior view.

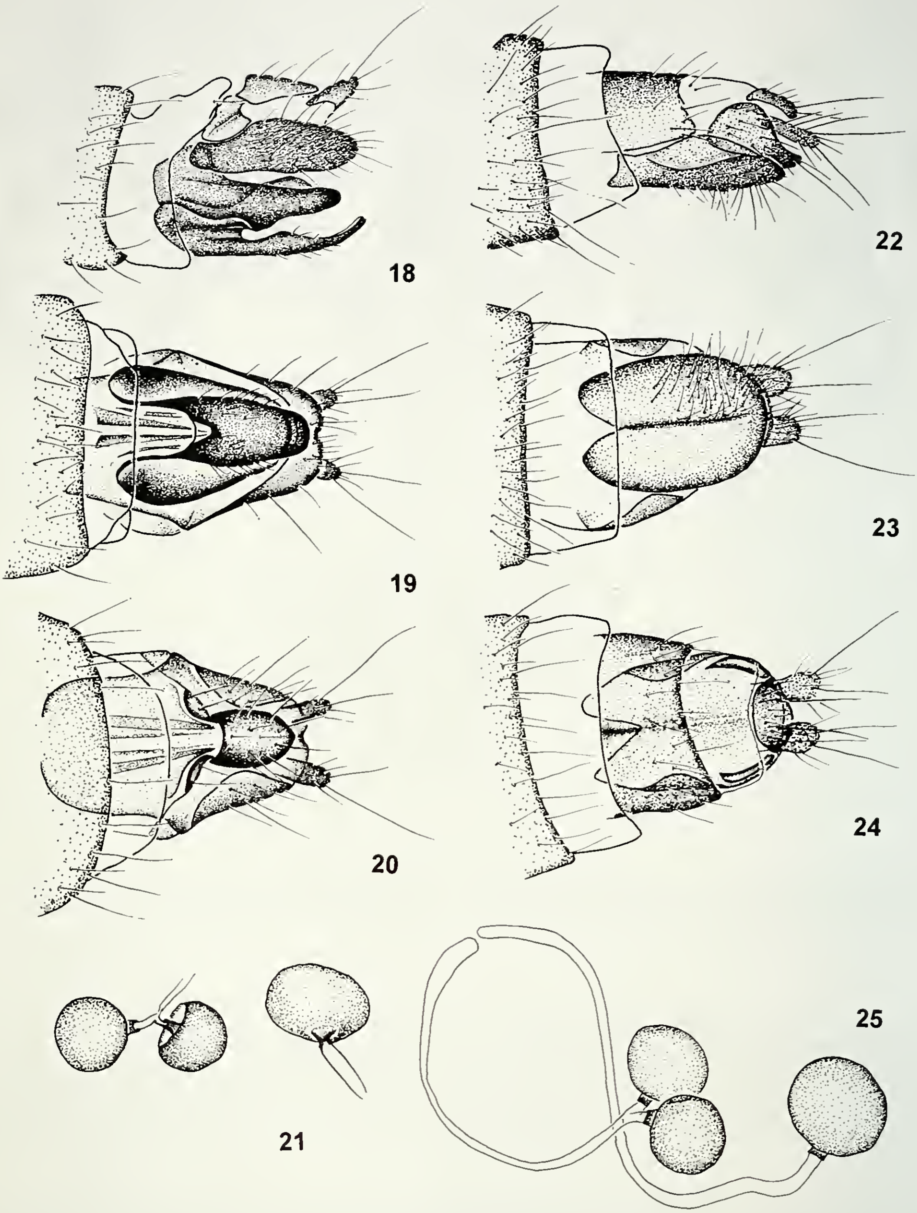
Female terminalia (Figs 22-25). Sternite 8 sheath-like, simple, ventrally with a shallow longitudinal depression which is covered with numerous erect, soft setulae; tergite 8 clearly separated from supra-anal plate; subanal plate rather densely setulose. Three sphaerical spermathecae of smooth surface present; the simple spermatheca larger.

Biology

The specimens were collected in the undergrowth of a rather open *Pinus* forest. They were swept from grass and some flowering Leguminosae.

Discussion

This species forms together with *L. bilobata* a monophyletic group. The relationships with the other species of the subgenus remain unknown.



Figs 18-25

Female terminalia and spermathecae of *Lauxania* s. str: 18-21, *L. cylindricornis* (Fabricius); 22-25, *L. siciliana* sp. n. 18, 22, lateral views; 19, 23, ventral views; 20, 24, dorsal views; 21, 25, spermathecae.

KEY TO THE EUROPEAN SPECIES OF *LAUXANIA* LATREILLE (sensu Shatalkin, 2000)

1 Anterior fronto-orbital seta inclined; arista either bare or thickened, but no distinct rays visible; hind tibia without dorsal preapical seta. Male: postgonites absent; aedeagus very large, strongly sclerotized, medially with 2-9 spines 2

1* Both fronto-orbital setae reclinate; arista with distinct rays; hind tibia with a dorsal preapical seta. Male: postgonites present, either asymmetrical or symmetrical; aedeagus soft, membranous (subgenus *Lauxania*) 3

2 First flagellomere short, barely more than twice as long as broad; head without produced fronto-facial angle; face bulging medially, transverse depression in lower fourth of head, reaching almost oral margin; mesonotum mat, thinly microtrichose (subgenus *Czernushka* Shatalkin) . . . . *L. albomaculata* Strobl, 1909

2* First flagellomere enlarged, at least 4 times as long as deep; antennae on a projection of face and frons, fronto-facial angle at 90°; face strongly concave, with transverse depression at about middle; mesonotum shining, without microtrichosity (subgenus *Callixania* Papp) . . . . *L. minor* Martinek, 1974

3 Head (Fig. 1): rays of arista almost twice as long as diameter of base of arista; scape and pedicel yellowish; their length subequal; horizontal depression in lower third of face straight, not reaching oral margin. Male: surstylus roundish-hemisphaerical, about as high as wide (Fig. 14); postgonites strongly asymmetrical, left postgonite much enlarged, halter-like; right postgonite rudimentary (Fig. 16); aedeagus encircled by the ring-shaped pregonite; hypandrium anteriorly without patch of black setae on ventrally directed, paired lobes (Fig. 17); bacilliform plate large, undivided (Fig. 15). Female: sternite 8 forming a simple plate (Figs 22-23) (female of *L. bilobata* unknown) 4

3* Head (Fig. 2): rays of arista about as long as diameter of base of arista; scape and pedicel brownish to blackish; scape about 1.5 times as long as pedicel; face with a distinct V-shaped horizontal depression in lower third which reaches oral margin medially. Male: surstylus basally globular, distally with a strong posteriorly directed protuberance (Figs 5, 9); postgonites symmetrical, small (Figs 8, 9); pregonites separated from each other, anteriorly with a pair of ventrally directed, more or less parallel-sided protuberances which end in a rather sharp laterally directed extension; hypandrium with patch of about 5 black setae on anterior paired lobes (Figs 5, 7); bacilliform plate divided into 2 only narrowly connected acute lobes. Female with complicated, laterally invaginated sternite 8 (Figs 18-20) . . . . *L. cylindricornis* (Fabricius, 1794)

4 Male: hind tibia apically with a rather large brush of black setulae on the whole ventral half (Fig. 3). Terminalia: surstylus slim, distinctly longer than wide in profile (Fig. 10); hypandrium anteriorly with a pair of conspicuous lobes; posteriorly truncate (Fig. 12) . . . . *L. bilobata* sp. n.

4* Male: hind tibia apically with a small, flattened plate on ventral side which is covered by a narrow brush of black setulae (Fig. 4). Terminalia: surstylus more robuste, only slightly longer than wide in profile (Fig. 14); hypandrium without paired lobes anteriorly, posteriorly with a pair of short rods (Fig. 16) . . . . *L. siciliana* sp. n.

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I wish to express my sincerest thanks to L. Papp (Budapest) and A. Shatalkin (Moscow) for sending me reprints and for their useful suggestions; to V. Martinek (Dobruska) for reprints and specimens of *L. minor*; to V. Korneyev (Kiev) and S. Leuzinger (Zürich) for the translation of Russian and Hungarian texts; to V. Korneyev (Kiev) and R. Meier (Copenhagen) for the loan of the Lauxaniids in their care; to G. Sabella (Catania) for his help in finding good collecting spots in Sicily, and to B. Landry (Geneva) for his comments on the manuscript.

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REVUE SUISSE DE ZOOLOGIE 108 (3): 455-461; septembre 2001

Another new species of *Grosphus* Simon (Scorpiones, Buthidae) for Madagascar

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Another new species of *Grosphus* Simon (Scorpiones, Buthidae) for Madagascar. - *Grosphus garciai* sp. n., the tenth representative of the genus *Grosphus* Simon (Scorpiones, Buthidae), is described from the Ankarafantsika Reserve in Madagascar. A revised key to the species of *Grosphus* is given.

Key-words: Scorpion - *Grosphus* - new species - Madagascar -Ankarafantsika Reserve.

INTRODUCTION

The genus *Grosphus*, with nine nominal species, is known to occur only in Madagascar. The first species was described under *Scorpio* (*Androctonus*) *madagascariensis* by Gervais (1844). This was followed by another description of a single species by Pocock (1889). A more important contribution was that of Kraepelin (1900), in which several species of the genus *Grosphus* were described. In his comprehensive contribution to the scorpions of Madagascar, Fage (1929) dealt with all the species known to that date and described a new variety of *Grosphus limbatus*, which he named *annulata*. This variety has later been raised to species rank and named *Grosphus annulatus*. In the studies by Lourenço (1995 and particularly 1996), several new scorpion taxa were described from the Madagascar fauna, and the number of scorpion species from there increased by more than three times. The genus *Grosphus*, however, has remained more stable in its composition and after the monograph of Fage (1929), only two further species have been described (Lourenço, 1996, 1999). Another new species of *Grosphus* from the Malagasy fauna is presented in the following in the paper.

TAXONOMIC TREATMENT

Grosphus garciai sp. n. Figs 1-11

MATERIAL: Male holotype and juvenile paratype from Madagascar, Province of Majunga, Ankarafantsika Reserve, Forest Station Ampijoroa, Ampijoroa village (16°18'45.2'' S - 46°48'54.2'' E), 73 m., Gerardo García Herrero coll., June/2000. Deposited in the Muséum d'Histoire naturelle, Genève (MHNG).

Manuscript accepted 14.02.2001

ETYMOLOGY: Patronym in honour of Mr. Gerardo García Herrero, who collected the specimen.

DIAGNOSIS: Close to *Grosphus madagascariensis* (Gervais), distinguished by: (i) Yellowish to reddish yellow variegated, with an intense brownish pigmentation (*G. madagascariensis* is dark to blackish in colour); (ii) smaller size 'see Table I); (iii) movable fingers of pedipalps with 13 oblique rows of granules, in contrast to 12 in *G. madagascariensis*; (iv) pedipalp and metasoma carinae weaker and with much less conspicuous spinoid granules; intercarinal tegument much less granular; (v) lobe at the base of movable finger reduced.

DESCRIPTION (based on male holotype): Morphometric measurements, see Table I.

Coloration. Basically yellow to reddish yellow, variegated with intense brownish pigmentation over the entiry body, pedipalps and legs. Prosoma: carapace dark yellowish variegated with spots more intensely marked laterally and behind the median eyes; eyes surrounded by black pigment. Mesosoma: dark yellowish with confluent brownish zones and one longitudinal yellowish stripe over tergites I-VI. Metasoma: all segments reddish yellow, variegated with brownish pigmentation over

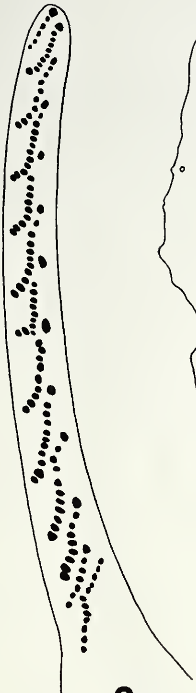
TABLE I. Morphometric values (in mm) of the male holotype of *Grosphus garciai* sp. n. and of an adult male *G. madagascariensis* from Monangarivo.

	G. garciai sp. n.	*G. madagascariensis*
Total lenght	32.0	54.0
Carapace:		
- length	4.4	6.1
- anterior width	3.0	4.4
- posterior width	5.0	7.2
Metasomal segment I:		
- length	2.7	4.4
- width	2.7	3.9
Metasomal segment V:		
- length	4.8	6.6
- width	2.7	3.8
- depth	2.5	3.5
Vesicle:		
- width	2.3	3.4
- depth	2.2	3.1
Pedipalp:		
- Femur length	4.1	5.8
- Femur width	1.2	1.6
- Tibia length	4.9	7.0
- Tibia width	1.9	2.4
- Chela length	8.2	11.5
- Chela width	2.4	3.4
- Chela depth	2.1	3.2
Movable finger:		
- length	4.3	6.3

FIGS 1-2
Grosphus garciai sp. n., male holotype, dorsal and ventral aspects

ventral and lateral aspects; a triangular brownish spot present on the dorsal face of each segment. Vesicle reddish yellow with some scattered light brownish spots; aculeus reddish yellow. Venter: coxapophysis, sternum, genital operculum and pectines yellowish; sternites reddish yellow; sternite V with a white approximately triangular basal spot. Chelicerae yellowish, variegated with dark pigmentation; fingers reddish. Pedipalps: mostly reddish yellow variegated with brownish pigmentation. Legs yellowish variegated with light browish pigmentation.

Morphology. Carapace moderately to intensely granular; anterior margin with a weak median concavity. All carinae weak; furrows moderate to weak. Median ocular tubercle anterior to the centre of the carapace; median eyes separated by one ocular diameter. Three pairs of lateral eyes. Shape of sternum in between subtriangular and sub-pentagonal. Mesosoma: tergites with thin but intense granulation. Median carina moderate on all tergites. Tergite VII pentacarinate. Venter: genital operculum formed by two subtriangular plates. Pectines: pectinal tooth count 18-19;



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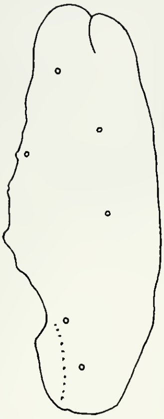

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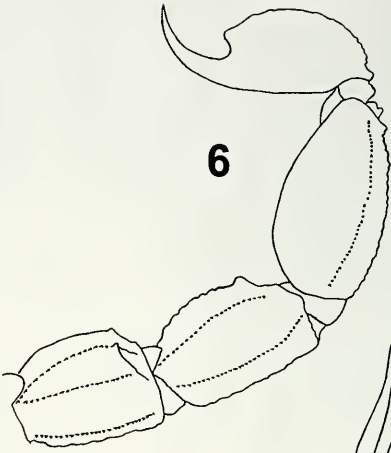

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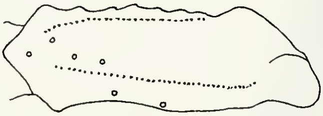

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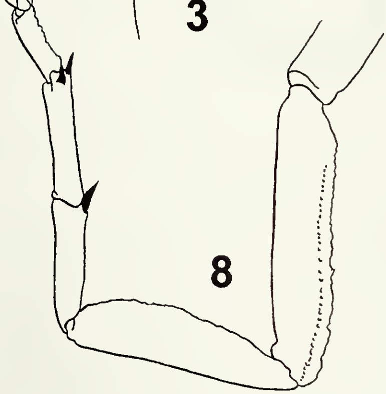

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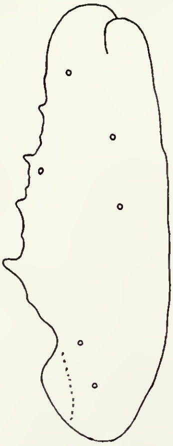

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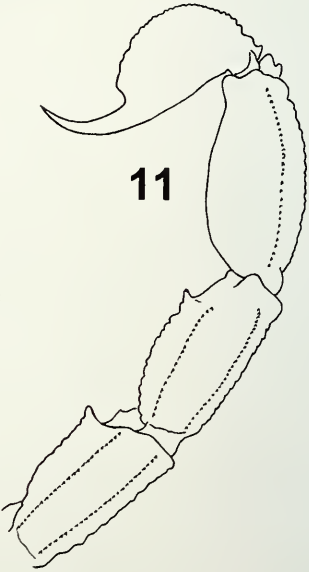

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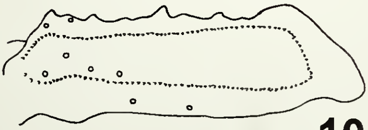

10

basal middle lamellae of each pecten not dilated. Sternites smooth, with moderately elongated, slightly oval stigmata; sternite VII with four vestigial carinae and a few thin granules. Metasoma: segments I and II with 10 carinae, moderately crenulate. Segments III and IV with 8 carinae, moderately crenulate. Segment V with 5 carinae, the dorsal one being only weakly marked. Dorsal carinae on segments I-IV with a moderately pronounced posterior spinoid granule. Intercarinal spaces moderately granulated. Telson with scattered granules on lateral and ventral surfaces; dorsal surface smooth; aculeus moderately curved and shorter than the vesicle; subaculear tooth small. Cheliceral dentition characteristic for the family Buthidae; two distinct basal teeth present on the movable finger, the more basal one being reduced (for a comparaison see Vachon, 1963); ventral aspect of finger and manus densely covered with, long setae. Pedipalps: femur pentacarinate; tibia with carinae represented by some spinoid granules only on the internal face; chelae smooth without carinae; all sides weakly granular to smooth. Dentate margin on movable finger composed of 13 oblique rows of granules. Trichobothriotaxy; orthobothriotaxy A-α (see Vachon, 1973, 1975). Legs: tarsus with numerous short thin setae ventrally. Tibial spurs present on legs III and IV; pedal spurs present on legs I to IV; all spurs strong.

Variation. The juvenile male paratype, shows a pectinal tooth count of 20-20. Its carinae are more strongly marked than in the adult, as is the case in juveniles of several buthid species.

COMMENTS: Preliminary examination of the specimens, first lead me to the conclusion that they could only be juveniles of *G. madagascariensis*. Many external traits such as the number of pectinal teeth and general morphology are similar in those two species (patterns of pigmentation can sometimes be different between juveniles and adults). However, the dissection of the holotype showed, that its genital organs, including hemispermatophores, where completely formed, proving that the type specimen is adult.

ECOLOGY: The species was found at night in dry forest with a sandy soil. It was collected together with *Grosphus madagascariensis* (Gervais) and *Grosphus bistriatus* Kraepelin (also deposited in the MHNG).

FIGS 3-11

3-8. *Grosphus garciai* sp. n., male holotype. 3. Dentate margin of movable finger. 4-5. Tibia and femur, dorsal aspect, showing trichobothrial pattern. 6. Metasomal segments III-V and telson, lateral aspect. 7. Distal region of hemispermatophore showing hook and flagellum. 8. Leg IV with spurs (in black). – 9-11. *Grosphus madagascariensis* (male). 9-10. Tibia and femur, dorsal aspect, showing trichobothrial pattern. 11. Metasomal segments III-V and telson, lateral aspect.

KEY TO THE KNOWN SPECIES OF THE GENUS *GROSPHUS*

1. Pectines with a maximum of 21 teeth 2

(1) Pectines with more than 22 teeth 4

2. Coloration yellowish to reddish yellow, variegated with a brownish pigmentation; total length averaging 30 mm. .... *G. garciai* sp. n.

(2) Coloration dark, from reddish brown to dark brown; total length averaging 50 mm 3

3. Coloration reddish brown to dark brown; metasomal segment I longer than wide; basal middle lamellae of pectines in females oval .... *G. madagascarienis*

(3) Coloration reddish brown with some lighter spots; metasomal segment I wider than long; basal middle lamellae of pectines in females subquadrangular .... *G. hirtus*

4. Coloration blackish throughout; pectines with 30 to 40 teeth; total length more than to 90 mm .... *G. grandidieri*

(4) Coloration from reddish-brown to yellowish, never blackish; total length less than 90 mm 5

5. Mesosoma with homogenous coloration, reddish-brown or yellowish 6

(5) Mesosoma with one blackish longitudinal median stripe, or with two blackish longitudinal lateral narrow stripes 9

6. Total length more than 70 mm; mesosoma reddish brown; basal middle lamellae of pectines in females two times longer than wide at their base .... *G. flavopiceus*

(6) Total length less than 60 mm; mesosoma yellowish; basal middle lamellae of pectines in females three times longer than wide at their base 7

7. Metasomal segment V and telson pale yellowish .... *G. intertidalis*

(7) Metasomal segment V and telson with blackish spots or blackish throughout 8

8. Metasomal segment V and telson with blackish spots .... *G. annulatus*

(8) Metasomal segment V and telson blackish .... *G. feti*

9. Mesosoma with a wide blackish longitudinal median stripe; basal middle lamellae of pectines in females three times longer than wide at their base and covering the 4 proximal teeth .... *G. limbatus*

(9) Mesosoma with two narrow blackish longitudinal lateral stripes; basal middle lamellae of pectines in females two times longer than wide at their base and covering only the proximal tooth .... *G. bistriatus*

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REVUE SUISSE DE ZOOLOGIE 108 (3): 463-481; septembre 2001

On the separation of *Sitticus ranieri* Peckham & Peckham and *S. saxicola* (C. L. Koch) (Araneae, Salticidae)

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On the separation of *Sitticus ranieri* Peckham & Peckham and *S. saxicola* (C. L. Koch) (Araneae, Salticidae). - *Sitticus ranieri* Peckham & Peckham and *S. saxicola* (C. L. Koch) constitute a close group of species due to the morphology of their copulatory organs. Re-examination of specimens previously identified as *Sitticus saxicola* from Fennoscandia has revealed that they belong to *S. ranieri*. Redescriptions with illustrations of both species are provided. *S. saxicola* has a disjunct distribution, occurring in mainly montane areas in the central parts of Europe and on the Balkan peninsula, as well as in the Russian Far-East (known from Sakhalin). *S. ranieri* shows a wide, hypoarcto-boreal distribution throughout northern Europe and Siberia, extending into North America. North American males of *S. ranieri* from southern British Columbia, Washington, Oregon, and Wyoming differ from those examined from other parts of the range (northern Palaearctic, Alaska, Yukon, Saskatchewan, Manitoba, Colorado) by having slightly different proportions of the bulbus and by lacking a streak of white hairs between the anterior median eyes. Reasons are given for presently not taking these differences into nomenclatorial account.

Key-words: Araneae - Salticidae - *Sitticus* - taxonomy - Holarctic.

INTRODUCTION

Within the jumping spider genus *Sitticus* C. L. Koch, *S. ranieri* Peckham & Peckham, 1909 and *S. saxicola* (C. L. Koch, 1846) constitute a morphologically close species pair in the Holarctic region. Both were redescribed by Prószyński (1971b), the former under the name *S. lineolatus* (Grube, 1861). Re-examination of old material, as well as access to new material, have shown that *S. ranieri* has previously been misidentified as *S. saxicola* in northern Europe. In this paper, diagnostic characteristics of the two species are given together with comments on their distribution.

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S. saxicola was originally described on material from Bavaria, Germany. The species is mainly montane in Continental Europe. It has recently also been found in the Far East of Russia (Marusik *et al.*, 1992). The presence of a seemingly disjunct European occurrence of this species in northern Fennoscandia was announced by Holm (1931), followed by Palmgren (1943), Tullgren (1944, 1952), Holm (1950), Hackman (1951), and Granström (1979). The illustration of an epigyne attributed to *S. saxicola* by Tullgren (1952), drawn from a female collected in Swedish Lapland, however, rather appears to show an epigyne of *S. ranieri*. Examination of the corresponding specimen confirmed this assumption. Re-examination of other Fennoscandian specimens attributed to *S. saxicola* revealed that they all had been misidentified.

Sitticus ranieri was for a long time known as a Nearctic species until Prószyński (1971a,b) synonymized it with *Sitticus lineolatus* (Grube, 1861). The identity of *Attus lineolatus* Grube was disclosed by Prószyński (1971a,b) after examination of the holotype. *A. lineolatus* was transferred to *Sitticus* and the Nearctic *Sitticus ranieri* Peckham & Peckham and *S. haydeni* Levi & Levi were placed under *S. lineolatus* as junior synonyms (Prószyński, 1971a, b), as was *S. mazamae* Schenkel (Prószyński, 1971b). However, *S. lineolatus* is an invalid name because *Attus lineolatus* Grube, 1861 is a primary homonym of *Attus lineolatus* Sundevall, 1833 (Platnick, 1993) [the latter now in synonymy with *Salticus cingulatus* (Panzer)], and must therefore be replaced by the next oldest available name, *S. ranieri* (Platnick, 1993). Examination of the holotype and other material identified as *S. ranieri*, as well as the holotype of *S. haydeni*, revealed slight differences from the holotype and other material identified as *S. lineolatus* in the male sex. We have, however, been unable to morphologically distinguish females of the American morph (for which *S. ranieri* was described) from the Siberian morph (for which *S. lineolatus* was described). At present we regard the two morphs as conspecific. Further investigations may well reveal that they differ at the species level. If so, *Icius daisetsuzanus* Saito, 1934 (described from Mt. Daisetsu on Hokkaido in Japan; no material from Japan has hitherto been available to us) may be conspecific with the Siberian morph (see Saito, 1934: pl. 12 fig. 13, pl. 14 fig. 51) and no replacement name required for *S. lineolatus* sensu Grube.

DEPOSITORIES

AMNH	American Museum of Natural History, New York, NY, USA (N. I. Platnick)
CNBW	Collection of Nationalpark Bayerischer Wald, Grafenau, Germany
CNC	Canadian Collection of Insects and Arachnids, Ottawa, Canada (C. D. Dondale)
CTh	Collection of K. Thaler, University of Innsbruck, Innsbruck, Austria
IBPN	Institute for Biological Problems of the North, Magadan, Russia (Y. M. Marusik)
ISEN	Siberian Zoological Museum of the Institute for Systematics and Ecology of Animals, Novosibirsk, Russia (D. V. Logunov)
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge, MA, USA (L. Leibensperger)
NHMB	Naturhistorisches Museum, Basel, Switzerland (A. Hänggi)
NHRS	Swedish Museum of Natural History, Stockholm, Sweden (T. Kronestedt)
RBCM	Royal British Columbia Museum, Victoria, B. C., Canada (T. Steigenberger)
ZMHU	Zoological Museum of Helsinki University, Helsinki, Finland (J. Terhivuo)
ZMUU	Zoological Museum of Uppsala University, Uppsala, Sweden (T. Jaenson)
ZMWU	Zoological Museum of Wrocław University, Wrocław, Poland (W. Wesołowska)
UWBM	Burke Museum, University of Washington, Seattle, WA, USA (R. Crawford)

ABBREVIATIONS IN THE TEXT

ALE = anterior lateral eyes
AME = anterior median eyes
ap = apical
d = dorsal
Fm = femur
I, II, etc. = referring to first leg, second leg, etc.
L = length
Mt = metatarsus
PLE = posterior lateral eyes
pr = prolateral
Pt = patella
rt = retrolateral
Tb = tibia
Tr = tarsus
v = ventral

For the leg spination the system adopted is that used by Ono (1988). Measurements are given in millimetres.

Sitticus ranieri Peckham & Peckham, 1909 Figs 1, 2, 4, 5, 8-10, 14, 16, 17, 18-20

Attus lineolatus Grube, 1861: 175 (♂) (name permanently invalid, preoccupied by *Attus lineolatus* Sundevall, 1833, replaced by *Sitticus ranieri* in Platnick, 1993). Holotype from Russia, Yakutia: Vilyuy River in ZMWU, examined. Bonnet 1955: 802.

Sitticus lineolatus; Prószyński, 1971a: 223, figs 37-39 (♂); 1971b: 192, figs 2, 14-21 (♂) 22-30 (♀); Chikuni, 1989: 150, 277, fig. 19 (♂♀).

Sittacus ranieri Peckham & Peckham, 1909: 520, pl. 43, fig. 5a-c (♂♀) ["*Sittacus*" is an incorrect subsequent spelling of *Sitticus* Simon, 1901 (ICZN Article 33.3)]. Lectotype examined (see below).

Sitticus ranieri; Roewer, 1954: 1251; Platnick, 1993: 812, 1998: 939, www; Prószyński, www.

Sitticus ranierinus Bonnet, 1958: 4081 [unjustified emendation (ICZN Article 33.2.3)].

Sitticus saxicola (misidentification); Palmgren, 1943: 23, fig. 22 (♂♀); Tullgren, 1944: 32, pl. 2 figs 37, 38 (♂ only), 1952: 151, fig. 1 (♀).

Sitticus haydeni Levi & Levi, 1951: 232, figs. 36, 45, 46 (♂). Holotype examined (see below). Roewer, 1954: 1251.

Sitticus mazamae Schenkel, 1951: 45, fig. 45 (♀). Holotype from USA: Oregon, Crater Lake, in NHMB, not examined (figs 24 & 29 in Prószyński, 1971b). Roewer, 1954: 1251.

COMMENTS

To us, Prószyński's (1971a,b) synonymization of *Sitticus ranieri* with *S. lineolatus* sensu Grube is not unambiguously warranted but needs further investigation. When compared with *S. lineolatus* sensu Grube, the male type specimen of *S. ranieri* [examined by Prószyński (1971b) and erroneously called "holotype" instead of lectotype], as well as other males examined by us (listed under American morph below), differ in certain proportions (cf. Figs 1 & 2 and Fig. 24). Moreover, the bulbus in the Siberian morph (*S. lineolatus* sensu Grube) is distally somewhat more tapering and exhibits a more or less pronounced shallow concavity prolaterally (see arrow in inset of Fig. 24). Maybe most significant is the presence of streaks of white hairs, one between the AMEs, continuing a short distance backwards, and one on each side between AME and ALE. These are characteristic in males of the Siberian morph, but absent (or hardly traceable) in the males examined and listed under the American

TABLE I

Differences between *Sitticus ranieri* and *S. saxicola*

	Sitticus ranieri	*S. saxicola*
Males		
Carapace: details in colour pattern and pilosity of cephalic part	*Siberian morph*: AMEs surrounded by white hairs, in upper part ("eyebrows") additionally with black hairs; three short longitudinal patches of white hairs at the front: one in the median line between AMEs and one above each ALE (Fig. 16) (the latter may be indistinct) *American morph*: median longitudinal stripe at the front of carapace absent (Fig. 17).	"Eyebrow" (around upper half of each AME) with numerous white and orange scales close to the eye rim, black hairs outside of them.
Leg I length	Comparatively short (Fig. 14; cf. Fig. 25 for Tb); slight sexual dimorphism [TbIL/TbIVL: ♂♂(Siberian morph) 0.54-0.60 (N=11), (American morph) 0.55-0.60 (N=10); ♀♀ (from the area inhabited by the Siberian morph) 0.46-0.48 (N=5)]	Comparatively long (Fig. 15; cf. Fig. 25 for Tb); striking sexual dimorphism [TbIL/TbIVL: ♂♂ 0.76-0.84 (N=10); ♀♀ 0.53-0.55 (N=5)]
Palpal segments	Pt, Tb and cymbium dusky brownish and with dark hairs; distal part of blackish brown Fm with patch of white hairs dorso-prolaterally	Pt , Tb and cymbium light brownish; Pt and Tb with whitish hairs (longest laterally on Tb), cymbium with whitish hairs in proximal half, dark ones in distal part
Retrolateral tibial apophysis in ventral view	Evenly curved, sharply pointed: tip directed forwards (Fig. 10)	More or less straight, protruding outwards-forwards at an oblique angle; distalmost part of tip slightly bent towards cymbium and (in lateral view, not shown here) upwards (dorsad) (Fig. 13)
Dorsodistal protrusion of palpal tibia	Slightly convex on prolateral side (*arrow*), tip rounded (Fig. 8)	Distinctly concave on prolateral side (*arrow*), tip more set off (Fig. 11)
Females		
Carapace	Face densely furnished with white hairs; without orange hairs	Face with appressed white and orange hairs
Abdomen	Without orange hairs	With scattered orange hairs
Epigyne	Edges of openings to copulatory ducts relatively straight and converging at an acute angle (epigynal atrium V-shaped) (Figs 18 & 19)	Edges of openings to copulatory ducts relatively rounded (epigynal atrium more or less pear-shaped) (Figs 21 & 22)
Spermathecae	Copulatory ducts comparatively long (Fig. 20)	Copulatory ducts comparatively short (Fig. 23)

morph below (cf. Figs 16 & 17). The remark on North American salticids by Crawford (1988: 34) is applicable in this case:"…the potential exists in this family for numerous species with similar genitalia, which differ in color and other sexual display characters."

We could not morphologically distinguish females of the Siberian and American morphs. Further research, including studies of courtship behaviour and DNA, is required to throw further light on the possible distinctness of the two morphs.

DIAGNOSIS. See Table I.

DESCRIPTION

MALE (Siberian morph) (Russia: Chita Area). *Measurements.* Carapace 2.32 long, 1.83 wide, 1.19 high at PLE. Ocular area 1.10 long, 1.38 wide anteriorly and 1.40 posteriorly. Diameter of AME 1.41. Abdomen 2.23 long, 1.83 wide. Cheliceral length 0.68. Clypeal height 0.23. Length of leg segments:

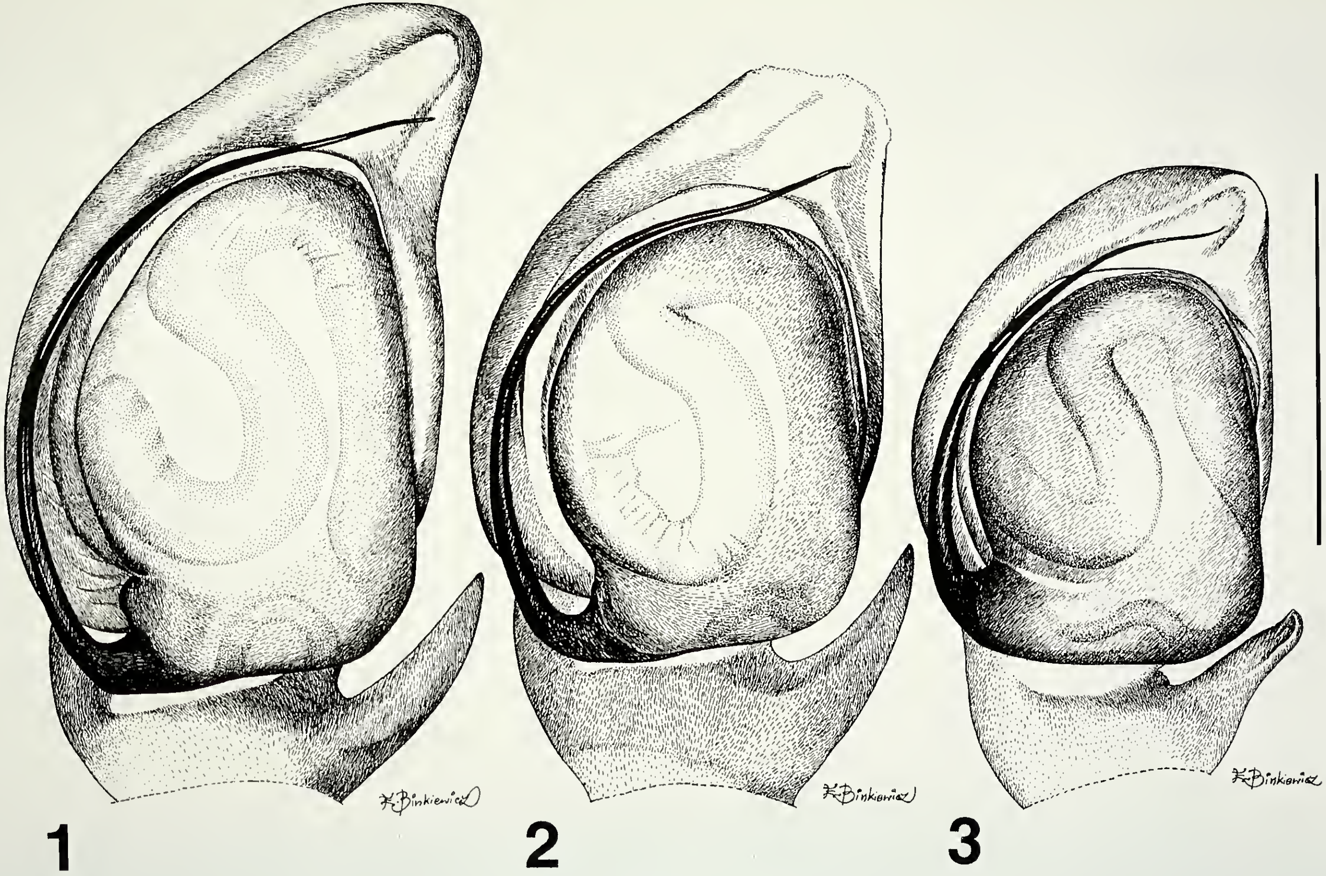
	Fm	Pt	Tb	Mt	Tr	Total
I	1.25	0.68	0.70	0.75	0.48	3.86
II	1.15	0.65	0.60	0.63	0.45	3.48
III	1.18	0.58	0.63	0.75	0.48	3.62
IV	1.88	0.75	1.28	1.18	0.60	5.69

Leg spination. Leg I: Fm d 0-1-1-4; Pt pr and rt 0-1-0; Tb pr 1-2, rt 1-0, v 1-1-2ap; Mt pr and rt 1-1, v 2-2ap. Leg II: Fm d 0-1-1-4; Pt pr and rt 0-1-0; Tb pr 1-1, rt 1-0, v 1-1-2ap; Mt pr and rt 1-1, v 2-2ap. Leg III: Fm d 0-1-1-4; Pt pr and rt 0-1-0; Tb d 1-0, pr and rt 1-1-1, v 1-2ap; Mt pr and rt 1-1-2ap, v 2-2ap. Leg IV: Fm d 0-1-1-5; Pt pr and rt 0-1-0; Tb d 1-1, pr and rt 1-1-1, v 1-0-2ap; Mt d 1-0, pr and rt 1-1-2ap, v 2ap.

Coloration. Carapace dark to blackish brown. Eye field black, with a short median longitudinal stripe of white hairs from between AMEs rearwards and with a more or less distinctly marked elongated spot of white hairs behind each ALE. Spot of white hairs in midline between PLEs. Clypeus medium to blackish brown, with white hairs. Sternum and chelicerae dark brown. Maxillae and labium dark brown, with yellow apices. Abdomen: dorsum dark grey-brown, with a pair of light spots (sometimes poorly marked); sides brownish yellow, with inclined, dark brownish grey lines; venter light to yellowish grey. Book-lung covers and spinnerets grey, with yellowish tinge. All legs yellowish to median brown, with numerous dark to blackish brown stains and rings; coxae lighter (yellowish to brownish grey); leg I: see Fig. 14. Palp medium to blackish brown.

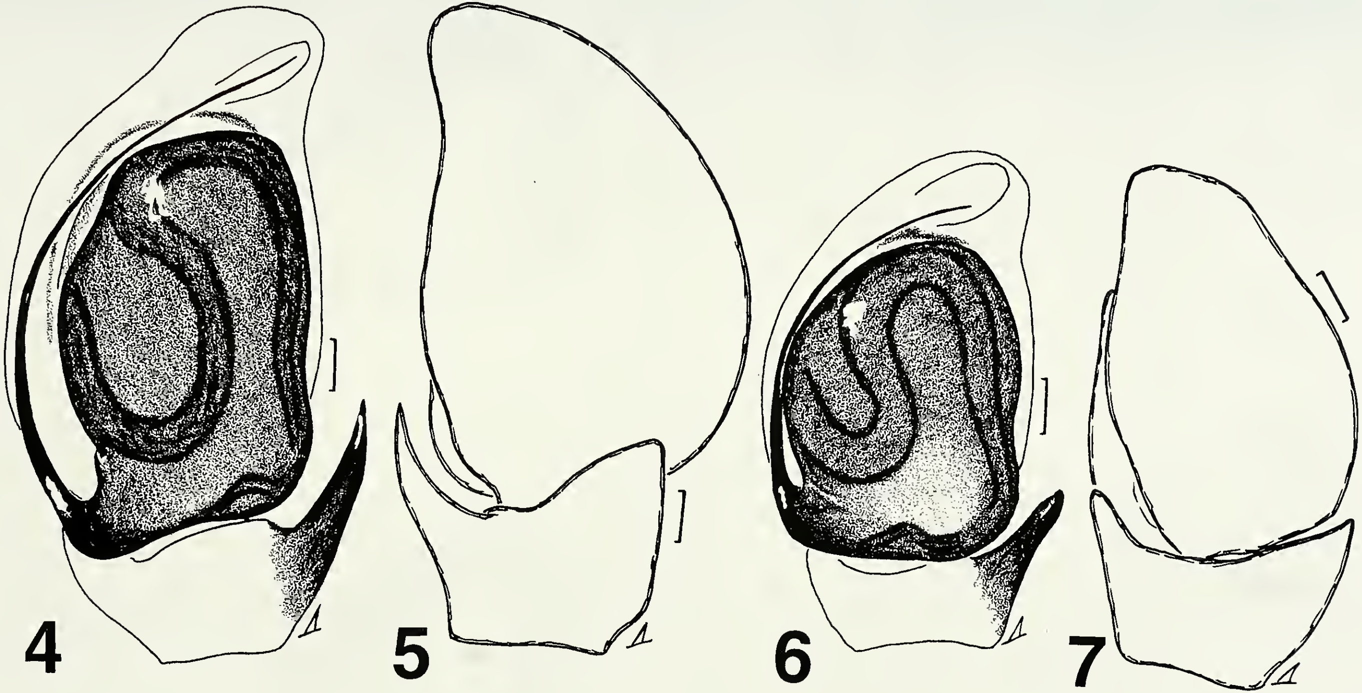
Palp. Structure as in Figs 1, 4, 5, shape of tibia as illustrated in Figs 8-10 (see also Table I).

MALE (American morph) (USA: Washington, Pierce Co., Mt. Rainier Nat. Park). *Measurements*. Carapace 2.20 long, 1.60 wide, 1.13 high at PLE. Ocular area 1.05 long, 1.28 wide anteriorly and 1.30 posteriorly. Diameter of AME 0.38. Abdomen 2.13 long, 1.75 wide. Cheliceral length 0.60. Clypeal height 0.20. Length of leg segments:



FIGS 1-3

Left male palp, ventral view. – 1. *Sitticus ranieri* (Siberian morph) (British Columbia: Summit Lake). – 2. *S. ranieri*, lectotype (right palp, mirror image). – 3. *S. saxicola* (Germany: Bavaria). Scale line: 0.5 mm (all same scale).



FIGS 4-7

Left male palp, ventral (4, 6) and dorsal view (5, 7). – 4, 5. *Sitticus ranieri* (Siberian morph) (Russia: the Altai). – 6, 7. *S. saxicola* (Russia: Sakhalin). Scale lines: 0.1 mm.

	Fm	Pt	Tb	Mt	Tr	Total
I	1.15	0.54	0.70	0.60	0.55	3.54
II	1.10	0.58	0.60	0.63	0.45	3.36
III	1.15	0.55	0.60	0.73	0.50	3.53
IV	1.78	0.65	1.33	1.20	0.60	5.56

Leg spination. Leg I: Fm d 0-1-1-4; Pt pr 0-1-0; Tb pr 1-1-1, rt 1-0, v 1-2-2ap; Mt pr 1-1ap, rt 1ap, v 2-2ap. Leg II: Fm d 0-1-1-3; Pt pr and rt 0-1-0; Tb pr 1-1, d and rt 1-0, v 1-1-2ap; Mt pr and rt 1-1ap, v 2-2ap. Leg III: Fm d 0-1-1-5; Pt pr and rt 0-1-0; Tb d 1-1-0, pr and rt 1-1-1, v 2ap; Mt d 1-0, pr and rt 1-2ap, v 2-2ap. Leg IV: Fm d 1-0-1-5; Pt pr and rt 0-1-0; Tb d 0-1-0, pr and rt 1-2-1, v 1-0-2ap; Mt d 0-1-0, pr and rt 1-1ap, v 2-2ap.

Coloration. Carapace medium to dark brown, with black radial veins. Eye field black, covered with black hairs (numerous appressed and, more frontally, scattered long erect ones). Spot of white hairs in midline between PLEs. Clypeus brown, covered with thin light hairs. Sternum, maxillae, labium and chelicerae brown, with light yellow apices. Abdomen: dorsum dark grey-brown, with a pair of rounded white spots in the posterior half; venter greyish to yellowish brown. Book-lung covers yellowish brown. Spinnerets yellowish to greyish brown. All legs yellowish to medium brown, dorsally usually darker (brown); coxae, at least III and IV, light (yellowish). Palp medium to dark brown.

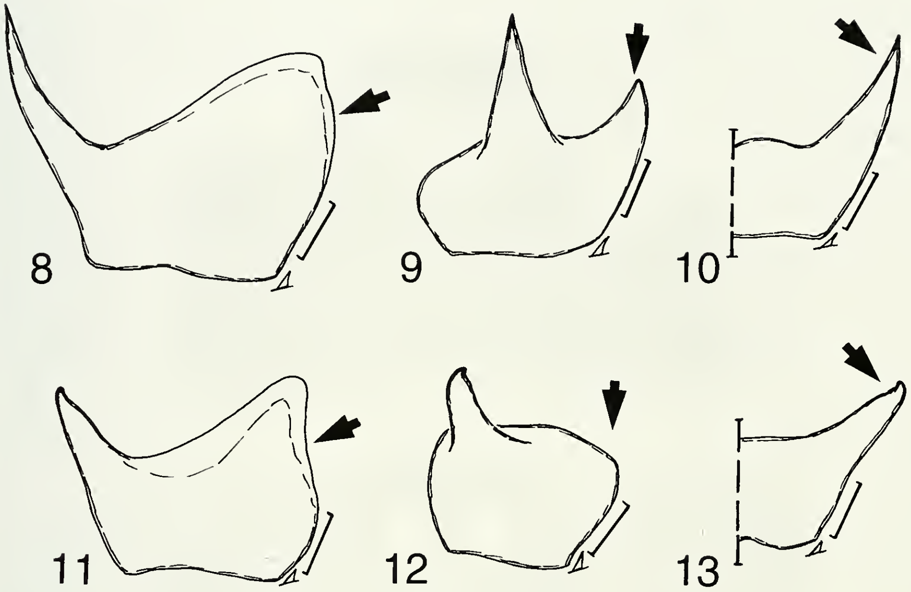
Palp. Structure as in Fig. 2 (see also Table I).

FEMALE (USA: Washington, Pend Oreille Co.). *Measurements*. Carapace 2.52 long, 2.18 wide, 1.40 high at PLE. Ocular area 1.30 long, 1.63 wide anteriorly and 1.63 posteriorly. Diameter of AME 0.45. Abdomen 4.00 long, 3.50 wide. Cheliceral length 0.75. Clypeal height 0.23. Length of leg segments:

	Fm	Pt	Tb	Mt	Tr	Total
I	1.35	0.85	0.75	0.70	0.48	4.13
II	1.28	0.80	0.70	0.65	0.50	3.93
III	1.40	0.63	0.78	0.80	0.60	4.21
IV	2.40	0.95	1.66	1.48	0.65	7.14

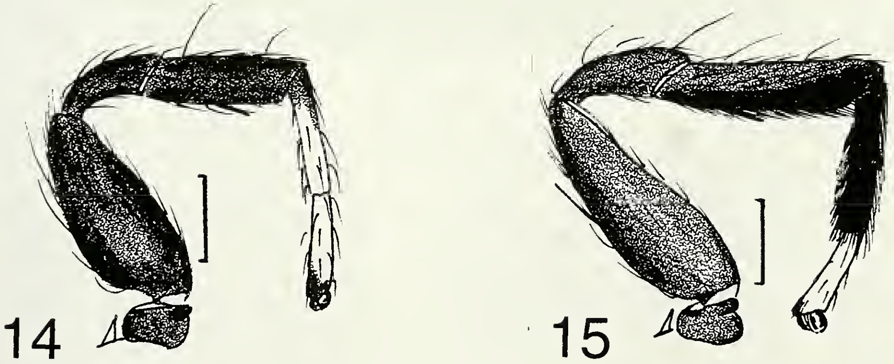
Leg spination. Leg I: Fm d 0-1-1-2; Tb pr 1-1, v 1-2-2ap; Mt pr 1-1ap, v 2-2ap. Leg II: Fm d 0-1-1-4; Tb pr 1-1, v 1-1-2ap; Mt pr 1-1ap, v 2-2ap. Leg III: Fm d 0-1-1-4; Pt pr and rt 0-1-0; Tb pr 1-1-1, rt and v 1-0; Mt pr and rt 1-1-2ap, v 2-2ap. Leg IV: Fm d 1-1-3; Pt pr and rt 0-1-0; Tb d 1-1-0, pr and rt 1-1-1, v 1-0-2ap; Mt pr and rt 1-1-2ap, v 2ap.

Coloration. Carapace brown, with numerous black veins, covered with white appressed hairs. Eye field black, covered with black hairs. Short median stripe of white hairs between PLEs continuing into thin white median line in thoracic part. Clypeus brown, densely covered with white hairs. Maxillae and labium brown, with white apices. Sternum and chelicerae brown. Abdomen: dorsum grey-brown, with one pair of smaller oblique white spots in anterior half followed by one pair of larger oblique white patches at about the middle and by a few light chevron-like markings



FIGS 8-13

Left male palpal tibia, dorsal (8, 11) and retrolateral view (9, 12), tibial apophysis only, ventral view (10, 13). – 8-10. *Sitticus ranieri* (Siberian morph) (Sweden). – 11-13. *S. saxicola* (Italy). *Arrows* point at differences between the two species. Scale lines: 0.1 mm.

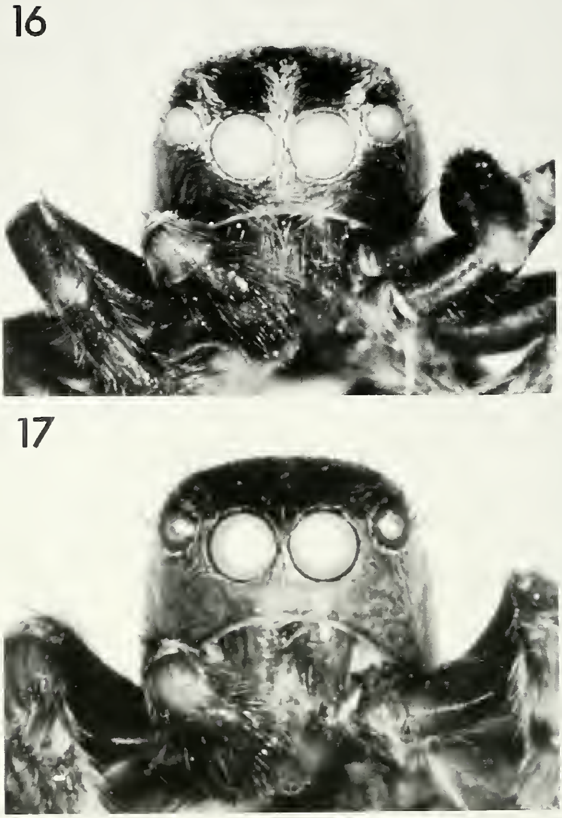


FIGS 14, 15

Right leg I of male, retrolateral view. – 14. *Sitticus ranieri* (Siberian morph) (Sweden). – 15. *S. saxicola* (Italy). Scale lines: 0.5 mm.

posteriorly, all forming a pale median band in some specimens; sides yellowish, with inclined white stripes; venter yellowish. Book-lung covers and spinnerets grey, with a brownish to yellowish tinge. All legs yellow-brown, with pale brownish grey rings; coxae lighter (yellowish). Palp yellow-brown, tarsus somewhat darker.

Epigyne and spermathecae as in Figs 18-20.

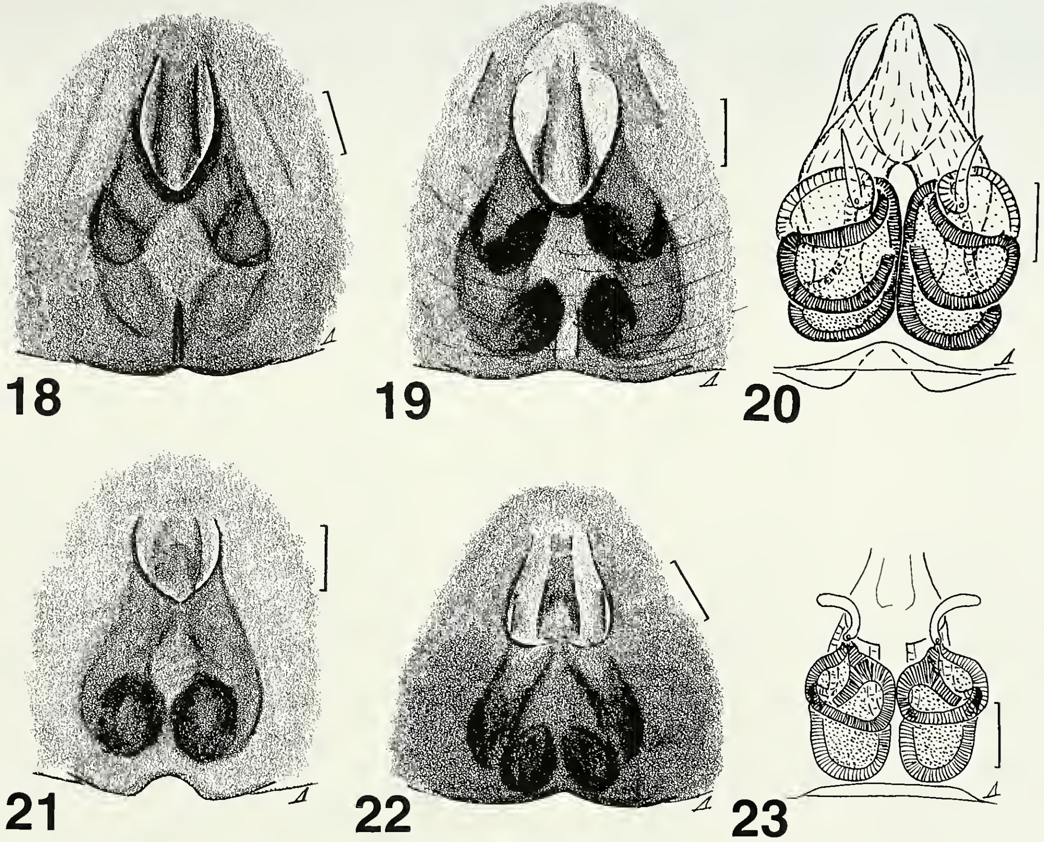


Figs 16, 17

Male of *Sitticus ranieri*, seen from in front. – 16. Siberian morph (Saskatchewan: Black Lake). – 17. American morph (British Columbia: Bridal Lake).

Material examined

Siberian morph (corresponding to *S. lineolatus* sensu Grube, 1861). **SWEDEN**. Torne Lappmark: Tuopti, 21 June 1928, 1♂ (Å. Holm, ZMUU); Kårsavagge, 580 m asl, 5-15 July 1976, 2♂ (Å. Holm, ZMUU); Abisko National Park, Mt. Nuolja, 650 m asl, 29 June 1977, 1♀ (Å. Holm, ZMUU): Abisko, SW of Abisko Östra, pitfall traps, 10-17 June 1978, 2♂ 1♀, 24 June-2 July 1978, 2♂ (Å. Holm, ZMUU); Kebnekaise, Aug. 1944, 1♀ (S. Österling, NHRS). – **FINLAND**. Lapponia inarensis: Inari, 1908 (T. Itkonen, ZMHU). 1♂. – **RUSSIA**. Chita Area: Kyra Distr., Sokhondo Reserve, ca. 1700 m asl, mountain moss-lichen bog with *Betula nana*, 11 June 1991, 2♂ (D. V. Logunov, ISEN). Chukotka: Amguema River basin, km 174 on the road Egvekinot-Iultin, 19 June 1989, 8♂ (+2 subad.♂) (Y. M. Marusik, ISEN). Krasnoyarsk Territory: W part of Kryzhyna Mt. Range, ca. 40 km NE of Cheremshanka, 1400-1800 m asl, mountain tundra, 7-12 July 2000 (R. Dudko, ISEN). Magadan Area: Solnechnyi village (environs of Magadan), under stones, 20 June 1987, 1♀ (Y. M. Marusik, ISEN); Upper reaches of Kolyma R., 61°40’N 147°30 E. summer 1987, 2♂ 2♀ (S. Bukhkalo, ISEN); Babushkina Bay (ca. 125 km E of Magadan), summer 1995, 1♂ (K. Regel, IBPN). Murmansk Area: Kola peninsula, 7 km S of Monchegorsk, June-August 1994, 3♂ 1♀ (M. Kozlov, ISEN). Tuva: Tes-Khem Distr., 20 km NW of Khol`-Oozhu village, Kangai-Kyry Mt., ca. 2100 m asl, mountain tundra, 9 July 1989, 1♂ (D. V. Logunov, ISEN). Yakutia: “Wilui”(=Vilyuy River), 1♂ (Maak,



FIGS 18-23

Epigyne, ventral view (18-19, 21-22), and spermathecae, dorsal view (20, 23). – 18-20. *Sitticus ranieri* (18, Russia: Kola peninsula; 19, 20, Russia: Magadan Area). – 21-23. *S. saxicola* (21, Italy; 22, 23, Russia: Sakhalin). Scale lines: 0.1 mm.

ZMWU, holotype of *Attus lineolatus* Grube, 1861). For other material studied by DVL, see Logunov (1992) and Danilov & Logunov (1994). – **CANADA**. British Columbia: Summit Lake, Alaska Highway at mile 392, 17 & 24 June, 1 July 1959, 1♂ 3♀ (R. E. Leech, CNC), 1 mile W Summit Lake, on moss-lichen mountain, 1 June 1981, 1♂ (C. D. Dondale, CNC); border with Alaska, Klondyke Highway, under rocks above treeline, 5 June 1981, 1♂ (C. D. Dondale, CNC). Manitoba: Churchill, 14 July 1949, 1♀ (J. B. Wallis, CNC); Hudson Bay Railway, at mile 256, Spring Lake, 12 July 1917, 1♂ (J. H. Emerton, MCZ). Northwest Territories: Salmita, 15 July 1953, 1♀ (J. G. Chillcott, CNC); 20 miles E Tuktoyaktuk, 3-5 July 1971, 3♂ 1♀ (W. R. M. Mason, CNC). Saskatchewan: Black Lake, summer 1981, 1♂ (T. A. Pearce, CNC). Yukon Territory: Carcross, sand dunes, 4 June 1981, 1♀ (C. D. Dondale, CNC); Dempster Highway at km 132, tundra and stony mountain side, 22 June 1981, 1♀ (C. D. Dondale, CNC). – **USA**. Colorado: Gunnison Co., Elk Mts, Copper Creek Valley, 10,500 ft asl, 2-11 July 1954, 1 ♂ (H. Levi, MCZ); Gunnison Co., Elk Mts, Copper Lake, 11,100 ft asl, 2 July 1954, 1 ♂ (H. Levi, MCZ).

American morph (*S. ranieri* sensu Peckham & Peckham, 1909). **CANADA**. British Columbia: Vancouver Is., Forbidden Plateau, 4000 ft., 6-9 August 1950, 1♂ (R. Guppy, AMNH); Bridal Lake 43 km W of Creston, 5900 ft asl, outside of a beehive, 22 July 1990, 1♂ (D. W. Knight, RBCM); Glacier, on logs, 1♂ (G. W. & E. G. Peckham, MCZ, lectotype). – **USA**. Oregon: Wallowa Mts., Dollar Lake, 23 July 1956, 1♂ 1♀ (B. Malkin, AMNH) [material identified by J. Prószyński, the copulatory organ of the female is probably the one depicted in Prószyński (1971: figs 23 & 28), now absent from the vial]. Washington: Clallam Co., Olympic Nat. Park, Eagle Point, 6000 ft. asl, 22 July 1978, 1♂ 1♀ (R. Crawford, UWBM); Pend Oreille Co., Deemer Creek, 4600 ft asl, boggy riparian meadow, pitfall, 11-14 June 1986, 1♀ (R. Crawford, UWBM); Pierce Co., Bearhead Mtn. summit, 6000-6089 ft asl, under rock, 15 Aug. 1982, 1♀ (J. P. Pelham, UWBM), Mt. Rainier Nat. Park, Panorama Point, 6880 ft. asl, pitfall, 5-13 Aug. 1976, 1♂ (D. H. Mann, UWBM). Wyoming: Teton National Park, Holly Lake, above timberline, rocks, 19 July 1950, 2♂ 1♀ (H. Levi, MCZ); Yellowstone National Park, July 1931 (W. J. Gertsch, AMNH, holotype of *S. haydeni*); Yellowstone National Park, Mammoth Hot Springs, 28 July 1950, 1 ♂ (H. Levi, MCZ).

DISTRIBUTION Fig. 26

Sitticus ranieri was described from eastern Siberia by Grube (1861, sub *Attus lineolatus*), but it was not until Prószyński (1971a) examined the holotype that its identity became clear. In the meantime the species was described from North America under three different names. The species (sub *S. lineolatus*) has recently become known as being wide-spread in Siberia (cf. records summarized in Logunov & Marusik, 2000). It has also been reported from Japan (Hokkaido) (Chikuni, 1989; Matsuda, 1997) and may be conspecific with the species described under the name *Icius daisetsuzanus* (see Saito, 1934; Matsuda, 1997). With the findings reported here, the known range of *S. ranieri* is extended westwards to northern Fennoscandia, thus making it a Holarctic hypoarcto-boreal element. Its distribution in the Nearctic is restricted to the northern boreal and hypoarctic region of Canada (eastwards to Newfoundland: Dondale *et al.*, 1997) and to montane areas in USA (Washington, Oregon, Wyoming, Colorado). However, as emphasized above, a renewed study on the conspecificity of what is now standing as one species in North America is wanting.

Sitticus saxicola (C. L. Koch) Figs 3, 6, 7, 11-13, 15, 21-23

Euophrys saxicola C. L. Koch, 1846: 17, pl. 471 figs. 1284, 1285 (♂♀). Type material from Germany: Bavaria, Mt. Stück (=Mt. Stückstein, cf. Fischer, 1993) lost (Prószyński, 1971b).

Attus saxicola; Bösenberg, 1903: 426, 430, pl. 41 figs 631 A-D (♂ ♀).

Sitticus saxicola; Tullgren, 1944: 31, fig. 19a, pl. 2 fig. 36 (♀ only); Bonnet, 1958: 4082; Prószyński, 1971b: 188, figs 1, 3-13 (♂ ♀), 1991: figs 1389.1-4 (♂ ♀), www; Harm, 1973: 394, figs 6, 52, 57, 58, 64 (♂ ♀); Logunov & Wesołowska, 1995: 173, figs 9-16 (♂ ♀); Platnick, 1993: 813, 1998: 939 (in part), www (in part); Fuhn & Gherasim, 1995: 248, figs 114A-F (♂ ♀); Żabka, 1997: 95, figs 364-369 (♂ ♀).

Attus cingulatus Simon, 1868: 50 (♂). Holotype from Switzerland: Zermatt, not located.

Sitticus cingulatus; Roewer, 1954: 1244.

Attus montigenus Thorell, 1875: 108 (♂). Bösenberg, 1903: 426, 434, pl. 42 figs 638 A-C (♂). Holotype from Poland or Czech Republic: Riesengebirge, in Naturhistorisches Museum Berlin, not examined (illustrated in Prószyński, 1971b).

Sitticus montigenus; Bonnet, 1958: 4076.

Sitticus littoralis (incorrect synonymy); Roewer, 1954: 1246.

DIAGNOSIS. See Table I.

DESCRIPTION

MALE (Germany: Bavaria). *Measurements*. Carapace 2.32 long, 1.65 wide, 1.10 high at PLE. Ocular area 1.03 long, 1.48 wide anteriorly and 1.34 posteriorly. Diameter of AME 0.38. Abdomen 2.25 long, 1.88 wide. Cheliceral length 0.68. Clypeal height 0.18. Length of leg segments:

	Fm	Pt	Tb	Mt	Tr	Total
I	1.47	0.78	1.00	0.95	0.63	4.83
II	1.16	0.63	0.63	0.68	0.53	3.63
III	1.05	0.49	0.63	0.70	0.48	3.35
IV	1.95	0.69	1.20	1.18	0.65	5.67

Leg spination. Leg I: Fm d 0-1-1-3; Pt pr 0-1-0; Tb pr 1-0, v 1-2-2ap; Mt pr 1-1ap, v 2-2ap. Leg II: Fm d 0-1-1-3; Pt pr 0-1-0; Tb pr 1-1, rt 0-1, v 1-2-2ap; Mt pr 1-1, v 2-2ap. Leg III: Fm d 0-1-1-3; Pt pr and rt 0-1-0; Tb d 1-0, pr and rt 1-1-1, v 1-2ap; Mt pr rt and v 2-2ap. Leg IV: Fm d 1-1-3; Pt pr and rt 0-1-0; Tb 1-1-0, pr and rt 1-1-1, v 1-0-2ap; Mt pr and rt 1-2-2ap, v 2ap.

Coloration. Carapace dark brown, with black veins and narrow band of white hairs along lateral rims. Carapace covered with orange, white and black appressed hairs (especially dense in eye field). Eye field black, with a more or less contrasting black Δ-shaped area between PLEs, intersected by a narrow longitudinal median stripe of white hairs; patch of white hairs at inner side of each PLE. Clypeus brown, poorly covered with recumbent light and erect black hairs. Sternum and chelicerae brown. Maxillae and labium brown, with white apices. Abdomen: dorsum multicoloured, with a pattern of black, white and orange hairs, in posterior half with a pair of large light patches, sometimes confluent, with white hairs. In front of each patch a black area present, anterior to it a smaller light dot. A pattern of small chevron-like bars posteriad to the large white patches. Sides brownish yellow with inclining dark brown lines; venter brownish yellow. Book-lung covers and spinnerets brownish yellow. All legs light brown, with dark brown stains and rings, but Fm I dark brown dorsally, Tb I and Mt I ventrally black with a well marked black edging, and Tr I contrastingly light yellowish with numerous white hairs (Fig. 15). Mt I dorsally with a patch of white hairs in each half. Palp yellowish brown, but basal parts of femora dark brown.

Palp. Structure as in Figs 3, 6, 7, shape of tibia as in Figs 11-13 (see also Table I).

FEMALE (Germany: Bavaria). *Measurements*. Carapace 2.68 long, 2.08 wide, 1.35 high at PLE. Ocular area 1.23 long, 1.65 wide anteriorly and 1.60 posteriorly. Diameter of AME 0.48. Abdomen 3.25 long, 2.70 wide. Cheliceral length 0.73. Clypeal height 0.18. Length of leg segments:

	Fm	Pt	Tb	Mt	Tr	Total
I	1.30	0.78	0.80	0.70	0.50	4.08
II	1.28	0.80	0.65	0.65	0.48	3.86
III	1.33	0.70	0.70	0.83	0.50	4.06
IV	2.35	0.98	1.45	1.38	0.65	6.81

Leg spination. Leg I: Fm d 0-1-1-3; Tb pr 1-1,v 1-2-2ap; Mt pr 1-1, v 2-2ap. Leg II: Fm d 0-1-1-3; Pt pr 0-1-0; Tb pr 1-1, v 1-2-2ap; Mt pr 1-1, v 2-2ap. Leg III: Fm d 1-1-3; Pt pr and rt 0-1-0; Tb d 1-0, pr and rt 1-1-1, v 1-2ap; Mt pr and rt 1-1-2ap, v 2ap. Leg IV: Fm d 1-1-3; Pt pr and rt 0-1-0; Tb d 1-0, pr and rt 1-1-1, v 1-2ap; Mt pr and rt 1-1-2ap, v 1-0-2ap.

Coloration as described for the male, but different in the following: carapace posterior to ocular area lighter brown; a pair of whitish spots behind ALEs; leg I coloured as remaining legs (yellowish brownish, with dark brown stains and rings); palp yellow, with brown femora.

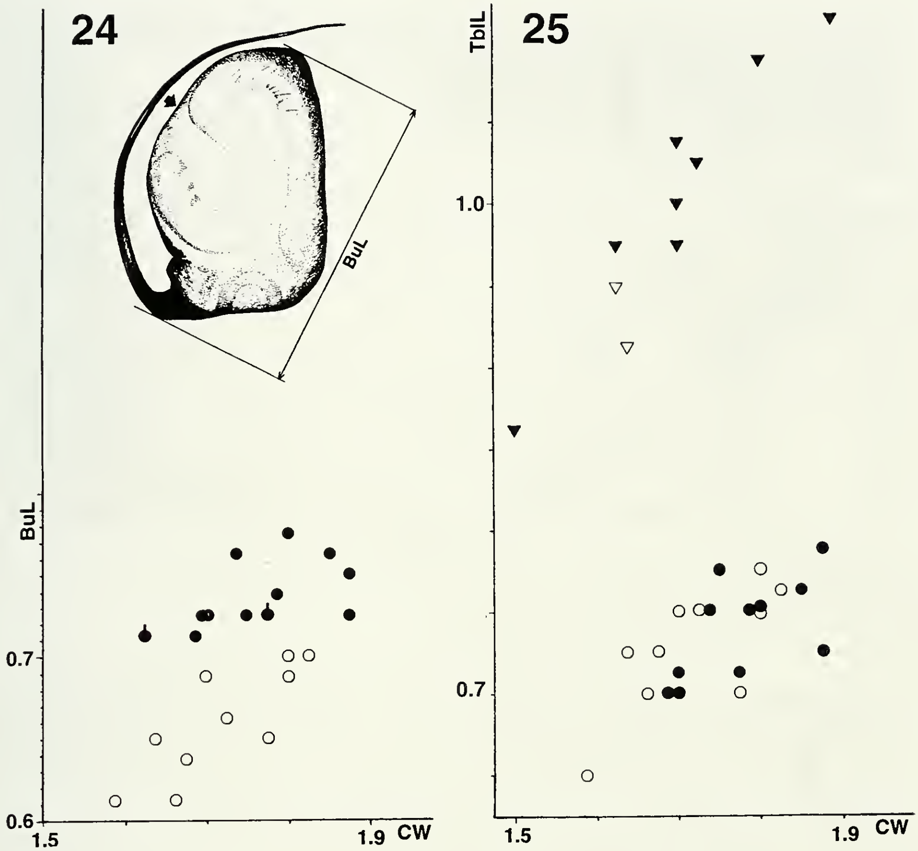
Epigyne and spermathecae as in Figs 21-23.

MATERIAL EXAMINED

AUSTRIA. Tyrol: Kaisergebirge, Brentenjoch, 1200 m asl, 10 June 1966, 1♀ (K. Thaler, CTh), Kaisertal, 900 m asl, 9 June 1966, 1♂ (K. Thaler, CTh). – **ITALY**. Trentino: Bezzecca (nr Lake Garda), Corno, 1500 m asl, 27 May 1963, 1♂ 2♀ (K. Thaler, CTh). – **SWITZERLAND**. Wallis: Saas-Tal, 1♂ (E. Schenkel, NHMB); Fiesch, 2♂, 1♀ (E. Schenkel, NHMB). – **GERMANY**. Bavaria (Bayern): Bayerischer Wald National Park, 750-1340 m asl, on spruce trunks (mostly dead trees; Weiss 1995) and rocks, 1993-94, 8♂ 5♀ (I. Weiss, CNBW). – **POLAND**. Tatra, 1♂, Galicia, Przemysł, 1♀ (Collectio Thorell, NHRS). – **RUSSIA**. Sakhalin: Aniva Distr., Chekhova Peak, ca. 1000 m asl, 1♂ (A. M. Basarukin, ISEN); Kholmsk Distr., Slepikovskogo Peninsula, 6-9 June 1992, 1♂ (A. M. Basarukin, ISEN); Okha Distr., Pil'tun Bay, 6 July 1991, 1♀ (A. M. Basarukin, ISEN); Tamarinsk Distr., Lake Ainskoye, Ptichya River, 13 June 1984, 1♀ (A. M. Basarukin, ISEN).

DISTRIBUTION Fig. 26

The occurrence of *Sitticus saxicola* in Europe is so far as known mainly restricted to montane areas in Central Europe (France, Switzerland, Italy, Austria, Germany, Czech Republic, Slovak Republic, Poland, Romania) as well as in Croatia (Risnjak) and Yugoslavia of today (Prószyński, 1971b). The records from Ukraine: Cherkassy Area (Pichka, 1974) and from the European part of Russia: Kursk and Voronezh Areas (Pichka, 1965, 1984) are in need of verification.



Figs 24, 25

24. Bulbus length (BuL)/carapace width (CW) ratios in males of *Sitticus ranieri* (○ = American morph, ● = Siberian morph; filled circles with bar refer to two males from Colorado). *Arrow* in inset pointing at concavity in the Siberian morph (cf. text). – 25. Tibia I length (TbIL)/carapace width (CW) ratios in males of *Sitticus saxicola* (▼ = European specimens, ▽ = specimens from Sakhalin) and *S. ranieri* (○ = American morph, ● = Siberian morph).

The species has mostly been found at higher altitudes (from 700 to 2000 m asl). Records from lower altitudes in Europe are few [Poland: Kraków area (Prószyński, 1971b)]. Early records from Germany: Rhineland and Westphalia (Bösenberg, 1903) were not specified to localities but there are areas of higher altitudes (above 700 m asl) in both provinces; a more recent record from the Harz was apparently from a high altitude locality (Harm, 1973). All Hungarian localities mentioned in Chyzer & Kulczyński (1891) are situated in present-day Slovak Republic, Romania (Suligul, Borsec) and Croatia (Risnjak), all of them more or less montane. The records from Yugoslavia (Serbia): Topčider (sub *S. montigenus*) and Kopaonik, both mentioned in Stojičevič (1929), are in need of verification. Recent records from Sakhalin (summa-

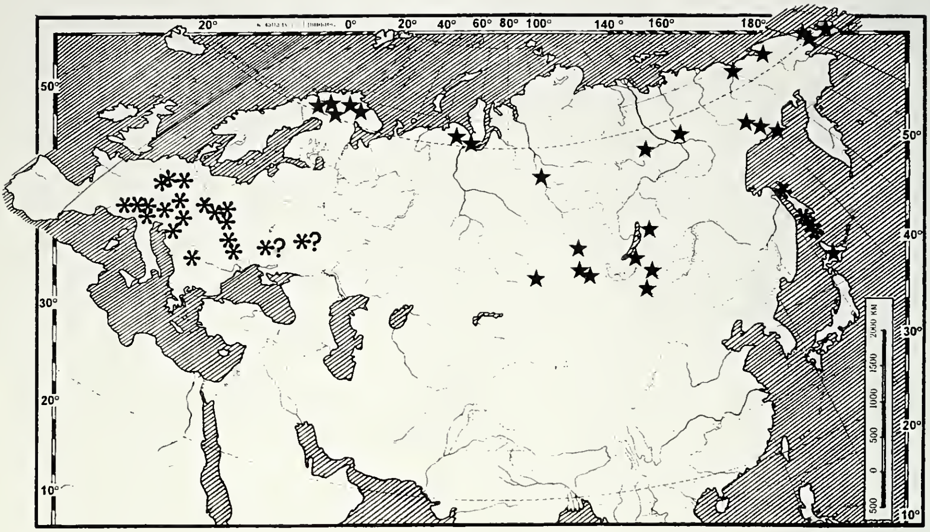


FIG. 26

Distribution of *Sitticus ranieri* (★) and *S. saxicola* (✱) in the Palaearctic region. ✱? denote finds of *S. saxicola* in need of verification (cf. text).

rized in Logunov & Marusik, 2000), indicate that *S. saxicola* has a disjunctive, amphi-Eurasian subboreal distribution (sensu Gorodkov, 1984; see also Logunov, 1996) (Fig. 26). So far, no morphological differences have been found between Sakhalin and West Palaearctic specimens. A recent record from the Altai (Marusik *et al.*, 1996) is erroneous and pertains to *S. ranieri* (already reported under the name *S. lineolatus* by Logunov & Wesołowska, 1995). A record of *S. saxicola* from Russia: Samara area (Krasnobaev & Matveev, 1993) is a misidentification of a female *Sitticus distinguendus* (own observation). A record from Kazakhstan (Ust'-Kamenogorsk) (Savelyeva, 1990) is most probably also erroneous.

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REVUE SUISSE DE ZOOLOGIE 108 (3): 483-486; septembre 2001

Isoperla zwicki sp. n. (Plecoptera, Perlodidae), a new Italian stonefly species

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Isoperla zwicki sp. n. (Plecoptera, Perlodidae), a new Italian stonefly species. - A new species of Perlodidae (Insecta, Plecoptera) is described from Northern Italy: *Isoperla zwicki* sp. n. Together with the description of the main taxonomical characters, remarks on its systematic affinities are given. On the basis of the structure of the male peneal armature this species can be assigned to the *sudetica* species-group.

Key-words: Stoneflies - Plecoptera - Perlodidae - *Isoperla zwicki* - Italy.

INTRODUCTION

Isoperla is a stonefly genus composed by more than one hundred species, with a Holarctic distribution (Zwick, 1973); 14 of these have been cited for Italy (Fochetti *et al.*, 1998).

From material collected by a colleague (Vanin, Univ. of Pavia) in Northern Italy we describe a new species belonging this genus, whose distribution seems to be very limited, considered that knowledge about stonefly-fauna of this area was considered good.

The main character for the identification of *Isoperla* species is the shape of the male peneal armature and the spines that compose it. Other characters, such as the head colour, the shape of the male's lobe of the 8th sternite and the shape of the female subgenital plate can be sometimes useful as accessory instruments for the species discrimination.

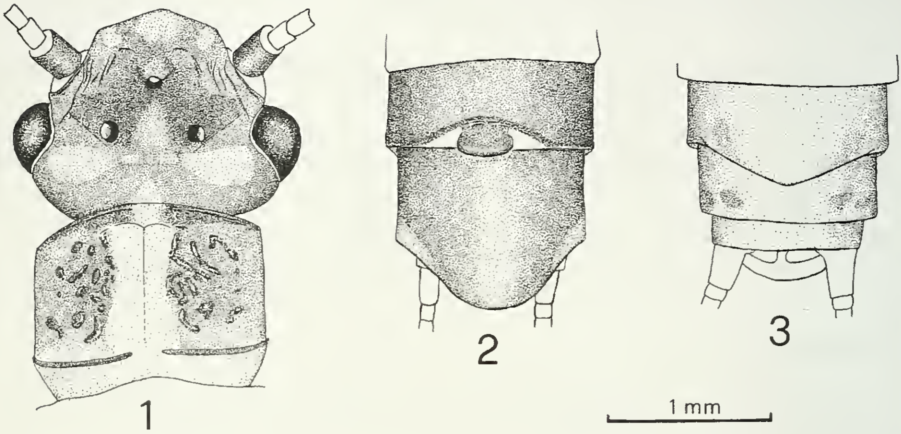
DESCRIPTION

Isoperla zwicki sp. n. Figs 1-5

Material: Italy, Trentino-Alto Adige, Val Gsies (Bolzano), Santa Maddalena m 1800, leg. Vanin, 15-VIII-1998: 1 male (holotype); 13-VIII-1999: 1 male, 1 female (paratypes). Other material: Italy, Trentino-Alto Adige, brook Pull, Sesto (Bolzano), 8-VIII-1985, 21 males, 2 females. The holotype and the male paratype are deposited to the Museo di Zoologia del Dipartimento di Biologia Animale e dell'Uomo della Università di Roma "La Sapienza". A female paratype is deposited to the Muséum d'histoire naturelle, Geneva.

Manuscript accepted 20.02.2001

Diagnosis: Middle size *Isoperla*. Head with brown colour, darker in the anterior part forming a characteristic pattern (Fig. 1). Four pale areas on the head: a triangular one between the posterior ocelles, a small triangular one on the occipital part of the head and two drop shaped behind the composed eyes (Fig. 1). Pronote rectangular, darker in both lateral sides and lighter in the middle (Fig. 1). Mesonote and metanote dark. Legs brown and abdomen dark (darker in the male than in the female). Both sexes macropterous.



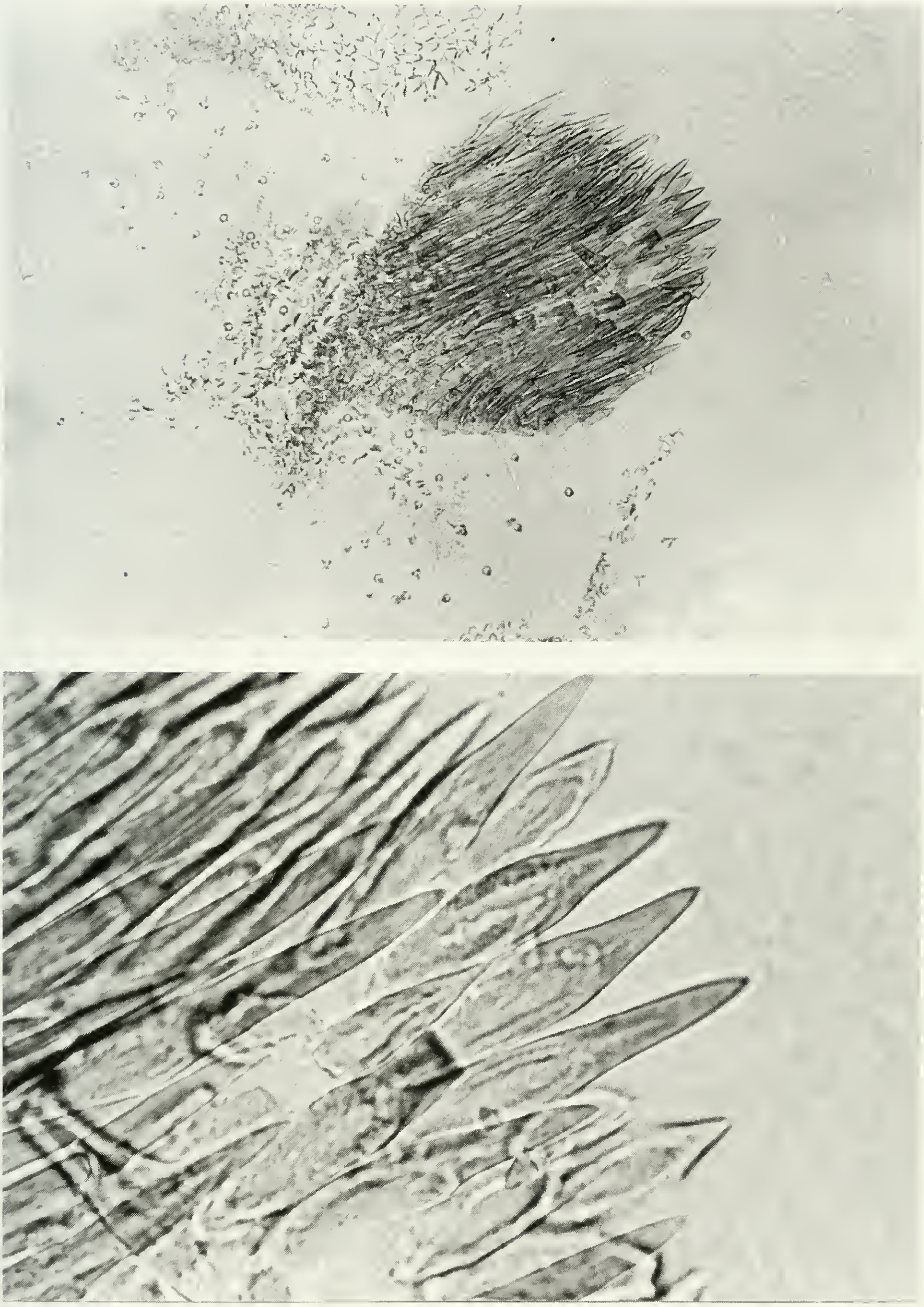
FIGS 1-3

Isoperla zwicki sp. n. 1: Head. 2: Ventral view of the tip of the male abdomen. 3: Ventral view of the tip of the female abdomen.

Male holotype (Figs 2, 4, 5): Forewing: 10 mm. Total length: 9.5 mm. Macropterous. Lobe of the tip of the 8th sternite dark, short and wide (length/width rate approximately 1/2). The peneal armature is plane and with truncate leaf shape (length: 130 μm; width: 100 μm) and without accessory armatures. The armature spines are elongated (length: up to 36 μm; width: up to 5 μm) and spear-shaped.

Female (Fig. 3): Forewing: 10 mm. Total length: 8.5 mm. Macropterous. Subgenital plate slightly triangular and wide.

Affinities: According to Consiglio's *Isoperla* species-group classification (1967), this species belongs to the *sudetica*-group, which is characterized by plane peneal armature and long pointed spines with non parallel margin. The peneal armature within this group is approximately as long as wide. *I zwicki* clearly differs from the closest European *Isoperla* species belonging to this group, *I. sudetica* (Kolenati, 1859) and *I. silesica* Illies, 1951 on the basis of the descriptions given in the literature (Illies, 1951, 1952). It can be easily distinguished from *I. sudetica* by the lack of accessory armatures, by the peneal armature shape (more rounded and with a median emargination in *I. sudetica*), by the smaller size of the armature and of the armature spines in the new species. Also, armature size and length of the armature spines are



FIGS 4-5
Isoperla zwicki sp. n. 4: Peneal armature (x 500). 5: Spines of the peneal armature (x 2500).

smaller in *I. zwicki* than in *I. silesica*, which displays a more squared peneal armature (see Illies, 1951, 1952). Besides, the lobe of the tip of the 8th sternite is shorter and wider in *I. zwicki* than *I. sudetica*. This character is not drawn in *I. silesica*. The head pattern is similar to that of *I. goertzi* Illies, 1951. The female subgenital plate is very similar to that of *I. sudetica*.

Etymology: This species is named after our friend and colleague P. Zwick, to whom we are deeply indebted.

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REVUE SUISSE DE ZOOLOGIE 108 (3): 487-493; septembre 2001

Morphologie und Verbreitung von *Coluber* (sensu lato) *andreanus* (Werner, 1917) (Reptilia: Serpentes: Colubridae)

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Morphology and distribution of *Coluber* (sensu lato) *andreanus* (Werner, 1917) (Reptilia: Serpentes: Colubridae). - Andreas' racer is a poorly known species from the southern Zagros mountains. It is outstanding in various features of head and body scalation (e.g., parietals, temporals, supralabials, ventrals) including dorsal scale row reduction. This species may be related to the *Coluber* (s. l.) *najadum* group. *Zamenis hotsoni* Boulenger is considered to be a junior synonym of *Coluber* (s. l.) *andreanus*, but further clarification is necessary to dispel reservations regarding the type series of *Z. hotsoni*.

Key-words: Colubridae - *Zamenis andreana* - *Z. hotsoni* - *Coluber* (sensu lato) - morphology - relationships - Zagros range.

EINLEITUNG

Werner (1917) beschrieb *Zamenis andreana* auf Grund zweier Exemplare aus "dem Gebiete zwischen Kazerun-Schiraz-Persepolis" in der iranischen Provinz Fars. Kurze Zelt später stellte Boulenger (1920a) ein neues Taxon aus der gleichen Gattung und Gegend auf, nämlich *Z. hotsoni* aus der Umgebung von Shiraz. Werner (1929) verwies *Z. hotsoni* in die Synonymie von *Z. andreana*, welche er darauf *Coluber* auct. zuordnete (Werner, 1936).

Abgesehen von den insgesamt vier Individuen der Typenserien von *Zamenis andreana* und *Z. hotsoni* existiert ein einziger publizierter Beleg dieses Taxons aus dem Bergland von Luristan (Schmidt, 1955). Mit Ausnahme von Erwähnungen in zwei Artenlisten zur Herpetofauna des Iran (Anderson, 1963; Schleich, 1977) fand diese "sehr auffällige" Art (Werner, 1917) im neueren Schrifttum kaum Beachtung. Insbesondere fehlt jeglicher Hinweis in Latifis (1991) Werk über die Schlangen des Iran.

Bei Zornnattern (*Coluber* auct.) normalerweise fehlende Eigenheiten der Beschuppung und die angeblich abweichende Bezahnung (Schmidt, 1955) erklären, weshalb die hier vorgestellte Art auch in systematisch breit angelegten Beiträgen zu paläarktischen Zornnattern unberücksichtigt bleibt (bspw. Schätti & Wilson, 1986; Schätti, 1987).

Manuskript angenommen am 07.03.2001

Die vorliegende Untersuchung befasst sich mit der Morphologie dieser fast in Vergessenheit geratenen und in wissenschaftlichen Sammlungen offenbar seltenen Art. Mögliche verwandtschaftliche Beziehungen werden diskutiert.

MATERIAL

Die Syntypen von *Zamenis andreana* wurden vom Orientalisten Friedrich Carl Andreas in den Jahren 1878 und 1905 gesammelt und waren ursprünglich im Zoologischen Museum der Universität Göttingen deponiert. Das kleinere Exemplar gelangte später in die Sammlung der California Academy of Sciences, San Francisco (CAS). Der höchst wahrscheinlich einst eingetrocknete und heute leicht geschrumpfte sowie spröde weibliche Syntypus (coll. 1878) wurde zwischen 1977 und 1980 in die Bestände des Zoologischen Forschungsinstituts und Museum Alexander Koenig (ZFMK) in Bonn integriert (Böhme & Bischoff, 1984). Das vermeintliche Typenmaterial von *Zamenis hotsoni* ist im Natural History Museum, London (BMNH) deponiert. Das von Schmidt (1955) erwähnte Exemplar befindet sich im Zoologisk Museum, København (ZMUC). Dessen Maxillarknochen sind entfernt und lagen für diese Untersuchung nicht vor; die Überprüfung der Anzahl Zähne übernahm Jens B. Rasmussen.

Für diese Arbeit wurden alle fünf soweit bekannten Exemplare untersucht. Es sind dies: BMNH 1920.3.20.4 (juv. ♂), "Shiraz", Major J. E. B. Hotson, "Pres. Bombay Nat. Hist. Soc." (Syntypus von *Zamenis hotsoni*, vgl. Bemerkungen zum Typenmaterial); BMNH 1946.1.14.60 (♀), "Shiraz, Hotson" (Syntypus von *Z. hotsoni*, ehemals BMNH 1920.8.6.2). CAS 100474 (♂), "Fars Prov." [Katalogeintrag], F. C. Andreas 1905 (Syntypus, Sammlung Andreas Nr. 160). ZFMK 31600 (♀), "Umgebung von Shiras", F. C. Andreas 1878 (Syntypus, Sammlung Andreas Nr. 164). ZMUC R6044 (♀), "Karun, S. Luristan", K. Paludan (Feldnummer 186).

MORPHOLOGIE

Rostrale bedeutend breiter als hoch, Hinterrand rund und kaum zwischen die Internasalia eingebettet. Letztere etwa gleich lang wie Präfrontalia. Frontale vorne nur wenig breiter als hinten, etwas kürzer als Längsnaht zwischen den Parietalia. Hinterrand der letzteren stumpf, cranial stark verbreitert und in Kontakt mit unterem Postokulare. Nasale geteilt; Loreale viereckig oder pentagonal und kaum länger als hoch. Präokulare einfach; normalerweise zwei Postokularia, das obere etwas grösser (beidseitig drei bei BMNH 1946.1.14.60). Vorderes Subokulare langgestreckt und teilweise paarig (rechts bei ZUMC R6044, links bei BMNH 1920.3.20.4), sehr klein im Falle von BMNH 1946.1.14.60 oder fehlend wie bei CAS 100474 (vgl. Fig. 1 und Tabelle 1). Sieben Supralabialia, drittes und viertes ans Auge stossend. Acht Sublabialia, die vier ersten in Kontakt mit vorderen Inframaxillaria. Letztere im Vergleich mit hinteren Inframaxillaria variabel bezüglich Länge und Grösse. Ein einzelnes vorderes Temporale welches den Hinterrand des vierten Supralabiale berührt; bei ZMUC R6044 beidseitig mit Parietale verschmolzen (Fig. 1). Eines (CAS 100474, rechts) oder zwei Schilder in der hinteren Temporalreihe; oberes zweites Temporale

FIG. 1

Kopfbeschuppung von *Coluber* (s. l.) *andreanus* (ZMUC R6044). Photo Claude Ratton.

bei BMNH 1920.3.20.4 deutlich länger als unteres und in der Grösse dem vorderen Temporale entsprechend.

Ventralia 217-ca. 269 (♂♂ 217-ca. 218, ♀♀ 250-ca. 269), Subcaudalia 85-96 (92-96, 85-94). Dorsalia auf der Höhe des zehnten Ventrale und in der Körpermitte (50% der Ventralia) in 17 Längsreihen, 15 oder 17 vor dem Anale. Reduktion bei CAS 100474 durch Verschmelzen der dritten und vierten Reihe auf der Höhe des 188. Ventrale (87% der Gesamtzahl der Ventralia). Reduktion der dorsalen Längsreihen bei zwei Weibchen (ZFMK 31600, ZMUC R6044) fehlend; nicht feststellbar beim Typenmaterial von *Zamenis hotsoni* (vgl. unten). Apikalgrübchen der Dorsalia einfach. Maximale Kopf/Rumpf- und Schwanzlänge der Syntypen gemäss Werner (1917) 445 + 155 mm (♂) resp. 586 + 164 mm (♀).

Maxillare mit 9-13 isodonten Zähnen (Tabelle 1), entweder mit einem Diastema vor den beiden letzten Zähnen (Syntypen von *Zamenis hotsoni*) oder ohne Zwischenraum (CAS 100474). Hemipenis zumindest basal stark bestachelt (CAS 100474); Weibchen (ZMUC R6044) mit massiger Postanaldrüse die bis zum fünften Subcaudale reicht.

Pileus, Schnauze und Schläfen in Alkohol hell bräunlich und ohne erkennbare Zeichnung; Oberlippen- und Augenregion mehrheitlich hell (gelblich oder weiss). Kopf und Vorderkörper dorsal “hell olivengrau”, Rumpf “nach hinten in ockergelb übergehend” resp. “hellbraun” (Werner, 1917). Dorsalia mit dunklem medianem Längsstrich; letzterer basal breiter und meist schwarz. Unterste Dorsalreihe sowie Unterseite gelblich.

Tabelle 1

Morphologische Merkmale von *Coluber* (s. l.) *andreanus*: Ventralia (Ven), Subcaudalia (Sub), Subokulare (Soc, rechte und linke Seite), Temporalia (Temp), Anzahl Längsreihen Dorsalia auf der Höhe des 10. Ventrale, in der Körpermitte und unmittelbar vor dem Anale (bei BMNH 1920.3.20.4 nur Wert in Körpermitte) sowie Anzahl Maxillarzähne (Maxil). Im Falle des weiblichen Syntypus (ZFMK 31600) liegen keine Angaben zur Bezahnung vor, da dessen Zustand keine Untersuchung zuliess.

Exemplar, Geschlecht		Ven	Sub	Soc	Temp	Dorsalia	Maxil	Bemerkungen
BMNH 1920.3.20.4 juv.	♂	c. 218	96	1/2	1 + 2	17	11 + 2	Syntypus von *Z. hotsoni*
BMNH 1946.1.14.60	♀	c. 269	-	1/1	1 + 2	17-17-15	10 + 2	Syntypus von *Z. hotsoni*
CAS 100474	♂	217	92	0/0	1 + 1/2	17-17-15	13	Syntypus
ZFMK 31600	♀	267	94	1/1	1 + 2	17-17-17	-	Syntypus
ZMUC R6044	♀	250	85	2/1	(1) + 2*	17-17-17	7 + 2	* vgl. Fig. 1

VERBREITUNG

Diese Zornnatter ist bislang einzig aus dem Gebiet zwischen Kazerun, Shiraz und Persepolis (Takht-i-Jamshid resp. Takht-e-Jamslad) in der iranischen Provinz Fars sowie dem Bergland von Luristan belegt. Möglicherweise lebt sie in weiten Teilen des südlichen Zagros Gebirges und dessen Ausläufern.

Genauere Angaben zu Herkunft und Fundumständen des vorliegenden Materials fehlen mit Ausnahme von ZMUC R6044. Dieses Exemplar wurde von Knud Paludan im Rahmen der "Danish Scientific Investigations in Iran" gesammelt. Vom 15. bis 28. Mai 1935 hatte er sein Quartier in Karun, einer Station (Istgah-e-Karun, 33°25'N 48°59'E) der sich damals in Bau befindenden Eisenbahnstrecke vom Kaspischen Meer an den Persischen Golf (Bandar Khomeyni). Die Bahnstation liegt auf ca. 1300 m am Ab-i-Cezar, einem Zufluss des Ab-i-Diz (Rudkhaneh-ye-Dez), der nördlich von Ahvaz (31°19'N 48°42'E) in den Karun mündet. Dieser schiffbare Fluss hat mit Paludans Standort gleichen Namens jedoch nichts zu tun.

Das aus Karun verzeichnete zoologische Material wurde "ausschliesslich im Tchambachital an der Südseite des Flusses und auf dem Paris-Massiv" gesammelt. Am 25. Mai 1935 hielt sich Paludan auf dem "Plateau des Paris (etwa 2400 m)" auf (Paludan, 1938: Abb. 8). Die an diesem Tag erbeutete Zornnatter sowie ein *Ophisops elegans* ssp. mit gleichem Funddatum (vgl. Schmidt, 1955) stammen wahrscheinlich aus dem Gebiet zwischen dem Plateau und dem Ab-i-Cezar bei Karun. In dieser Region sind einstige Wälder praktisch ganz verschwunden und durch Eichengebüsch ersetzt.

BEMERKUNGEN ZUM TYPENMATERIAL VON *ZAMENIS HOTSONI*

Die Beschreibung von *Zamenis hotsoni* erfolgte eigenartigerweise zweimal (Boulenger, 1920a, 1920b). Die beiden Texte sind bis auf einen Vermerk zum Verbleib des Jungtieres ("The smaller specimen is now in the British Museum", Boulenger, 1920a) identisch. Der im März 1920 erfolgte Eintrag dieses Exemplars in den Katalog der Londoner Sammlung (BMNH) mit einer Bemerkung zu dessen Herkunft ("Pres. Bombay Nat. Hist. Soc.") stammt aus der Hand von G. A. Boulenger. Der grössere (weibliche) Syntypus von "about 500 mm." gelangte im August des gleichen Jahres ins frühere British Museum (Natural History), also nach Boulengers Pensionierung und der Veröffentlichung der Originalbeschreibung am 20. Juli 1920 (gemäss Datierung auf dem Umschlag). Wahrscheinlich sandte Boulenger eine Kopie seines Manuskripts nach Bombay, wo die Arbeit im Dezember 1920 abermals erschien.

Da Major J. E. B. Hotson anfänglich beide Syntypen von *Zamenis hotsoni* der Bombay Natural History Society vermachte, liess Boulenger (1920a, 1920b) deren Geschlecht unerwähnt. Zum zunächst unzugänglichen Weibchen fehlen praktisch sämtliche relevanten Daten. Der vermeldete Ventralwert (196) liegt bei weitem ausserhalb der bei Andreas' Zornnatter festgestellten Spanne und stimmt mit keinem der beiden Syntypen von *Z. hotsoni* überein. Das juvenile Männchen besteht aus drei Teilen und besitzt mindestens 218 Ventralia. Das Weibchen ist ebenfalls arg verletzt, hängt stellenweise nur an schmalen Fetzen des Integuments zusammen und weist ca. 269 Ventralia auf (Tabelle 1).

Die Diskrepanz zwischen der Beschreibung und dem vermeintlichen Typenmaterial von *Zamenis hotsoni* bleibt vorderhand mysteriös und bedarf weiterer Abklärungen. Eigenartig ist in diesem Zusammenhang der Umstand, dass Werner (1929) *Z. hotsoni* zwar kommentarlos in die Synonymie von Andreas' Zornnatter stellte, dabei aber Boulengers Angaben zur Anzahl der Ventralia und Subcaudalia (90) unbeachtet liess ("V. 220-264, Sc. 91-93").

VERWANDTSCHAFTLICHE BEZIEHUNGEN

Ohne weitere Bemerkung stellte Werner (1936) *Zamenis andreana* in einem Anhang ("Verzeichnis der bisher aus Persien bekannten Amphibien und Reptilien") zu den Zornnattern (*Coluber* auct.). Trotz der extrem niedrigen Anzahl von Maxillarzähnen bei ZMUC R6044 folgte Schmidt (1955) dieser Ansicht. Seine Argumentation beruht zur Hauptsache auf der langgezogenen Form und dem Verlauf des Hinterrandes der Parietalia sowie auf dem Vorkommen eines vorderen Subokulars ("[...] there can be no question that Werner's allocation of this very distinct species to *Zamenis* (i.e., *Coluber*) was correct").

Schmidt (1955) erwähnte das Subokulare wohl in erster Linie zur Abgrenzung von Andreas' Zornnatter gegenüber anatolisch-iranischen Zwergnattern der Gattung *Eirenis* Jan. Diese verfügen über eine geringe Anzahl Supralabialia (sieben), normalerweise ein einzelnes vorderes Temporale und einzelne Arten, bspw. *E. modestus* (Martin), weisen auf dem Rumpf oft durchgehend 17 Dorsalia auf, d. h. eine Reduktion fehlt (Schmidtler & Baran, 1993) .

Morphologisch unterscheidet sich Andreas' Zornnatter von den mittlerweile aus *Coluber* (sensu Schätti & Wilson, 1986) herausgelösten paläarktischen Gattungen *Hierophis* Fitzinger, *Hemorrhois* Boie und *Platyceps* Blyth ("*rhodorachis* Gruppe", vgl. Schätti, 1987, 1988) insbesondere durch einfache (statt paarige) Apikalgrübchen und wahrscheinlich plesiomorphe Merkmalszustände der Beschuppung. Dazu gehören die geringe Anzahl der Dorsalia (15-17 Längsreihen statt 19 oder mehr), deren fakultative Reduktion im hinteren Rumpfbereich, lateral weit ausladende Parietalia resp. ein einzelnes vorderes Temporale sowie wenige Supralabialia (sieben statt acht oder mehr). Erwähnenswert ist ausserdem ein ausgeprägter Sexualdimorphismus der Ventralia mit extrem hohen Werten bei Weibchen.

Für eine klare systematische Zuordnung von Andreas' Zornnatter fehlt momentan Information zu phylogenetisch aussagekräftigen Merkmalen. Solange etwa kein osteologisches Material und Details des Hemipenis vorliegen, ist eine genauere Beurteilung der verwandtschaftlichen Beziehungen von *Coluber* (s.l.) *andreanus* nicht möglich. Wahrscheinlich handelt es sich bei dieser Art um einen Vertreter einer frühen Radiationsgruppe innerhalb paläarktischer Zornnattern.

Beim aktuellen Stand unserer Kenntnis erscheint eine vorläufige Gruppierung von Andreas' Zornnatter mit *Coluber* (sensu lato) *najadum* (Eichwald) am sinnvollsten. Diese vom Balkan bis in den Iran verbreitete Art bildet zusammen mit *C.* (s. l.) *collaris* (Müller) aus dem östlichen Mittelmeerraum (Schätti *et al.*, 2001) und einer Spezies aus dem Zagros Gebirge (Schätti & McCarthy, 2001) eine Verwandtschaftsgruppe. Wie *C.* (s.l.) *andreanus* weisen sie einfache Apikalgrübchen auf; im Weiteren zeichnen sich all diese Arten durch einen schlanken Habitus (vgl. Werner, 1917) und tiefe Dorsalwerte (17-19 Längsreihen in der Körpermitte) aus.

Die *Coluber* (s.l.) *najadum* Gruppe und Arten der Saharo-Sindischen Gattung *Platyceps* (typische Art: *Coluber ventromaculatus* Gray) sind monophyletisch (vgl. Schätti, 1993). Weitere morphologische Untersuchungen in diesem systematischen Umfeld sind am Laufen und vorläufige molekulare Resultate (mtDNA) zur Phylogenie paläarktischer Zornnattern und verwandter Gattungen im allgemeinen erscheinen demnächst.

VERDANKUNGEN

Wolfgang Böhme (Bonn), Robert C. Drewes (San Francisco) und Jens B. Rasmussen (Kopenhagen) stellten Untersuchungsmaterial zur Verfügung. Letzterer verifizierte die Bezahnungswerte von ZMUC R6044. Spezieller Dank gebührt auch Colin McCarthy (London), der einige Details der Beschuppung beim Typenmaterial von *Zamenis hotsoni* genauestens überprüfte.

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REVUE SUISSE DE ZOOLOGIE 108 (3): 495-511; septembre 2001

A review of the genus *Batasio* (Teleostei: Bagridae) in Indochina, with the description of *B. tigrinus* sp. n. from Thailand

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A review of the genus *Batasio* (Teleostei: Bagridae) in Indochina, with the description of *B. tigrinus* sp. n. from Thailand. – Catfishes of the genus *Batasio* occurring in the Mae Khlong, Sittang and Salween basins and in the Malay Peninsula are reviewed. Four species are recognised, *B. affinis*, *B. dayi*, *B. havmolleri* (all previously considered synonyms of *B. tengana*) and *B. tigrinus*, new species. Notes on the identity of all other nominal species of *Batasio* are provided.

Key-words: *Batasio* - Bagridae - taxonomy - Indochina.

INTRODUCTION

Species of the South and Southeast Asian catfish genus *Batasio* Blyth, 1860 are small to medium-sized bagrid catfishes with laterally compressed body found in moderate to fast-flowing streams. They possess the following synapomorphies: presence of large sensory pores on the head, a narrow mental region, presence of a pair of prominent posterior processes on the anterior part of the vomer, the entopterygoid transversely elongated and bar-like, the ectopterygoid absent and the metapterygoid in close contact with the quadrate but free from the hyomandibular (Mo, 1991).

To date, only four species of *Batasio* are regarded as valid, viz. *B. batasio* (Hamilton, 1822), *B. tengana* (Hamilton, 1822), *B. travancoria* Hora & Law, 1941, and *B. pakistanicus* Mirza & Jan, 1989. *Pimelodus chandramara* Hamilton, 1822 (with *P. rama* Hamilton, 1822 as a subjective junior synonym), previously considered to belong to a distinct genus, *Rama* Bleeker, 1858 (with *Chandramara* Jayaram, 1972 as a subjective junior synonym; Talwar & Jhingran, 1991) has been considered a species of *Batasio* by Mo (1991). Because of the very distinct differences that separate *Rama chandramara* from *Batasio* species, such as the short adipose-fin base (vs. moderately long adipose-fin base in *Batasio*; 10.2–13.5 % SL vs. 22.2–34.3) and

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visible (vs. not visible) orbital margin when the head is viewed ventrally, we consider *Rama* to be a distinct genus from *Batasio* pending a more detailed study. The only taxonomic study of *Batasio* to date was conducted by Hora & Law (1941), who synonymised the following nominal species with *B. tengana*: *B. affinis* Blyth, 1860 (with *Macrones blythii* Day, 1877 as an unnecessary replacement name), *Leiocassis fluviatilis* Day, 1888, *Macrones dayi* Vinciguerra 1890, *Macrones merianiensis* Chaudhuri, 1913, and *Mystus havmolleri* Smith, 1931. *Mystus stigmaturus* Fowler, 1934, has also been considered a synonym of *B. tengana* (see Kottelat, 1989) by recent workers. While examining specimens of *Batasio* from Indochina (definition here follows that of Kottelat, 1990), it became apparent that this material, previously identified as *B. tengana*, consists of four species. This paper reviews the taxonomy of the Indochinese species of *Batasio* and provides diagnoses for these four species, one of which is described as new. Notes on the identity of the other Indian and Burmese nominal species are also provided.

MATERIAL AND METHODS

Measurements were made point to point with dial callipers and data recorded to tenths of a millimetre. Counts and measurements were made on the left side of specimens whenever possible. Subunits of the head are presented as proportions of head length (HL). Head length itself and measurements of body parts are given as proportions of standard length (SL). Measurements follow those of Ng & Kottelat (1998) and numbers in parentheses following a particular count are the numbers of examined specimens with that count.

Drawings of the specimens were made with a Nikon SMZ–10 microscopic camera lucida. The specimens examined for the present study are in Academy of Natural Sciences, Philadelphia (ANSP), Natural History Museum, London (BMNH), California Academy of Sciences (CAS), the collection of the second author (CMK), Muséum d'histoire naturelle, Genève (MHNG), Museum of Zoology, University of Michigan, Ann Arbor (UMMZ), National Museum of Natural History, Smithsonian Institution, Washington (USNM), Zoological Reference Collection, National University of Singapore (ZRC) and Zoological Survey of India, Calcutta (ZSI).

KEY TO THE INDOCHINESE SPECIES OF *BATASIO*

1 Adult colour pattern consisting of four dark brown vertical bars on body: one on head passing through eye, second running obliquely anterior to dorsal fin, third at anterior third of adipose fin and last on posterior extremity of caudal peduncle . . . . *B. tigrinus* sp. n.

\- Adult colour pattern consisting of a dark brown predorsal oblique bar; dark brown spot on side of body below adipose fin and bar on head passing through eye present or absent 2

2 No dark brown spot on side of body below adipose fin; snout long (41.0–44.6 % HL); distal four–fifths of dorsal fin dark brown, with a narrow hyaline distal margin . . . . *B. dayi*

\- Dark brown spot on side of body below adipose fin; snout short (31.9–41.5 % HL); distal one-third to half of the dorsal fin dark brown, with a narrow hyaline distal margin 3

3 Dorsal spine long (14.0 % SL); large eyes (24.4 % HL) set far apart (31.7 % HL); distal one-third of dorsal fin dark brown, with a narrow hyaline distal margin; pelvic origin in front of base of last dorsal-fin ray .... *B. affinis*

\- Dorsal spine short (10.7–12.4 % SL); small eyes (18.2–23.5 % HL) set near each other (25.9–28.6 % HL); distal half of dorsal fin dark brown, with a narrow hyaline distal margin; pelvic origin below or slightly behind last dorsal-fin ray .... *B. havmolleri*

DESCRIPTIONS

Batasio affinis Blyth, 1860 Fig. 1

Batasio affinis Blyth, 1860: 150 (type locality: Myanmar: Tenasserim).
Macrones affinis: Günther, 1864: 83; Day, 1873: 111.
Macrones Blythii Day 1877: 445 (unnecessary replacement name for *Batasio affinis* Blyth, 1860).
Macrones blythii: Day 1889: 151.
? *Leiocassis fluviatilis* Day, 1888: 805 (type locality: Myanmar: Tenasserim, Anin stream, near Weywoon [15°41'N 97°48'E], Wagroo); Day, 1889: 164.
Batasio tengana (in part): Hora & Law, 1941: 36.
Mystus blythii: Menon & Yazdani, 1968: 125.

Material examined. ZSI F7880/1, holotype, 67.3 mm SL; Myanmar: "Sitang River, Tenasserim"; Berdmore, date unknown. We have also examined a photograph (deposited in the library of ZRC) of a specimen (of unknown size) collected by T. Roberts in March 1992 in the Tenasserim River basin (the current disposition of the specimen is unknown).

Diagnosis. Batasio affinis can be differentiated from all other congeners in having a unique combination of the following characters: a colour pattern consisting of a greyish brown body with a dark brown predorsal oblique bar and a dark brown spot on the side of the body below the adipose fin, dark brown band on distal half of dorsal fin, dorsal-spine length 14.0 % SL, body depth at anus 18.0 % SL, snout length 36.0 % HL, eye diameter 24.4 % HL, interorbital distance 31.7 % HL. Fin ray counts: dorsal I,6; pectoral I,8; pelvic i,5; anal iv,8; caudal 7/8. See Key and Discussion for further comparison with *B. havmolleri.*

Distribution. Batasio affinis is known only from the Tenasserim River basin and "Tenasserim Provinces" in southern Myanmar (Fig. 2). Note that the "Tenasserim Provinces" in Blyth's (1860) original description is much larger than today's Tanintharyi (Tenasserim) state of Myanmar. Blyth's "Tenasserim Provinces" also seems to have included parts of the present Myanmar states of Kayah, Kayin (Karen), Mon and part of Bago (Pegu) (Fang & Kottelat, 1999).

Remarks. While Blyth's recorded the origin of the holotype of *B. affinis* simply as "Tenasserim", Menon & Yazdani (1968: 126) record the locality of the holotype as "Sittang R., Tenasserim". These are also the data on the label, which obviously is not the original Blyth's label. Hora & Law (1941) mention only Tenasserim. Blyth's

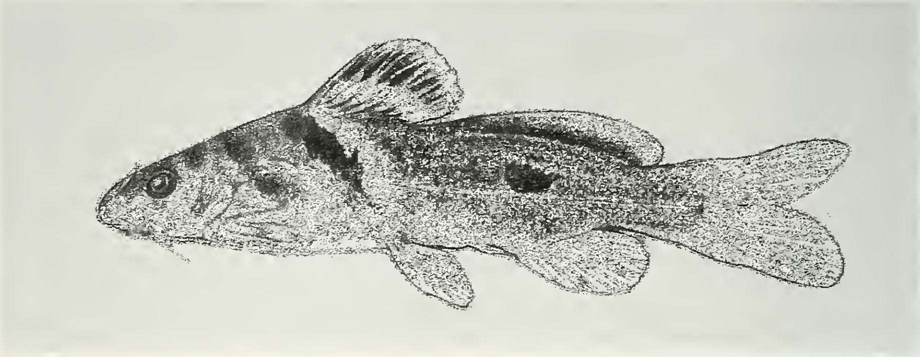

FIG. 1

Batasio affinis, after photograph of a specimen collected from Tenasserim River (drawing by Kelvin K. P. Lim).

(1860) original description of *B. affinis* is part of a paper reporting fishes obtained "chiefly from the Sitang River and its tributary streams, Tenasserim Provinces". The introduction further says that the paper deals with "fluviatile species, mostly collected by the late Major Berdmore in the Sitang river and its tributaries, with a few notices of new or little known species from the Gangetic streams and their outlets". We are not convinced that this statement allows to interpret that all species reported from "Tenasserim" by Blyth are ipso facto from the Sitang basin. Blyth explicitly gives the locality as Sitang for a few species (*Ambassis notatus*, *A. lala*, p. 138; *Toxotes microlepis*, p. 142; *Mastacembelus unicolor*, *M. zebrinus*, p. 144, etc.), therefore we feel that those not recorded as originating from the Sitang should be retained as from "Tenasserim". We are not aware of recent collections from the Sitang basin which could demonstrate that all the "Tenasserim" species described by Blyth effectively are from the Sitang. Collections by the second author and others in the Salween basin in Thailand (especially the Mae Nam Moei drainage) have yielded a number of species identified as conspecific with Blyth's species. This especially applies to many small size species known to inhabit hill streams and likely to have restricted distribution ranges (as evidenced by the distribution of their congeners in adjacent basins). If these identifications are correct, we expect that the range of some of these species may extend across the Salween to the Sitang basin, but we do not expect that this would be the case for all. Therefore, we hypothesize that part or all of Blyth's "Tenasserim" specimens are from or south of the Salween basin. Nominal species described by Blyth from Tenasserim freshwaters and (possibly) with small ranges are: *Glyptothorax trilineatus*, *Exostoma berdmorei*, *Siluricthys* [sic] *berdmorei* [*Pterocryptis berdmorei*], *Barbus caudimarginatus* [*Puntius caudimarginatus*], *Prosteacanthus spectabilis* [*Acantopsis spectabilis*], *Cobitis cincticauda* [*Schistura cincticauda*], *Homoloptera* [sic] *bilineata* [*Homaloptera bilineata*]. *Batasio affinis* is not recorded from the Salween basin in Thailand (pers. obs.; Ukkatawewat & Vidthayanon, 1998); the specimen from Tenasserim River basin mentioned above and the syntypes of *Leiocassis fluviatilis* are the only specimen we are aware of since its original description.

FIG. 2

Map showing distribution of Indochinese *Batasio* species. Open symbols indicate type localities. Type locality of *B. affinis* not indicated due to imprecise information (see text).

Leiocassis fluviatilis Day (1888: 805) has been treated as a synonym of *B. tengana* by Hora & Law (1941). Its syntypes are apparently lost (Whitehead & Talwar, 1976; Eschmeyer, 1998). The original description of *L. fluviatilis* is brief and not very informative. The colour pattern given in the original description ("yellowish horny" and "a large black blotch on the lateral line above the anal fin, another between the pectoral and the first dorsal") could refer to *B. affinis*, *B. havmolleri* or *B. merianiensis* (although the tip of the caudal lobes are described as being black, a character not seen in any of the three species). We tentatively consider *L. fluviatilis* to be a junior synonym of *B. affinis* because the two nominal species are found in the same general area (Tenasserim) and as far as is known, there appears to be only a single species of *Batasio* in this area. The type locality is also in Tenasserim: "Anin stream, near Weywoon, Wagroo" On the maps available to us (1:250,000, Series 1501S, Sheet ND 47-2, Royal Thai Survey Department, 2516 [1973]), this locality appears as Wewun [15°41'N 97°48'E]. The Anin Chaung is a small stream entering the Andaman Sea at 15°36'N 97°44'E, with its headwaters about 20 km NW in the mountain range which constitutes the southern boundary of the Ataran, the southernmost branch of the Salween.

Batasio affinis was placed in *Macrones* by Day (1875: 445), who considered it as a junior secondary homonym of *Bagrus affinis* Jerdon (1849: 338), a species which he placed in the synonymy of *M. vittatus* (p. 448). Day proposed *M. blythii* as a replacement name. But, under art. 57.3.1 of the International Code of Zoological Nomenclature, *Batasio affinis* and *Bagrus affinis* are not secondary homonyms as they have not been brought in combination with the same generic name [the key criterion is the combination of the generic and specific names and, to our knowledge, *Bagrus affinis* has never been used as *Macrones affinis*], and therefore *Macrones blythii* is an unnecessary replacement name. That the two nominal species were then considered congeneric is not relevant to the argument [art. 59.1 does not apply as it explicitly concerns secondary homonyms which have already been shown homonyms under art. 57.3.1]. And even if the two names were treated as secondary homonyms, then it seems that under art. 59.3 *B. affinis* cannot be rejected since the substitute name [*M. blythii*] is not in use. The Code does not define "in use". We are only aware of a single usage of the name as a valid species-group name, as *Mystus blythii*, in Menon & Yazdani's (1968: 125) ZSI type catalogue.

Batasio dayi (Vinciguerra, 1890) Fig. 3

Macrones dayi Vinciguerra, 1890: 230, pl. 7 fig. 3 (type locality: Myanmar: Meetan).
Macrones (Macronoides) dayi: Hora, 1921: 179
Aoria (Macronoides) dayi: Prashad & Mukerji, 1929: 180; Mukerji, 1933: 818.
Batasio tengana (in part): Hora & Law, 1941: 36: Kottelat, 1989: 13; Vidthayanon *et al.*, 1997: 43.

Material examined. BMNH 1893.2.16.8, 1 ex., syntype, 56.2 mm SL; Myanmar: Meetan (=Mitan Chaung, a rivulet flowing south from the summit of Mulayet Taung, 16°11'N 98°32'E). - ZRC 46108, 3 ex., 62.6-82.7 mm SL; Myanmar: Kachin State, Myitkyina market; C. J. Ferraris, Tun Shwe & Mya Than Tun, 4-8 Nov 1997.

Diagnosis. Batasio dayi can be differentiated from all other congeners in having a unique combination of the following characters: colour pattern of body consisting only in a dark brown oblique predorsal bar, distal four-fifths of the dorsal fin dark brown with a narrow hyaline distal margin, body depth at anus 19.2–20.5 % SL, snout length 41.0–44.6 % HL, interorbital distance 22.2–25.8 % HL. Fin ray counts: dorsal I,7; pectoral I,8; pelvic i,5; anal iv,8; caudal 8/9.

Distribution. Batasio dayi is known from the Salween and Irrawaddy River drainages in Myanmar (Fig. 2).

Batasio havmolleri (Smith, 1931) Figs 4, 5

Mystus havmolleri Smith, 1931: 24, fig. 12 (type locality: Thailand: Klong Thalerng near Ban Ron Phibun).

Mystus stigmaturus Fowler, 1934: 94, figs 41 & 42 (type locality: Thailand: Nakhon Sritammarat); Fowler, 1939: 58; Geisler *et al.*, 1979: 686.

Mystus havmölleri: Smith, 1945: 389, fig. 86; Geisler *et al.,* 1979: 686.

Batasio tengana (non Hamilton): Hora & Gupta, 1941: 23, pl. 4 fig. 7; Hora & Law, 1941: 36 (in part); Kottelat & Wirtz, 1983: 406; Kottelat, 1989: 13 (in part); Lim *et al.*, 1993: 6; Vidthayanon *et al.,* 1997: 43 (in part).

Material examined. ZRC 41973, 1 ex., 70.5 mm SL; Thailand: Ranong Province, King Amphoe Suk Sam Lan, Ton Koi waterfall; D. C. J. Yeo et al., 11 August 1997. – ZRC 42188, 2 ex., 23.2–47.7 mm SL; Thailand: Ranong Province, stream N of Khuraburi, 100 km S of Ranong; M. Kottelat et al, 5 November 1995. – ZRC 42204, 3 ex., 39.1–53.1 mm SL; CMK 12153, 3 ex., 34.6-72.2 mm SL; Thailand: Ranong Province, Khlong Kho Krue at Ban Kho Krue, km 3.5 on road to Nam Tok Kho Krue, branching E 3 km S of Kraburi on road to Ranong; M. Kottelat et al., 6 November 1995. – CMK 5384, 1 ex., 43.7 mm SL; Thailand: Ranong Prov.: stream on road from Ranong to Kra Buri, km 37; M. Kottelat & A. Kottelat-Kloetzli, 24 April 1985. - USNM 90304, 1 ex., holotype, 38.0 mm SL; Thailand: Klong Thalerng near Ban Ron Phibun, coll. unknown, January 1927. – USNM 90305, 2 ex., paratypes, 37.5–40.7 mm SL; Thailand: Klong Thalerng; H. M. Smith, January 1927. – ANSP 59338, 1 ex., 59.0 mm SL (holotype of *M. stigmaturus*); ANSP 59339–59341, 3 ex., 53.0–57.1 mm SL (paratypes of *M. stigmaturus*); Thailand: Nakhon Sritammarat; R. M. de Schauensee, 6 May 1933. – ANSP 59342, 4 ex., 48.3–59.0; Thailand: Nakhon Sritammarat; R. M. de Schauensee, 21 May 1933. – CMK 5177, 3 ex., 55.1-60.0 mm SL; Thailand: Surat Thani Prov.: Khlong Sok at Ban Khlong Sok, Tapi River basin; S. Lumlertdacha *et al.*, 4 April 1985. – MHNG 2158.48, 29 ex., 33.8–71.2 mm SL; Thailand: Phangnga Prov.: Lam Pi, north of Phuket; R. Geisler, April 1975. – ANSP 77435, 1 ex., 62.7 mm SL; Thailand: waterfall at Trang, a 40 foot–fall of the Trang River at Chong, 12 miles E of Thap Thian or Trang; R. M. de Schauensee collectors, 13 October 1936. – CMK 12116, 1 ex., 42.0 mm SL; Thailand: Satun Prov.: stream in Ban Kong Kruat; 6°52'4"N 100°01'48"E; M. Kottelat *et al.,* 4 November 1995. – ZRC 43757, 4 ex., 25.8–64.7 mm SL; Thailand: Narathiwat Province, Bacho, Bhudo Padee National Park; H. H. Tan *et al.,* 24 October 1998. – ZRC 392, 5 ex., 46.5–71.1 mm SL; Malaysia: Terengganu, Sungai Tok Dor, 11.5 miles S of Jerteh; E. R. Alfred, 5 July 1958. – ZRC 2401, 3 ex., 51.6–64.5 mm SL; Malaysia: Perak, Chenderoh Lake; collector unknown, 1938. – ZRC 39533, 2 ex., 31.4–35.3 mm SL; Malaysia: Perak, tributary of Sungai Kulim 11 km before Gerik; H. H. Tan *et al.,* 19 November 1995. – ZRC 41062, 2 ex., 11.5–13.0 mm SL; Malaysia: Perak, Sungai Kenderong at Gerik (5°25'28.5"N 101°7'39.0"E); H. H. Ng *et al.,* 17 February 1997. – ZRC 41076, 12 ex., 13.2–21.7 mm SL; Malaysia: Perak, Sungai Lebey, ca. 16 km from Gerik on Gerik–Kota Bharu road (5°27'33.3"N 101°13'26.9"E); H. H. Ng *et al.,* 17 February 1997. – ZRC 41090, 2 ex., 15.9–22.0 mm SL; Malaysia: Kedah, Caruk Bukit Sebelah, a small rocky stream ca. 2 km before Baling on Gerik–Sungai Petani road (5°40'54.8"N 100°56'33.8"E); H. H. Ng *et al.,* 18 February 1997.

Diagnosis. Batasio havmolleri can be differentiated from all other congeners in having a unique combination of the following characters: body with a dark brown predorsal oblique bar and a dark brown spot on the side below the adipose fin, dorsal-

FIG. 3
Batasio dayi, ZRC 46108, 82.7 mm SL (photograph by Tan Heok Hui).

FIG. 4
Batasio havmolleri, CMK 5177, 55.1 mm SL (photograph by M. Kottelat).

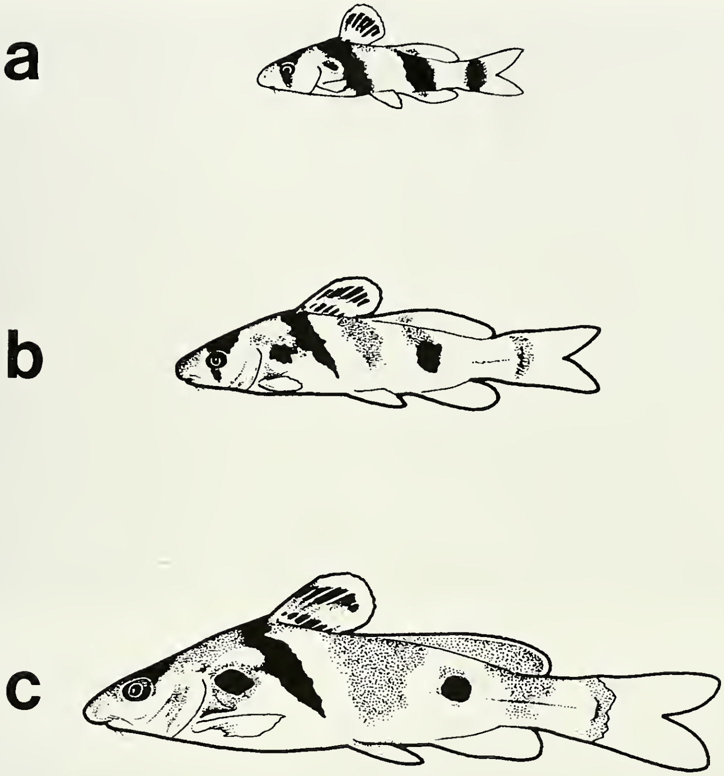

FIG. 5

Schematic illustration showing ontogenic change in colour pattern of *Batasio havmolleri*: a. ZRC 43757, 25.8 mm SL; b. ZRC 43757, 38.5 mm SL; c. ZRC 43757, 57.4 mm SL (drawing by Kelvin K. P. Lim).

spine length 10.7–12.4 % SL, length of adipose-fin base 30.0–33.3 % SL, body depth at anus 18.7–21.1 % SL, snout length 38.3–41.5 % HL, eye diameter 18.2–23.5 % HL, interorbital distance 25.9–28.6 % HL. Fin ray counts: dorsal I,7; pectoral I,8 or I,8,i; pelvic i,5; anal iv,8, iv,9 or v,9; caudal 8/9. See Key and Discussion for further comparison with *B. affinis* and *B. tigrinus*.

Distribution. *Batasio havmolleri* is known from the Malay Peninsula, south of the isthmus of Kra. It extends to the south as far as the Perak River basin on the west coast and the Terengganu River basin on the east coast. At present, it is known to extend to the north as far as the Tapi River basin on the east coast and the area of Ranong along the west coast (Fig. 2). Its distribution range may actually be more extensive towards the north but this area has not been surveyed on the Myanmar side (western slope) and very poorly on the Thai side (eastern slope). The southern end of the Malay Peninsula has been more surveyed and the presence of the species much further south is not expected.

Notes on Biology. Batasio havmolleri is found in rivers and streams with moderate to swift current and a predominantly rocky bottom, less frequently in slow flowing streams with a muddy substrate. The fish hide among stones or submerged vegetation during the day and come out at night to feed.

Remarks. The colour pattern of *B. havmolleri* changes with age. Newly hatched fish (ca. 3 mm) are unpigmented, but at ca. 6 mm SL, they begin to develop a colour pattern consisting of two vertical dark bars: one on the head passing through the eye and another on the dorsum just below the rudimentary dorsal fin (Kottelat & Wirtz, 1983). By the time they develop into juveniles of about 10–25 mm SL, the number of dark brown bars increases to four: one on the head passing vertically through the eye, the second running obliquely anterior to the dorsal fin, the third vertically at the anterior third of the adipose fin and the last one vertically on the posterior extremity of the caudal peduncle (Fig. 5a). The first and last bars, as well as the dorsal and ventral thirds of the third bar gradually fade with age (the bars begin to fade when the specimen is ca. 40 mm SL; Fig. 5b), leaving behind a dark brown spot below the anterior third of the adipose fin (Fig. 5c).

This ontogenetic change in coloration was noted by Smith (1945) and explains the difference in coloration between the types of *Mystus havmolleri* and *M. stigmaturus* (the types of the former species are smaller than those of the latter and represent the juvenile coloration).

Batasio tigrinus sp. n. Fig. 6

Batasio tengana (in part): Vidthayanon *et al.*, 1997: 43.

Holotype. ZRC 40624, 62.1 mm SL; Thailand: Kanchanaburi Province, Mae Nam Khwae Noi basin, Huai Lia, km 49 on road from Thon Pha Phun to Sangkhla Buri (15°4'25"N 98°33'51"E); H. H. Tan & H. H. Ng, 28 July 1999.

Paratypes. CMK 14431, 2 ex., 49.5–52.8 mm SL; Thailand: Kanchanaburi Province, Mae Nam Khwae Noi basin, Huai Lia, km 49 on road from Thon Pha Phun to Sangkhla Buri (15°4'25"N 98°33'51"E); K. Kubota, April 1998. – CMK 14533, 9 ex., 42.9–59.7 mm SL; Thailand: Kanchanaburi Province, Mae Nam Khwae Noi basin, Huai Khayeng (Huai Pak) at Ban Huai Khayeng (14°35'14"N 98°34'56"E); M. Kottelat & K. Kubota, 3 April 1998. – CMK 14541, 1 ex., 56.1 mm SL; Thailand: Kanchanaburi Province, Mae Nam Khwae Noi basin, Nam Khung upstream of Ban Huai Pak Khung (14°38'44"N 98°31'23"E); M. Kottelat & K. Kubota, 3 April 1998. – ZRC 40623, 1 ex., 62.0 mm SL; CAS 213312, 1 ex., 59.0 mm SL; data as for holotype.

Diagnosis. Batasio tigrinus can be differentiated from all other congeners in having fewer vertebrae (35–37 vs. 38–41) and a unique adult colour pattern consisting of four vertical dark brown bars on a greyish brown head and body (vs. with predorsal bar and posterior spots, mottled coloration, or horizontal midlateral stripes). It can be further differentiated from its congeners in having a unique combination of the following characters: length of adipose-fin base 23.9–26.7 % SL, pectoral–spine length 10.3–12.9 % SL, dorsal–spine length 9.4–12.5 % SL, body depth at anus 18.4–20.8 % SL, snout length 31.9–36.9 % HL, and interorbital distance 29.3–31.9 % HL. See Key and Discussion for further comparison with *B. havmolleri.*

Description. Head and body laterally compressed. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally

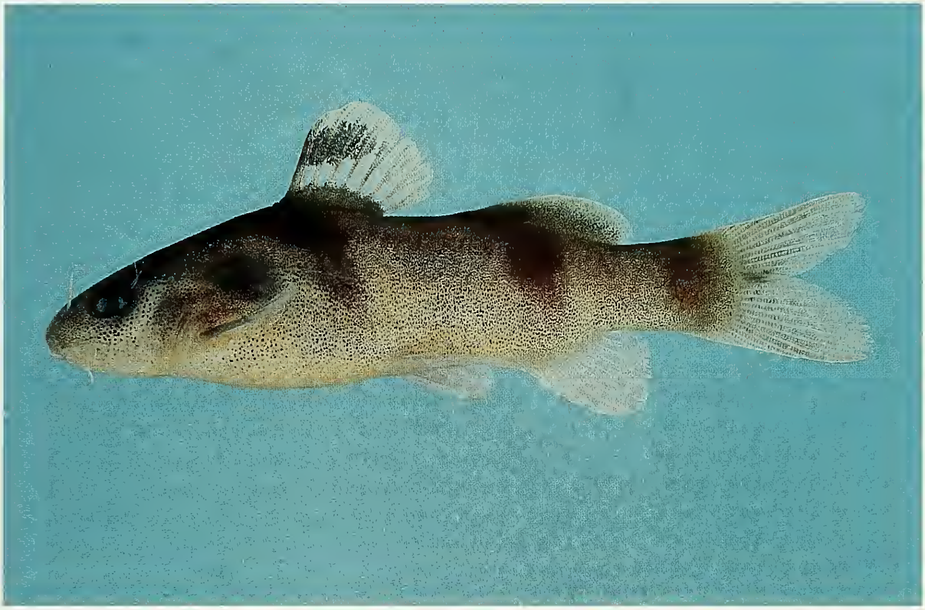

FIG. 6
Batasio tigrinus, paratype, CMK 14431, 52.8 mm SL (photograph by M. Kottelat).

FIG. 7
Batasio tengana, UMMZ 209009, 54.8 mm SL, left side, reversed (photograph by Tan Heok Hui).

from there to end of caudal peduncle. Ventral profile horizontal to origin of anal, then sloping dorsally to end of caudal peduncle. In % SL (n = 12): head length 24.2–26.7, head width 13.9–15.5, head depth 16.3–19.5, predorsal distance 36.2–38.9, preanal length 65.6–69.7, prepelvic length 47.1–50.9, prepectoral length 21.3–24.1, body depth at anus 18.4–20.8, length of caudal peduncle 16.1–19.0, depth of caudal peduncle 10.1–11.8, pectoral-fin length 16.9–19.1, pectoral–spine length 10.3–12.9, length of dorsal-fin base 14.2–16.7, dorsal–spine length 9.4–12.5, pelvic-fin length 13.2–15.3, length of anal-fin base 13.3–16.1, caudal-fin length 20.0–26.5, length of adipose-fin base 23.9–26.7, dorsal to adipose distance 7.3–9.2; in % HL: snout length 31.9–36.9, interorbital distance 29.3–31.9, eye diameter 20.3–24.8, nasal barbel length 20.0–29.8, maxillary barbel length 42.6–58.9, inner mandibular barbel length 13.3–16.7, outer mandibular barbel length 20.0–28.2. Branchiostegal rays 6 (10). Gill rakers 3+5 (1) or 3+6 (1). Vertebrae 18+17=35 (1), 18+18=36 (4) or 18+19=37 (9).

Fin ray counts: dorsal I,7 (10), pectoral I,8 (8) or I,8,i (2), pelvic i,5 (10), anal iv,9 (7), or v,8 (3), caudal 8/9 (10). Dorsal origin nearer tip of snout than caudal flexure. Pectoral spine stout, with 6 (1), 7 (5), 8 (3) or 10 (1) large serrae on posterior edge. Anal origin slightly posterior to adipose origin. Depressed dorsal not reaching adipose fin. Caudal fin forked.

Colour. In 70% ethanol: body and head brownish-grey with four vertical dark brown bars: one on head passing through eye, second running obliquely anterior to dorsal fin, third at anterior third of adipose fin and last on posterior extremity of caudal peduncle. Dorsal fin hyaline, with a subdistal, horizontal dark brown elliptical mark on anterior half. Other fins with dusky rays and hyaline membranes.

In life, body and head yellowish grey to dark grey, with patterning from blackish to black. Oblique bar from dorsal origin followed by an adjacent, pale yellowish bar more or less of same width.

Distribution. Batasio tigrinus is presently known only from the Mae Nam Khwae Noi basin (part of the Mae Khlong basin) in western Thailand (Fig. 2).

Etymology. From the Latin *tigrinus*, meaning of tigers, in reference to the striped coloration of this species. An adjective.

DISCUSSION

In the only taxonomic study of *Batasio* to date, Hora & Law (1941) recognised *B. tengana* as the only valid species with a colour pattern of dark vertical stripes or blotches, invoking great intraspecific differences in the coloration and in the length and position of the adipose fin to explain the variation they observed among their samples. In fish taxonomy papers of that time, decisions often had to be based on a few samples and/or very few specimens, often (by present and our personal standards) poorly preserved as a result of the logistical problems and difficult technical conditions of field work at that time. Re-examination of many cases of such 'highly variable' widely distributed species previously known from a few disparate individuals has shown that, in fact, many are aggregates of distinct, often not even closely related, species (e.g. Ng, 1999a; 1999b; Kottelat & Ng, 1999). Hora & Law had access to only 18 specimens for their study; 10 from Bengal, 4 from Assam, 1 from Mergui, 1 from Tenasserim, and 2 from Perak, that is, 4 specimens from the area discussed here. Our examination of large series of *B. havmolleri* (85 specimens, up to 29 in a single series [MHNG 2158.48]), including observation of a large series of live, captive bred individuals (Kottelat & Wirtz, 1983) shows that the adult coloration, the length of the snout, the interorbital distance, the eye diameter, and the length and position of the adipose fin do not exhibit much variation within populations and species, and can be reliably used as diagnostic characters. Considering the confusion surrounding the validity of the nominal species of *Batasio*, we feel that it is necessary to discuss these nominal species in some detail here. This especially concerns the nominal species with a colour pattern of dark vertical stripes or blotches and currently considered synonyms of *B. tengana* (i.e. *B. affinis*, *B. fluviatilis*, *B. dayi*, *B. merianiensis*, *B. havmolleri*, and *B. stigmaturus*).

The original description of *B. tengana* gives the colour as "diaphanous, with a silver coloured membrane investing the viscera and spine, and with a gloss of gold at the sides. On the back are many black dots, which are collected into a spot above each pectoral fin and also on the crown of the head. The fins of the back and tail are also dotted, so that the edge of the last is black, and several spots are formed on the first" (Hamilton, 1822: 176). The type locality of *B. tengana* is often given as the Brahmaputra River (e.g. see Eschmeyer, 1998), following the original description, but Hora (1949) narrowed it down to "Gualpara" (=Goalpara in Assam state, Northeast India) based on original notes made by Hamilton. Although we have been unable to obtain topotypic material of *B. tengana*, we examined a specimen of *B. tengana* collected from the Brahmaputra River drainage (UMMZ 209009, 54.8 mm SL; Fig. 7) having a colour pattern that seems to agree with the original description and the accompanying figure (Hamilton, 1822: pl. 39 fig. 58), i.e. a species of *Batasio* with a relatively slender body and a dark vertical bar on the dorsal half of the body in front of the dorsal fin terminating in a spot below the dorsal fin. This spot does not exactly correspond to the position of the spot in Hamilton's drawing which is, as he wrote, above the pectoral fin; in fact, the spot which he described apparently corresponds to the upper half of the air bladder which often appears as a dark area (see Figs. 1, 3-7). This single *B. tengana* specimen differs from all congeners in having more closely–set eyes (interorbital distance 22.2 % HL vs. 25.9–43.0). The colour pattern of *B. tengana* is also unique among species with vertical markings (*B. dayi*, *B. affinis*, *B. havmolleri*, *B. merianiensis*, *B. tengana*, and *B. tigrinus*) and only *B. dayi* (here considered a valid species, from the Salween basin) has a similar pattern. In both species, only the dark brown vertical predorsal bar is present (vs. predorsal bar and either spots or vertical bars present posteriorly in *B. affinis*, *B. havmolleri*, *B. merianiensis* and *B. tigrinus*). However, the predorsal bar in *B. dayi* does not terminate in an elliptical spot on the humeral region, as is the case in *B. tengana*. Furthermore, *B. dayi* differs from *B. tengana* and all other species with vertical markings (*B. affinis*, *B. havmolleri*, *B. merianiensis* and *B. tigrinus*) in having a longer snout (41.0–44.6 % HL vs. 31.9–41.5) and distal four–fifths (vs. one-third to half) of the dorsal fin dark brown. It further differs from the single available *B. tengana* in having a stouter body (body depth at anus 19.2–20.5 % SL vs. 16.4).

Batasio affinis was described from the "Tenasserim Provinces" (see above) in southern Myanmar (Burma). The species was described as having a distinct predorsal vertical bar, and "posterior to this first band are obscure traces of three or four others, the last at the base of the tail" (Blyth, 1860). We have examined a photograph of a specimen from the Tenasserim River basin (see Material examined) and which we identify as *B. affinis*. The colour pattern of this specimen is very similar to that of adult *B. havmolleri*, except that the dark brown mark on the dorsal fin is larger in *B. affinis* (covering most of the distal half of the fin, except for a hyaline distal margin vs. the distal one-third [in most specimens, this mark is less extensive that on the one in Figure 4]). This photograph shows the larger eye (ca. 26 % HL) and shorter snout (ca. 37 % HL) which we consider characteristic of *B. affinis* (see below), although the colour pattern differs somewhat from that of the original description, which may possibly be explained by ontogenetic changes in the colour pattern [in some specimens of *B. havmolleri* and, we hypothesize in *B. affinis* as well, the pale bands between the darker marks on the body and caudal peduncle appear darker medially; this probably explains the "three or four" other bars mentioned by Blyth]; the holotype does not retain any colour pattern. Therefore, we do not consider *B. affinis* and *B. havmolleri* conspecific. The two species also differ in the single examined *B. affinis* having a longer dorsal spine (ca. 14 % SL on the photograph; 14.0 % SL vs. 10.7–12.4), shorter snout (36.0 % HL vs. 38.3–41.5), larger eyes (24.4 % HL vs. 18.2–23.5) set further apart (31.7 % HL vs. 25.9–28.6), and a more anterior pelvic-fin origin (in front of base of last dorsal-fin ray vs. below or slightly behind).

Batasio merianiensis (from Assam in Northeast India) also has a colour pattern similar to those of *B. affinis* and *B. havmolleri*. We have examined the holotype, but no additional material was available. We consider it to be a distinct species differentiated from both *B. affinis* and *B. havmolleri* in having a shorter adipose-fin base (22.2 % SL vs. 34.3 in *B. affinis* and 30.0-33.3 in *B. havmolleri*). It further differs from *B. havmolleri* in having larger eyes (25.9 % HL vs. 18.2–23.5).

Batasio tigrinus can be differentiated from *B. affinis*, *B. dayi* and *B. havmolleri* in having an adult colour pattern of four dark brown vertical bars (only *B. havmolleri* specimens of less than 40 mm SL have such a colour pattern). It can be further differentiated from *B. havmolleri* in having a shorter pectoral spine (10.3–12.9 % SL vs. 13.3–15.3), adipose-fin base (23.9–26.7 % SL vs. 30.0–33.3), and snout (31.9–36.9 % HL vs. 36.9–41.5), more widely–set eyes (interorbital distance 29.3–31.9 % HL vs. 23.2–26.3), and fewer vertebrae (35–37 vs. 38–40).

Both *B. batasio* and *B. travancoria* can be differentiated from all their congeners in having a combination of a slender body (body depth at anus 14.7–17.2 % SL vs. 18.0–22.5) and a colour pattern consisting of a dark brown midlateral stripe. The midlateral stripe in *B. batasio* is expanded to form an elliptical dark brown spot immediately below the dorsal-fin base (absent in *B. travancoria*) while that of *B. travancoria* is expanded at the posterior edge of the caudal peduncle to form a triangular dark brown mark (absent in *B. batasio*). Furthermore, *B. batasio* has a greyish brown coloured body with a mottled pattern of faint brown patches while *B. travancoria* has a uniformly–coloured dark brown body. *Batasio batasio* further differs from its congeners in having a long snout (43.9–46.2 % HL vs. 31.9–41.5) and *B. travancoria* further differs from its congeners in having a flatter head (head depth 14.8–15.5 % SL vs. 16.3–21.2).

Batasio pakistanicus was described from the Indus River basin by Mirza & Jan (1989). The original description is rather uninformative, and we are unable to verify the accuracy of the figure provided. Based on the original description and figure, we are not able to determine if *B. pakistanicus* belongs to *Batasio* or *Rama*. If we consider *B. pakistanicus* to belong in the former genus, the colour pattern (a black humeral spot with a dark streak on the dorsum) clearly differentiates it from all other congeners (including the Indochinese species discussed here).

COMPARATIVE MATERIAL

Batasio batasio: ZRC 40570, 10 ex., 53.4–67.8 mm SL; India: Assam, Dibrugarh.

Batasio merianiensis: ZSI F 7781/1, 1 ex., holotype, 65.7 mm SL; India: NE Assam, Meriani junction.

Batasio tengana: UMMZ 209009, 1 ex., 54.8 mm SL; Bangladesh: Chittagong, Koilla Khal (creek), 6 miles E of Feni–Chittagong highway on road to Ramgarh (22°55'N 91°36'E).

Batasio travancoria: ZSI 13449/1, 1 ex., holotype, 73.6 mm SL; India: Travancore, from the foot of the largest falls of Peruntenaruri, a tributary of the Pamba River at Edakadathy. – ZSI 13452/1, 1 ex., 58.1 mm SL; India: Travancore, Palode, Chittar River. – CMK 10028, 5 ex., 85.1–101.0 mm SL; India: Kerala, Panamkulam, ca. 26 km from Chalakudy on Chalakudy–Valparai road.

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The Cosmopterigidae (Lepidoptera) of the Galápagos Islands, Ecuador

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The Cosmopterigidae (Lepidoptera) of the Galápagos Islands, Ecuador. - The Cosmopterigidae of the Galápagos Islands include eight species: *Cosmopterix attenuatella* (Walker, 1864), *C. yvani* sp. n., *C. madeleinae* sp. n., *C. galapagosensis* sp. n., *Pyroderces rileyi* (Walsingham, 1882), *Ithome volcanica* sp. n., *Periploca longipenis* sp. n., and *Periploca darwini* sp. n. The new species are described and all species are illustrated. *Cosmopteryx* [sic] *apiculata* Meyrick, 1922 is synonymized with *C. attenuatella. Cosmopterix galapagosensis* was reared on *Eleocharis mutata* (L.) Roem. & Schult. (Cyperaceae).

Key-words: Moths - Cosmopterigidae - Galápagos Islands - taxonomy - Cyperaceae – Coccoidea.

INTRODUCTION

The Cosmopterigidae include some of the most beautifully colored moths, particularly in the genus *Cosmopterix*. However, in recent years their attractiveness was not sufficient to generate much attention from lepidopterists interested in the Neotropical fauna, except for Becker (1984) and Hodges (1997), who provided lists of species. In the Neotropical Region the Cosmopterigidae contain about 130 species including the six described in the following pages. The life-history of only a few of them is known.

MATERIAL AND METHODS

In 1989 and 1992, I surveyed most of the Galápagos islands for five months, concentrating on micro moths. I collected about 230 specimens of Cosmopterigidae, mostly with a mercury-vapor lamp set in front of a white cotton sheet and powered by a small generator. Also, I reared one *Cosmopterix* species from *Eleocharis mutata* (L.) Roem. & Schult. (Cyperaceae). Forty-seven additional specimens were made available to me by L. Roque, C. Causton and T. Paulson of the Charles Darwin Research Station, Santa Cruz, Galápagos (ECCD). Among them was a species that I had not encountered during my survey. The Galápagos fauna of Cosmopterigidae now includes eight species.

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To determine the identity of the Galápagos Cosmopterigidae I compared specimens collected in the Galápagos with the type specimens of the species described from the Nearctic and Neotropical regions available at the National Museum of Natural History, Washington, D.C. (USNM), at The Natural History Museum, London (BMNH), and at the Cornell University Insect Collection, Ithaca, New York (CUIC), or with specimens identified by R.W. Hodges (USNM) for a few North American species for which I did not see the holotype. These collections contained the specimens I needed to examine except for the types of two Neotropical *Cosmopterix* species. These types belong to the Naturhistorisches Museum Wien (NMW), and they had been borrowed by J.C. Koster of The Netherlands, who is revising the Neotropical fauna of Cosmopterigidae. With the descriptions and illustrations I sent to Mr. Koster, he determined that the two *Cosmopterix* species are different from those present in the Galápagos, and he confirmed my suspicion that three of the Galápagos *Cosmopterix* species were undescribed.

For examination of the genitalia the specimens were dissected in a concentrated (20%) hot KOH solution. Dissected parts were kept in lactic acid stained with orange G for examination and illustration purposes. They were subsequently stained in chlorazol black before being mounted on slide in Euparal.

Genitalia were sketched with a camera lucida mounted on a compound microscope. The drawings were finished in pencil with a stereo-microscope, inked and scanned at high resolution. The resulting electronic files were cleaned in Adobe Photoshop and grouped on plates with Adobe Illustrator before being printed.

The specimens treated here will be deposited in the "Muséum d'histoire naturelle," Geneva, Switzerland (MHNG), my personal collection (BLC), the BMNH, the Canadian National Collection of Insects and Arachnids (CNC), the collection of the ECCD, and the USNM.

SYSTEMATIC TREATMENT

Cosmopterix Hübner

Redescribed by Hodges (1978), this cosmopolitan genus includes about 200 species (J.C. Koster, pers. comm.).

KEY TO THE *COSMOPTERIX* SPECIES OF THE GALÁPAGOS ISLANDS

1 Forewing base (before fascia) brown with thin longitudinal white lines 2
1' Forewing base either brown on costal half and orange on inner half, or brown with a large longitudinal yellow stripe and thinner white lines 3
2(1) Forewing's shining spots at base of fascia disconnected, spot on costal margin farther from middle of fascia than spot on inner margin; without dark-brown scales at margin of fascia and shining spots; base of inner margin with a thick white line; longitudinal white line beyond fascia complete (Fig. 1) . . . . *yvani*

2' Forewing's shining spots at base of fascia forming united transverse band; with dark-brown scales at margins of fascia and shining spots; inner margin with one-scale thin white line beyond base; longitudinal white line beyond fascia usually interrupted in middle (Fig. 4) . . . *attenuatella*

3(1') Base of forewing brown on costal half, usually with a thin diagonal white line; inner half yellowish orange; without dark-brown scales bordering shining spots; longitudinal white line beyond fascia visible only at apex, if present (Fig. 3) . . . . *galapagosensis*

3' Base of forewing brown on inner half; costal half with a large pale-yellow stripe and two longitudinal white lines; with dark-brown scales bordering shining spots; with longitudinal white line beyond fascia (Fig. 2) . . . . *madeleinae*

Cosmopterix yvani sp. n. Figs 1, 9, 10

Holotype ♂, Ecuador: Galápagos, Pinta, ca. 50 m elev., 20.iii.1992, M[ercury] V[apor] L[amp] (B. Landry), (CNC type no. 22680).

Paratypes, Ecuador: 10 ♂ from the Galápagos Islands, collected at MVL by B. Landry. 3 with same data as holotype (one dissected, slide BL 1138); 5 more from *Pinta*: 1, Plaja Ibbetson, 13.iii.1992; 1, Plaja Ibbetson, 14.iii.1992; 2, arid zone, 15.iii.1992; 1, 200 m elev., 16.iii.1992. *Floreana*, 1 (slide BL 1216), Las Cuevas, 23.iv.1992. *Isabela*, 1 (slide BL 1264), nr. Tagus Cove, 100 m elev., 21.v.1992. (MHNG, BLC, BMNH, CNC, ECCD, USNM).

Diagnosis. A unique feature of this species is the thick white line at the base of the forewing's inner margin.

Description. MALE (n=11) (figs 1, 9, 10). Head brown with three longitudinal white lines reaching posterior margin of head: one on each side from antenna along upper side of eye and one medially from about anterior margin of eye; with a few white scales before antenna; frons paler brown than occiput and shining. Haustellum and maxillary palpus pale beige. Labial palpus with six thin longitudinal stripes: three white and three brown on segment II, and two of each color on segment III. Antenna from apex with two dark-brown flagellomeres, two white, five dark brown, one white, one dark brown, two white, three dark brown sometimes with white scales ventrally, rest (including scape) longitudinally lined with white and dark brown but some flagellomeres may lack white scales of second row. Thorax brown with three thin longitudinal white lines: one on each side laterally on medial side of tegula, prolonging lateral white lines of head, and one medially from base to posterior margin. Foreleg coxa laterally dark brown at base to pale greyish brown toward apex, pale greyish brown medially; femur mostly dark brown, with three short white stripes apically, with pale greyish-brown stripe medially; tibia dark brown with longitudinal white stripe laterally; tarsomeres I-III as tibia, tarsomere IV without white, tarsomere V white apically. Midleg coxa beige; femur greyish brown with few white scales apically; tibia dark brown with diagonal white lines at base, middle, and apex; tarsomeres dark greyish brown dorsally, beige ventrally, with a few white or off-white scales at apex of tarsomeres I-III, and V. Hindleg coxa beige; femur beige laterally, greyish brown medially; tibia dark brown, laterally with longitudinal white stripe ventrally from base to median spines and beyond in diagonal toward dorsal edge, with another thinner white line dorsally from base to about 1/3, and with ring of white apically, spines white to off-white, elongate scales on dorsal edge mostly dark brown except for off-white apical bunch; tarsomeres dorsally dark brown with some white scales, beige ventrally, tarsomere I white at base and apex, tarsomere II white apically, other tarsomeres white on most of lateral surface. Wingspan: 9.5-11.0 mm. Forewing base brown with five longitudinal white lines: one subcostal from middle to fascia; one from base below costa, slightly inclined toward middle of wing and ending shortly before fascia; one above cubital fold from about 2/5 to shortly before fascia; one shorter below fold from 1/2 to 4/5; and one on inner margin from base to about 4/5, thicker on basal half; yellow fascia from about 1/2 to about 4/5 wing length; four shining spots pinkish silver, two costal spots farther from middle of fascia than inner margin spots and not touching costa, inner margin spots bigger than costal spots and touching inner margin, with a few white scales on costa above costo-apical silver spot; brown area beyond fascia with median longitudinal white stripe from shortly beyond fascia to shortly before apex of wing; fringe brown, paler below fascia. Hindwing uniformly greyish brown with concolorous fringe. Abdomen dorsally mostly yellowish orange with brown at apex of segments; laterally greyish brown with beige at apex of apical segments; ventrally beige; thin scales surrounding genitalia greyish brown dorsally and beige ventrally.

Male genitalia (n=3) (figs 9, 10). Apex of right uncus arm enlarged to the left and with a dorsal longitudinal depression; projection anteriorly rounded, laterally flattened, and with short bumps on dorsal edge; apex pointed, dorso-ventrally flattened, and directed downward. Arms of juxta broadly down-curved, of same width for most of length, laterally compressed on distal third, apically pointed. Valvae short, enlarging apically to about twice the basal width; apical margin almost straight on dorsal half; apex rounded. Aedeagus short, larger and bulbous on basal half, slightly bent to the right from middle; baso-ventral flange of medium size, rounded; bulbus ejaculatorius equal in length to sclerotized part of aedeagus.

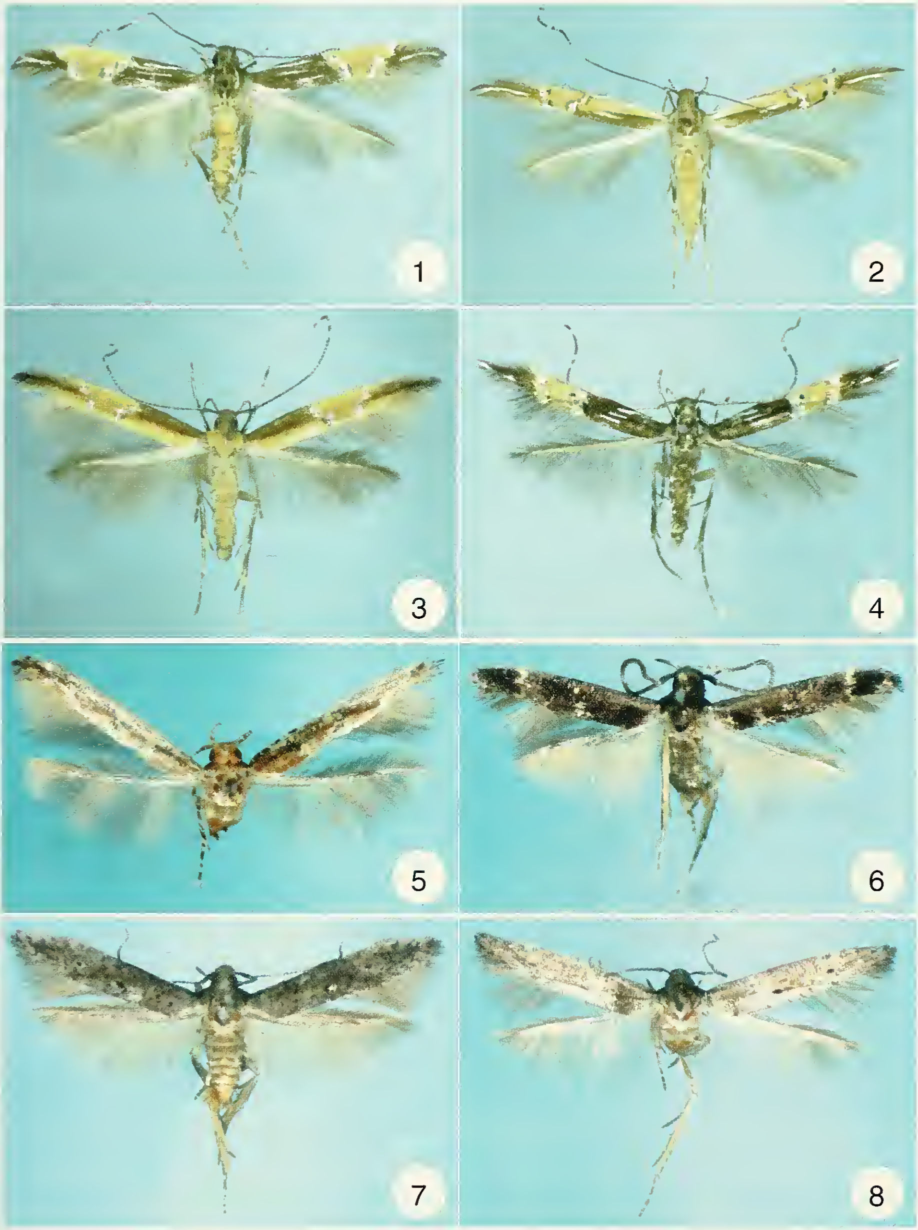
FEMALE. Unknown.

Etymology. The specific epithet derives from the name of my father, Yvan Landry, especially for his encouragement along the path that led me to become a lepidopterist.

Biology. The host plant is unknown. Moths come to light and were found mostly at lower elevations, from March until May.

Distribution. Possibly endemic to the Galápagos where it was found on the islands of Floreana, Isabela, and Pinta.

Remarks. In describing the male genitalia of *Cosmopterix* species, authors such as Hodges (1978), Koster, and Sinev (S. Koster, pers. comm.) refer to the most dorsal structure as the right arm (or brachium) of the gnathos. However, in a subsequent paper Hodges (1999) mentioned that the Cosmopterigidae do not have a gnathos, without indicating what should be the name of this structure. I have contacted Dr. Hodges and he is now of the opinion that this structure is the right arm of the uncus because of the presence of a patch of setae at its base and at the base of the other very reduced arm (pers. comm.). This is the interpretation I have adopted. I have also adopted Hodges' (1978) interpretation and terminology for the arms extending above



Figs 1-8

Adults of Cosmopterigidae species. 1. *Cosmopterix yvani*; 2. *C. madeleinae*; 3. *C. galapagosensis*; 4. *C. attenuatella*; 5. *Pyroderces rileyi*; 6. *Ithome volcanica*; 7. *Periploca longipenis*; 8. *P. darwini*.

the valva, calling them "arms of the juxta." However, Sinev (S. Koster, pers. comm.) refers to this structure as the "anellus arms" and Riedl (1969) as the free costa of the valva. My interpretation of the bulbus ejaculatorius comes from Sattler (1979).

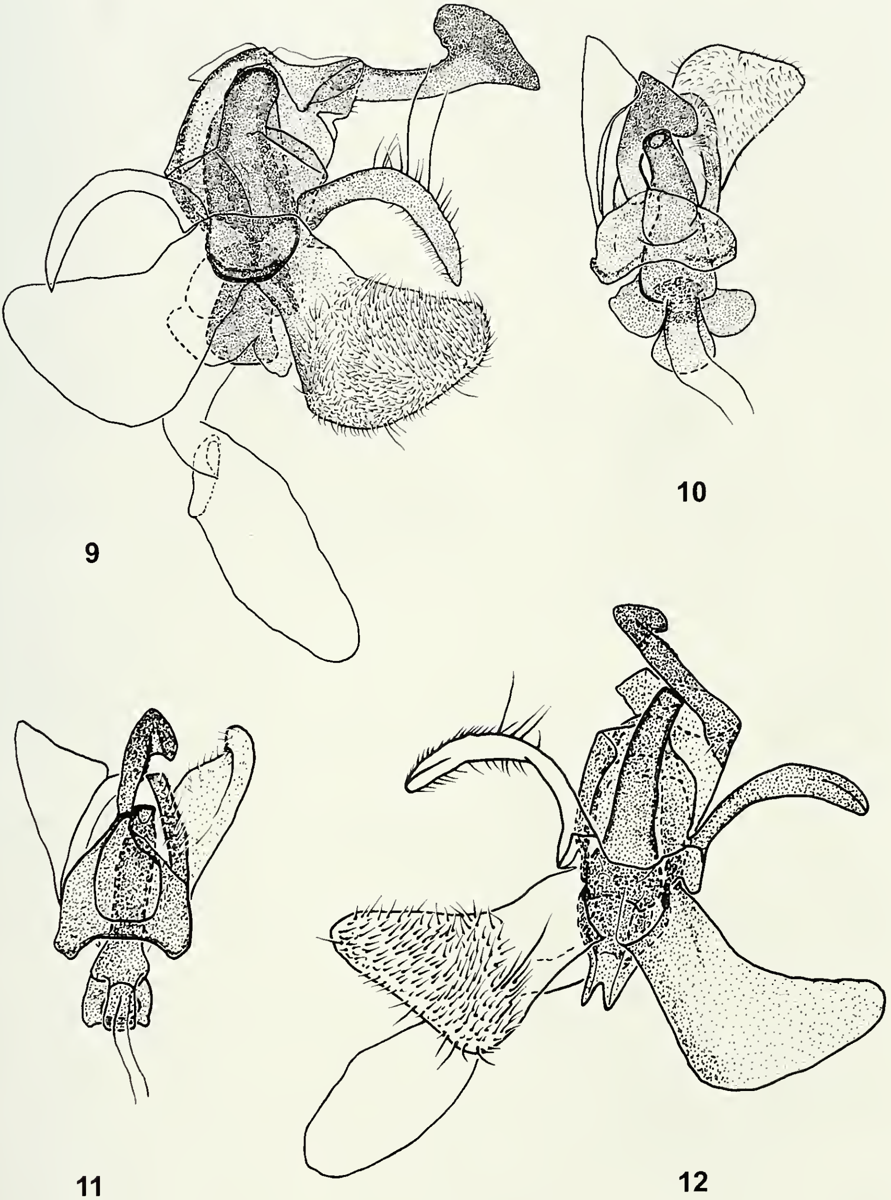
Cosmopterix madeleinae sp. n. Figs 2, 11, 12, 26

Holotype ♂, Ecuador: Galápagos, Santa Cruz, Los Gemelos, 27.v.1992, M[ercury] V[apor] L[amp] (B. Landry), (CNC type no. 22681).

Paratypes, Ecuador: 30 ♂, 17 ♀, 1 of sex undetermined from the Galápagos Islands. *Isabela*: 2 ♀, Volcan Darwin, 1000 m elev. (B. Landry); 3 ♂ (slide BL 1262), 1 ♀ (slide BL 1260), Volcan Darwin, 1240 m elev., 19.v.1992, MVL (B. Landry); 1 ♀, ca. 15 km N Puerto Villamil, 25.v.1992, MVL (B. Landry); 1 ♂, 1 ♀, Volcan Alcedo, Cumbre, 1200 m elev., La Caseta, 9.iv.1999, U[ltra] V[iolet] L[ight]- F[luorescent] L[ight] (L. Roque); 1 ♂, 6 ♀ (slide BL 1259), 1 sex undetermined, Volcan Alcedo, 1100 m elev., 13.x.1998, UVL (L. Roque); 10 ♂, Volcan Alcedo, top, 1100 m, 16.x.1999, sweep net, asociado *Tournefortia* spp. (L. Roque). *Pinta*: 3 ♂ (slide BL 1141), 1 ♀, 400 m elev., 17 and 18.iii.1992, MVL (B. Landry). *San Cristóbal*: 1 ♀ (slide BL 1263), pampa zone, 18.ii.1989, MVL (B. Landry). *Santa Cruz*: 4 ♂ (slide BL 1261), 1 ♀, same data as holotype; 4 ♂, 3 ♀ (CNC slide MIC 4680), Los Gemelos, 31.i.1989, MVL (B. Landry); 4 ♂, Finca S[teve] Devine, 17.iii.1989, MVL (B. Landry). (CNC, ECCD, MHNG, BLC, BMNH, USNM).

Diagnosis. This species is recognizable by the pattern of the forewing base: this area is dark brown on the inner half of the wing and has a large pale-yellow longitudinal stripe bordered by white on the costal half.

Description. MALE (n=31) (figs 2, 11, 12). Head brown to dark brown on occiput, with three thin longitudinal white lines reaching posterior margin of head: one on each side from antenna along upper side of eye and one medially from about anterior margin of eye; with few, if any, white scales before antenna; larger scales of vertex and frons greyish brown or yellowish brown, shining. Haustellum and maxillary palpus white to pale beige. Labial palpus with six thin longitudinal stripes: three white and three brown on segment II, and two of each color on segment III. Antenna from apex with two dark-brown flagellomeres, two white, five dark brown, one white, one dark brown, two with white second row and dark-brown first row, two to five mostly dark brown but with some white scales, three or four with white first row and dark-brown second row, about 15 mostly dark greyish brown with one or two white scales on first row, rest dark brown with one white stripe dorsally and one ventrally; scape dark brown with a white stripe dorsally and two more ventral beige stripes. Thorax dark brown with paler orange-brown scales apically, with three white longitudinal lines: one medially and two on medial side of each tegula. Foreleg coxa greyish brown laterally, beige medially; femur dark brown laterally with a white stripe apically, beige medially; tibia dark brown with a white stripe laterally, beige medially; tarsomeres dark brown to greyish brown dorsally with white on tarsomeres I-II, base of III, and V, mostly beige ventrally. Midleg coxa beige; femur medially beige, laterally beige at base, greyish brown apically: tibia laterally dark brown with white diagonal stripes at base (reaching middle dorsally), middle, and apex; tarsomeres mostly dark greyish brown dorsally, with white at apex of tarsomeres I-III and V, beige to greyish brown ventrally. Hindleg coxa and femur beige; tibia whitish beige medially, laterally dark brown with white as a large diagonal band from base to about 1/3, as a shorter larger diagonal band in middle from base of spines, and as



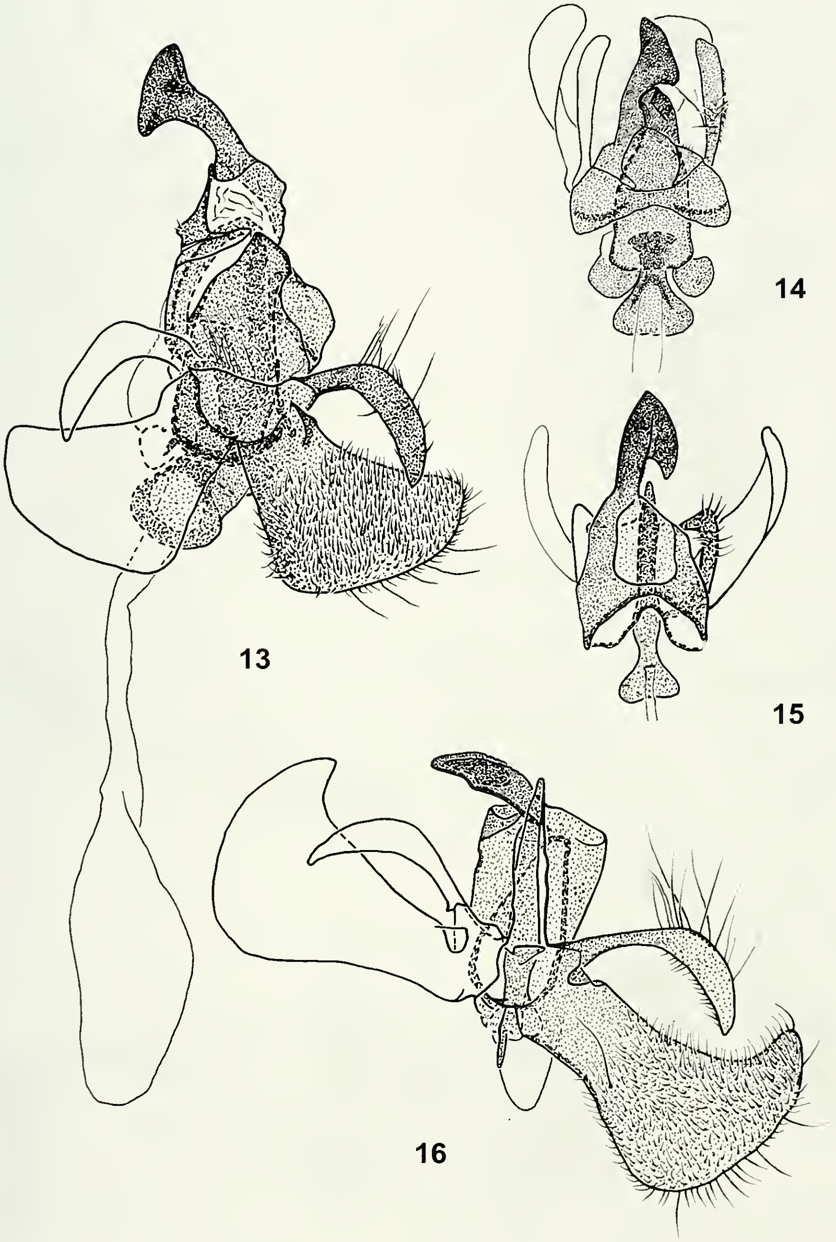
FIGS 9-12

Male genitalia of *Cosmopterix* species (10 and 11 are dorsal views). 9, 10. *C. yvani*; 11, 12. *C. madeleinae*.

rings subapically and apically, spines greyish brown and beige, elongate scales on dorsal edge mostly dark brown and white but yellow at apex; tarsomeres dorsally dark greyish brown with white at apex of tarsomeres I and II (sometimes also on III-V) and subbasally on tarsomere I, ventrally beige to greyish beige. Wingspan: 7.0-9.5 mm. Forewing base dark brown along costa as a thin line enlarging toward fascia and usually becoming paler brown, with white stripe of medium width not quite reaching fascia below costa, with a large pale-yellow (sometimes apically darker yellow to bronze colored) longitudinal band from base to fascia on costal side of cubital fold, usually with a thin white line on costal margin of yellow stripe toward the middle, mostly brown on inner side of cubital fold, with a short and straight white longitudinal bar subapically, and with a thin white line on inner margin from base to about 1/3; yellowish-orange to bronze-brown fascia from about 1/2 to about 7/10 wing length; four silvery-pink shining spots with a few dark-brown scales on basal margins, inner margin spots touching inner margin, costal spots not touching costal margin and farther from middle of fascia than inner margin spots, anterior spots often not connected to each other, posterior spots usually connected; apical area of wing mostly yellowish orange at base along inner margin and sometimes on all of base except for white scales on costa, dark brown beyond base with a longitudinal white stripe sometimes becoming pale yellow at apex or with yellow scales on its costal margin; fringe mostly pale yellow to pale brown along inner margin, dark brown toward apex. Hindwing pale greyish brown with a yellowish tinge toward apex sometimes; fringe pale greyish brown along inner margin, darker brown toward apex and on costa. Abdomen dorsally mostly yellowish orange except for beige or pale greyish-brown apical margin of segments; laterally mostly pale greyish brown but beige toward apical margin of segments; ventrally mostly beige; thin scales around genitalia pale yellowish beige.

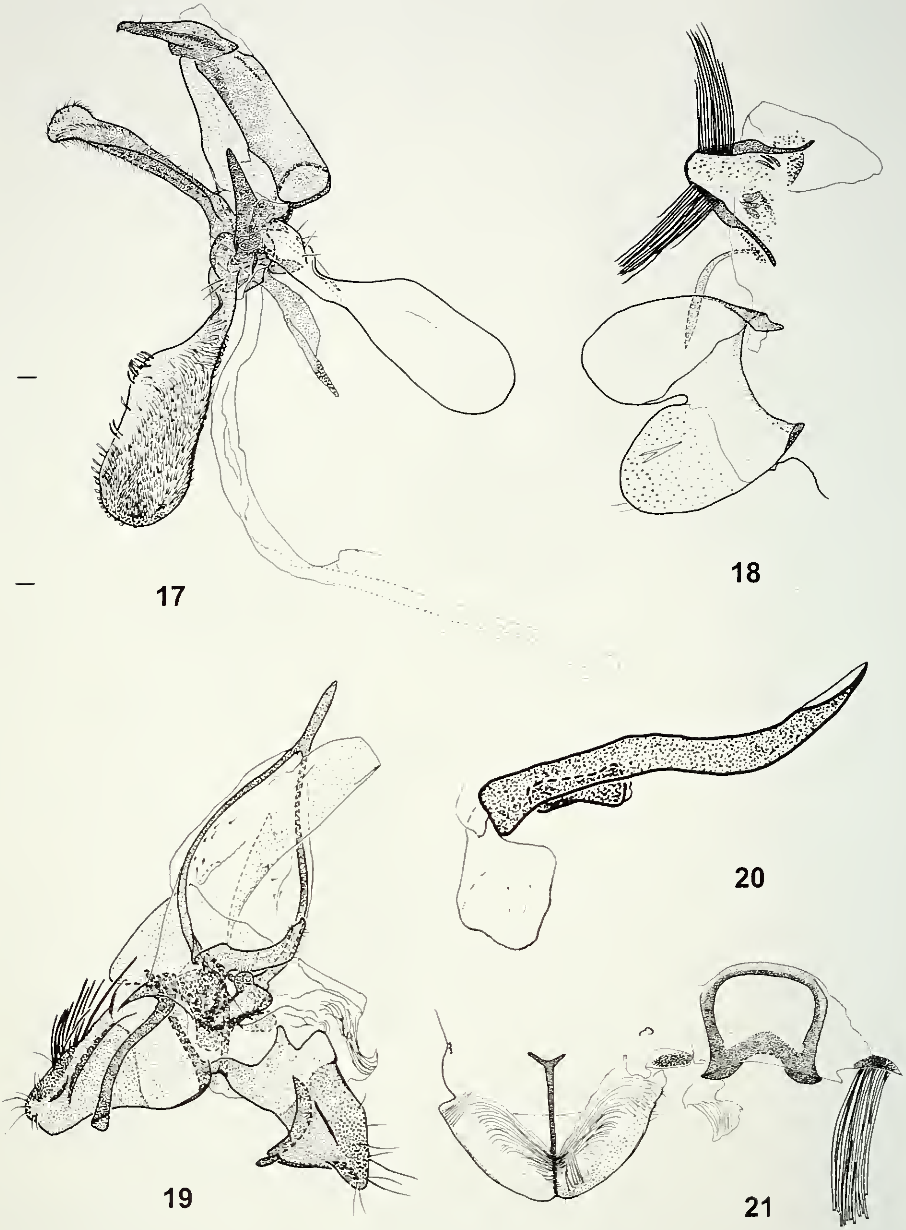
Male genitalia (n=3) (figs 11, 12). Right uncus arm shortly serrated dorsally toward apex; projection enlarged to the left, of medium size, and subtriangular (in dorsal view), rounded at apex and anteriorly, and with slightly concave margin basally; apex dorso-ventrally flattened; lateral margins slightly enlarged. Arms of juxta narrow, broadly down-curved, circular in cross section and of same girth for most of length; medial margin forming edge subapically; apically rounded. Valvae more or less L-shaped, wider in the middle; apical margin almost straight. Aedeagus rather narrow and straight for most of length, slightly enlarged and bulbous on basal 1/4, only slightly bent to right at apex; ventral flange absent, basoventral margin deeply concave; bulbus ejaculatorius about as long as sclerotized part of aedeagus.

FEMALE (n=17). Wingspan: 7.0-11.0 mm. Frenulum with two acanthae. Sternum VII scales set in sinuous rows; posterior margin not modified, slightly concave. Female genitalia (n=4) (fig. 26). Papillae anales not elongate, rounded apically. Posterior and anterior apophyses slender and straight; anterior apophyses shorter than posterior apophyses by about 1/3, connected by slightly more melanized band along apical margin of tergum VIII. Ostium bursae surrounded by ring of sclerotization of which the antero-ventral part is slightly prolonged anteriorly. Ductus bursae very slender, with small and poorly sclerotized bend before inception of ductus seminalis,



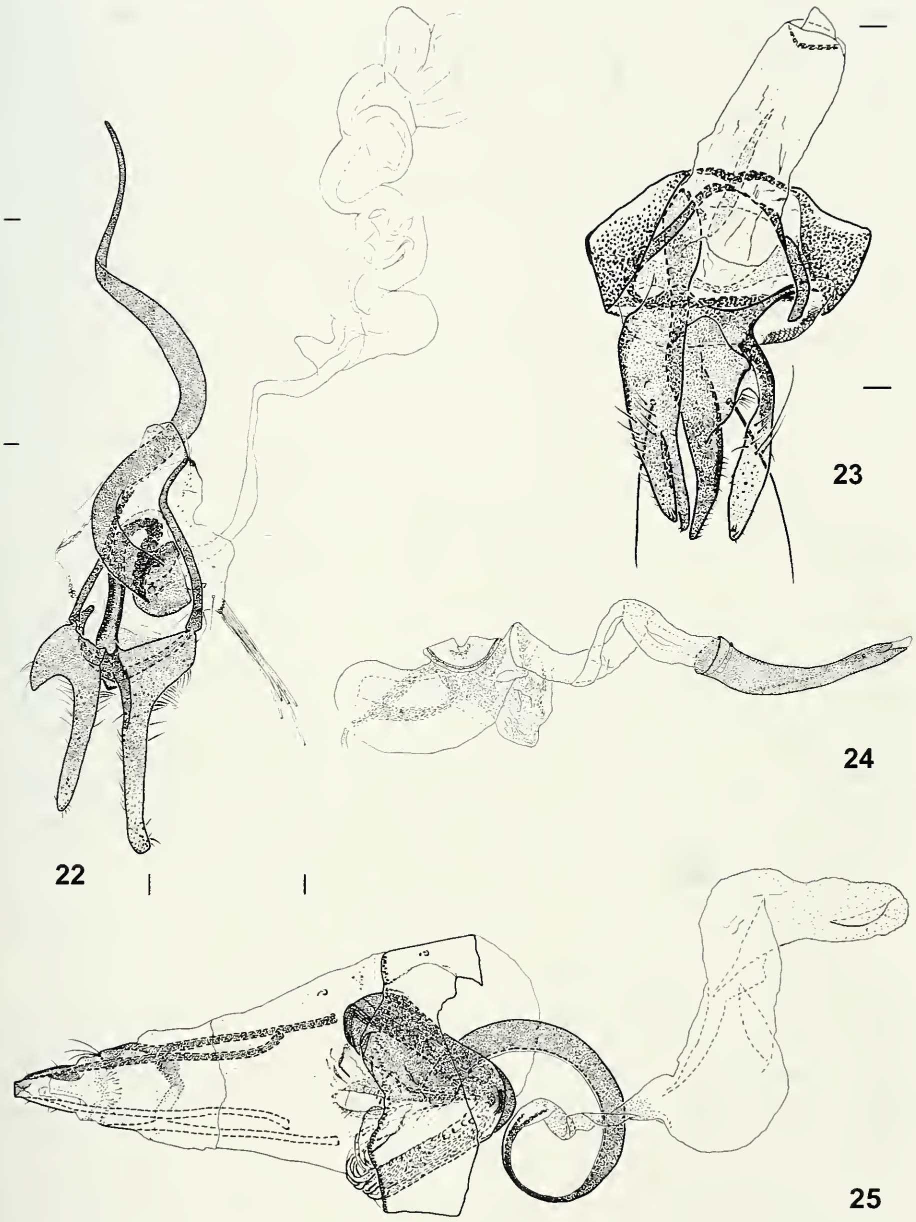
Figs 13-16

Male genitalia of *Cosmopterix* species (14 and 15 are dorsal views). 13, 14. *C. galapagosensis* (scale = 0.5 mm); 15, 16. *C. attenuatella.*



Figs 17-21

Male genitalia of Cosmopterigidae species. 17-18. *Pyroderces rileyi*:17. Whole genitalia (scale = 0.5 mm); 18. Abdominal segment VIII. 19-21. *Ithome volcanica*: 19. Genitalia without aedeagus; 20. Aedeagus; 21. Abdominal segment VIII.



FIGS 22-25

Genitalia of *Periploca* species (scales = 0.5 mm). 22. *P. longipenis*, male; 23-24. *P. darwini*, male: 23. Genitalia without aedeagus; 24. Aedeagus; 25. *P. longipenis*, female.

without distinct junction with corpus bursae. Corpus bursae slender and long, with slight curve subapically, without signum.

Etymology. I take pleasure in naming this species in honor of my mother, Madeleine Marois, for her love and encouragement to continue my work on Lepidoptera, especially when there seemed to be little hope that I could derive a decent living from it.

Biology. The host plant is unknown. Moths were taken only at higher elevations, in agriculture, scalesia, and pampa zones. They were taken at light or swept from the vegetation from January to May and in October.

Distribution. Possibly endemic to the Galápagos where it was found on the islands of Isabela, Pinta, San Cristóbal and Santa Cruz.

Remark. I found the dissymetric anal papillae shown on figure 26 on that specimen only.

Cosmopterix galapagosensis sp. n. Figs 3, 13, 14, 27

Holotype ♂, Ecuador: Galápagos, Santa Cruz, Los Gemelos, 27.v.1992, M[ercury] V[apor] L[amp] (B. Landry), (CNC type no. 22682).

Paratypes, Ecuador: 26 ♂, 13 ♀ and 4 of sex undetermined (because the wings are not spread) from the Galápagos Islands and collected by B. Landry except otherwise indicated. *Isabela*: 2 ♂, 2 km W Puerto Villamil, 5.iii.1989, MVL; 1 ♂, 3 km N Santo Tómas, Agriculture zone, 8.iii.1989, MVL; 1 ♂, 11 km N Puerto Villamil, 9.iii.1989, MVL; 1 ♂, ca. 15 km N Puerto Villamil, 25.v.1992, MVL; 1 ♂, Volcan Darwin, 300 m elev., 15.v.1992, MVL; 1 ♂ (slide BL 1265), Volcan Darwin, 630 m elev., 17.v.1992, MVL; 1 ♂, Volcan Darwin, 1000 m elev., 18.v.1992, MVL; 1 ♂ (slide BL 1266), Volcan Darwin, 200 m, 11.ii.1999, UVL (L. Roque); 2 ♂, 1 ♀, Volcan Alcedo, cumbre, 1200 m elev., La Caseta, 9.iv.1999, UVL-FL (L. Roque). *San Cristóbal*: 1 ♂, 4 km SE Puerto Baquerizo, 12.ii.1989, MVL; 1 ♂ (slide BL 1142), 1 km S El Progreso, 14.ii.1989, MVL; 2 ♂, pampa zone, 18.ii.1989, MVL; 3 ♂, 4 km SE Puerto Baquerizo, 20.ii.1989, MVL; 2 ♂, base of Cerro Pelado, 22.ii.1989, MVL. *Santa Cruz*: 3 ♂, 9 ♀ (CNC slides MIC 4681 & 4683), Tortuga Bay, 29.i.1989, MVL; 1 ♂, 3 ♀, 4 of sex undetermined, Tortuga Bay, reared from *Eleocharis mutata* leaf, emerged 30.i.-8.ii.1989; 1 ♂, Media Luna, pampa zone, 21.i.1989, MVL; 1 ♂ (CNC slide MIC 4682), Media Luna, 8.ii.1989, MVL. (CNC, ECCD, MHNG, BLC, BMNH, USNM).

Diagnosis. This species can be recognized readily by the brown costal half and the yellowish-orange inner half of the forewing base.

Description. MALE (n=27) (figs 3, 13, 14). Head brown to orange brown on occiput, with three thin longitudinal white lines reaching posterior margin of head: one on each side from antenna along upper side of eye and one medially from about anterior margin of eye; with a few white scales before antenna; vertex and frons with large greyish-brown shining scales. Haustellum and maxillary palpus pale greyish beige. Labial palpus with six thin longitudinal stripes: three white and three brown on segment II, and two of the same colors on segment III. Antenna from apex with two dark-brown flagellomeres, two white, one dark brown, one white, one dark brown, two mostly white with some dark-brown scales, two or three mostly dark brown with white scales, two or three with white first row and dark-brown second row, about 20 with complete dark-brown second row and incomplete white first row, basal three and scape dark brown dorsally with two longitudinal white lines and a larger beige stripe ventrally. Thorax yellowish orange to orange brown, browner at base, with thin longitudinal white line medially, sometimes with one or two white scales on medial margin of tegula. Foreleg coxa pale greyish brown; femur laterally dark brown on dorsal half, beige on ventral half, medially pale greyish brown, with longitudinal white stripe at apex dorsally; tibia laterally dark brown with a longitudinal white stripe, medially greyish beige; tarsomeres mostly greyish brown, with white dorsally as a longitudinal stripe on tarsomere I, at apex of tarsomere II, on all of tarsomere V, and sometimes on tarsomere III at apex. Midleg coxa greyish to yellowish beige; femur greyish beige basally to darker greyish brown toward apex, with a few white scales apically; tibia mostly greyish brown with diagonal white lines at base, middle, and apex; beige ventrally on tarsomeres I-V and dorsally at apex of last tarsomere, greyish brown elsewhere with white scales at apex of tarsomeres I and II dorsally. Hindleg coxa pale yellowish beige; femur entirely greyish beige; tibia dark brown with white as a short dorsal line at base, as a short stripe medially from base of spines, dorsally before apex, and at apex, spines whitish beige, elongate scales on dorsal edge dark brown except for a pale yellow bunch apically; tarsomeres greyish brown dorsally with white at apex of tarsomeres I-V but not always on IV, greyish brown to beige ventrally. Wingspan: 9.0-11.0 mm. Forewing base pale yellow to yellowish orange on inner half (on inner side of cubital fold), dark brown on costal half, usually with a thin diagonal white line from base on costa to beyond middle of brown basal area (often inconspicuous at base); pale-yellow to yellowish-orange fascia from about 2/5 to 7/10 wing length; four silvery-pink shining spots not touching wing margins, usually disconnected from each other along median line, costal spots farther from middle of fascia than inner margin spots, without dark-brown scales at spots' margins; apical area of wing mostly pale yellow to yellowish orange at base on costa and along inner margin, darker orange brown in middle, dark brown on most of costa and at apex, sometimes with thin longitudinal white line at apex; fringe brownish to yellowish beige along inner margin, brown and darker toward apex. Hindwing greyish brown; fringe mostly greyish brown, darker at apex but pale yellow at base of inner margin. Abdomen segments I-VI dorsally mostly yellowish orange, with pale greyish-brown apical margin; ventrally mostly greyish brown; slightly darker brown laterally; elongate scales surrounding genitalia pale yellow.

Male genitalia (n=4) (figs 13, 14). Apex of right uncus arm enlarged to the left by short and rounded laterally flattened knob, produced anterodorsally, and bearing short bumps on dorsal edge; apically flattened dorso-ventrally by subapical 90° upward bend of ventral margin; apex rounded in dorsal view but pointed in lateral view. Arms of juxta curved downward at almost right angle before middle, slightly enlarged (in lateral view) after bend, laterally compressed beyond middle, pointed apically. Valvae short, wide at base and widening to over twice the basal width; apical margin and apex broadly rounded. Aedeagus short, bulbous and larger on basal half, curved slightly to the right at apex; basoventral flange rather large, rounded; bulbus ejaculatorius almost twice the length of sclerotized part of aedeagus.

FEMALE (n=13). Wingspan: 10.0-11.0 mm. Frenulum with two acanthae. Sternum VII with conspicuous pattern of scale sockets; posterior margin medially produced into a rounded lobe bearing minute spines. Female genitalia (n=2) (fig. 27).

Papillae anales elongate and pointed, but not strongly melanized apically. Posterior and anterior apophyses slender and straight; anterior apophyses shorter than posterior apophyses, connected dorsally by slightly more melanized band along apical margin of tergum VIII. Ostium bursae near anterior margin of sternum VIII medially, surrounded by dorso-ventrally flattened and anteriorly projecting sclerotized structure. Ductus bursae slender, elongate, with a pair of short and elongate sclerotized patches before corpus bursae. Inception of ductus seminalis on corpus bursae beside connection with ductus bursae. Corpus bursae elongate, with a pair of rather large signa near middle; each signum a rounded plate with short inwardly directed crest.

Etymology. Named for the Galápagos Islands, where the type locality is located and from where all the known specimens were collected.

Biology. Moths were observed flying around *Eleocharis mutata* (L.) Roem. & Schult. (Cyperaceae) growing in small pools of brackish water, and leaves with mines and larvae were collected. Eight adults emerged and were pinned. All other specimens were collected from January to May, at light, from sea level to the highest elevations on the three islands where the species was found. According to Wiggins & Porter (1971) the host plant occurs on Isabela, San Cristóbal, and Santa Cruz. It is also widespread in tropical America, from the West Indies to Brazil. It grows in shallow pools of fresh water, but occasionally in saline habitats.

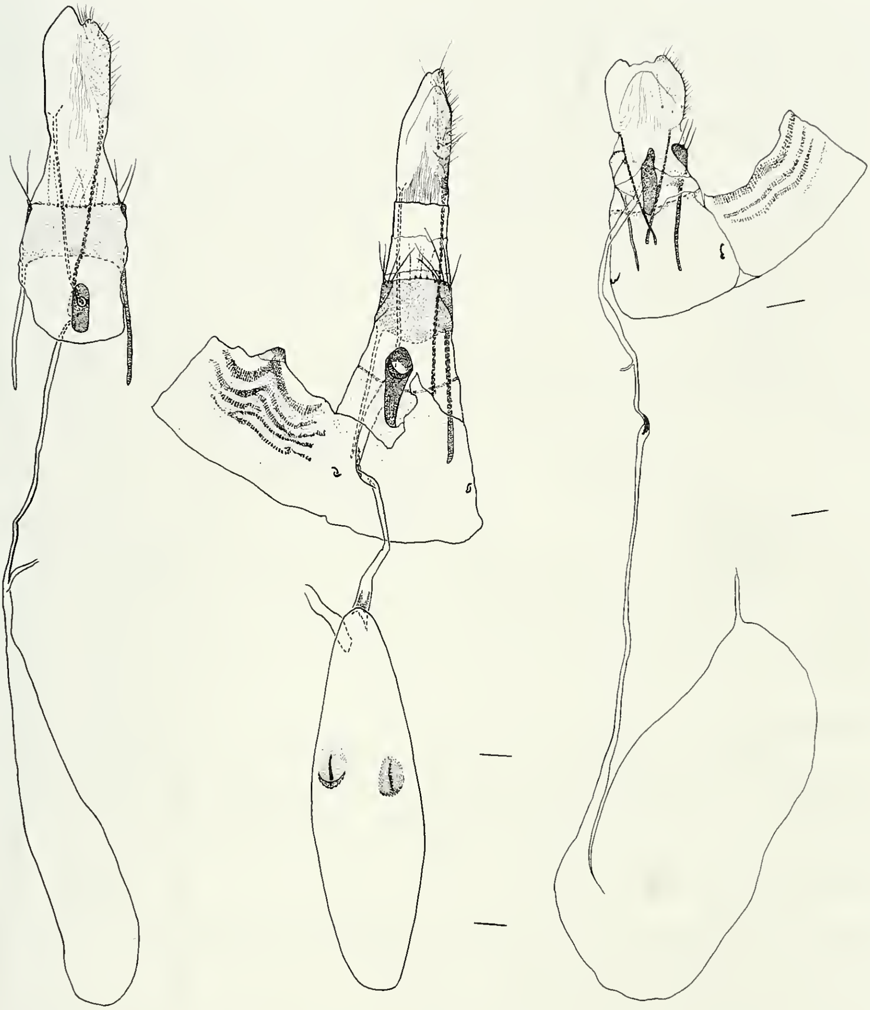
Distribution. Possibly endemic to the Galápagos where it was found on the islands of Isabela, San Cristóbal, and Santa Cruz.

Cosmopterix attenuatella (Walker) Figs 4, 15, 16, 28

Gelechia attenuatella Walker, 1864: 1019; Riedl, 1969: 727, figs 46, 202, 290, 372; Hodges, 1978: 26, pl. 2, figs 25, 26, text figs 5g, 19c; Becker, 1984: 43; Edwards & Nielsen, 1996: 102.
Cosmopteryx [sic] *flavofasciata* Wollaston, 1879: 438; Fletcher, 1933: 1-2; Common, 1990: 255, fig. 25.2.
Cosmopteryx [sic] *mimetis* Meyrick, 1897: 339; Fletcher, 1920: 102.
Cosmopteryx [sic] *apiculata* Meyrick, 1922: 568; Clarke, 1965: 486, pl. 239, figs 1-1b; Becker, 1984: 43. **New synonym.**
Cosmopteryx [sic] *antillia* Forbes, 1931: 356, pl. 42, fig. 6.
Cosmopteryx [sic] *superba* Gozmány, 1960: 419, fig. 4A.

Diagnosis. This species can be separated readily from its three Galápagos congeners by the united band formed by the shining spots at the base of the forewing fascia (fig. 4). On average, this is the smallest of the four Galápagos *Cosmopterix* species; the wingspan of the males (n=45) varies from 7.0 to 9.0 mm, and the wingspan of the females (n=24) is between 7.5 to 9.5 mm. The moths also appear generally darker than the other three species. The male genitalia (figs 15, 16) are characterized by the slender and apically pointed aedeagus. In the female genitalia (fig. 28), the ostium bursae is in a narrow sclerotized tube extended and enlarged anteroventrally, the corpus bursae is large and without signum, and the ductus bursae connects with the corpus bursae at its anterior end.

Biology. The larva is a miner in leaves of *Cyperus* species (Cyperaceae). The account of the biology of *C. flavofasciata* by Fletcher (1933), also mentioned by Hodges (1978), is a translation from Chrétien (1917), who was referring to *Cosmo-*



26 27 28

Figs 26-28

Female genitalia of *Cosmopterix* species (scales = 0.5 mm). 26. *C. madeleinae*; 27. *C. galapagosensis*; 28. *C. attenuatella*.

pterix crassicervicella Chrétien. *Cosmopterix crassicervicella* is listed as a synonym of *C. attenuatella* by Fletcher (1933), but not by Hodges (1978) or Edwards and Nielsen (1996). *Cosmopterix crassicervicella* is in fact a valid species, restricted to the Mediterranean region (J.C. Koster, pers. comm.). A short description of the biology and larva of *C. mimetis* (a true synonym of *C. attenuatella*) is provided by Fletcher (1920). Larvae were found on leaves of "motha grass" (*Cyperus rotundus* L.). They are 3 mm long and uniformly light yellow. They mine either in the middle or in the apical part of the leaf, the mine running along and on either side of the midrib. *Cyperus rotundus* is also called "corocillo," nut grass, and purple nutsedge. It is a cosmopolitan weed also found in the Galápagos island of San Cristóbal (Wiggins & Porter, 1971).

Cosmopterix attenuatella has not been reared in the Galápagos. Moths were collected at light from January to May and in October, from sea level to the highest elevations on several islands. Some specimens were swept from the vegetation in the day time.

Distribution. Pantropical. Fernandina, Isabela, Santa Cruz, San Cristóbal, Santiago.

Remarks. I have studied the lectotype of *C. apiculata* Meyrick (designated by Clarke, 1965) and found it to be identical to *C. attenuatella* Walker. Meyrick (1922) indicates a close relationship between *C. apiculata* and *C. pentachorda* Meyrick, but this is untenable when the genitalia are examined. The synonymy was confirmed by J.C. Koster (pers. comm.).

Pyroderces Herrich-Schäffer

This rather large genus containing some 80 known species is mostly distributed in the tropical, subtropical, and warm temperate parts of the Old World. Three species occur in the New World (Hodges, 1978; Becker, 1984).

Pyroderces rileyi (Walsingham) Figs 5, 17, 18, 32

Batrachedra rileyi Walsingham, 1882: 198; Howard, 1896: 348; Howard, 1897: 29; Dyar, 1902: 534; Walsingham, 1906: 179; Swezey 1909: 22, pl. 3, figs 9-11; Chittenden, 1916: 1-20, figs 1-7, pls 1-4.

Pyroderces rileyi; Durrant, 1912: 207, fig. 3; Berger, 1917: 71; Busck, 1917: 362-366, 370, figs 5-7, pls 7, 8, 10-12; Heinrich, 1921: 820-821, pls 102, 103, 105-107; Williams, 1931: 158, pl. 27, figs 9-11; Silvestri, 1943: 247-250, figs 307-309; Peterson, 1948: 136, pl. L13, figs Q-U; Hodges, 1978: 47, pl. 3, figs 29, 30, text figs 2d, 8h, 23h; Hinton, 1981: 235; Becker, 1984: 44; Common, 1990: 254; Pierce, 1995: 433; Edwards & Nielsen, 1996: 103.

Sathrobrota rileyi; Hodges, 1962: 74, figs 59, 117, 169; Riedl, 1969: 742, figs 55, 210, 297, 383.

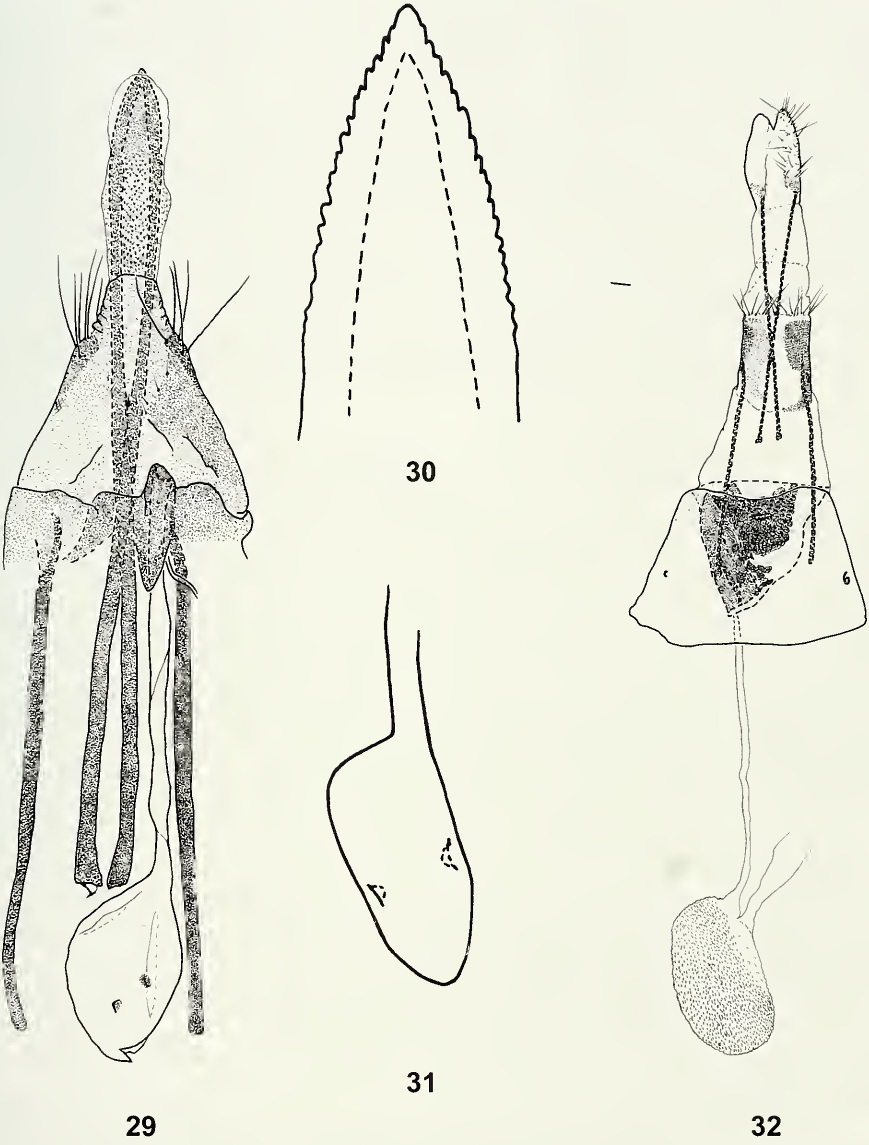
Anatrachyntis rileyi; Zimmerman, 1978: 1044, figs 64, 219, 733, 736, 739, 740, 742, 743, 744.

Batrachedra stigmatophora Walsingham, 1897: 104.

Pyroderces stigmatophora; Meyrick, 1914: 203

Anatrachyntis stigmatophora; Meyrick, 1915: 326.

Diagnosis. In the Galápagos Islands, this species may be considered roughly similar to the *Cosmopterix* species, but its wing pattern (fig. 5) and genitalia are very distinctive (figs 17, 18, 32).



Figs 29-32
Female genitalia of Cosmopterigidae species. 29-31. *Ithome volcanica*: 29. Whole genitalia; 30. Papillae anales; 31. Corpus bursae, natural shape. 32. *Pyroderces rileyi* (scale = 0.5 mm).

Biology. The caterpillar has been reported as a scavenger in dead plant material, but also as a leaf-miner and eating seeds or fruits on their surface or inside (Zimmerman, 1978), and as a predator of scale insects (Pierce, 1995). It has been reported to feed on dasheen (*Colocasia esculenta* (L.) Schott, Araceae), pineaple (*Ananas comosus* (L.) Merr., Bromeliaceae), flowers of castorbean (*Ricinus* species, Euphorbiaceae), flowers of bushmint (*Hyptis* species, Lamiaceae), cotton seed and rotten cotton bolls (*Gossypium* species, Malvaceae), milo maize grain (*Sorghum vulgare* Pers.), stems, husks, and tassels of corn (*Zea mays* L.) (Poaceae) (Hodges 1978). Zimmerman (1978) added: aloe (*Aloe* species, Aloaceae), many kinds of old leguminous pods and tamarind (*Lysiloma* species), and raintree (or saman, *Samanea saman* (Jacq.) Merr.) (Fabaceae), banana (*Musa paradisiaca* L., Musaceae), dead panic grass (*Panicum* torridum Guad., Poaceae), coffee beans and cherries (*Coffea* species, Rubiaceae), *Rochea* species (= *Crassula*, Crassulaceae), Hawaiian soap-tree (*Sapindus oahuensis* Hildebr. ex Radlk., Sapindaceae), eggplant (*Solanum melongena* L., Solanaceae), and others.

I have seen three specimens from the Galápagos. They were reared from stems of white mangrove (*Laguncularia racemosa* (L.) Gaertn. *f.*, Combretaceae) by C. Causton, in April 1999, and by T. Paulson, in July 2000. The twigs from which the moths were reared were infested with the cottony cushion scale (*Icerya purchasi* Maskell, Margarodidae). The caterpillars appeared to feed on eggs and larvae of the scales (L. Roque, pers. comm.). White mangrove is found on the shores of tropical America, in West Africa, and on several Galápagos Islands (Wiggins & Porter, 1971). Pierce (1995) mentioned that *Pyroderces rileyi* is an obligatory predator on scale insects (including *I. purchasi*). This false assertion is based on Berger (1917) who wrote that "the caterpillars are regularly found feeding on the cottony cushion scale" and on Hinton (1981) who mentioned that the caterpillar is "an occasional predator" of *Coccus* and *Pseudococcus*.

Busck (1917), Heinrich (1921), and Zimmerman (1978) have illustrated the larva and pupa.

Distribution. Widely dispersed in the warm and tropical regions of the World (Zimmerman, 1978). Undoubtedly introduced to the Galápagos where it is known only from the CDRS and Puerto Ayora, Santa Cruz.

Remarks. Common names for this species are the pink cornworm, the pink bud moth, and the pink scavenger caterpillar (Zimmerman, 1978).

Ithome Chambers

Ithome is distributed in the New World from Tennessee and North Carolina in the United States to Peru and the Amazon Basin of Brazil (Hodges, 1978). It contains 18 described species, including the following.

Ithome volcanica sp. n. Figs 6, 19-21, 29-31

Holotype ♂, Ecuador: Galápagos, Isabela, Tagus Cove, 13.v.1992, M[ercury] V[apor] L[amp] (B. Landry), (CNC type no. 22683).

Paratypes, Ecuador: 27 ♂, 37 ♀, from the Galápagos Islands, collected at MVL by B. Landry, except as indicated. *Española*: 3 ♂ (slide BL 1139), 8 ♀, Bahía Manzanillo, 25.iv.1992; 1 ♀, same locality, 29.iv.1992; 1 ♂, 1 ♀ (slide BL 1217), Las Tunas Trail, 100 m elev., 30.iv.1992; 2 ♀, Punta Suarez, 2.v.1992. *Floreana*: 3 ♀ (slide BL 1220), Punta Cormoran, 21.iv.1992; 1 ♂, Finca Las Palmas, Zona Arida, 300 m, 26.xii.1997, UVL-F[luorescent] L[ight] (L. Roque). *Isabela*: 6 ♂ (CNC slide MIC 4687), 2 ♀, Puerto Villamil, 2.iii.1989; 2 ♂, 1 km W Puerto Villamil, 3.iii.1989; 1 ♂, 2 ♀, 2 km W Puerto Villamil, 5.iii.1989; 1 ♂, 3 km N Santo Tómas, Agriculture Zone, 8.iii.1989; 1 ♂, 11 km N Puerto Villamil, 9.iii.1989; 1 ♂, 2 ♀, 8.5 km N Puerto Villamil, 11.iii.1989; 1 ♂ (slide BL 1219), 1 ♀, same data as holotype; 1 ♂, Volcan Darwin, 300 m elev., 15.v.1992. *Pinta*: 1 ♀ (slide BL 1275), Plaja Ibbetson, 13.iii.1992; 1 ♀, Arid Zone, 15.iii.1992. *San Cristóbal*: 2 ♀ (CNC slide MIC 4686), Puerto Baquerizo, 17.ii.1989. *Santa Cruz*: 1 ♂, 5 ♀, C[harles] D[arwin] R[esearch] S[tation], Arid Zone, 17.i.1989; 1 ♀, same locality, 19.i.1989; 2 ♂ (slide BL 1218), 1 ♀, same locality, 3.ii.1989; 1 ♀, same locality, 6.iii.1992, U[ltra] V[iolet] L[ight]; 1 ♂, same locality, 7.iii.1992, UVL; 1 ♀, 4 km N Puerto Ayora, 20.i.1989; 1 ♂, Tortuga Bay, 29.i.1989; 1 ♂, 1 ♀, Tortuga Reserve, W Santa Rosa, 6.ii.1989; 1 ♀, Finca S[teve] Devine, 17.iii.1989. *Seymour Norte*: 2 ♂ (slide BL 1276), 29.iii.1992. (CNC, ECCD, MHNG, BLC, BMNH, USNM).

Material excluded from type series. Nine specimens without abdomen that were collected at the same places and dates as some of the paratypes, except for two, collected on Marchena, on 23 March 1992.

Diagnosis. Other than *I. volcanica*, no narrow-winged gelechioids in the Galápagos are known to have shining black forewings with a thin pale yellow transverse bar (although sometimes incomplete) subapically. The two species of *Periploca* treated here and some species of Scythrididae may appear similar in color and size, but they are dark grey, lack subapical pale-yellow markings, and are usually a little bigger than *I. volcanica*. In addition, the males of *I. volcanica* can be recognized without dissecting by the presence of a bunch of long pale-yellow scales on each side of the abdomen apically.

Description. MALE (n=28) (figs 6, 19-21). Head shining, grey on face, dark brown dorsally. Haustellum pale grey. Labial palpus pale grey on dorsal edge, black elsewhere with a few white scales along ventral edge and apex of third segment. Antennal scape dark greyish brown except for off-white apical row of scales, with a one-scale pecten (although rarely two scales are present); flagellum basally dark greyish brown, changing to pale grey from middle. Thorax dark brown, almost black, with a slight shine. Legs medially off-white to pale yellow. Laterally, foreleg dark brown on coxa with white to yellowish-white spots at apex of femur, beyond middle and at apex of tibia, and at apex of tarsomeres I, II, and V. Midleg laterally dark brown except for pale-grey and beige coxa, and white to pale-yellow spots at apex of femur (made of 1-2 scales usually), beyond middle and at apex of tibia, and at apex of all tarsomeres. Hindleg laterally dark brown except for off-white coxa and tibial spines, and pale yellow to white at base of tibial spines, crest of elongate scales on dorsal edge of tibia, apex of tarsomeres I-IV, and all of tarsomere V. Wingspan: 7.0-8.0 mm. Forewing dark brown, almost black, with more or less conspicuous pale-yellow markings as a small spot on cubital fold medially, a smaller spot (sometimes absent) slightly more costal and posterior, and a subapical transverse line sometimes disconnected in middle; fringe pale greyish beige. Hindwing pale greyish brown; costal fringe greyish brown, with a few shorter and wider pale greyish-brown to beige scales subbasally, dorsal fringe pale yellowish to greyish brown. Abdomen beige with greyish brown in middle of some terga, to mostly greyish brown; base of genitalia laterally with bunch of pale-yellow scales projecting beyond genitalia. Margins of sternite VII heavily melanized (fig. 21); posterior margin concave in middle and laterally produced into wide but short lobes. Lateral membrane of segment VII with a pocket of elongate pale-yellow scales apically. Tergum VII not modified, broadly convex apically. Tergum VIII broadly convex; posterior margin slightly excavated medially; median sclerotized rod very thin, almost reaching middle of segment VII, with two thin and short (although variable in length) branches at anterior end. Sternum VIII asymetrical basally, with pair of long and narrow anteriorly directed sclerotized rods; right "segment" short, tapering to rounded apex, medially with short and broad projection terminated by short spine; left "segment" short, apically blunt, basally with long, narrow, glabrous, and apically rounded and slightly enlarged projection.

Male genitalia (n=5) (figs 19-21). Uncus of medium length, narrow, apically pointed. Arms of tegumen very narrow, slightly larger toward base. Subscaphium moderately melanized. Membrane on each side of subscaphium with 4-5 thin setae on each side. Membrane below subscaphium produced anteriorly into a triangular, apically rounded pocket with deciduous, pointed scale-like setae of medium length. Right valva a short rounded knob with few short setae apically. Left valva medium sized, elongate, directed upward, slightly curved, slightly hooked apically, with few short setae medially. Both valvae with short antero-basal projection, longer on left side, connected to short "vinculum." Juxta a short and narrow plate connecting vinculum and base of aedeagus ventrally. Aedeagus narrow, with submedian left curve followed by right curve, pointing slightly to right, basally blunt, dorsal margin forming sharp and narrow point apically; vesica without cornuti.

FEMALE (n=37). Wingspan: 8.0-9.0 mm. Antennal flagellomeres more slender than those of the male. Frenulum with three acanthae. Female genitalia (n=4) (figs 29-31). Papillae anales strongly melanized, dorsoventrally compressed, serrated on lateral margins, fused and pointed apically. Intersegmental membrane between papillae and segment VIII spinulate. Posterior apophyses straight, wide, extending beyond segment VI, slightly enlarged apically, bluntly terminated, perfectly circular in cross section. Segment VIII posterolaterally more strongly melanized, bearing few long setae; with a few short setae ventrally near middle. Anterior apophyses straight, narrower than posterior apophyses, extending to segment IV, terminated as posterior apophyses. Ostium bursae in middle of glabrous sterigma fused to posterior margin of sternite VII. Sterigma a rather wide but short plate with a short tube projecting posteriorly in middle, and with a cone-shaped and apically rounded flap of medium length projecting anteriorly in the middle. Ductus bursae parallel sided throughout length, extending to segment V. Ductus seminalis connecting on ductus bursae near ostium. Corpus bursae small, elongate, laterally compressed, with pair of short crest-shaped signa.

Etymology. The specific epithet refers to the geologic nature of the Galápagos Islands, and to the similarity in color of the moth's forewings with the color of several lava fields I have seen in the archipelago.

Biology. The host plant is unknown. Caterpillars of other species of *Ithome* are known to feed on flowers of Fabaceae and Polygonaceae. *Ithome concolorella* (Chambers) has been accidentally introduced into Hawaii where it has become a pest on *Acacia farnesiana* (L.) Willd. and *Prosopis chilensis* (Mol.) Stuntz (Hodges, 1978). Specimens of *I. volcanica* were collected at light from December to May, from the littoral to the agriculture zones, but especially at lower elevations.

Distribution. Apparently endemic: Española, Floreana, Isabela, Marchena, Pinta, San Cristóbal, Santa Cruz, Seymour Norte.

Remarks. I have based my description of the male's abdominal segment VIII and genitalia on Hodges' (1978) interpretations of these structures. However, the fusion and asymetry shown in this species, as well as the absence of a published comprehensive morphological study, make the identification of these structures difficult. Therefore, I am not certain that I have correctly interpreted the valvae, the elongate basal projection of sternum VIII's left "segment" (or sclerite of Hodges, 1978), the antero-basal projections of the "valvae," and the vinculum.

Periploca Braun

Previously recorded from Canada and the United States only and known to include 27 described species (Hodges, 1978), *Periploca* is reported for the first time from the Neotropical Region on the basis of the two new species described below.

Periploca longipenis sp. n. Figs 7, 22, 25

Holotype ♂, Ecuador: Galápagos, Isabela, Tagus Cove, 13.v.1992, M[ercury] V[apor] L[amp] (B. Landry), (CNC type no. 22684).

Paratypes, Ecuador: 3 ♂, 15 ♀ collected in the Galápagos at MVL (except otherwise indicated) by B. Landry. *Isabela*: 1 ♂ (CNC slide MIC 4676), 2 ♀, 1 km W Puerto Villamil, 3.iii.1989; 1 ♂, 2 ♀, 8.5 km N Puerto Villamil, 11.iii.1989; 3 ♀ (slide BL 1279), same data as holotype; 1 ♀, Volcan Darwin, 300 m elev., 15.v.1992; 2 ♀ (slide BL 1277), Volcan Darwin, 300 m elev., 20.v.1992. *Santa Cruz*: 1 ♂ (CNC slide MIC 4703), Tortuga Reserve, W Santa Rosa, 6.ii.1989; 3 ♀ (slide BL 1278), Estacion Cientifica Charles Darwin, 6.iii.1992, U[ltra] V[iolet] L[amp]; 1 ♀, Estacion Cientifica Charles Darwin, 7.iii.1992, UVL; 1 ♀, Bahía Conway, 14.iv.1992. (CNC, BLC, MHNG, BMNH, ECCD, USNM).

Diagnosis. In the Galápagos islands, this species is superficially similar to species of Scythrididae, *Ithome volcanica*, and *Periploca darwini*. The Scythrididae all have a pecten made of several scales whereas the pecten of the Galápagos *Periploca* species is made of a single basal scale. *Ithome volcanica* differs in forewing pattern from the *Periploca* species by the presence of a pale-yellow subterminal line. The males of the two *Periploca* species can be separated easily by features of the male genitalia, especially the very long aedeagus protruding off the tip of the abdomen in *P. longipenis*. There are also some subtle differences in wing pattern between the two species; for example, the forewing ground color appears more uniformly greyish brown in *P. longipenis* and it usually has numerous dark-brown spots of raised scales, whereas the forewing ground color in *P. darwini* has paler, almost white, areas and a darker brown base, and there are only two small dark-brown spots of unraised scales.

Description. Male (n= 4) (figs 7, 22). Head scales brown to greyish brown, beige tipped, slightly shining. Haustellum scales greyish brown, tipped off-white. Labial palpus dark greyish brown, almost black laterally, medially with scales greyish brown at base and white apically; third segment about as long as second. Ocellus present. Antennal scape mostly dark greyish brown, with scales only slightly beige tipped, except at apex, more prominently beige tipped; pecten's unique scale narrow, basally yellowish beige, dark greyish brown in middle, apically off-white to white and pointed, obtuse, or notched; flagellum greyish brown, darker and with beige-tipped scales on basal few (4-5) segments, with raised scales from about 1/3. Thorax mostly concolorous with head, but with dark greyish-brown spot apically on mesothorax, and greyish beige on metathorax. Leg scales greyish brown, slightly beige or off-white tipped. Foreleg tibia with beige rings at 1/3, 2/3, and apically; tarsomeres beige ringed apically; scales more conspicuously beige tipped on tarsomere I. Midleg tibia with beige rings in middle, subapically, and apically; tarsomeres beige ringed apically. Hindleg tibia beige ringed at base of median pair of spines and apically, with dorsal crest of elongate scales pale greyish brown to yellowish brown apically; tarsomeres apically beige tipped. Wingspan: 8.5-10.0 mm. Forewing ground color uniformly mouse grey, varying in shades, with dark-brown (almost black) spots of raised scales; most scales greyish brown, tipped off-white; with a slight bluish-grey tinge at base; with a few to about 50 evenly dispersed small spots of completely dark-brown scales, except at base; with a bigger dark-brown spot followed by white-tipped scales in cubital fold before middle; with another slightly smaller dark-brown spot preceded by white-tipped scales along mid-line at about 2/3 wing length; apex with most scales raised and more conspicuously tipped off-white; fringe pale greyish brown. Hindwing uniformly greyish brown; fringe pale greyish brown to pale yellowish brown. Abdomen without scent gland between segments II and III; segments dorsally greyish brown with paler greyish-beige apical margin; ventrally with a large median band of pale greyish-beige scales paler at tip; laterally with scales greyish brown tipped with white. Segment VIII dorsally very narrow, laterally with short lobes bearing a few elongate pale yellowish brown with pale yellow tip scales, ventrally produced and conical.

Male genitalia (n=2) (fig. 22). Tegumen very narrow for whole length, asymmetrical, the right side shorter, twisted to point to the left because of the protruding aedeagus. Vinculum narrow, fused with base of valvae. Manica (? juxta) an inverted "J." Valvae asymmetrical, with a medium-sized base and a narrow medial arm; left valva shorter, base with short lateral projection pointing apically, arm gently pointed; right valva's base without projection, arm apically rounded, slightly bent laterally. Aedeagus about twice length of valva, narrow, spiralled twice, gradually narrowing to a point, without spines; vesica without cornuti.

FEMALE (n=15). Wingspan: 8.5-10.0 mm. Antennal flagellomeres narrower than in males. Frenulum with three acanthae. Female genitalia (n=3) (fig. 25). Papillae anales dorsoventrally flattened, apically fused, strongly melanized, and blunt. Apophyses of equal length and of medium girth; posterior apophyses curved anteriorly; anterior apophyses straight, connected sub-basally by narrow band. Ostium bursae in medium-sized funnel at base of sternite VII medially, slightly melanized inside funnel. Intersegmental membrane VI-VII with large well melanized and V-shaped pocket holding a bunch of short specialized scales on each side. Posterior margin of sternum VI slightly concave medially. Ductus bursae shortly membranous, subsequently sclerotized in an almost complete spiral followed with membranous but scobinated section. Ductus seminalis connecting on ductus bursae on membranous base. Corpus bursae separated into basal unscobinated section and apical, narrower and shorter scobinated section, without signa.

Etymology. Derived from the Latin *longus* and *penis*, and referring to the very long aedeagus of the male.

Biology. The host plant and immature stages are unknown. Moths are attracted to light and were collected from sea level to 300 meters in elevation, from February until May. Many *Periploca* larvae are associated with junipers (*Juniperus*, Cupressaceae), one species makes stem galls on *Ceanothus* (Rhamnaceae), and another bores in the thorns of honey locust (*Gleditschia triacanthos* L., Fabaceae) (Hodges, 1978).

Distribution. Possibly endemic to the Galápagos, where it was collected on Isabela and Santa Cruz.

Remarks. In this species and the next I believe that the vinculum is a very narrow band and that segment VIII is variable in size and shape. This interpretation seems to contradict Hodges (1978) but it is supported by an examination of the sequence in which the structures are found and by the presence of scales and setae on segment VIII. Because of the two *Periploca* species' strong superficial similarity, there is a possibility that some of the females associated with the males of this species belong to the following species. However, because of the very strong differences in male genitalia between these two species and the known variation in the female genitalia in this genus (see Hodges, 1978), this possibility is very small.

Periploca darwini sp. n. Figs 8, 23, 24

Holotype ♂ (dissected, BL 1149), Ecuador: Galápagos, Isabela, V[olcan] Darwin, 1000 m elev., 18.v.1992, M[ercury] V[apor] L[amp] (B. Landry), (CNC type no. 22685).

Paratype. *Isabela*: 1 ♂ (BL slide 1282), Volcan Darwin, 630 m elev., 16.v.1992, MVL (B. Landry) (MHNG).

Diagnosis. The diagnosis provided for *P. longipenis* is useful also for *P. darwini*.

Description. MALE (n=2) (figs 8, 23, 24). Head scales greyish brown to dark brown tipped white or greyish white, wider scales along midline more evenly colored greyish brown with only a slightly paler tip and with a bronze shine. Haustellum scales pale greyish brown tipped greyish white. Labial palpus dark brown with scales slightly paler at base, with a few white scales at base of second segment; medially paler greyish brown, with white-tipped scales; third segment about as long as second. Ocellus present. Antennal scape mostly dark greyish brown with scales slightly paler tipped, apical scales more conspicuously white tipped; single scale of pecten narrow, mostly pale, off-white, pale greyish-brown near middle, notched or pointed apically; flagellum greyish brown, slightly darker brown on first 2-3 segments, with raised scales from before middle. Thorax mostly dark greyish brown with a bronze shine, dark scales only slightly paler apically, greyish white; metathorax pale greyish white. Legs laterally with dark-brown scales tipped paler off-white or greyish white, medially uniformly pale greyish white. Foreleg tibia with three off-white rings, subbasally, medially, and apically; tarsomeres apically ringed off-white. Midleg with scales conspicuously tipped white; tarsomeres apically ringed off-white. Hindleg tibia with ring of paler greyish brown white-tipped scales at base of median set of spines, dorsal crest of scales of medium length, pale greyish beige; tarsomeres apically ringed off-white. Wingspan: 8.5-9.5 mm. Forewing scales mostly greyish brown, with or without white apically, some scales completely dark brown and others white; with a bronze tinge on mostly greyish-brown base; mostly white from about 1/6 to 1/3 and on inner half at about 2/3; with raised scales on apical 1/3; with two small dark-brown spots, one in cubital fold submedially, the other in middle postmedially; also with small inconspicuous darker spots along inner margin on apical third and at apex; fringe pale greyish brown. Hindwing pale greyish brown with concolorous fringe. Abdomen without scent gland between segments II and III; segments dorsally pale greyish beige with slightly paler posterior margin; ventrally with scales greyish brown except for their white base and apex. Segment VIII very narrow dorsally and ventrally; enlarged laterally and bearing numerous pointed scales of medium length and pale yellowish white.

Male genitalia (n=2) (figs 23, 24). Intersegmental membrane before genitalia with rather wide and short bumps bearing numerous pointed scales of medium length. Tegumen and vinculum narrow, symmetrical, not produced. Manica (?juxta) protruding anteriorly and attached to base of aedeagus, about 1/3 length of valva. Valvae asymmetrical, each with a pair of elongate arms bearing short and stout setae apically, especially on medial arm; left valva divided at midlength in two arms of about same length and shape, and rather narrow and narrowly rounded apically, also with a short bump bearing a long seta ventrally near middle; right valva's medial arm in continuity with broad base and rather heavily melanized, base with a long seta ventrolaterally, lateral arm arising dorsolaterally from base, down-curved, narrow, slightly shorter and not as strongly melanized as medial arm. Aedeagus coming through manica above right valva, about as long as valva + juxta, slightly down-curved, dorsally with long slit arising almost from base, apically pointed, without spines; vesica with minute, slender cornuti.

FEMALE. Unknown.

Etymology. The specific epithet refers to the name of the type-locality, Volcan Darwin, which in turns refers to the name of the father of modern evolutionary thought, Charles Darwin, who visited the Galápagos in 1835. Darwin actually landed on four of the Galápagos Islands, including Isabela, at Tagus Cove, at the base of Volcan Darwin (Sulloway, 1984).

Biology. The host plant and immature stages are unknown. The only two specimens known were collected at light, in May, at elevations of 630 and 1000 m on Volcan Darwin, Isabela.

Distribution. Possibly endemic to the higher parts of Isabela, the largest of the Galápagos Islands.

Remarks. The two known specimens of *P. darwini* do not appear to be very fresh. Consequently, the diagnostic features of the forewing pattern and color may show differently when other specimens become available for study.

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A new triozid pest (Hemiptera, Psylloidea, Triozidae) on ornamental Trumpet Trees (*Tabebuia* spp., Bignoniaceae) in Brazil

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A new triozid pest (Hemiptera, Psylloidea, Triozidae) on ornamental Trumpet Trees (*Tabebuia* spp., Bignoniaceae) in Brazil. - *Trioza tabebuiae* Burckhardt & Santana, sp. n. is described and illustrated from Brazil, Paraná State. It differs from other Triozidae in the absence of sclerotised apical tibial spurs. It is associated with *Tabebuia* spp. (Bignoniaceae), a new-world genus with several ornamental trees. This is the first neotropical record of a psylloid host within this plant family. The sucking of the larvae produces a characteristic deformation on the *Tabebuia* leaves. Leaves attacked by *T. tabebuiae* remain longer on the tree than unaffected ones.

Key-words: Psylloidea - Bignoniaceae - taxonomy - biology- pest.

INTRODUCTION

Trumpet trees or tecoma belong to the genus *Tabebuia* (Bignoniaceae) which consists of some 100 species of tropical American trees and shrubs. Several of the tree species provide much valued timber, in fact possibly the most durable American wood. Some 400 year-old beams in Panama are still in excellent condition (Mabberley, 1987). In addition the genus includes several members with very attractive flowers in white, yellow, rose or violet colours. For their beautiful flowers they are frequently planted in urban environments such as parks, streets, avenues, squares or gardens. In Brazil several species of the genus are known as "yellow ipê". In Curitiba, PR, the most frequently planted ornamental is *Tabebuia alba* (Cham.) Sandw.

Tabebuia alba locally called "ipê-da-serra", "ipê-amarelo", "ipê-amarelo-da-serra", "ipê-mandioca", "ipê-branco", "ipê-tabaco" or "ipê-mamona" can grow up to 20-30 m in height, and possesses compound leaves, whose superior part is glabrous whereas its inferior part is densely silvery tomentous (fig. 17). It is a deciduous and heliophytic tree of the "Pinhais" forests and semideciduous forests of medium alti-

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tudes. It flowers profusely from July to September when leaves are completely absent. The fruits are ripe from October to November.

For cultivation the seeds are put in trays or pots for germination. With a rate of over 80%, germination of the seedlings generally occurs after 5-10 days (Lorenzi, 1992). Growing in urban environments where human vandalism is a frequent cause of destruction, the trees are planted after having reached a certain size. The cultivation is usually done in nurseries taking 2-3 years. The large number of plants which is together in the nurseries for long periods of time, creates ideal conditions for numerous pests.

In the last two years many *Tabebuia* plants showed at a first stage young leaves with wrinkled margins, and later shortened and completely coiled leaves. During a survey in September 1999 the cause of the damage could be attributed to the sucking of psylloid larvae. The species proved to be an undescribed member of the large and artificial genus *Trioza*. In March, June and September 2000, the same *Trioza* species was also found on other *Tabebuia* species which showed similarly damaged leaves.

The aim of the present paper is to describe and illustrate the new triozid and the damage on its host plants, to describe its biology and discuss some striking morphological and biological features.

MATERIAL AND METHODS

Psylloids were sampled at Colombo, PR on *Tabebuia alba*, and at the Forest Nursery, Curitiba City, PR on *Tabebuia alba*, *T. chrysotricha*, *T. heptaphylla* and *T. roseo-alba*. The former specimens were used for preparing the description, the latter for studying the population dynamics. In the nursery the plants, ranging from 0-3 years of age, were kept in plastic bags, separated by species. The plant material for the present study was taken between 24.ix.1999 and 24.xi.2000.

For each observation, 10 plants were randomly selected. A branchlet with 2 or 3 leaves showing the symptoms of psylloid attack was taken of each plant. These samples were conditioned in polypropylene bags, and stored in refrigerators at the entomology laboratory of Embrapa. Later they were examined under a dissecting microscope. The insects were counted and then conserved in 70% alcohol.

The morphological terminology follows Hollis (1984) and Ossiannilsson (1992). Type material is conserved in the Naturhistorisches Museum Basel, Switzerland (NHMB). For the drawings and measurements (1♂, 1♀, 2 larvae), specimens were cleared in KOH, dissected and mounted in Canada Balsam on microscopical slides.

TAXONOMIC TREATMENT

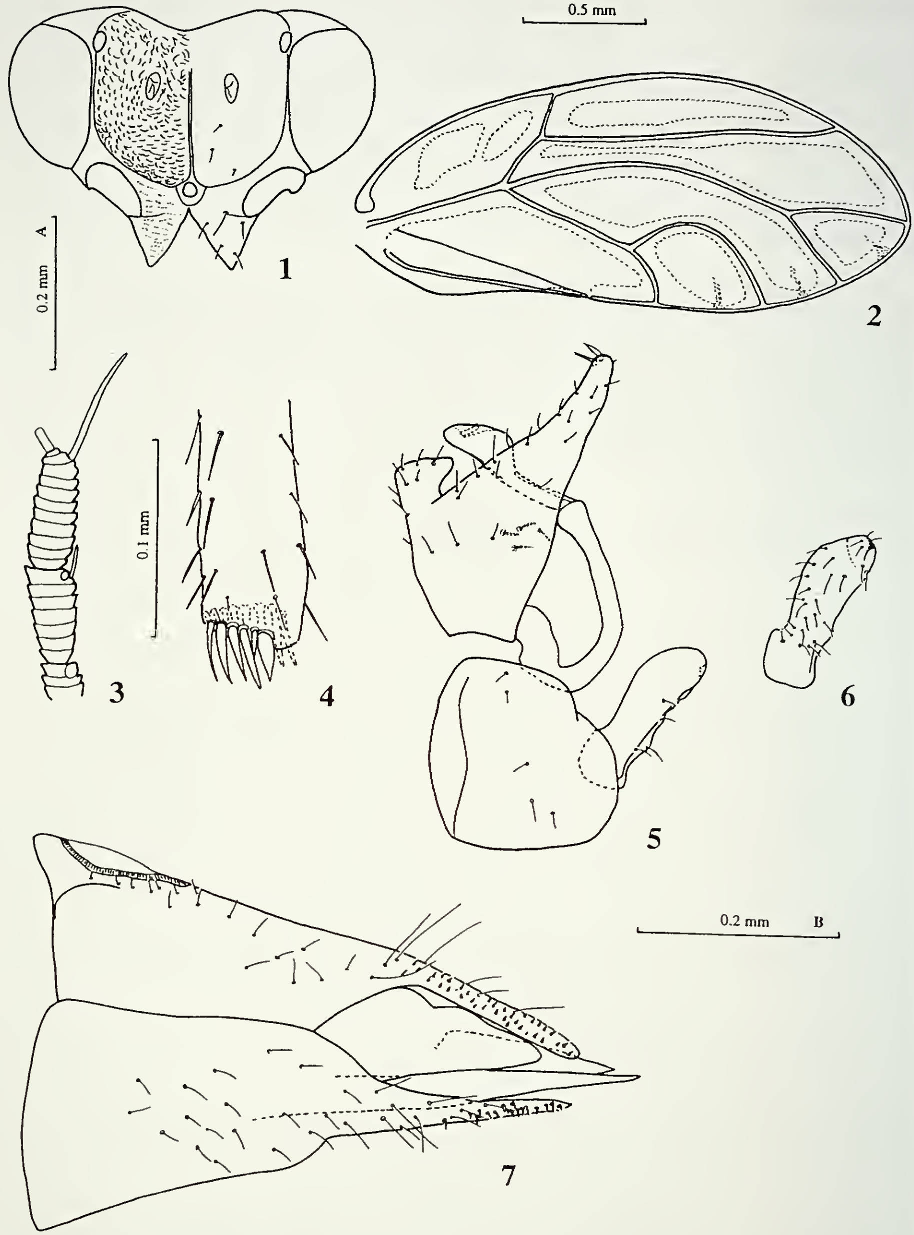
Trioza tabebuiae Burckhardt & Santana, sp. n. Figs 1-15

Holotype ♂, Brazil: Paraná State, Colombo, 25.x.1999 (D. L. Q. Santana), dry mounted (NHMB); 4♂, 10♀, 30 larvae (paratypes), same data as holotype, dry and slide mounted, and preserved in 75% alcohol (NHMB).

DESCRIPTION

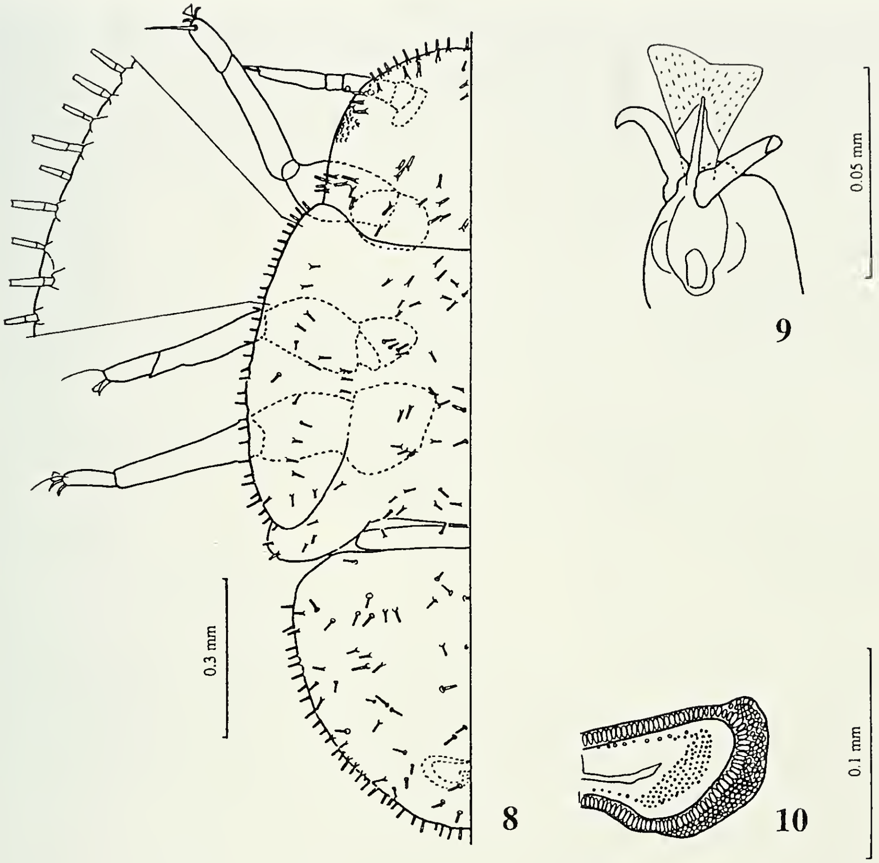
Adult (figs 11-12). Straw-coloured to ochreous. Antenna with apices of segments 4, 6 and 7 dark brown, segments 9 and 10 entirely dark brown. Genal processes yellowish. Mesoscutum with two anterior slightly darker spots; mesoscutum with two submedian longitudinal slightly darker stripes. Forewing with ochreous veins and weakly fumous subtransparent membrane. Hindwing greyish. Legs yellowish. Abdomen with light to dark brown tergites and slightly lighter ventrites. Genitalia yellow.

Head (fig. 1) slightly narrower than thorax, inclined from longitudinal body axis in an angle of 45°. Eyes hemispherical. Vertex subrectangular, weakly produced anteriorly; covered in more or less even microsculpture and a few setae anteriorly. Genal processes lying in a plane lower and more inclined than that of vertex, about half as long as vertex along mid-line, subacute; sparsely covered in a few moderately long setae. Antennae 10-segmented, 1.35-1.41 times as long as head width, bearing a subapical rhinarium on each of segments 4, 6, 8 and 9; segment 9 with a moderately long apical seta; segment 10 with two unequal terminal setae (fig. 3), one subacute, about as long as segment, and the other one truncate, about a quarter as long as segment. Clypeus elongate and slightly protruding, bearing two moderately long setae. Labium 0.52-0.55 times as long as head width. Thorax arched, pronotum medially with short posterior lobe. Forewing (fig. 2) oblong-oval, widest near the middle, 4.18-4.83 times as long as head width, 2.24-2.64 times as long as wide; fore margin strongly, hind margin weakly curved; vein Rs almost straight, long, branching of vein M proximal to Rs - Cu_{1a} line; m_1 cell value 1.31-1.67, cu_1 cell value 1.45-1.73; wing apex weakly angular. Surface spinules irregularly moderately densely spaced, present in all cells leaving broad spinule-free stripes along the veins. Hindwing slightly shorter than forewing, membranous; costal setae grouped. Metacoxa with well-developed meracanthus. Metatibia 1.09-1.12 times as long as head width, slender, swollen basally with several small spines, bearing an apical crown of 18 densely spaced, yellowish spurs (fig. 4); apical spurs not black nor strongly sclerotised. Metabasitarsus without black spurs. Abdominal tergites 3 in male and 4 in female with lateral setae. Genitalia as in figs 5-7. Male proctiger 0.36 times as long as head width, with long posterior lobes which bear a few sclerotised peg setae apically. Male subgenital plate subglobular bearing lateral setae. Paramere, in profile, lamellar, rounded apically, bearing an inward directed apical sclerotised tooth. Proximal segment of aedeagus U-shaped, slightly expanded apically; distal portion with a weakly expanded, rounded apex; sclerotised end tube of ductus ejaculatorius short, weakly curved. Female genitalia cuneate; proctiger 1.09 times as long as head width, 4.16 times as long as circumanal ring, 1.00 times as long as subgenital plate; sparsely covered in setae in basal half, and in peg setae in apical half which forms a narrow projection. Subgenital plate narrowed in apical third, basally with long setae, apically with peg setae. Valvulae 1 and 2 straight lacking teeth; valvulae 1 cuneate; valvulae 3 membranous narrowly rounded apically.



FIGS 1-7

Trioza tabebuiae sp. n. 1: head, dorsal view; 2: forewing; 3: antennal segments 9 and 10; 4: apex of metatibia; 5: male genitalia in profile; 6: paramere, inner face; 7: female genitalia, in profile. Scales lines: fig. 1 (scale A) = 0.2 mm, fig. 2 = 0.5 mm. figs 3-4 = 0.1 mm, figs 5-7 (scale B) = 0.2 mm.



FIGS 8-10

Trioza tabebuiae sp. n., fifth instar larva. 8: dorsal view and detail of forewing pad; 9: apex of tarsus with arolium and claws; 10: circumanal ring. Scales lines: fig. 8 = 0.3 mm, fig. 9 = 0.05 mm, fig. 10 and detail of forewing pad of fig. 8 = 0.1 mm.

Measurements in mm (1♂, 1♀). Head width 0.48-0.50, antennal length 0.68, forewing length 2.01-2.42, male proctiger length 0.17, paramere length 0.15, length of distal segment of aedeagus 0.15, female proctiger length 0.55.

Fifth instar larva (figs 8, 14). Body colour whitish-yellowish with dark dots (fig. 14). Body out-line oval, 1.74-1.86 times as long as wide, flattened dorsally. Body sparsely covered in narrow sectasetae dorsally and marginally. Antenna 5 or 6-segmented, flagellar segmentation indistinct; bearing 4 rhinaria and 2 terminal setae. Forwing pad narrow, with very small humeral lobe, 2.07-2.15 times as long as antenna. Tarsus with claws and narrowly fan-shaped short arolium (fig. 9). Caudal plate 0.81-0.96 times as long as wide, narrowly rounded apically. Caudal plate 4.17-4.50 times as wide as outer circumanal ring, the latter consisting of a single row of pores anteriorly and posteriorly, and several rows laterally (fig. 10).

Measurements in mm (3 specimens). Body length 1.42-1.46; forewing pad length 0.61-0.65; caudal plate breadth 0.26-0.28.

Forth instar larva (fig. 13). Differs from fifth instar in the smaller body dimensions the fused tibia and tarsus, and the reduced dark pattern.

Egg (fig. 15). Base wide, strongly narrowing to apex which ends in a long filament.

HOST PLANT, DAMAGE AND PHENOLOGY

T. tabebuiae was observed from September 1999 to March 2000 and September to October 2000. Larvae were found during the whole observation period except for August 2000 (tab. 1), when plants mostly lacked leaves or had leaves burnt by frost.

TABLE 1

Average number of larvae collected on *Tabebuia* plants in the forest nursery of Curitiba, PR.

Species	24.ix.1999	22.iii.2000	28.vi.2000	29.viii.2000	23.ix.2000	23.x.2000	24.xi.2000
T. alba	18.3	13.1	12.0	0	0.1	2.1	21.9
T. chrysotricha	–	16.0	0	0	0.3	0	2.3
T. heptaphylla	–	–	4.2	0	0	0	0
T. roseo-alba	–	0	0	0	0	0	0

The sucking of larvae induces in fresh young leaves the upwards curving of the margins producing open marginal rolls. These become closed in mature leaves forming a tubular structure. The growth of the nerves of the affected leaves seems to be less than that of the internerval tissue, resulting in a wrinkled aspect (figs 17-18). In heavy infestations all the leaves of the plant are distorted (figs 16, 19). When larger leaves are infested, the damage consists only of the marginal roll.

Among the examined *Tabebuia* spp., *T. alba* showed in average the highest *T. tabebuiae* density (tab. 1) and consequently the largest damage. In second place comes *T. chrysotricha* (fig. 18) and third *T. heptaphylla* (fig. 20). In both species the leaf damage is similar to that of *T. alba*. *T. roseo-alba*, sampled in the same area, did not host *T. tabebuiae* and, consequently did not show damaged leaves.

The leaves of *Tabebuia* plants drop in winter (May to August). In plants infested by *T. tabebuiae*, however, a great part of the attacked leaves remained on the plants. This suggests that feeding of *T. tabebuiae* inhibits leaf drop (fig. 21). Even after strong and repeated frosts, some leaves, burnt and dry, remained on the plants. No living triozids were found on leaves which were dry by the frost. Some larvae where found alive on the remaining green parts of the leaf.

DISCUSSION

Trioza tabebuiae is separated from other *Trioza* spp. by the absence of sclerotised spurs on the metatibia. The presence and number of sclerotised apical metatibial spurs is normally very constant in Triozidae. There are no other characters suggesting a close relationship to any of the currently known tropical American species.

FIGS 11-14

Trioza tabebuiae sp. n. 11: adult, dorsal view; 12: adult, lateral view; 13: fourth instar larva; 14: fifth instar larva.

FIGS 15-18

15: *Trioza tabebuiae* sp. n., egg; 16: *Tabebuia alba* plant completely damaged by *T. tabebuiae*; 17-18: leaf damaged by *T. tabebuiae* and undamaged leaf; 17: *T. alba*; 18: *T. chrysotricha*. (Photos 16-18 by Francisco A. Santana).

FIGS 19-21

Leaf damage by *T. tabebuiae* sp. n. 19: *Tabebuia alba*; 20: *T. heptaphylla*. (Photos by Francisco A. Santana). 21: View of nursery after occurrence of frosts. Note remaining dry leaves on attacked plant.

Another unusual feature of the species is its association with the family Bignoniaceae. Apart from the North American *Craspedolepta pulchella* (Crawford) which was questionnably reported from *Chilopsis* (Hodkinson, 1988), this is the first psylloid host record from this family in the new world.

ACKNOWLEDGMENTS

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Nouvelles données sur *Stenasellus strinatii* (Crustacea, Isopoda, Asellota, Stenasellidae), stygobie de Sumatra (Indonésie)

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New data on *Stenasellus strinatii* (Crustacea, Isopoda, Asellota, Stenasellidae), stygobiont from Sumatra (Indonesia). - A detailed redescription of the previously poorly described species *Stenasellus strinatii* Magniez, 1991 from karstic waters of Sumatra is given in consequence of the discovery of this species in a second cave on the island and of other new species in the same region.

Key-words: Aselloidea - Asellota - Isopoda - karstic aquifers on Sumatra Island - Stenasellidae - stygobiont.

INTRODUCTION

L'espèce *Stenasellus strinatii* Magniez, provenant des collections d'eau d'une grotte de la région centrale de Sumatra, avait été très sommairement définie en quelques lignes et le seul pléopode II mâle figuré (Magniez, 1991, fig. 4F). Il est vrai que cet appendice présentait des traits particuliers permettant de reconnaître l'espèce parmi tous les taxons connus à cette époque. La découverte d'une seconde station cavernicole de *S. strinatii* dans cette grande île, et surtout la mise en évidence de 3 espèces nouvelles de *Stenasellus* dans des aquifères karstiques de la même région (Magniez, sous presse), rendent indispensable une description complète de *S. strinatii*, afin de préciser ses affinités et de permettre des comparaisons.

Stenasellus strinatii Magniez, 1991 Figs 1-17

Origine et matériel. Station-type: Sumatera Barat, Ngalau Baso (ngalau = grotte), située à environ 76 km au Nord de Padang (grotte citée par Wolff, 1934-1937 p. 521), 13/03/1988 (n°3), P. Strinati & C. Hug leg.: 3 ♂ de 6,6 (♂ M1 étudié), 6,0 (holotype) et 5,1 mm; 1 ♀ adulte à oostégites de repos génital de 6,2 mm (allotype); 2 ♀ à marsupium vide de 5,7 et 6,0 mm (♀ F1 étudiée); 1 ♀ subadulte sans oostégites de 4,7 mm.

Seconde station (SUM-498): Sumatera Barat, Bukittinggi, Ngalau Kamang (environ 8 km au NW de la précédente), 16/07/1992, L. Deharveng & A. Bedos leg.: 1 ♂ adulte de 5,8 mm (♂ M2 étudié).

Le lot de Ngalau Baso, avec holotype et allotype appartient au Muséum d'histoire naturelle de Genève; l'échantillon de Ngalau Kamang sera déposé au Muséum de Bogor (Java, Indonésie). L'espèce a été dédiée au Dr Pierre Strinati, collaborateur du Muséum d'histoire naturelle de Genève et prospecteur infatigable.

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DÉFINITION. *Stenasellus* de taille réduite (6 mm). Pléopodes I du mâle très allongés; second article de l'endopodite des pléopodes II aciculaire et démesurément allongé (2 fois plus long que le premier), avec un éperon sternal aux 2/3 de sa longueur; orifice spermatique efférent terminal, petit et inerme. Exopodite des pléopodes IV légèrement bifide distalement; endopodites des pléopodes III, IV et V totalement bilobés.

REDESCRIPTION DE L'ESPÈCE. Corps allongé, forme très typique du genre, chétotaxie réduite (Fig. 1). Les lots capturés comportant des femelles à marsupium, la taille de 6 mm peut être considérée comme correspondant aux dimensions courantes de l'espèce dans ses populations naturelles. Céphalon à marge rostrale très régulièrement concave; marges génales et postérieure convexes. Otolithe des organes de Bellonci sphéroïdal, pigmenté et bien visible par transparence. Péréion à bords très parallèles avec les marges latérales des coxopodites légèrement visibles en vue dorsale. Pléon: pléonites I et II libres présentant le grand développement en longueur et en largeur caractéristique des Sténasellides (Fig. 1); pléotelson allongé, très régulièrement ovalaire, avec pointe caudale à peine marquée.

Appendices céphaliques et maxillipèdes: antennules courtes: hampe de 4 articles, fouet avec 6-7 articles; les deux premiers sans lame olfactive, les suivants avec 2 L.O. jumelées de 90 µm environ, insérées sur la marge distale-interne; article distal avec une seule L.O., une longue soie sensorielle lisse et plusieurs soies plus courtes. Antennes avec hampe de 6 articles dont le 3ème porte l'exopodite rudimentaire ou squama conique, armée de 2 épines inégales (Fig. 10). Fouet très court, ne dépassant pas 30 articles sur les plus grands spécimens. Mandibules: processus inciseur à 4 fortes dents sclérifiées brunes. À gauche, lacinia mobilis à 4 dents bien indurées (Fig. 11); lobe mandibulaire avec 7 lames dentelées (à droite, la distale est bifide et plus grande, Figs 11 et 12): lobe molaire hyalin avec une dizaine de tiges lisses de longueurs différentes. Paragnathes ovalaires garnis de fines sétules. Maxillules: lobe externe avec marge distale portant une douzaine de lames dentelées et 2 soies plumeuses plus petites: lobe interne plus petit, avec 3 grosses épines denticulées et 2 plus petites presque lisses (Fig. 13). Maxilles trilobées: lobes externe et médian avec chacun 5 lames falciformes monopectinées identiques, de longueur décroissante de l'extérieur vers l'intérieur: lobe interne avec une douzaine de tiges polymorphes, plus ou moins plumeuses et insérées sur deux rangs (Fig. 14). Maxillipèdes typiques: partie coxopodiale portant un petit endite charnu chez la femelle adulte, qui développe un vaste oostégite hyalin lors de la mue parturielle (Fig. 15); endite de la partie basipodiale avec 2 crochets rétinaculaires et 6 tiges plumeuses distales. Palpe à 5 articles portant respectivement 0-0-0-2-3 soies lisses sur leur marge externe et 1-7-10-8-7 sur leur marge interne.

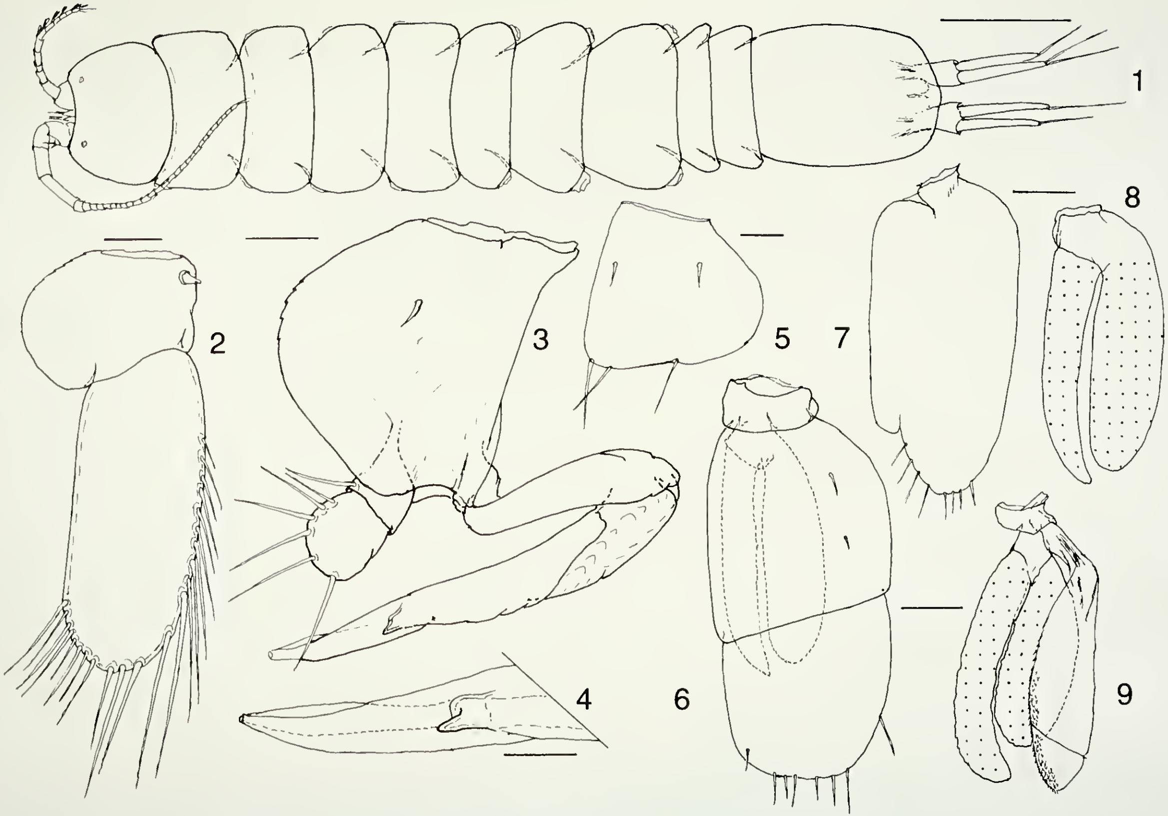
Péréiopodes très robustes, relativement courts, mais de longueur croissante de l'antérieur vers le postérieur. Péréiopodes I (gnathopodes) très indurés, courts (Fig. 16), tournés vers l'avant, portés sous les maxillipèdes et non ambulatoires, mais préhensiles comme chez tous les Sténasellides. Marge palmaire des méropodite et carpopodite portant quelques épines lisses très volumineuses. Propodite fortement renflé et très musculeux; sa marge palmaire avec 2 énormes épines lisses suivies de 5-

6 épines monopectinées en "brosse à dents" de taille décroissante vers l'apex. Dactylopodite avec 4-5 lames ensiformes mucronées inclinées et de taille croissant de la basale à l'apicale (Fig. 17). Ongle très volumineux, s'engageant entre les 2 épines propodiales basales, ce qui verrouille la subchéla lorsqu'elle se referme. Caractère préhensile et aptitude au fouissage de ces appendices très accusés.

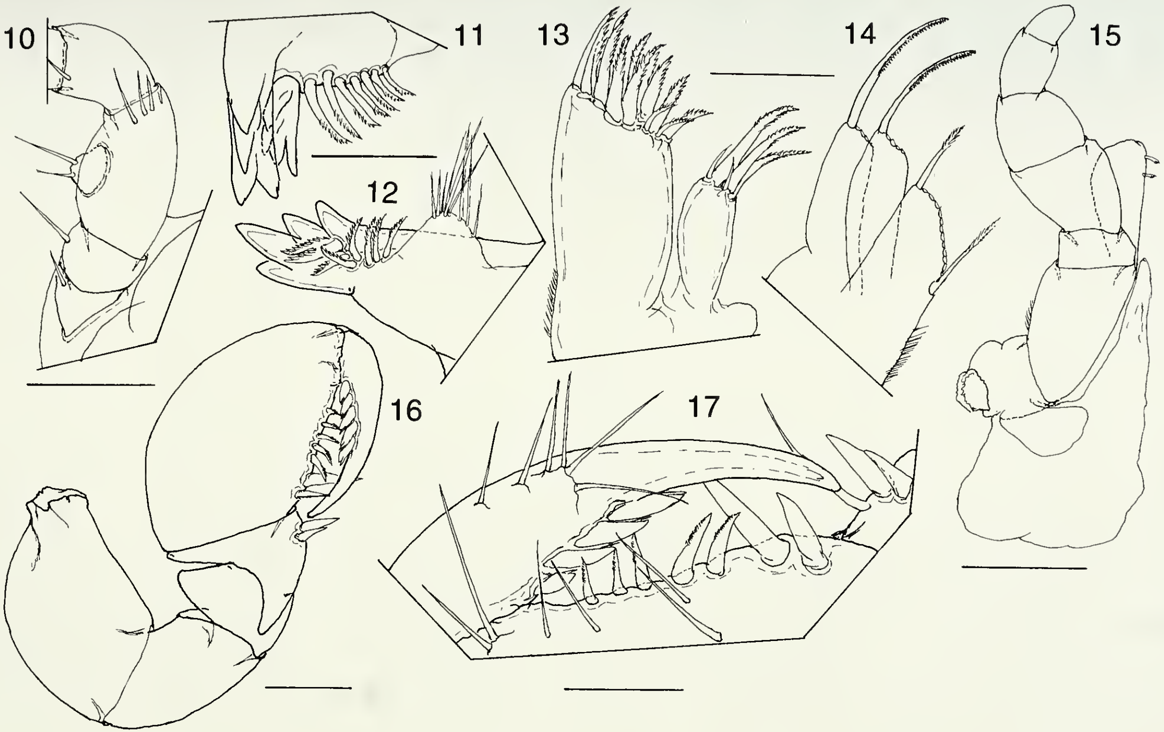
Péréiopodes II à VII: péréiopodes II-IV avec carpopodite un peu renflé, une herse de fortes épines lisses dressées sur la marge palmaire des méropodites et carpopodites, celle du propodite portant très peu d'éléments; ensembles méropodite + carpopodite / propodite + dactylopodite légèrement subchéliformes; ces appendices, essentiellement ambulatoires ayant probablement un rôle secondaire de préhension ou contention. Par contre, les épines carpopodiales des appendices V-VII sont inclinées distalement et ces pattes sont manifestement purement ambulatoires. Une soie lisse, une soie sensorielle "en palmier" et une soie bipectinée à l'angle distal-externe des carpopodites II-IV. Cette dernière, observée en premier par Lanza (1966), sur le *Stenasellus pardii* de Somalie est donc un caractère très constant des Stenasellidae. Dactylopodites II à VII avec un ongle courbe long et acéré, plus une unique épine lisse subunguéale sternale oblique (un seul spécimen avec unilatéralement un dactylopodite V à 2 épines). Une longue papille génitale cylindroïde à l'angle interne du coxopodite de chaque péréiopode VII des mâles.

Pléopodes I à VI: pléopodes I mâles à protopodite plus large que long, avec un crochet rétinaculaire très basal; exopodite très allongé (ceci sans doute en relation avec l'allongement exceptionnel de l'organe copulateur pour lequel le pléopode I constitue un opercule protecteur), avec marges interne et distale portant plus de 20 soies (Fig. 2). Pléopodes II mâles: protopodite sensiblement aussi long que large; marge externe très convexe, avec quelques denticules marginaux; marge interne concave, abritant l'article I de l'endopodite en position de repos (Fig. 3). Exopodite biarticulé très court, avec article I muni d'une soie externe; article II arrondi avec 6 soies marginales distales et externes. Endopodite biarticulé, géniculé au repos, mais très protractile en activité, articulations protopodite-article I et article I-article II à très grand débattement; article proximal ou manubrium un peu dilaté distalement, normalement allongé comme chez la plupart des *Stenasellus*; article distal aciculaire et extrêmement long (≥ 2 fois le proximal). Un vaste infundibulum proximal prolongé par un conduit interne ouvert par un petit orifice spermatique efférent distal; face sternale avec un éperon sclérifié (Fig. 4) et toute la partie de l'organe copulateur située au delà de cette formation anhiste, uniquement cuticulaire. Cette configuration très originale sépare *S. strinatii* de tous les autres *Stenasellus* connus, aussi bien ceux d'Extrême-Orient que ceux d'Afrique orientale et de la péninsule arabique et ceux d'Europe méridionale (cf. Magniez & Stock, 1999, 2000). Pléopodes II femelles très courts, mais très larges, libres, avec marge interne rectiligne; chétotaxie très réduite (1 soie exopodiale et 2 soies distales) (Fig. 5).

Pléopodes III: exopodites (opercules) au moins 2 fois plus longs que larges, avec suture interarticulaire légèrement oblique et quelques fines soies marginales-distales (Fig. 6). Pléopodes IV: exopodite ovalaire hyalin, 2 fois plus long que large (Fig. 7), avec marge distale nettement bilobée: un grand lobe externe portant moins de



FIGS 1-9: *Stenasellus strinatii.* 1. Habitus du ♂ M1, face dorsale; antennule (A1) gauche et antenne (A2) droite omises; seules quelques soies uropodiales ont été représentées. 2. Pléopode I droit, face sternale du même. 3. Pléopode II droit, face sternale, du même. 4. Extrémité de l'article II de l'endopodite du précédent. 5. Pléopode II gauche, face sternale, de la ♀ F1. 6. Pléopode III gauche de F1, face sternale. 7. Exopodite du pléopode IV gauche de F1, face sternale. 8. Endopodite du précédent, face sternale. 9. Pléopode V gauche de F1, face sternale. Les aires respiratoires sont ponctuées en Figs 8 et 9. Échelles: 1 mm (1), 200µm (6, 7, 8, 9), 100µm (2, 3, 5), 50µm (4).



FIGS 10-17: *Stenasellus strinatii.* 10. Hampe de l'antenne droite de F1, face sternale. 11. Portion distale de la mandibule gauche de F1. 12. Portion distale de la mandibule droite de F1, les tiges du lobe mandibulaire sont déviées par la pression de la lamelle. 13. Une maxillule de F1. 14. Une maxille de F1, une seule lame de chaque série a été représentée. 15. Maxillipède droit, face sternale, de la ♀ à marsupium F1. 16. Un des péréiopodes I (gnathopode) de M1, seule l'armature palmaire a été représentée. 17. Marges palmaires des propodite et dactylopodite du précédent. Échelles: 200µm (10, 15, 16), 100 µm (11, 12, 13, 14, 17).

10 fines soies et un petit lobe interne glabre situé en retrait (aspect original, cet exopodite étant entier chez tous les Stenasellidae précédemment décrits). Pléopodes V: exopodite hyalin, relativement étroit: un pétiole musculeux et une rame en massue, avec article distal petit et suture oblique. Aires d'écailles épicuticulaires recouvrant des zones glandulaires d'aspect classique (Fig. 9). Endopodites des pléopodes III, IV et V similaires, très grands et totalement bilobés (bilobation présente chez la majorité des espèces d'Extrême-Orient, mais aussi chez certaines d'Afrique orientale et de la péninsule arabique): lobe externe oblong relativement large, lobe interne, plus étroit et plus long avec extrémité courbée vers le précédent (Figs 6, 8 et 9). Uropodes grêles, longueur ≈ 2/3 du pléotelson, biramés (endopodite un peu plus long que l'exopodite, Fig. 1); les deux rames prolongées par de longues soies sensorielles à direction caudale.

Affinités. *S. strinatii* est parfaitement distinct de la première espèce de *Stenasellus* décrite de Sumatra: *S. covillae* Magniez, 1987 des eaux karstiques de l'extrême Ouest de l'île (Lhok'nga), comme le montre l'architecture respective des pléopodes sexuels des deux espèces (Magniez, 1991, figs 4E et F). D'ailleurs, les localités-types des deux formes sont éloignées de plus de 650 km. Une troisième espèce de Sumatra (Magniez, sous presse), dont l'aire est pourtant géographiquement très proche de celle de *S. strinatii*, est morphologiquement beaucoup plus étroitement apparentée à *S. covillae* qu'à ce dernier. Cependant, il est évident que toutes les espèces (12) répertoriées ou capturées à ce jour en Extrême-Orient continental et insulaire: Cambodge + Thaïlande et îles de Bornéo, Phuket, Sumatra, appartiennent au même rameau évolutif des Stenasellidae, correspondant au genre euro-afro-asiatique *Stenasellus* des auteurs.

Remarques biologiques et écologiques. Les spécimens ont été capturés à vue, étant sur le fond de collections d'eau karstique des cavités prospectées, mais leur aspect montre que ce sont des fouisseurs, aptes à vivre et à se déplacer dans des galeries creusées dans l'argile. Leur appareil respiratoire (endopodites III, IV et V = branchies de très grande surface, exopodites IV et V très grands et assurant la ventilation des précédents) donne à penser qu'ils sont capables de subsister dans des eaux pauvres en O_2 dissous.

Dans les captures de Ngalau Baso se trouvaient 2 femelles adultes à marsupium vide, c'est-à-dire en fin d'intermue de reproduction, après libération de leurs pulli. La naissance des jeunes est donc intervenue au cours des mois précédant la capture (janvier et février). Si le développement intramarsupial est aussi lent que celui de *Stenasellus virei* (9-10 mois), les femelles ne peuvent se reproduire chaque année.

CONCLUSIONS

En Extrême-Orient, les Stenasellidae ont été découverts d'abord dans les eaux souterraines continentales (Cambodge, cf. Boutin, 1971), puis en milieu insulaire (Bornéo, Phuket, cf. Magniez, 1997). Les aquifères karstiques de la vaste île de Sumatra semblent particulièrement riches, puisque outre les deux espèces connues: *S. covillae* et *S. strinatii*, trois autres espèces du centre de l'île viennent d'être étudiées (Magniez, sous presse). Par ailleurs, il serait étonnant que le genre soit absent de Java et que l'immense Bornéo n'abrite qu'une seule espèce (prospections insuffisantes?).

REMERCIEMENTS

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The Batrisini of Sri Lanka (Coleoptera: Staphylinidae: Pselaphinae)

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The Batrisini of Sri Lanka (Coleoptera: Staphylinidae: Pselaphinae). – The Sri Lankan Batrisini are revised and their distribution pattern is discussed. Twelve genera and 62 species are recognized, described and illustrated. The following taxa are new: *Batrisoplatus incisivus* sp. n., *B. occipitalis* sp. n., *Batoxylomorpha femoralis* gen. n., sp. n., *Batrisiotes mussardi* sp. n., *B. puncticeps* sp. n., *B. pyriformis* sp. n., *Tribasodema factiosum* sp. n., *T. tribulosum* sp. n., *Veddabatrus asper* gen. n., sp. n., *V. sexualis* sp. n., *Coryphomobatrus frater* gen. n., sp. n., *Coryphomus adventus* sp. n., *Nesiotomina appendiculata* sp. n., *N. bellax* sp. n., *N. carinifrons* sp.n., *N. difficilis* sp. n., *N. femoralis* sp. n., *N. foveifrons* sp. n., *N. perbrincki* sp. n., *N. tibialis* sp. n., *N. transjugata* sp. n., *Batrisomalus cautus* sp. n., *B. currax* sp. n., *B. foveolatus* sp. n., *B. obtectus* sp. n., *B. pubis* sp. n., *B. tuberculatus* sp. n., *Batribolbus abas* sp. n., *B. aemulus* sp. n., *B. carinatus* sp. n., *B. furcipes* sp. n., *B. gracilipes* sp. n., *B. hystrix* sp. n., *B. incurvus* sp .n., *B. mussardi* sp. n., *B. onustus* sp. n., *B. pertubator* sp. n., *B. punctatus* sp. n., *B. trebax* sp. n., *Batrisiella aulica* sp. n., *B. dryas* sp. n., *B. favea* sp. n., *B. illicebrosa* sp. n., *B. retusa* sp. n., *B. srilankana* sp. n., and *Baceysus pretiosus* gen. n., sp. n. *Cratnodes* Jeannel is placed in the synonymy of *Batrisomalus* Raffray; *Coryphomodes temporalis* Jeannel is transferred to *Veddabatrus*. Keys are provided for genera and species.

Key-words: Coleoptera-Staphylinidae-Pselaphinae-systematics-Sri Lanka.

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INTRODUCTION

Sri Lanka is an island of almost 65.600 square kilometres with a complex relief. The great diversity on the island was probably generated by the complex physical conditions and rainfall patterns. The island had an important position in the trade routes and in the economy of the British Empire. It was visited by numerous entomologists and its insect fauna was treated in the monographic series "Fauna of British India". As the country benefits from a good road and accommodation infrastructure, its major ecosystems and habitats types were readily accessible. The early entomological fieldwork was comparatively facile, in the noteworthy absence of administrative restrictions, which today form a worldwide net preventing potential research and increase of knowledge of the local biodiversity but not degradation of endangered habitats. In spite of the favorable conditions encountered by earlier entomologists, the beetles of Sri Lanka remained inadequately known. The first samples of forest floor litter in Sri Lanka made by the senior author in January 1970 contained many unknown taxa of Scydmaenidae, Euaesthetinae, Scaphisomatini, Cyathigerini, Tenebrionidae and Alticinae, some of them common and characteristic elements of the local fauna (e.g., members of *Euconnus* Thomson, *Baeocera* Erichson, *Edaphus* Motschulsky, and *Clavicornaltica* Scherer).

Since the 1960, large collections of beetles from Sri Lanka became available for study. Most of them are from the 1962 expedition of the Lund University, the 1970 expedition of the Muséum d'histoire naturelle in Geneva, and the long-term Smithsonian Ceylonese Insect Project. A large number of beetle taxa from the first two expeditions were already treated, primarily in the Supplementa of Entomologica Scandinavica, in the Revue suisse de Zoologie and in the Mitteilungen der Schweizerischen Entomologischen Gesellschaft, but comparatively little was published on staphylinids.

Hammond (1975) discussed the historical aspects of research on Ceylonese staphylinids and revised the Oxytelini of Ceylon. He saw records of 387 species, not including the Pselaphinae and Scaphidiinae, which were at that time separated from staphylinids and classified as distinct families, and estimated the total number of species of Staphylinidae occurring in Sri Lanka to be likely less than 700. Subsequently, significant additions to the knowledge of the Staphylinidae of Sri Lanka were provided only by Comellini (1977) and Puthz (1976, 1978) for the Euaesthetinae, and Puthz (1990) for the Megalopiinae. The Scaphidiinae were studied by Löbl (1971), who recognised 44 species among 867 specimens examined. As for the

Pselaphinae, Jeannel (1961) gave the last and most complete account of the group. He reported 49 species from Sri Lanka, including several not seen by him, among some 120 specimens. Bythinoplectini is the only pselaphine group of Sri Lanka studied after Jeannel's work (Coulon, 1989). Consequently, the Pselaphinae, that are with about 8.600 described species a major group, appear just slightly more species-rich in Sri Lanka than the Scaphidiinae with some 1400 species known world-wide.

About one third (16 species, 56 specimens) of the species reported from Sri Lanka by Jeannel (1961) are Batrisini, the subject of the present study. A collection of almost one thousand specimens of pselaphines from Sri Lanka put together in 1964 and 1965 by the late Robert Mussard (Geneva) and donated to the Geneva Museum, includes many Batrisini obviously unknown to Jeannel. The senior author began to study this material in 1969 but for various reasons completed the work only recently, in collaboration with the junior author.

MATERIAL AND METHODS

For the present study we have examined 2851 specimens of Batrisini from Sri Lanka. They belong to 62 species in 12 genera. Since the previous descriptions are inadequate, we give new descriptions and illustrations for all taxa encountered in Sri Lanka. In addition to the material from the Muséum d'histoire naturelle, Geneva (MHNG), type material and collections from the following institutions were examined:

MNHN:	Muséum National d'Histoire Naturelle, Paris
MZLU:	Museum of Zoology, Lund University, Lund
MRAC:	Musée royal de l'Afrique centrale, Tervuren
NHML:	The Natural History Museum, London
NMCC:	The National Museum, Colombo
NMNH:	National Museum of Natural History, Washington
ZMUM:	Zoological Museum of Moscow State University, Moscow
ZSMC:	Zoologische Staatssammlungen, München

Material deposited in the private collection of the junior author is indicated by the acronym PCSK. The junior author examined also specimens deposited in the private collection of P. Hlaváč, Ružomberok (PCPH).

The length and width of body parts are measured at their longest and widest distances. The head length is measured from clypeal margin to anterior margin of neck. The abdominal segments are counted from the first exposed segment on wards, i.e., from the third morphological tergite and sternite, respectively. The state of the metathoracic wings was not checked consistently and is only referred to when the wings are found reduced. Illustrations of the palpi, antennae, legs and aedeagi were made from specimens dissected and mounted in Canada balsam on acetat slides. The foveal pattern was examined in dissected specimens of one to four species of each genus, except for *Baceysus* gen. n. and *Batoxylomorpha* gen. n., of which only one specimen is available. All taxa examined have similar patterns of prosternal foveae and most have similar mesosternal foveae: the lateral prosternal foveae are distant; the median mesosternal foveae are not fused; the lateral mesosternal foveae are biforked and have the anterior forks smaller than the posterior forks. The pattern of mesosternal foveae is mentioned only if different from above.

Designation of lectotypes in old syntypes series was not considered necessary for the purpose of stability of names. The label data of old type material are reproduced unmodified, whereas those of other material are given modified as follows: Ceylon, the official name of the country until 1972, is replaced by Sri Lanka, the province name is given with the first respective locality and not repeated for other localities from the same province, and the initials of the first name of the collector are consistently added if lacking on labels. Information on habitats for material from the Geneva expedition is given according to an unpublished list of localities.

The provinces of Sri Lanka are shown in Fig. 1. For basic information on geology, climate and habitats of Sri Lanka see Brinck *et al.*, 1971.

The material coming from the 1962 expedition of the Lund University (participants: P. Brinck, H. Andersson and L. Cederholm) is indicated by the acronym "ExpL", that from the 1970 and 1972 expeditions of the Geneva Muséum d'histoire naturelle (participants: R. Mussard, C. Besuchet and I. Löbl) by the acronym "ExpG".

RESULTS AND DISCUSSION

Distribution patterns, areas of endemism and diversity

Sri Lanka is a continental island which was linked to India several times in the past, the last connection existed at the end of the Pleistocene. The 50 km separating the island are interspaced with shoals knows as the Adams Bridge. Considering the past connections, Sri Lanka and India are expected to possess similar faunas (Darlington, 1957). Nevertheless Jeannel (1961) considered the pselaphines of Sri Lanka "essentially Malaysian, well different from those of India". The major problem in treating this kind of questions is the inadequate knowledge of the tropical pselaphines, those of India in particular. As far as the Sri Lankan Batrisini are concerned, all of the 62 species listed appear to be endemic, and five of the twelve genera are only known from Sri Lanka. Only four genera, *Nesiotomina* Jeannel, *Batrisomalus* Raffray, *Veddabatrus* gen. n. and *Batrisiella* Raffray, are known from both countries, Sri Lanka and India. Surprising is the obvious absence of *Mnia* Newton & Chandler, *Cratna* Raffray and *Sathytes* Westwood. These three genera are species-rich and widely distributed in Southeast Asia. *Mnia* occurs in various forest habitats and is common in the forest floor litter in southern India (Löbl, pers. obs.). *Batrisiella* Raffray is the only widely distributed Oriental Batrisini genus with members in Sri Lanka, and *Batrisoplatus* Raffray and *Baceysus* gen. n. are the only groups indicating close Sri Lankan - Malaysian relationships. Like the Pauropoda (Scheller, 1970), Batrisini show distinct connections to the Afrotropical fauna. *Coryphomus* Jeannel and *Batrisiotes* Jeannel were known so far only from tropical Africa. The former genus is represented in Sri Lanka by a single species, the latter by three species. Hence, the present data indicate complex and poorly understood origin of the Sri Lankan Batrisini.

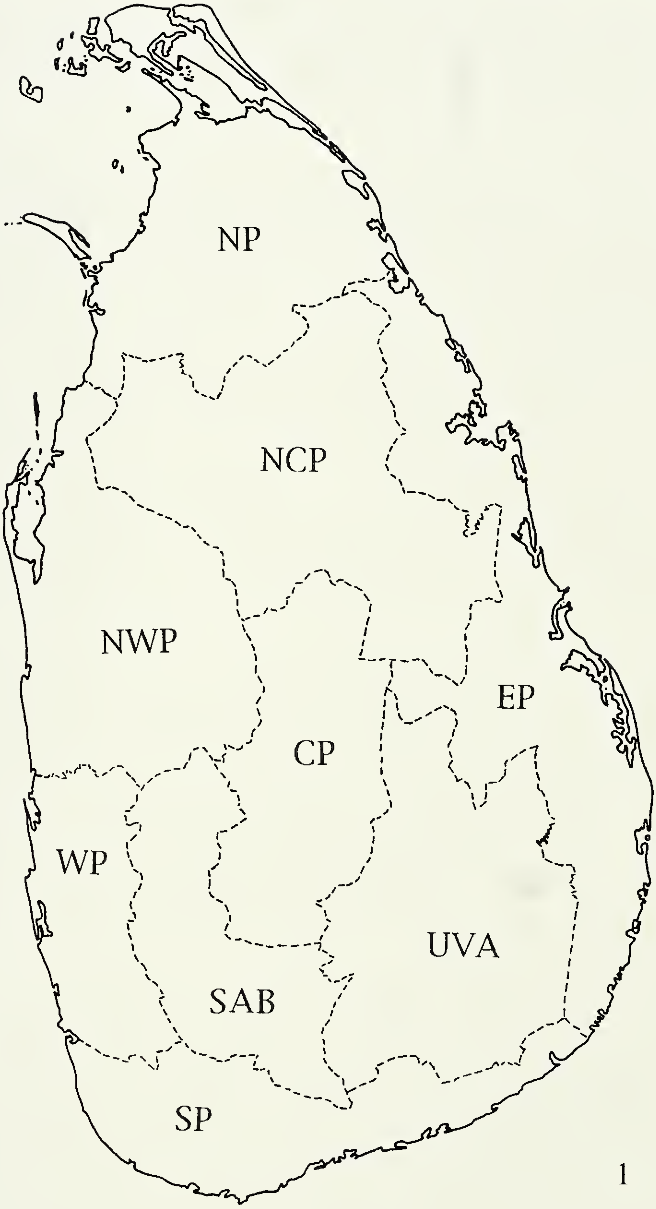


FIG. 1

Sri Lanka, with Provinces. NP = Northern Province; NCP = North Central Province; NWP = North Western Province; EP = Eastern Province; CP = Central Province; UVA = Province of Uva; WP = Western Province; SAB = Province of Sabaragamuwa; SP = Southern Province.

The Central Highlands of Sri Lanka are well known for their large number of narrow endemic Staphylinoidea (see, Hammond, 1975; Puthz, 1971; Szymczakowski, 1972). Most of these species occur above 1500m in the montane wet forest ecosystem, less in the sub-montane wet evergreen forests from 900 to 1500m. Among the Batrisini, some species of *Batrisomalus* Raffray and most of *Nesiotomina* Jeannel probably belong to this category. Eleven species appear to be exclusive to the montane zone (*Tribasodema armatum* (Raffray), *Nesiotomina transjugata* sp. n., *Batrisiella caviventris* (Raffray) and most of the members of *Batrisomalus* Raffray). Ten species are known only from the sub-montane zone (*Batoxylomorpha femoralis* gen. n., sp. n., *Coryphomobatrus frater* gen. n., sp. n., most species of *Nesiotomina*, *Batrisiella remyi* Jeannel and *B. retusa* sp. n.). Only one, *Batribolbus dentipes* (Raffray), was found in the sub-montane and montane zones. Nine species appear to be exclusive to the lowland wet evergreen forest ecosystem (*Veddabatrus asper* gen. n., sp. n., *Nesiotomina femoralis* sp. n., several species of *Batribolbus* and *Batrisiella lewisi* Jeannel). Only two species are exclusively from the dry Chloroxylon and Manilkara zones (*Batrisiella saucia* (Raffray) and *Veddabatrus sexualis* gen. n., sp.n.). *Coryphomus adventus* sp. n. is the sole Batrisini from rotten coconut trunks near sea shore. Most species that occur in the dry zones were also found in the intermediate and in the wet lowland zones, or are known from the wet and the sub-montane zones. *Batrisiella puberula* Jeannel is found in dry and wet lowland zones, and in the submontane zone.

Pselaphinae are found usually in the same or in similar habitats as Scydmaenidae. Members of both groups are mostly hygrophilous predators of micro-arthropods, with their highest diversity in the subtropics and tropics. The Pselaphinae are generally significantly more species-rich than the Scydmaenidae. A noteworthy exception from this rule appears to be found in Sri Lanka, from where 201 species of Scydmaenidae were described (Besuchet, 1971; Franz, 1971, 1982), to which a number of unstudied species of Cephenniini may be eventually added. As an explication for the diversity of the Sri Lankan scydmaenids Franz (1982) suggested a high mutation rate induced by natural radioactivity. As far as we know, his opinion was not corroborated by later studies.

With the present study the number of Batrisini species known from Sri Lanka raises almost four times. Nevertheless it is difficult to extrapolate the present data and estimate the real diversity of the group. The fact that 13 of 62 species are represented by a single specimen, and that two of them are from old collections, indicate insufficient field work. The main sources of the new material are sifting of moist tree and shrub litter on the forest floor, collecting by means of an aspirator on sandy stream banks, and light traps. Window traps and flight intercept traps have not been used in Sri Lanka to collect pselaphines and beating/sweeping of the vegetation was apparently carried out sporadically. Obviously little attention was paid to sample the edaphic fauna and arthropods associated with moos growing on stems in montane habitats. Hence, significantly higher number of species of Batrisini may be expected to occur in Sri Lanka. A likely realistic estimation of the number of Sri Lankan pselaphines would be between 200 and 250 species. Worldwide the Pselaphinae represent about 20% of all Staphylinidae (Newton, 1990). It appears that Hammond (1975) under-estimated the number of species inhabiting Sri Lanka, or that some of the major and poorly studied groups, such as Paederinae and Aleocharinae, are depauperized there.

SYSTEMATICS

The former Batrisinae were downgraded to supertribe rank (Batrisitae) as a consequence of the reduction of the pselaphids to the level of a subfamily of staphylinids (Newton & Thayer, 1995). This action preserved the internal organisation of the group. The Batrisitae were until present subdivided in to three tribes. The Amauropini, with 12 genera, are distributed in the Mediterranean and eastern Nearctic region. The Batrisini are diverse and almost world-wide (not in New Zealand). The Metopiasini including six Neotropical genera were transferred to Euplectitae (Chandler, 2001). The Amauropini are certainly ill-based. The characters used to define the Amauropini (Jeannel, 1948; 1950) are either restricted to some of its members and may vary within a single species (the presence of spines instead eyes), or are adaptations to subterranean habitats as the depigmented cuticle and the reduction of eyes in many but not all members, or are divers homoplasies that may be found in a variety of other Batrisini. Among Jeannel's characters of the Amauropini, the abdominal ones may be highly variable within closely related species (see Leleup, 1970) and are found in a large number of other distinctive Batrisitae. Besuchet (1986) stated that *Protamaurops* Müller is intermediate between "*Amaurops* s.l." and "*Batrisodes* s.l." and doubted the validity of Amauropini. Later, Besuchet (1999) synonymized implicitly, but not explicitly, these two tribal names in placing *Paramaurops* Jeannel in the Batrisini.

Four subtribes were established within the Batrisini: the Ambicocerina with four Afrotropical genera, the cosmopolitan Batrisina (including the former Trabisina) with 199 genera [Newton & Chandler (1989), to which at least *Batrisopsis* Raffray and *Trisinus* Raffray from the Batrisini genera incertae sedis should be added (Löbl, pers. observation)], the Leupeliina with a single Afrotropical species, and the Stilipalpina with four Afrotropical genera. Leleup (1976, 1981) discussed the characters of the Afrotropical subtribes and demonstrated the weakness of their taxonomic status. As the Amauropini, obviously also the Ambicocerina, Leupeliina and Stilipalpina are ill-based. In the absence of an adequate revision of the huge and morphologically (and ecologicaly) very diverse Batrisini, we refrain from placing the other tribal and subtribal names in synonymy. As the Metopiasini are excluded (and not known from the Old World), the taxa of Batrisitae are treated in the present paper as Batrisini, without considering the subtribes.

Jeannel (e.g., 1959; 1960a; 1961) subdivided the Batrisina in to five groups. He based his classification primarily on the position of the eyes, the presence or absence of a pair of lateral pronotal sulci and the presence of either two or three basal foveae on each elytron. Only the members of one of these groups, the "division V", appear to be linked by a synapomorphy. They possess a highly derived aedeagus with a strongly sclerotized, articulated, dorsal lobe. Among the Batrisini of Sri Lanka, *Batrisiella* Raffray may be placed in Jeannel's "division V", which was referred to as the *Batrisocenus* complex by Nomura (1991). *Batrisoplatus* Raffray is certainly not closely related to members of the *Batrisocenus* complex but the aedeagi in the former genus are similar to those of the latter group. Similarly, *Baceysus* gen. n. has a strongly reduced, plate-like aedeagus, resembling the aedeagi of *Batrisodes* Reitter, *Sathytes* Westwood, or *Mnia* Newton & Chandler, but strongly differs in external characters from these genera. Obviously, the aedeagal characters may indicate relationships in some species groups as they may be homoplasious in other groups. As for the other characters of Jeannel's divisions, it is difficult to define from which size onwards the eyes or tempora are large, and hazardous to place species with an aberrant number of pronotal sulci (varying from zero to seven) or elytral foveae (varying from zero to four) in any division. The number of two or three foveae at the elytral basis is usually a reliable group characters, but may not work a priori as such (see *Batrisomalus* Raffray, *Syrbatus* Reitter). Hence, as for the subdivision of the Batrisini in to subtribes, we can neither use the Jeannel's subdivisions of the Batrisina.

The a priori high weighing of the state of the lateral carinae of the first abdominal tergite led to a paraphyletic grouping of the Batrisini genera (see Raffray, 1904; 1908; Jeannel, 1959) and the high weighing of the form and location of the male secondary characters led to multiplication of poorly defined genera (e.g., Jeannel, 1952; 1957; 1958). In fact, the secondary sexual characters may be expressed on any part of the exoskeleton of Batrisini. Males of a large number of species possess a deep excavation bearing more or less complex structures such as small notches, tubercles, carinae, sulci and patches of modified setae. Such structures are usually located on the abdominal tergites or on the head, rarely on the prothorax or elytra. *Cratna* Raffray, which monophyly is strongly supported (Löbl, 1986; Nomura, 1991), may demonstrate their unreliability as group characters in Batrisini. Males of most species of *Cratna* (13 described, about 20 additional ones in the collections of MHNG and PCSK) possess a complex abdominal excavation. *Cratna abdominalis* Löbl, however, has the first tergite only slightly impressed, lacking any particular features, and *C. torticornis* Raffray has sexually modified antennae and unmodified abdomen. Males of two of the undescribed species of *Cratna* have modified frons, but unmodified abdominal tergites and antennae. Most species of *Batrisiella* from Sri Lanka have quite similar male abdominal characters as *Cratna*, except for *Batrisiella puberula* Jeannel which possesses unmodified abdominal tergites but strongly modified metatibiae. In analogy, males of *Batribolbus* have the metasternum usually strongly modified, but in *B. furcipes* sp. n. the "metasternal" structure is translocated on to the first abdominal sternite. The male secondary sexual characters are, along with the aedeagal characters, most useful for the distinction of species. They may indicate relationships but we prefer not to base on them the definitions of taxa of higher rank than species. It is out of the scope of the present study to analyse the relationships within the Batrisini. Such work would require to study members of almost all described genera, because their potentially important characters (e. g., the presence of frontal foveae, the shape of the metasternal intercoxal processes, the pattern of the abdominal foveae, the presence of sulci and carinae on abdominal sternites) were usually not quoted by authors prior to Nomura (1991).

Key to the genera of Batrisini of Sri Lanka

1	Head and pronotum lacking sulci, pronotum evenly convex	2
-	Head and pronotum with sulci	3
2	Pronotum without tubercles or denticles. Elytra each with four basal foveae. Elytra and abdomen bearing trichomes. Antennal segments 2 to 8 much wider than long. Eyes large, occupying most of lateral head surface	*Baceysus* gen. n.
-	Pronotum with two antebasal tubercles. Elytra each with three basal foveae. Elytra and abdomen lacking trichomes. Antennal segments 2 to 8 elongate. Eyes small, occupying centre of lateral head surface	*Batoxylomorpha* gen. n.
3	Elytra with sutural striae widened posteriorly. Pronotum lacking antebasal sulcus, discal tubercles and denticles. Elytra each with two basal foveae	*Batrisiotes* Jeannel
-	Elytra with sutural striae throughout very narrow	4
4	Pronotum without antebasal sulcus, with denticulate lateral margin. Head gradually, strongly narrowed anteriorly. Elytra each with three basal foveae. Body comparatively flat, pronotum, elytra and abdomen in about same plane	*Batrisoplatus* Raffray
-	Pronotum with antebasal sulcus, with or without marginal denticles. Head not or slightly narrowed anteriorly. Elytra each with two or three basal foveae. Body usually convex, elytra raised above plane of pronotum and abdomen	5
5	Vertex lacking semicircular sulcus or oblique sulci, vertexal foveae isolated. Pronotum lacking denticles, thorns or tubercles. Elytra each with two basal foveae	*Batrisiella* Raffray
-	Vertex with semicircular or oblique sulci joined to foveae	6
6	Vertexal sulci not joined on frontoclypeus. Pronotum lacking carinae, thorns, tubercles or denticles, with three longitudinal, discal sulci. Elytra with two basal foveae. Antennal foveae distinct	*Batribolbus* Raffray
-	Pronotum with carinae and/or thorns, tubercles or denticles. Elytra each with two or three basal foveae	7
7	Pronotum with five dorsal and four lateral longitudinal sulci, and two pairs of antebasal thorns, discal carinae absent. Elytra each with three basal foveae	*Nesiotomina* Jeannel
-	Pronotum usually with three discal longitudinal sulci, and with two, or lacking lateral longitudinal sulci. If two additional sulci present on pronotal disc, pronotum with one pair of antebasal and one pair of discal thorns	8
8	Pronotum and elytra flattened. Pronotum with two longitudinal discal carinae, lacking denticles and thorns. Vertexal sulci converging anteriorly or obsolete. Elytra with two or three basal foveae	*Batrisomalus* Raffray
-	Pronotum not flattened, without longitudinal discal carinae, or with such carinae and with denticles or thorns. Vertex with semicircular sulcus. Elytra with three basal foveae	9

9 Pronotum with one pair of marginal denticles, lacking discal carinae, denticles and thorns .... *Coryphomus* Jeannel
\- Pronotum lacking marginal denticles, with discal thorns and/or denticles ... 10
10 Pronotum with pair of antebasal and pair of discal thorns, and short sulci between antebasal and discal thorns, lacking discal carinae .... *Tribasodema* Jeannel
\- Pronotum with discal carinae bearing thorns or denticles, lacking sulci anterior to antebasal thorns 11
11 Abdominal tergite 1 longer than tergite 4, tergite 4 short, not expanded. Elytra with subhumeral foveae .... *Veddabatrus* gen. n.
\- Abdominal tergite 1 shorter than tergite 4, tergite 4 long, strongly expanded. Elytra lacking subhumeral foveae .... *Coryphomobatrus* gen. n.

Batrisoplatus Raffray Fig. 2

Batrisoplatus Raffray, 1894b: 226; type species *Batrisoplatus rugulosus* Raffray, 1894.

Description. Habitus as Fig. 2. Length 1.6-2.0 mm. Body with dorsal side fairly flat. Vertex, pronotum, elytra and abdomen almost in same plan. Punctation dense. Pubescence short, recumbent or semi-erect on dorsal side of body, without particular, long macrosetae. Pubescence on ventral side of body and on legs very short, recumbent.

Head trapezoid, wider than long, narrower than pronotum. Vertex flattened or convex. Frontal lobe in plan with vertex or inclined, not impressed, with anterior margin angular. Antennal fossae close, frontoclypeus very narrow, overlapped by anterior part of frontal lobe and not visible in dorsal view. Antennal tubercles and lateral frontal foveae absent. Vertexal foveae in impressions. Semicircular sulcus with arms short, strongly converging anteriorly. Anterior, transverse section of sulcus delimited by carina extending anteriolaterally to reach lateral head margins above antennal insertions. Ocular-mandibular carinae touching and arcuate along eye margins. Occipital part of vertex abruptly truncate, with posterior wall perpendicular or strongly overhanging, overlapping anterior part of neck. Eyes large, notched posteriorly, multifaceted, facets large. Eye centres about at or posterior to head midlength. Tempora short. Ventral side of head very short, swollen transversally, strongly inclined toward neck. Gular foveae close, in common impression.

Antennae short. Scape cylindrical, with apical angles blunt, lacking modified setae or glandular orifices. Antennal segments 2 to 11 symmetrical. Pedicel as long as wide, much shorter and narrower than scape. Segments 3 to 10 wider than long, about as broad as but shorter than pedicel. Club formed by apical three segments. Maxillary palpi short, segment 3 subcylindrical, wider than long, segment 4 with broad base.

Pronotum short, wider than long, widest posterior middle, with broadly rounded anterior angles; strongly and abruptly emarginate between basis and widest points, with small marginal denticle at widest point. Disc weakly convex to flattened, with deep median sulcus; ridges, basomedian carina and lateral sulci lacking. One pair of basolateral foveae and one pair of lateral foveae present. Lateral humps not or hardly distinguishable. Prohypomeron smooth, paranotal ridge entire, sinuate in lateral view.

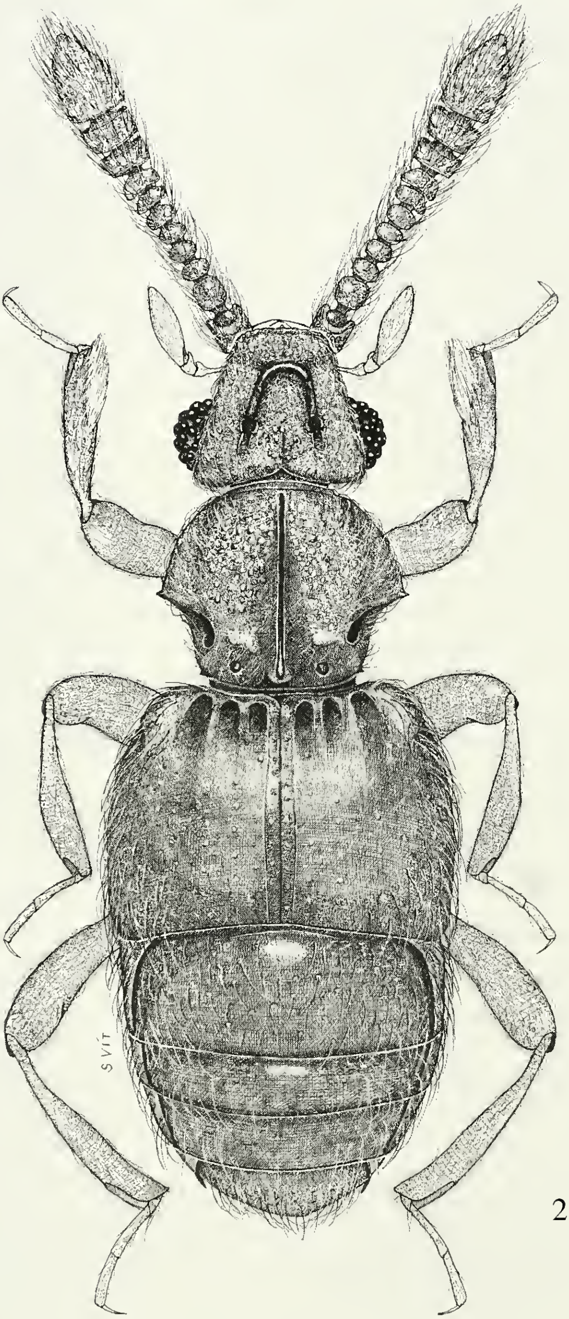


FIG. 2
Batrisoplatus incisivus sp. n.

Elytra short and broad, much shorter than abdomen, each with deep sutural stria, three basal foveae, one subhumeral fovea and lateral carina; basal ridge and discal striae absent. Base not rised to form ridge.

Metasternum strongly swollen, partly impunctate, with deep mesal sulcus. Anterior intercoxal process small, delimited by deep, mesal impression. Lateral metasternal foveae very close, lying in mesal impression close to intercoxal process, almost touching mesal axis of metasternum. Posterior intercoxal process narrow, prominent, with elongate notch to receive mediobasal abdominal process.

Legs fairly short and robust. Femora flattened, not or slightly curved, weakly narrowed basally, not narrowed apically. Tarsi slender, with segment 3 longer than segment 2.

Abdomen with 5 tergites exposed in dorsal view. Tergites 1 to 3 impressed basally; tergites 1 to 4 with large basolateral fovea and one pair of lateral carinae at each side. Tergite 1 raised apically, longer than tergite 2, shorter than tergites 2 and 3 combined; tergites 2 and 3 large, equally long, horizontal in mid-line, tergite 4 longer than tergite 3, inclined; tergite 5 with narrow horizontal basal area separated by transverse ridge from larger and vertical apical area. Base of sternites 1 to 4 impressed, each with two pairs of foveae, basolateral fold bearing long setae.

Secondary sexual characters. Eyes larger in males than in females. Apical margin of sternite 5 emarginate in male, arcuate in female. Legs and antennae without obvious sexual characters. Aedeagus with median lobe comparatively flat, with ventral process laminar, dorsal process prominent to form one or two apophysis, and with arcuate, slender, internal apophysis; setiform sensilla absent.

Distribution. Penang (West Malaysia), with one species, and Sri Lanka. Two additional, undescribed species from Singapore and continental West Malaysia are represented in the collection of MHNG, and further two from China are in the PCSK.

Habitat. The specimens from the Geneva expedition were found in moist, sifted vegetation litter, at forest edges or in forest.

Key to the species of *Batrisoplatus*

1 Vertex raised, overlapping neck, lacking medio-apical notch. Frons sharply delimited posteriorly and anteriorly by carinae and obliquely inclined. Pronotum lacking antebasal tubercles........................ 2

\- Vertex flattened, deeply notched above neck. Frons not throughout well delimited from vertex and about in same plan as vertex, lacking translucid, postantennal fields. Pronotum with low antebasal tubercles. Punctation on elytra and abdomen granulate .... *B. incisivus* sp. n.

2 Head and pronotum conspicuously wide, head about 1.5 times as wide as long. Frons with pair of translucid postantennal fields. Punctation on elytra and abdomen not granulate .... *B. occipitalis* sp. n.

\- Head and pronotum moderately wide, head hardly 1.3 times as wide as long. Frons lacking translucid postantennal fields. Punctation on elytra and abdomen granulate (West Malaysia) .... *B. rugulosus* Raffray

Batrisoplatus incisivus sp. n. Figs 2, 3

Holotype ♂: Sri Lanka: Central Prov.: Kandy, ca 600m, Udawattekele Sanctuary, 22.I.70, forest edge, ExpG # 18 (MHNG).

Paratypes: Sri Lanka: Central Prov.: Kandy, 26.I.64, R. Mussard, 1 ♂, 2 ♀ (MHNG); Dambulla, 17.I.70, ExpG # 5, forest edge, 1 ♀ (MHNG); North Central Prov.: Anuradhapura, 150m, 23.I.65, R. Mussard, 1 ♀ (MHNG); Polonnaruwa, 150m, 13.I.65, R. Mussard, 1 ♀ (MHNG); Uva Prov.: Inginiyagala, 12.II.70, ExpG # 63, 1 ♂ (MHNG); Eastern Prov.: Periyapullumalai near Pulaveli, 11.II.70, ExpG # 61, 2 ♀ (MHNG, PCSK); Ceylon, Coll. Cl. Müller, 1 ♀ (ZSMC).

Description. Length 1.60-1.75 mm. Head moderately large, not quite 1.4 times as wide as long. Vertex moderately raised medially, with punctation very dense and coarse, partly confluent, more dense on sides than on median portion. Intervals between punctures much smaller than puncture diameters, mostly formed by puncture margins. Vertexal sulcus semicircular, sharply delimited anteriorly. Frontal area anterior to sulcus almost in same plan as vertex, not delimited. Vertexal foveae in small, deep impressions, joined to sulcus. Posterior margin of vertex deeply notched in middle. Vertexal notch touching low median carina, latter slightly longer than notch and reaching anteriorly almost to line of posterior margin of vertexal foveae. Neck with low median carina. Pronotum 0.32-0.37 mm long, 0.40-0.45 mm wide, with pair of low, acute, antebasal tubercles. Median sulcus deep, starting near basal margin, almost reaching anterior margin, slightly narrowed anteriorly. Admesal area of pronotum smooth, forming shiny, triangular surface; smooth surface very wide near base, narrowed gradually toward middle third of pronotal length. Lateral humps weakly developed. Disc obliquely inclined anterior to line of antebasal tubercles, between median sulcus and lateral humps; punctation formed by large, elongate, partly confluent punctures arranged to form very short, oblique striae. Punctation on lateral humps granulate. Elytra and abdominal tergites with granulate punctation. Humeral protuberances fairly large, convex. First tergite about as long as second and third tergites combined. Tergites 1 to 3 with inner marginal carinae almost reaching apical margin, outer marginal carinae shorter.

Male characters. Eyes very large, strongly prominent, about as long as half of head length in dorsal view. Aedeagus (Fig. 3) with median lobe narrowed apically to form hook-like process and bearing broad subapical lamina.

Female characters. Eyes moderately large and prominent, about as long as one third of head length.

Comments. This species is easily distinguished from its congeners by the shape of the frons and the pronotum with antebasal tubercles.

Batrisoplatus occipitalis sp. n. Fig. 4

Holotype ♂: Sri Lanka: Central Prov.: Kandy, ca 600m, Udawattekele Sanctuary, 22.I.70, litter at forest edge, ExpG # 18 (MHNG).

Paratypes: Sri Lanka: Central Prov.: same data as holotype, 1 ♂, 2 ♀ (MHNG); Mululla, 600m, 4.II.70, ExpG # 45, under bark, 1 ♀ (MHNG); Kandy, 26.I.64, R. Mussard, 1 ♀ (MHNG).

Description. Length 1.8-2.0 mm. Head large, about 1.5 times as wide as long. Vertex strongly convex, with punctation very fine and very dense. Puncture intervals larger than puncture diameters. Vertexal sulcus almost V-shaped, with arms deeply impressed, sharply delimited from outside. Vertexal foveae in large, deep impressions. Frons with pair of translucid, transverse postantennal fields. Frontal lobe inclined, forming oblique plate anterior sulcus. Posterior margin of vertex not notched. Median vertexal carina long, low, extending from occipital margin about to line of anterior margins of vertexal foveae. Neck with high median carina and two admesal sulci. Pronotum 0.38-0.40 mm long, 0.52-0.54 mm wide, lacking antebasal tubercles. Median sulcus as in *B. incisivus*. Lateral humps not distinguishable. Disc evenly inclined from median sulcus to lateral margins, with two very fine carinae starting near base at level of basal foveae, converging anteriorly, reaching anterior third of pronotal length. Punctation very fine and very dense, distinctly less dense between discal carinae than on remainder of pronotum. Elytra and abdominal tergites without granulate punctation, elytral punctation much coarser and denser than that on abdomen, consisting of punctures well delimited, about as large as puncture intervals. Humeral protuberances fairly large. First abdominal tergite slightly longer than second tergite, much shorter than tergites 2 and 3 combined. Tergites 1 to 3 with inner marginal carinae reaching to or almost to apical margins, outer marginal carinae shorter.

Male characters. Eyes very large and prominent, similar as in *B. incisivus*. Aedeagus (Fig. 4) with median lobe extended apically by narrow, denticulate process and large lamina.

Female characters. Eyes smaller, as long as one third of head length.

Comments. This species shares with *B. rugulosus* the shape of the frons and posterior margin of the vertex. It may be distinguished from *B. rugulosus* by the much wider head and pronotum, the vertexal foveae lying in large impressions, the presence of translucid postantennal areas, the comparatively wider antennal segments 4 to 8, and the simple, not granulate punctation.

Batrisiotes Jeannel

Batrisiotes Jeannel, 1951a: 90; type species *Batrisiotes clavigeroides* Jeannel, 1951.

Description. Length 1.8-2 mm. Body weakly convex dorsally, with pronotum, elytra and abdomen in almost same plan. Punctation mostly usually fine and dense.

Head trapezoid, longer than wide, eyes included. Frontal lobe flattened or slightly impressed medially, truncate in dorsal view. Frontoclypeus narrow, vertical, clypeal margin overlapped by frontal lobe in dorsal view. Antennal fossae close. Vertex raised in middle to form hump, with nude vertexal foveae joined to semicircular sulcus. Occipital margin of vertex truncate. Antennal tubercles faint. Lateral frontal foveae faint. Eyes large and prominent in male, lying in posterior half of head, deeply notched posteriorly. Tempora short and rounded. Mandibular-ocular carinae curved dorsally distant from eye margins. Ventral side of head swollen, short. Gular foveae in shallow, common impression.

Antennae moderately long, with segments 2 to 11 symmetrical. Scape subcylindrical, flattened dorsally, with posterior angles not expanded. Pedicel small, elongate. Segments 3 to 11 fairly loose, segments 3 to 8 similar in size, club three-segmented. Maxillary palpi short, with segment 3 short, wider than long, impressed basally; segment 4 impressed and narrowed basoventrally, with short stalk.

Pronotum cordiform, about as long as wide and about as wide as head with eyes, with median sulcus, one pair of inner and one pair of outer basolateral foveae joined to lateral longitudinal sulci. Antebasal sulcus, discal tubercles and median antebasal fovea absent. Paranotal sulci distinct through their length, arcuate; surfaces smooth above and below their middle portion.

Elytra each much larger than pronotum, with lateral contours weakly arcuate, two basal foveae, entire sutural striae and lateral carinae. Subhumeral foveae lacking. Sutural striae gradually widened toward apex, forming conspicuous, smooth, impressed surfaces delimited by punctate adsutural areas and elytral disc. Base lacking ridge or fold above foveae. Posterior elytral margins bearing trichomes.

Prosternum swollen anterior intercoxal process, with two oblique sulci joined to lateral prosternal foveae. Mesosternum strongly inclined, flat. Metasternum strongly convex, with deep median impression. Lateral metasternal foveae close, situated posterior mesocoxal process, separated by narrow bridge; apical intercoxal process prominent, deeply notched.

Legs short, femora thick. Tarsi slender, segments 2 and 3 similar in length.

Abdomen long, subparallel, segments 1 to 3 almost equally wide, not or weakly narrowed apically, with 4 or 5 tergites visible in dorsal view. Tergite 1 large, not constricted basally, longer than tergite 2, eventually about as long as tergites 2 to 4 combined, inclined toward base, with outer and inner marginal carinae not or strongly modified, with or without trichomes. Tergites 1 to 4 with one pair of basolateral foveae. Tergites 2 and 3 lacking carinae or with shortened marginal carinae. Tergite 4 with basolateral digitiform tubercles. Sternite 1 not shortened mesally, with one pair of basolateral foveae. Following sternites lacking foveae.

Male secondary sexual characters located on tibiae or apparently absent; eyes larger in males than in females. Aedeagus with median lobe short and wide, flat ventral process, arcuate dorsal process and slender dorsal apophysis; setae absent.

Habitats. All specimens are from sieved leaf and other litter in lowland forests. The presence of trichomes indicate myrmecophily.

Distribution. Tropical Africa and Sri Lanka.

Comments. For general appearance of *Batrisiotes* see Leleup (1981). Three species were known hitherto: *B. clavigeroides* Jeannel, 1951 from Angola and Rep. of Congo, *B. joannae* Jeannel, 1960 from Rep. of Congo and *B. loebli* Leleup, 1981 from Ivory Coast (*B. depressicollis* Jeannel, 1956 was transferred to *Parabatrisus* Jeannel by Leleup, 1981). The Sri Lankan species differ from *B. clavigeroides* and *B. joannae* by the globose antennal segments 3 to 6 and narrower abdomen (Jeannel, 1960a), and from *B. loebli* by the pronotum having narrow median sulcus, and the complete lack of abdominal trichomes, or the abdominal trichomes present only on the basal portion of the tergite 1 (they extend in *B. loebli* along the entire inner marginal carinae of the tergite 1, as illustrated by Leleup, 1981).

KEY TO THE SPECIES OF *BATRISIOTES* OF SRI LANKA

1	Pronotum with median sulcus short, indicated by row of coarse punctures on discal centre, and with one pair of inner antebasal foveae. Abdominal tergite 1 with lateral marginal carinae raised to form vertical laminae bearing trichomes, and with two basolateral carinae bearing erect setae	*B. mussardi* sp. n.
-	Pronotum with median sulcus long, reaching close to anterior margin, with or without inner basolateral foveae. Abdominal tergite 1 with lateral marginal carinae not modified to form vertical laminae, and lacking basolateral carinae	2
2	Pronotum lacking inner antebasal foveae and antebasal tubercles. Abdominal tergite 1 lacking trichomes, with two deep basolateral impressions	*B. pyriformis* sp. n.
-	Pronotum with one pair of inner antebasal foveae and low antebasal tubercles. Abdominal tergite 1 with two basal trichomes, lacking impressions	*B. puncticeps* sp. n.

Batrisiotes mussardi sp. n. Fig. 5

Holotype ♂: SRI LANKA: CENTRAL PROV.: Dambulla, 17.I.70, ExpG # 5 forest litter (MHNG).

Paratype ♀: same data as holotype (MHNG).

Description. Length 1.80-1.85 mm. Body moderately convex. Punctation very fine and dense, on abdomen finer than on elytra and pronotum. Pubescence short, recumbent. Head as long as wide, with eyes nearly as wide as pronotum. Vertex swollen, gradually inclined to frontal lobe. Semicircular sulcus distinct, narrow, with arms subparallel near vertexal foveae, distinctly oblique more anteriorly, with transverse section delimited by inconspicuous carina extending anteriolaterally toward point above antennal base. Frontal lobe flat, slightly inclined. Posterior margin of vertexal foveae slightly anterior to level of eye centres. Antennal segments 3 to 6 subequal in size. Pronotum 0.38 mm long, 0.41-0.43 mm broad. Discus with mesal sulcus short, narrowed anteriorly, indicated by coarse puncture row on anterior half of disc. Discal tubercles faint. Outer antebasal foveae present. Elytra with adsutural area flat and impressed. Sutural striae narrow in basal third, gradually widened toward apical margin, completely smooth, each at apical margin about as wide as combined maximal width of adsutural areas. Disc slightly swollen along sutural striae, impressed along humeral protuberances; discal striae lacking. Humeral protuberances strongly raised, elongate. Apical margins triangular, each forming acute angle and bearing loose trichome on inner side of angle, longer setae curved mesally. First tergite about as long as tergites 2 to 4 combined, flattened on large basomedian area, inclined apically. Tergite 1 with basolateral margins expanded to form robust, laterally flattened processes bearing trichome on outer and ventral sides, smooth on inner sides. Lower inner margins of basolateral processes, likely homologous to inner marginal carinae, extending apically by short carinae. Raised outer margin, likely homologous to outer marginal carinae, touching elytral margin. Base of tergite 1 with low, short carina bearing erect setae at each side of basolateral processes. Tergites 2 and 3 with marginal carinae reaching mid-length of respective tergum.

Male characters. Eyes large, tempora very short, about twice as long as diameter of facets. Legs without obvious sexual characters. Aedeagus (Fig. 5) with ventral process wide, almost truncate, acute at angles; dorsal process prominent, irregularly curved and narrowed to form acute tip. Apophysis inserted at left side of median lobe, arcuate, with exposed tip.

Female characters. Eyes smaller, tempora longer, about as 3 times as long as diameter of one facet.

Comments. This species possesses trichomes similar as those in *B. clavigeroides* (Jeannel, 1951). It may be easily distinguished from *B. clavigeroides* by the narrower elytra and abdomen and the longer abdominal tergite 1 (see Jeannel, 1951b, 1959).

Batrisiotes puncticeps sp. n.

Holotype ♀: Sri Lanka: Sabaragamuwa Prov.: Ratnapura 21.I.70, in rotten wood, ExpG # 16a (MHNG).

Paratype ♀: Sri Lanka: Sabaragamuwa Prov.: Maratenna at 4500ft, 7 mls N Balangoda, 22.II.62, ExpL # 98 (MZLU).

Description. Length 2.25 mm. Body moderately convex. Punctation very dense and fairly coarse, punctures mostly sharply delimited, on lateral portions of vertex and on frontal lobe partly confluent, on middle portion of vertex very fine and becoming sparse anteriorly. Pubescence very short and strongly recumbent. Head slightly shorter than wide, distinctly narrower and shorter than pronotum. Vertex swollen, impressed in centre of occipital margin, inclined anteriorly. Vertexal sulcus V-shaped, with arms angulate and subparallel before reaching vertexal foveae. Vertexal foveae in deep impressions, with anterior margins about in line of eyes centres. Frontal lobe inclined, slightly impressed in mid-line, with anterior margin weakly angulate (dorsal view). Antennal segment 4 to 6 subequal in size. Pronotum 0.45 mm long, 0.52 mm wide, with median sulcus long and deep, reaching anterior seventh of pronotal length, widened at basal end. One pair of inner antebasal foveae present. Disc with two low antebasal tubercles in front of antebasal foveae. Elytra each with strongly raised, elongate humeral tubercle; disc without swollen and impressed areas, lacking discal stria. Adsutural areas flat, almost at same level as inner part of disc, narrowed from middle to apical margin. Sutural striae each gradually widened from mid-length toward apical margin, forming smooth surface, at apical margin about as wide as combined largest width of adsutural areas. Apex slightly prominent in outer half, bearing dense trichome reaching to sutural stria. Setae of trichome short, orientated backward, and with curved ends. Abdomen with tergite 1 almost as long as tergites 2 and 3 combined, inclined toward base, convex, lacking impressions, with two lateral trichomes situated below elytral trichomes and consisting of very dense setae raised obliquely. Basolateral margins raised up to tergal mid-length. Tergites 2 and 3 with inner marginal carinae slightly longer than one third of respective tergal length.

Female character. Eyes large, tempora comparatively long, exceeding in length 5 facet diameters.

Comments. This species may be distinguished from its congeners by the abdomen bearing trichomes in combination with the long median sulcus of pronotum and the presence of a pair of antebasal foveae.

Batrisiotes pyriformis sp. n. Fig. 6

Holotype ♂: SRI LANKA: UVA PROV.: Diyaluma Falls, ca 400m, 23.I.70, litter, forest up stream waterfalls, ExpG # 21 (MHNG).

Description. Length 1.95 mm. Dorsal side of body with punctation even, very fine and very dense. Pubescence very short and recumbent. Head trapezoid, about as long as broad, narrower than pronotum. Vertex slightly swollen, inclined gradually anteriorly. Vertexal foveae with anterior margins slightly posterior to line of anterior margins of eyes. Median vertexal stria faint, extending from neck about to line of posterior eye margins. Semicircular sulcus faint, indicated by fairly large, smooth, slightly impressed line. Frontal lobe slightly convex and inclined, with anterior margin truncate. Eyes large, tempora fairly short, about four times as long as diameter of one facet. Antennal segment 5 slightly longer than segments 4 or 6. Pronotum 0.36 mm long, 0.38 mm wide, with median sulcus deep, well marked, starting near base, extending to posterior seventh of pronotal disc. Discal tubercles and inner antebasal foveae lacking. Elytra with outer apical angles not prominent, obtusely angulate. Each elytron with discal stria extending from outer basal fovea almost to mid-length of disc. Humeral humps fairly high, elongate, abruptly ending posteriorly. Elytral trichomes loose, consisting of rows of about equally long, thickened setae situated on apical and apicolateral margins. Adsutural area flat, about in same plan as disc. Sutural striae normally narrow in basal half, widened gradually from mid-length toward apex, each at apical margin about as wide as punctate adsutural area. Abdomen with tergite 1 slightly longer than tergites 2 and 3 combined. Tergite 1 inclined toward base, inclined surface extending toward apical third of tergite, with two large and very deep, basolateral, foveiform impressions. Tergite 1 lacking trichomes, with basolateral margins strongly raised to form large, rounded protuberances reaching up to apical third of tergal length, with inner and outer marginal carinae short, close, meeting at highest point of each basolateral protuberance. Tergites 2 and 3 with faint lateral carinae.

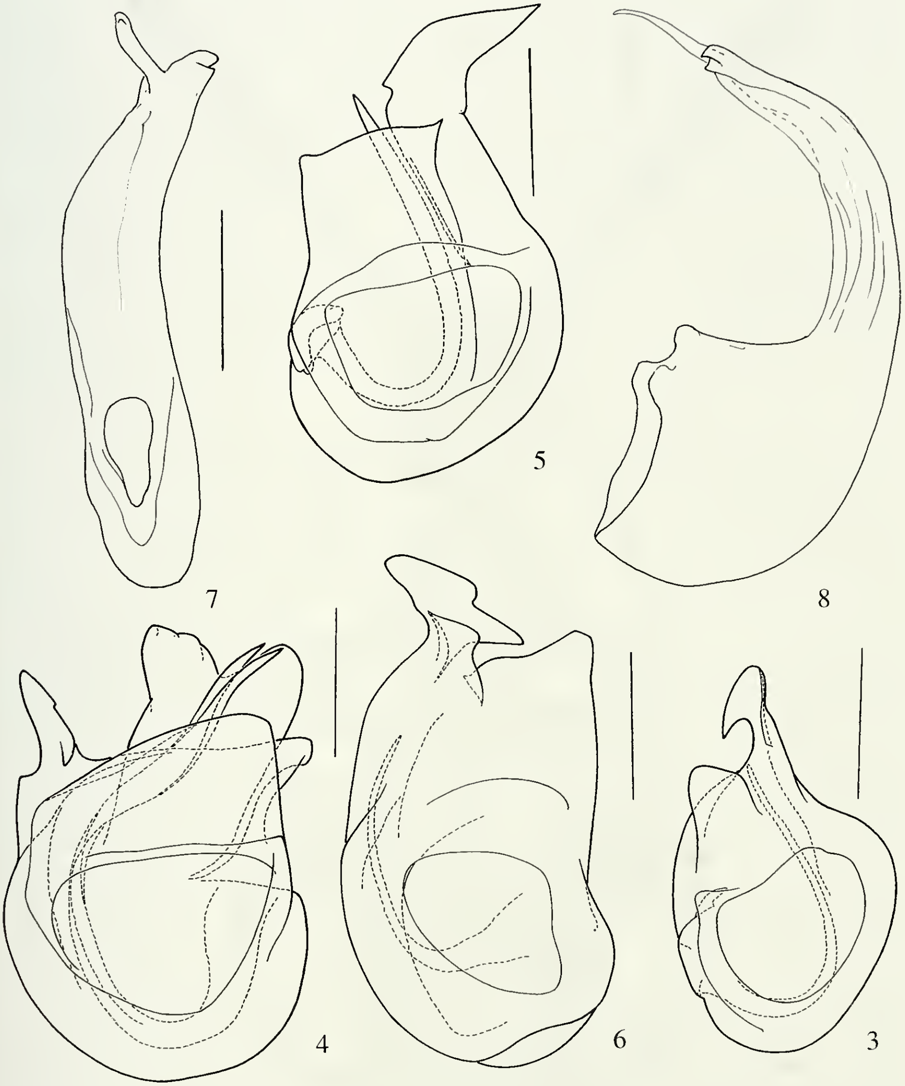
Male characters. Mesotibiae thickened, with large, robust, curved apical spine and strong, oblique, subapical setae on mesal margin. Aedeagus (Fig. 6) with median lobe forming large ventral lamina narrowed toward blunt apex and joined to dorsal process. Apex of dorsal process widened, forming transverse lamina irregularly narrowed. Arcuate apophysis inserted at right side, not prominent apically.

Comments. This species is characterized by the absence of the pronotal foveae and abdominal trichomes.

Batoxylomorpha gen. n. Fig. 9

Type species *Batoxylomorpha femoralis* sp. n. Gender: feminine.
Etymology: the name is derived from the similar genus *Batoxyla* and the word morpha.

Description. Habitus as Fig. 9. Length 2.3 mm. Body moderately convex, head, pronotum, elytra and abdominal tergite 1 almost in same plan; punctation very dense, mostly coarse. Pubescence on body and appendages short and recumbent.



FIGS 3 to 8: Aedeagi

3: *Batrisoplatus incisivus* sp. n., aedeagus in ventral view; 4. *Batrisoplatus occipitalis* sp. n., aedeagus in ventral view; 5: *Batrisiotes mussardi* sp. n., aedeagus in ventral view; 6: *Batrisiotes pyriformis* sp. n., aedeagus in ventral view; 7 and 8: *Batoxylomorpha* gen. n. *femoralis* sp. n., aedeagus in ventral (7) and lateral (8) views. Scale bars = 0.1 mm.

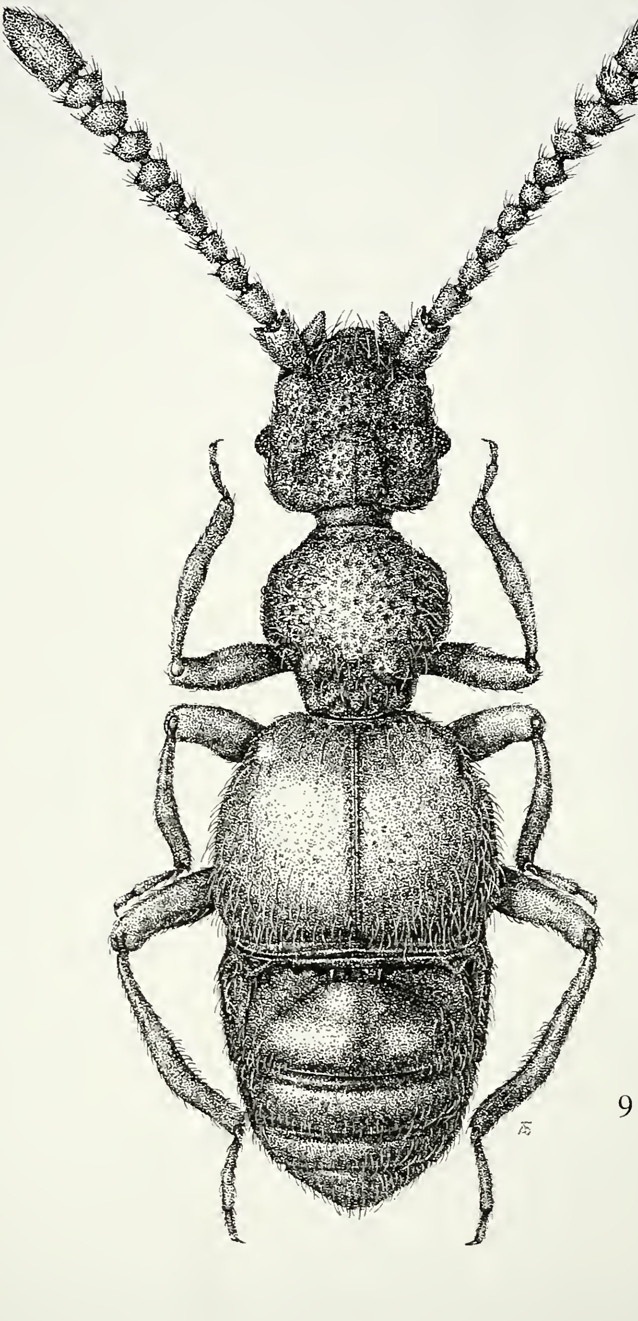


FIG. 9
Batoxylomorpha femoralis gen. n., sp. n.

Head about as long as wide, suboval. Vertex with pair of foveae and median carina, lacking sulci, convex and inclined toward neck. Occipital margin of vertex slightly arcuate. Antennal fossa widely separated, frontoclypeus wide and distinct from above. Interantennal bridge slightly impressed. Lateral frontal foveae absent. Antennal tubercles weakly developed. Lateral head margins convex and inclined. Eyes small, prominent, not notched, situated anterior to line of vertexal foveae, multifaceted, with small facets. Ocular-mandibular carina touching eye margins. Tempora long and rounded. Ventral side of head weakly swollen, moderately inclined toward neck. Postgenal erect setae inconspicuous. Neck with dorsomedian carina.

Antennae moderately long. Scape small, subcylindrical, with apical angles hardly prominent, lacking glandular orifices. Pedicel cylindrical, elongate. Segments 3 to 6 symmetrical. Club indistinctly 5-segmented, sole segment 11 large. Maxillary palpi with segments 3 short, narrowed mesally; segment 4 with very short basal stalk, widest at middle.

Pronotum cordiform, about as long and wide as head; disc raising slightly above plan of head, widest anterior middle. Disc evenly convex anteriorly and laterally, with two antebasal, acute tubercles, minute basomedian tubercle, two pairs of inner basolateral foveae, one pair of outer basolateral foveae and one pair of antebasal lateral foveae; lacking sulci, marginal denticles and basomedian carina. Lateral humps indistinct. Hypomeron with smooth, shiny intervals between coarse punctures; paranotal ridge reduced.

Elytra comparatively flat, not raising above plan of pronotum, combined much wider than long, each with sutural stria, lateral carina, and three basal foveae; basal ridge, discal stria and subhumeral fovea absent. Humeral area rounded, humeral protuberance absent.

Metasternum with anterior process sharply delimited by transverse ridge. Posterior intercoxal margin wide, truncate, with acute protuberance in middle. Lateral metasternal foveae widely separated. Metasternum covered throughout by dense, short pubescence.

Legs robust, femora thick at basis, moderately thickened toward apex. Tarsi conspicuously thick; segments 3 of protarsi and mesotarsi about as long as half of combined length of segments 1 and 2 of respective tarsi.

Abdomen longer than elytra, with 5 tergites visible in dorsal view, gradually narrowed apically. Tergite 1 longer than tergites 2 and 3 combined, slightly narrowed apically, impressed at base, with disc raising apically; outer and inner lateral carinae hardly raised, extending to apical margin; with one pair of short discal carinae and three pairs of basal foveae. Outer basal foveae lying at mid-distance of inner and discal carinae, inner foveae at each side of discal carinae. Tergites 2 to 3 similar in size, each shorter than tergite 4, impressed along base, with inner and outer lateral carinae not reaching apical margin, and single pair of lateral foveae. Tergites 4 with single pair of lateral carinae and lateral foveae. Sternite 1 in middle comparatively short, only somewhat longer than sternite 2, following sternites becoming gradually, slightly shorter. Sternite 1 with three pairs of basal foveae; inner pair close to intercoxal process, outer pair lying in large lateral impression, middle pair lying between inner and outer foveae. Sternites 2 and 3 with deeply impressed base, one pair of discal carinae, one pair of basal foveae at each side of carinae, and one pair of lateral foveae.

Male secondary sexual characters located on legs. Aedeagus with median lobe narrowed distally to form tubular process, ventral process and setiform sensilla absent.

Habitat unknown.

Distribution. Sri Lanka.

Comments. Batoxylomorpha resembles *Batoxyla* Raffray and *Sathytes* Westwood by the lack of vertexal and pronotal sulci, and by the short pubescence and conspicuously dense punctation. The flattened body and the pattern of carinae on abdominal tergites are similar to those of *Batrisoplatus.* The new genus may be separated, and is likely unique, in having the following features in combination: the anterior metasternal process separated by a transverse ridge, the posterior metasternal process wide and truncate, the abdominal sternites 2 and 3 each with a pair of discal carinae, the tarsi robust with the segment 3 shorter than the segment 2.

Batoxylomorpha femoralis sp. n. Figs 7 to 9, 11

Holotype ♂: Sri Lanka: Sabaragamuwa Prov.: Gilimale, 1000m, 10.IV.1973, G. Benick (MHNG).

Description. Length 2.3 mm. Head with vertex slightly raised in middle, median carina ending by minute point (lateral view), slightly anterior to vertexal foveae. Tempora almost twice as long as eyes in dorsal view. Punctation even, coarse punctures much larger than puncture intervals; additional, minute punctures on puncture intervals. Antennal segments 3 and 5 similar, elongate, each as wide as and slightly shorter than pedicel; segments 4 and 6 each slightly shorter than segment 5, hardly longer than wide; segments 7 to 10 each about as long as or slightly longer than segment 6, segment 7 hardly wider than long, segments 8 to 10 distinctly wider than long; segment 11 twice as long as wide and about as long as combined length of segments 8 to 10. Pronotum hardly wider than long (ratio 51/52), slightly narrower than head with eyes. Antebasal tubercles pointed dorsally. Discal punctation as that on head. Median part of metasternum moderately impressed. Median part of abdominal sternite 1 shallowly impressed; sternites 2 to 4 flattened in middle. Elytra with punctation dense and fine, not clearly delimited, without additional minute punctures intervals. Abdomen with punctation mostly very fine and dense, shallow, larger punctures scattered. Tergite 1 with discal carinae about as long as one ninth of tergal length.

Male characters. Protibiae straight and gradually thickened in basal three fifth, slightly curved, with outer side convex, mesal side concave in apical two fifth. Mesotrochanters with small, very narrow subbasal apophysis, araising from posterior side and pointed obliquely. Mesotibiae with short, obtuse, subbasal denticle on mesal side. Metatibiae flattened laterally, slightly curved, widest posterior middle, strongly narrowed toward base, slightly narrowed toward apex (Fig. 11). Aedeagus (Figs 7, 8) very slender in ventral view, curved, strongly arcuate dorsally, with basal bulb strongly expanded ventrally, apex of median lobe with apophysis.

Tribasodema Jeannel Fig. 10

Tribasodema Jeannel, 1961: 429; type species *Batrisus armatus* Raffray, 1894.

Description. Habitus as Fig. 10. Length 1.95-2.45 mm. Body elongate, convex. Punctation mostly very sparse and fine, very fine on pronotum, coarse on elytra; pubescence mostly long.

Head pyriform, about as long as pronotum, with eyes about as wide as pronotum. Vertexal hump usually with median carina, delimited by vertexal foveae and deep semicircular sulcus. Vertexal foveae in deep impressions. Lateral margins of vertex broadly rounded. Antennal insertions distant. Antennal tubercles distinct or faint, their margins extending to form anteriomesal carina. Lateral frontal foveae absent. Frontal lobe wide, impressed between antennal tubercles, gradually inclined toward clypeal margin; frontoclypeal area large, prominent, not separated from frontal lobe. Eyes small, prominent, multifaceted, notched posteriorly, with small facets; anterior eye margins situated about at head mid-length. Tempora long, much longer than eyes, rounded. Vertexal margin rounded. Ocular-mandibular carina indistinct. Ventral side of head with short and convex anterior part, long, strongly inclined posterior part. Gular foveae in small, common impression. Neck with dorsomedian carina.

Antennae long. Scape cylindrical. Segments 2 to 8 similar in size, elongate or subglobose. Club loose, segments 9 and 10 moderately enlarged, segment 11 much larger than segment 10. Maxillary palpi moderately long, segment 3 longer than wide, widened apically, segment 4 with short basal stalk.

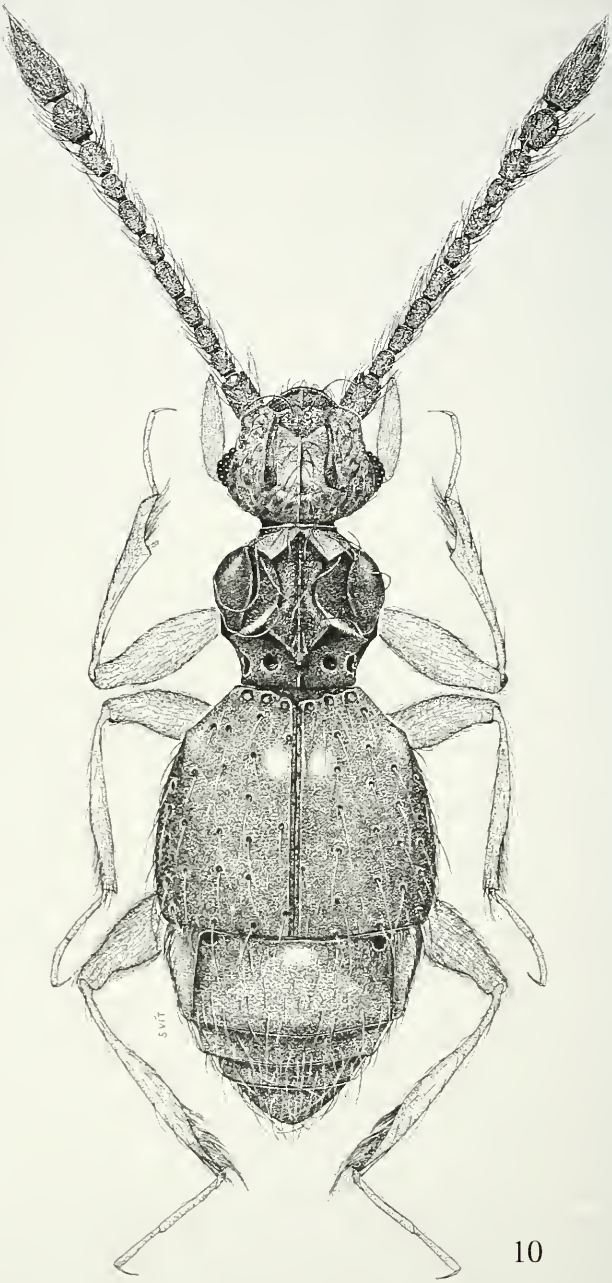
Pronotum raising above plan of head, cordiform, about as long as broad, broadly rounded anteriorly, widest in anterior half. Disc with two pairs of antebasal foveae, median longitudinal sulcus, two pairs of lateral longitudinal sulci, outer lateral sulci arcuate basally. Median sulcus separated from basal margin by short basomedian carina. Disc with pair of antebasal, acute protuberances at basal ends of inner lateral sulci, and pair of central spines lying at anterior ends of inner lateral sulci. Lateral humps distinct, without denticles. Antebasal transverse sulcus absent. Paranotal ridges entire, sinuate. Hypomera with basolateral foveiform or elongate impression.

Elytra large, longer than abdomen, convex, raising notably above plan of pronotum, each with three basal foveae and subhumeral fovea joined to lateral sulcus. Sutural striae obsolete or very fine. Basal ridge and discal striae absent. Lateral margins arcuate. Humeral protuberances distinct, humeral margins oblique.

Metasternum with median sulcus or narrow impression becoming deeper posteriorly; lateral metacoxal foveae fairly close, smaller than interval between them. Posterior intercoxal process fairly narrow, prominent, with short, rounded notch.

Legs long. Femora straight, robust, widest posterior mid-length, strongly narrowed basally, less narrowed apically. Tibiae slender, outer side of metatibiae with several longer setae. Tarsi slender, segment 3 shorter than or about as long as segment 2.

Abdomen lying notably below plane of elytra, gradually narrowed posteriorly, with 5 tergites visible in dorsal view. Tergite 1 moderately large, about as long as combined length of tergites 2 and 3, with basal impression narrow in middle, becoming larger near marginal carinae. Tergal disc convex. Marginal carinae fairly high at base, becoming gradually lower apically. Outer marginal carinae reaching apical



10

FIG. 10
Tribasodema armatum (Raffray).

margin, inner marginal carinae slightly shorter. Basodiscal carinae very short. Tergites 2 and 3 moderately inclined, with outer marginal carinae almost reaching apical margins; tergite 4 much shorter than tergite 1. Sternite 1 with three pairs of basal foveae. Following sternites without foveae.

Male secondary sexual characters located on antennae and legs. Eyes in males slightly larger than in females. Aedeagus highly reduced to form simple, elongate, arcuate or sinuate median lobe, lacking ventral process, apophysis and sensilla.

Habitats. Moist leaf and other forest litter and under bark, from plain up to montane habitats.

Distribution. Sri Lanka.

KEY TO SPECIES OF *TRIBASODEMA*

1 Vertex without median carina. Frontoclypeal punctation mostly very fine. Antennal segments 9 and 10 each about as long as wide or slightly longer than wide, female antennal segment 10 globular. Segment 11 about 2 to 2.5 times as long as wide . . . . *T. tribulosum* sp. n.

\- Vertex with median carina. Frontoclypeal punctation coarse or confluent. Antennal segments 9 and 10 elongate, segment 11 about 3 times as long as wide 2

2 Male with mesal margin of protibiae angulate at widest point; mesotrochanters, mesofemora (Fig. 29) and mesotibiae lacking robust denticles or tubercles . . . . *T. armatum* (Raffray)

\- Male with mesal margin of protibiae rounded at widest point; mesotrochanters, mesofemora and mesotibiae each with robust denticle or tubercle (Figs 26, 28) . . . . *T. factiosum* sp. n.

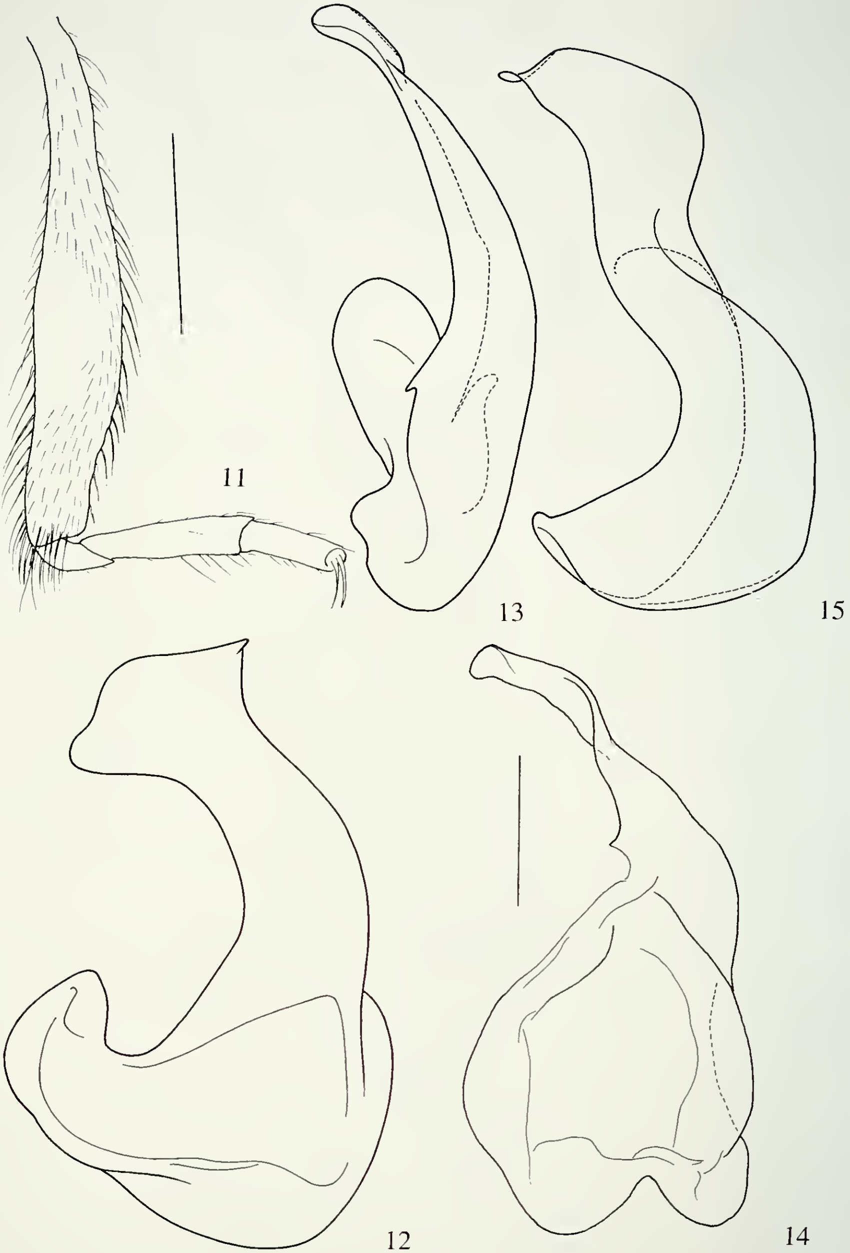
Tribasodema armatum (Raffray) Figs 10, 12, 13, 18 to 22, 29

Batrisus armatus Raffray, 1894a: 447.
Tribasodema armatum; Jeannel, 1961: 430.

Type material: SRI LANKA: CENTRAL PROV., 1 ♀ labelled: Simon Nuwara Elia Maturata (hand-written) /Ceylon/ Muséum Paris 1917 Coll. A. Raffray/ TYPE (red)/ B. Armatus Raffray det. (MNHN); 2 ♂ and 1 ♀ without type and the original locality labels, one of the ♂ with Jeannel's hand-written labels "Tribasodema armatum R."/"armatus Raf" (MNHN), the second ♂ in MHNG, the ♀ in MNHN.

Additional material. SRI LANKA: Ceylon, Coll. Cl. Müller, 3 ♂ (ZSMC, MHNG).

Description. Length 2.35-2.45 mm. Pubescence semi-erect or erect. Head, pronotum, abdomen and metatibiae with additional, scattered, very long, erect setae. Head without eyes about as long as wide. Punctation scattered and very fine on middle part of vertex, more dense and less fine on lateral portions of vertex and on frontoclypeus. Pubescence semi-erect, several pairs of very long, erect setae on vertex, antennal tubercles and frontoclypeus. Frontal lobe with short median sulcus; anteriomesal carinae short, oblique. Vertex with median portion flat and obliquely raised toward occipital margin, highest at occipital margin; median carina sharp, high, long, extending to semicircular sulcus. Vertexal foveae small, lying at line of posterior eye margins. Lateral and lateroposterior parts of vertex broadly rounded, middle



FIGS 11 to 15: *Batoxylomorpha* gen. n. and *Tribasodema* Jeannel
11: *B. femoralis* sp. n., male metatibia with tarsus; 12 and 13: *T. armatum* (Raffray), aedeagus in ventral (12) and lateral (13) views; 14 and 15: *T. tribulosum* sp. n., aedeagus in ventral (14) and lateral (15) views. Fig. 11: scale-bar = 0.2 mm; figs 12 to 15: scale bar = 0.1 mm.

of occipital margin abruptly inclined. Antennae with segments 2 to 4 subequal in size, or segment 4 slightly longer than segment 3, each about 1.5 times as long as wide; segments 5 to 7 subequal in size, each distinctly longer than segments 2 or 3; segment 8 about as large as segment 3; segment 11 about 3 times as long as wide. Pronotum 0.50-0.52 mm long, 0.55-0.60 mm wide. Median longitudinal sulcus deep, slightly widened basally, wider than lateral longitudinal sulci. Anterior pair of discal spines pointed dorsally, posterior pair of discal spines slightly oblique. Elytra about as long as combined broad, raised along suture.

Male sexual characters. Antennae as Fig. 19. Antennal segment 9 as long as segment 7, asymmetrically thickened ventrally, with irregular, denticulate ventral margin; segment 10 (Fig. 18) longer than segment 9, impressed and bearing microsensillae, with basoventral margin expanded to form a ridge; segment 11 slightly longer than segments 9 and 10 combined. Protibiae (Figs 20, 21) gradually widened toward apical third, angulate and flattened at widest point, abruptly narrowed from widest point to apex, with mesal margin bearing row of robust, oblique setae. Mesotrochanters rounded mesally, with short setae. Mesofemora with small tuft of short, erect setae situated posterior basal third (Fig. 29). Mesotibiae with apical third flattened laterally and bearing dense, robust pubescence forming long tuft reaching slightly posterior apical margin of respective tibia, and with small, narrow, hook-like apical thorn (Fig. 22). Metatibiae curved in apical half, becoming gradually wider toward apical third, narrowed toward apex (dorsal view), with dorso-apical impression; apical half of mesal side of tibiae flattened and impressed, bearing dense, robust, long setae, and long, narrow setal tuft extending about to apical margin of tarsomere 1. Aedeagus (Figs 12, 13) with distal process large, widened apically in dorsal view, arcuate in lateral view.

Female characters. Eyes smaller than in male. Antennal segments 9 and 10 symmetrical, elongate, segment 10 slightly longer and wider than segment 9.

Comments. This species is easily distinguished by the shape of the male protibiae.

Tribasodema factiosum sp. n. Figs 16, 17, 23, 26, 28

Holotype ♂: Sri Lanka: Central Prov.: Kandy, 700m, 14.II.70, ExpG # 67a, on rotten tree stem (MHNG).

Paratypes: Sri Lanka: Central Prov.: same data as holotype, 2 ♂, 7 ♀ (MHNG, PCSK); same data but 16.II.70, ExpG # 70, under bark, 4 ♂, 3 ♀ (MHNG, PCSK); same data but 17.II.70, ExpG # 71, under bark, 3 ♂, 4 ♀ (MHNG); same data but 600m, 15.I.70, ExpG # 3c, sieved litter, 1 ♂, 2 ♀ (MHNG).

Description. Length 1.95-2.15 mm. Pubescence semi-erect on most of body, recumbent on abdomen. Head slightly wider than long. Punctation very irregular, punctures mostly fairly large but shallow, partly confluent and separated by wrinkles, usually finer on median portions of vertex and frontoclypeus than an lateral portions. Vertex with large median portion swollen, delimited by semicircular sulcus, with low median carina extending from neck to transverse section of sulcus, highest near occipital margin, convex and inclined toward neck. Vertexal foveae lying slightly anterior to line of posterior eye margins. Frontal lobe lacking median sulcus; anteriomesal carinae long, arcuate, extending to near anterior clypeal margin. Antennae with all segments elongate, segments 2 to 7 subequal in size, segment 8 shorter than preceding segments, slightly longer than wide. Pronotum 0.47-0.51 mm long, 0.45-0.51 mm wide. Mesal sulcus widened basally, near base about twice as wide as in middle. Mediobasal carina very short. Basal area raised, irregularly punctate. Anterior discal spines pointed dorso-apically, raising from small tubercles. Elytra slightly wider than long, with faint sutural striae, adsutural areas raised.

Male characters. Antennae as Fig. 23. Antennal segments 9 and 10 appearing symmetrical in dorsal view, each distinctly longer than wide; segment 9 longer than segment 7, thickened apicoventrally; segment 10 with concave emargination on ventral side, normally thick near base, becoming gradually more thin toward apex (lateral view); segment 11 about as wide as segment 10, almost as long as segments 8 to 10 combined, 3 times as long as wide, with narrow, basal, glandular socle perpendicular to segmental axis. Mesotrochanters with large spine on posterior side. Mesofemora thickened, with large denticle bearing short pubescence at middle of mesal side (Fig. 28). Mesotibiae flattened, with mesal side slightly, gradually widened toward apical third, impressed in apical third, oblique denticle posterior middle and large, oblique, apical tooth (Fig. 26). Outer side of apical third and apex of mesotibiae with very dense, short, robust, recumbent setae. Metatibiae slightly arcuate, straight in apical portion, with ventral side flattened mesally. Apical third of metatibiae with robust, very dense mesal pubescence, becoming gradually longer toward apex, and with compact, narrow, subapical setal tuft exceeding apical margin of tarsomere 1. Aedeagus (Figs 16, 17) with distal process moderately large, abruptly bent at apex, straight in ventral view, arcuate in lateral view.

Female characters. Eyes slightly smaller. Antennal segments 9 and 10 similar to those of male but slightly shorter.

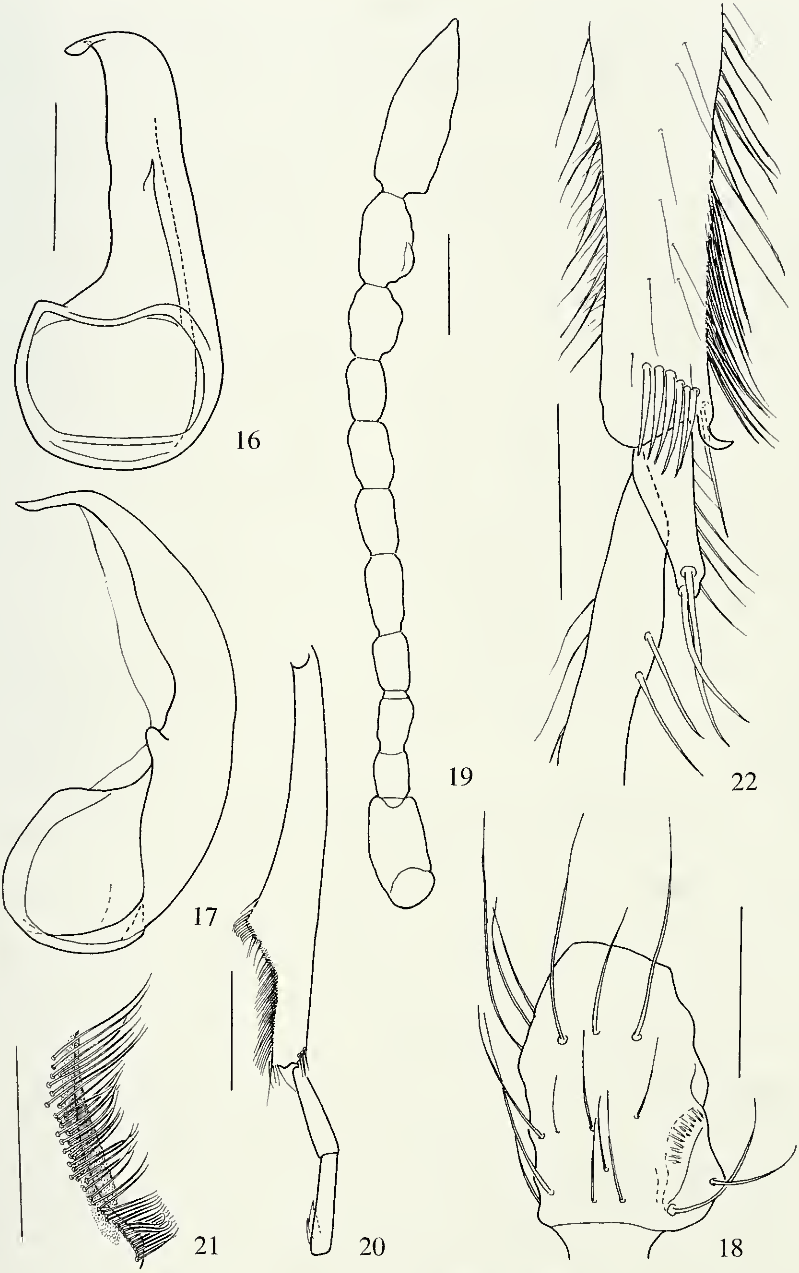
Comments. This species may be easily distinguished by the male mesolegs bearing robust denticles or tubercles.

Tribasodema tribulosum sp. n. Figs 14, 15, 24, 25, 27

Holotype ♂: SRI LANKA: CENTRAL PROV.: Kandy 700m, 17.II.70, ExpG # 71, under bark (MHNG).

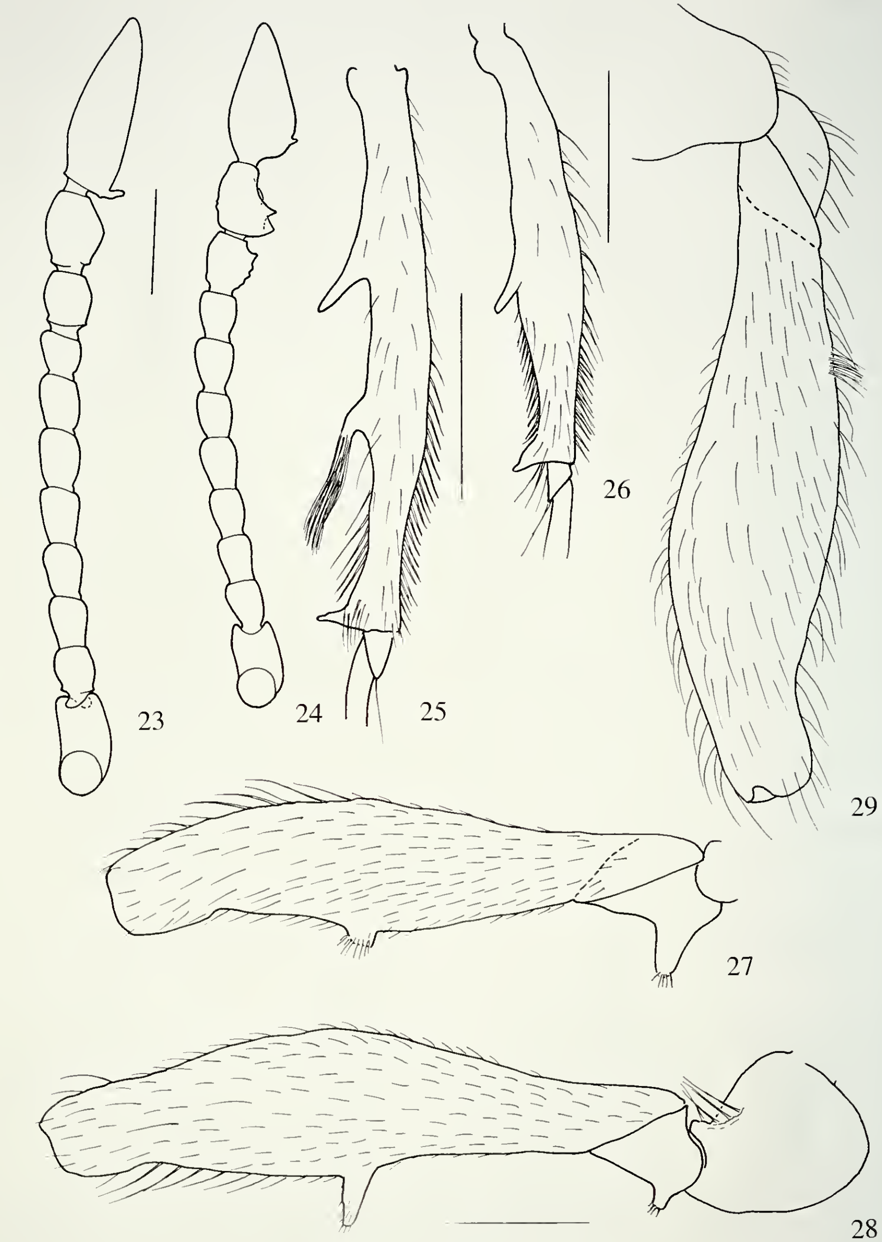
Paratypes: SRI LANKA: CENTRAL PROV.: same data as holotype, 1 ♂, 9 ♀ (MHNG, PCSK); Kandy, 600m, 4.II.70, ExpG # 3c, forest litter, 1 ♀ (MHNG); Mululla, 600, 4.II.70, ExpG # 45a, under bark, 1 ♂ (MHNG); above Talatuoya, 950-1000m, ExpG # 27a, 1 ♂ (MHNG); Kadugannawa, 500m, 5.XII.72 ExpG # 63, 1 ♀ (MHNG); WESTERN PROV.: Colombo Dist., Labugama 400 ft, 24.VIII.73, G. Ekis, 1 ♀ (NMNH).

Description. Length 2.0-2.15 mm. Pubescence mostly semi-erect, that on abdomen almost recumbent. Head, pronotum, abdomen and metatibiae with several additional, very long setae. Head wider than long. Punctation sparse and very fine on most of vertex and large portion of frontoclypeus, dense and coarse on posterior and mesal sides of antennal tubercles. Vertex strongly swollen in middle portion, highest in centre, lacking median carina. Vertexal foveae lying in line of posterior eyes margins. Frontal lobe lacking median sulcus; anteriomesal carinae long, curved mesally antennal fossa and extending on frontoclypeus almost to clypeal margin.



FIGS 16 to 22: *Tribasodema* Jeannel

16 and 17: *T. factiosum* sp. n., aedeagus in ventral (16) and lateral (17) views, scale bar = 0.1 mm; 18 to 22: *T. armatum* (Raffray), male antennal segment 10 (18), scale bar = 0.1 mm; male antenna, scale bar = 0.2 mm (19); male protibia with tarsus (20), scale bar = 0.2 mm; mesal protibial notch (21), scale bar = 0.1 mm; apical part of male mesotibia with base of tarsus (22), scale bar = 0.1 mm.



Figs 23 to 29: *Tribasodema* Jeannel

23: *T. factiosum* sp. n., male antenna; 24: *T. tribulosum* sp. n., male antennae; 25: *T. tribulosum* sp. n., male mesotibia; 26: *T. factiosum* sp. n., male mesotibia; 27: *T. tribulosum* sp. n., male mesofemur; 28: *T. factiosum* sp. n., male mesofemur; 29: *T. armatum* Jeannel, male mesofemur. Scale bars = 0.2 mm.

Antennal segments 2 to 8 elongate, segments 2 to 7 subequal in size, segment 8 distinctly shorter than segment 7. Pronotum similar to that of *T. armatum* but median longitudinal sulcus widened basally and twice as wide near base as in middle. Basal area irregularly wrinkled. Anterior discal spines pointed dorso-apically. Elytra combined wider than long, raised along suture.

Male characters. Antennae as Fig. 24. Antennal segment 9 asymmetrical, widened apicolaterally and impressed ventrally; segment 10 asymmetrical, widened basolaterally, deeply impressed on ventral side; segment 11 as long as or lightly longer than segments 9 and 10 combined, narrower than segment 10, about 2 times to 2.5 times as long as wide, with outer side more arcuate than inner side. Mesotrochanters (Fig. 27) with large denticle on mesal side. Middle of dorsomesal side of mesofemora with small tubercle bearing short setiform sensillae (Fig. 27). Mesotibiae (Fig. 25) with outer side slightly, almost evenly arcuate; mesal side thickened from base to middle third, with large, curved tooth araising between basal forth and third; middle third of mesotibiae flattened and smooth mesally, with denticle bearing long, compact, narrow setal tuft reaching almost tibial apex; apical third impressed; apex expanded to form conspicuous, triangular denticle perpendicular to tibial axis; apical third of outer side with very dense pubescence; dorso-apical margin with short, robust setae. Metatibiae gradually, moderately thickened toward apical fifth; apical fifth obliquely truncate and with compact, long and narrow setal tuft reaching slightly posterior tibial apex; apical half of mesal side and apex with conspicuous, dense and robust pubescence. Aedeagus (Figs 14, 15) with distal process moderately large and fold subapically in ventral view, sinuate in lateral view.

Female characters. Antennal segment 9 slightly elongate, subglobular; segment 10 globular.

Comments. This species may be easily separated by the absence of vertexal carina. It possesses an antennal club distinctly shorter than that in its congeners.

Veddabatrus gen. n. Fig. 30

Type species: *Veddabatrus sexualis* sp. n. Gender: masculine.

Etymology: the name is derived from Veddas, the ancient inhabitants of Sri Lanka, combined with an arbitrary abbreviation of Batrisini.

Description. Habitus as Fig. 30. Body convex, 2.35-2.90 mm long. Punctation mostly fine and sparse. Pubescence long, particular long setae absent.

Head subpentagonal, about as long as wide. Vertex with median hump low, convex, delimited by vertexal foveae and faint sulci. Median vertexal carina distinct. Sulci indicated by short, wide, glabrous impression anterior to each vertexal fovea, and by glabrous, impressed area on inclined part of frontoclypeus, anterior to vertexal hump. Antennal fossae broadly distant. Antennal tubercles hardly distinct, very weakly raised above plan of lateral parts of vertex. Lateral frontal foveae absent. Areas posterior antennal tubercles horizontal, convexly inclined laterally. Interantennal bridge and frontoclypeus not separated, wide, almost in same plan, distinct from above. Mandibular-ocular carinae bifid, with upper branch curved dorsally anterior eyes margin, lower branch reaching eye margin. Eyes small, prominent, not

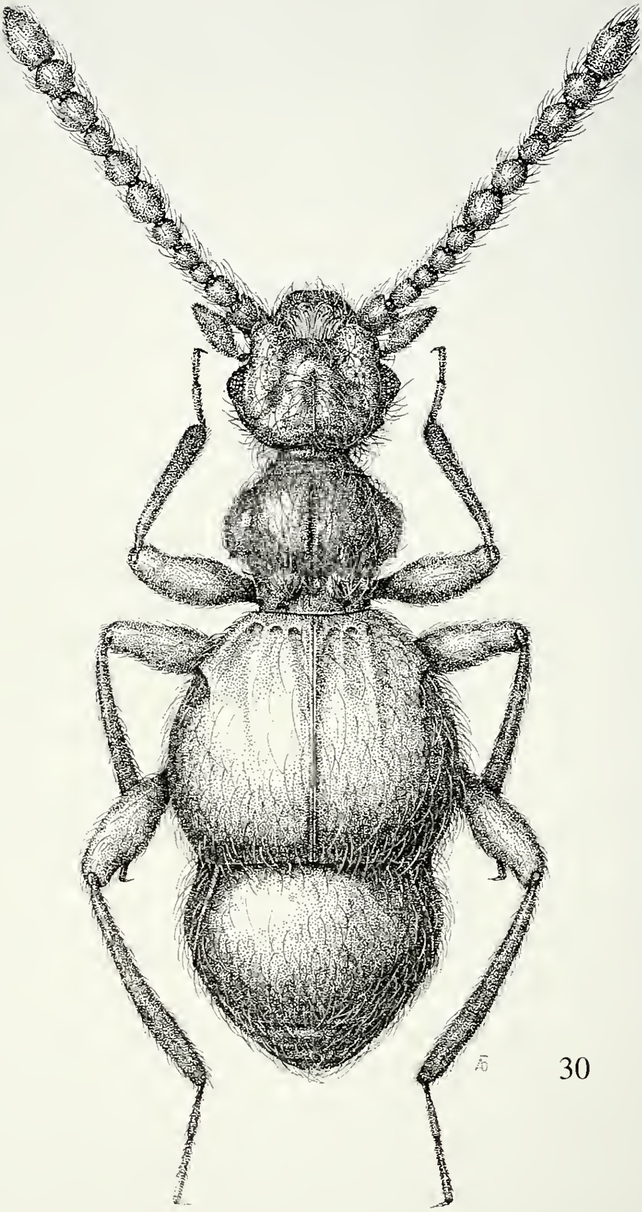


FIG. 30
Habitus of *Veddabatrus sexualis* gen. n., sp. n.

notched, with centres situated about at head mid-length, with small facets. Tempora long, evenly convex. Occipital margin moderately raised above plan of neck, convex, inflecting. Postgenae with perpendicular, long and sparse setae. Gular area not swollen, slightly inclined toward neck. Gular foveae in very deep foveiform impression. Neck with mediodorsal carina.

Antennae moderately long. Scape and pedicel subcylindrical, apical angles of scape not expanded and lacking glandular opening; segments 3 to 7 similar to pedicel. Club distinct, 3-segmented. Maxillary palpi with segment 2 curved and gradually thickened toward apex; segment 3 short, narrowed mesally, segment 4 without basal stalk, gradually narrowed apically.

Pronotum cordiform, about as long as wide, strongly convex, strongly narrowed anterior and posterior to lateral humps, raising high above plan of head, with median and two lateral sulci, pair of acute antebasal tubercles, basomedian and two admesal carinae, two pairs of inner basolateral foveae, one pair of outer basolateral foveae and one pair of antebasal foveae. Admesal carinae each with two denticles anterior to antebasal tubercles. Lateral humps large, convex, with or without denticle. Paranotal ridge strongly arcuate, not shortened.

Elytra convex dorsally and laterally, raising above plan of pronotum and abdomen, longer and much wider than pronotum, steeply inclined toward apical margin, each with three basal foveae, subhumeral fovea, deep sutural stria, discal stria and lateral carina extending anterior to line of humeral angle. Base fold-likely raised above foveae.

Metasternum deeply impressed in middle, with lateral metasternal foveae close, in common impression posterior metasternal process.

Legs long. Femora straight, narrowed basally and apically. Tibiae slender, with long, erect pubescence on outer side. Tarsi slender, segment 3 longer than segment 2.

Abdomen convex, longer than elytra, with 4 tergites visible in dorsal view. Tergite 1 about as long as or longer than tergites 2 and 3 combined, slightly widened apically, slightly inclined at apex, with three basal impressions separated by discal carinae, one pair of basolateral foveae, two pairs of mediobasal foveae at each side of discal carinae. Outer and inner marginal carinae of tergite 1 not raised, outer shortened, inner extending to apical margin of tergite. Tergites 2 and 3 similar in size, parallel-sided, with basal sulcus and one pair of basolateral foveae. Tergite 4 longer than tergite 3, inclined, with one pair of basolateral foveae. Sternite 1 with two deep, basal sulci at each side of median area and two large, basolateral impressions covered by pubescence; with six foveae, one at each end of basal sulci and one in each basal impression. Sternites 2 to 4 each with two pairs of basolateral foveae.

Male sexual characters affecting frons, antennae, legs and abdominal sternites. Aedeagus very strongly sclerotized, with basal bulb wide, dorsal and ventral processes of median lobe robust, and ventral diaphragm small.

Habitat. Forests, under logs, under bark, and in litter.

Distribution. Sri Lanka and South India.

Comments. This genus is likely related to *Tribasodema* Jeannel, *Batrisodiola* Jeannel, *Coryphomobatrus* gen. n. described below, *Tribasodites* Jeannel, and *Coryphomodes* Jeannel. It shares with them, in addition to the similar habitus, the moderately inclined frontoclypeus, the long tempora, the well developed vertexal hump, the pronotum with acute antebasal tubercles, the presence of one mesal and one pair of lateral sulci and the foveal pattern, including three foveae at base of each elytron. It may be distinguished from the former three genera, but not from *Tribasodites* and *Coryphomodes*, by the discal carinae of the pronotum bearing two denticles anterior to the acute antebasal tubercle. *Tribasodites* may be distinguished from *Veddabatrus* by the presence of lateral frontal foveae, the short abdominal tergite 1, the aedeagus elongate, with large ventral diaphragm and lacking robust ventral process, and the short tibial pubescence. *Coryphomodes* was described (Jeannel, 1960b) as having elytra with two basal foveae. The type species of *Coryphomodes*, *C. cristatus* Jeannel from Kumaon, India and the other species from India, *C. calcaratus* Jeannel, *C. humeralis* Jeannel and *C. temporalis* Jeannel, have three basal foveae, while *C. brevispina* (Jeannel) and *C. spinicollis* (Sharp) from Japan have elytra with two basal foveae (material of *C. coomani* (Jeannel) was not examined). Probably, these species form a polyphyletic assemblage. *Coryphomodes cristatus*, *C. calcaratus* and *C. humeralis* are linked, and separated from *Veddabatrus*, by large antennal foveae, comparatively flat elytra not or slightly raised above plan of pronotum, with discal striae replaced by carinae, abdominal tergite 1 short, only slightly longer than tergite 2, and very short tibial pubescence. The presence of the elytral carinae is likely a synapomorphy of these three species. *Coryphomodes temporalis* lacks antennal foveae and has elytra and other diagnostic characters, including the long tibial pubescence, similar to those in *Veddabatrus sexualis*. Therefore, *Coryphomodes temporalis* Jeannel is transferred here to *Veddabatrus*, comb. n.

Unfortunately, the male genital characters of the Indian *Coryphomodes* species could not be examined. The descriptions of two of them are based on males but their dissected aedeagi are not deposited in the NHML together with the specimens. As the descriptions and illustrations of the aedeagi published in Jeannel's latest papers are often inaccurate, their characters that may indicate relationships remain to be examined.

KEY TO SPECIES OF *VEDDABATRUS*

1 Frontoclypeus with inverted Y-shaped carina. Median vertexal carina sinuate in lateral view. Margins of lateral pronotal humps with minute denticle, not crenulate. Antennal segments 3 and 4 each much longer than wide. Discal carinae of tergite 1 as long as fourth of tergite (South India) .... *V. temporalis* (Jeannel)

\- Frontoclypeus without carina. Median vertexal carina straight in lateral view. Discal carinae of tergite 1 very short 2

2 Margin of lateral pronotal humps with distinct denticle and crenulate. Antennal segments 3 and 4 slightly longer than wide. Male with frontoclypeus bearing bunch of setae, antennal segments 6 and 7 enlarged, 6 flattened ventrally .... *V. sexualis* sp. n.

\- Margin of lateral pronotal humps smooth, lacking denticles, not crenulate. Antennal segments 3 and 4 conspicuously longer than wide. Male with frontoclypeus and antennal segments 6 and 7 unmodified .*V. asper* sp. n.

Veddabatrus sexualis sp. n. Figs 30, 31, 33, 34, 37

Holotype ♂: Sri Lanka: Northern Prov.: 2 mls NE Puliyan Kulam, 6.II.70, ExpG # 48b, forest litter (MHNG).

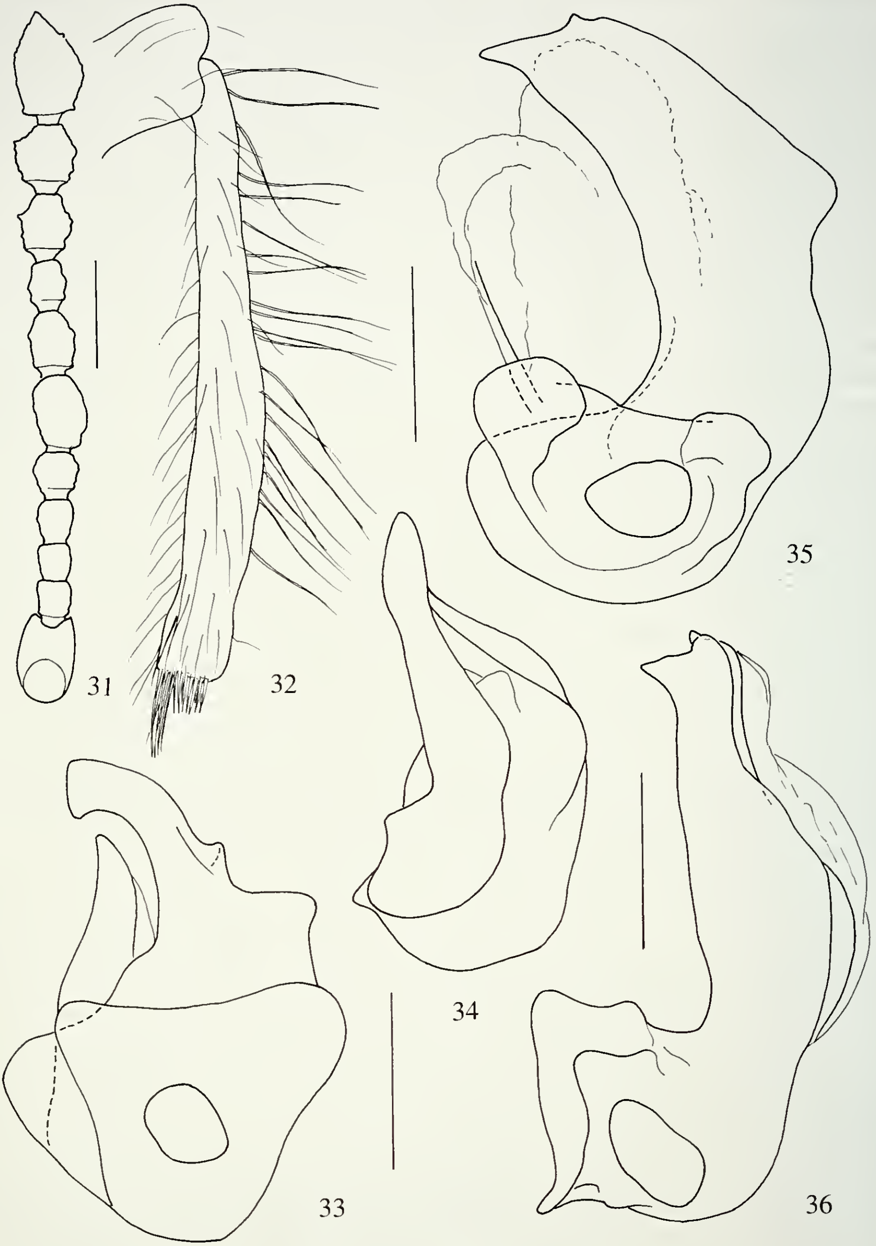
Paratypes: Sri Lanka: Northern Prov.: same data as holotype, 3 ♂, 3 ♀ (MHNG); Nedunleni, 6.II.70, ExpG # 49, forest litter, 1 ♂, 3 ♀ (MHNG); small stream 2 mls E Mankulam, 14.II.62, ExpL # 75, under logs, 1 ♂ (MZLU); North Central Prov.: Ambagaswewa, 3.II.70, ExpG # 44b, under bark, 2 ♀ (MHNG); Alut Oya, 3.II.70, ExpG # 43b, under bark, 4 ♂, 7 ♀ (MHNG, PCSK); Habarana, 7-8.II.62, ExpL # 55, under bark, 1 ♀ (MZLU); Eastern Prov.: Kantalai, 2.II.70, ExpG # 40a, under bark, 1 ♂ (MHNG).

Description. Length 2.35-2.40 mm. Pubescence semi-erect on head and pronotum, erect on elytra, recumbent on abdomen. Head with fine, granulate punctation on most of vertex; frontoclypeus irregularly wrinkled; punctation on antennal tubercles irregular, very shallow. Pubescence on median portion of vertex curved mesally, on lateral portion of vertex curved anteriorly. Median vertexal carina extended anteriorly up to line of anterior eye margin, slightly raised at anterior end, straight in lateral view. Tempora almost twice as long as eyes in dorsal view. Antennae with granulate punctation; segments 3 and 4 subequal, slightly smaller than segment 2; segments 5 and 6 in female equally large, about as long and wide as segment 2, in male segment 5 about as segment 2, following segments modified. Pronotum as wide as or slightly narrower than head with eyes. Margins of humps crenulate and with small basolateral denticle. Punctation finely granulate. Pubescence on most of disc curved posteriorly, along base curved anteriorly, on lateral humps curved mesally. Elytra about 1.5 times as long as pronotum, combined elytral width distinctly exceeding elytral length. Discal stria fine, hardly extending posterior basal third of disc. Humeral protuberance distinct, angulate. Punctation very fine and sparse. Abdominal tergite 1 about 1.1 to 1.5 times as long as tergites 2 and 3 combined. Discal carinae very short, not exceeding posterior basal impression, often concealed by elytra. Mesal part of tergite 2 horizontal, that of tergite 3 slightly inclined posteriorly. Punctation fine, consisting of punctures larger and denser that those on elytra.

Male characters. Frontoclypeus with dense bunch of yellow, erect setae. Antennae (Fig. 31) with segments 6 and 7 conspicuously modified, segment 6 about as large as scape, 1.5 times as long as wide, flattened ventrally; segment 7 smaller than segment 6, much larger than segment 2, about 1.3 times as long as wide; segment 8 as long as and narrower than segment 5, distinctly longer than wide; segment 9 about as large as segment 7; segment 10 as long as and wider than segment 9, slightly longer than wide; segment 11 about 1.7 times as long as wide, distinctly shorter than segments 9 and 10 combined. Metasternal impression very deep. Metacoxae with spinose apicoventral area (Fig. 37). Metatrochanters expanded posteriorly to form large laminae sharply margined ventrally and bearing apophysis on dorsal side (Fig. 37). Sternite 5 with large, shallow impression. Aedeagus (Figs 33, 34) with basal bulb conspicuously wide, right dorsal process abruptly narrowed, curved in apical part.

Female characters. Antennal segments 6 and 7 unmodified; segments 8 to 11 slightly shorter than those in male, segment 11 about as long as segments 9 and 10 combined.

Comments. This species is characterized by the crenulate pronotal humps and the sexually modified frons and antennal segments 6 and 7.



FIGS 31 to 36: *Veddabatrus* gen. n.

31: *V. sexualis* sp. n., male antenna, scale bar = 0.2 mm; 32: *V. asper* sp. n., male metatibia, scale bar = 0.1 mm; 33 and 34: *V. sexualis* sp. n., aedeagus in ventral (33) and lateral (34) views, scale bar = 0.1 mm; 35 and 36: *V. asper* sp. n., aedeagus in ventral (34) and lateral (35) views, scale bar = 0.1 mm.

Veddabatrus asper sp. n. Figs 32, 35, 36, 38

Holotype ♂: SRI LANKA: SABARAGAMUWA PROV.: Deerwood, Kuruwita, 6 mls NNW Ratnapura, 18-21.II.62, ExpL # 90:III, under bark of logs, forest (ZMLU).

Description. Length 2.3 mm. Pubescence as in *V. sexualis.*

Head without granulate punctuation. Punctation fairly coarse on frontoclypeus and on antennal tubercles, very fine on vertexal hump, coarse and very irregular, forming wrinkles, posterior antennal tubercles, on lateral parts of vertex. Mesal vertexal carina straight, thickened and raised anteriorly, forming a tubercle. Tempora moderately longer than eyes in dorsal view. Antennae with fine, granulate punctation; segments 3 to 7 about equally wide; segment 2 and 3 equally long, segment 3 slightly slender than segment 2, about 1.5 times as long as wide; segment 4 longer than segment 3, about twice as long as wide; segment 5 distinctly longer than segment 4; segments 6 and 7 each about as long as segment 4 (followings segments missing). Pronotum hardly wider than long and slightly wider than head with eyes. Margins of humps smooth, lacking basolateral denticle. Punctation partly granulate, mostly very fine, on admesal areas partly coarse. Elytra about 1.3 times as long as pronotum, combined elytral width distinctly exceeding elytral length. Humeral protuberance angulate. Discal striae short and almost faint, not reaching posterior basal fifth of disc. Punctation very fine. Abdomen with tergite 1 about as finely punctate as elytra. Discal carinae very short, about as long as 1/8 of tergite, exposed in dorsal view. Tergites 2 to 4 strongly inclined ventrally.

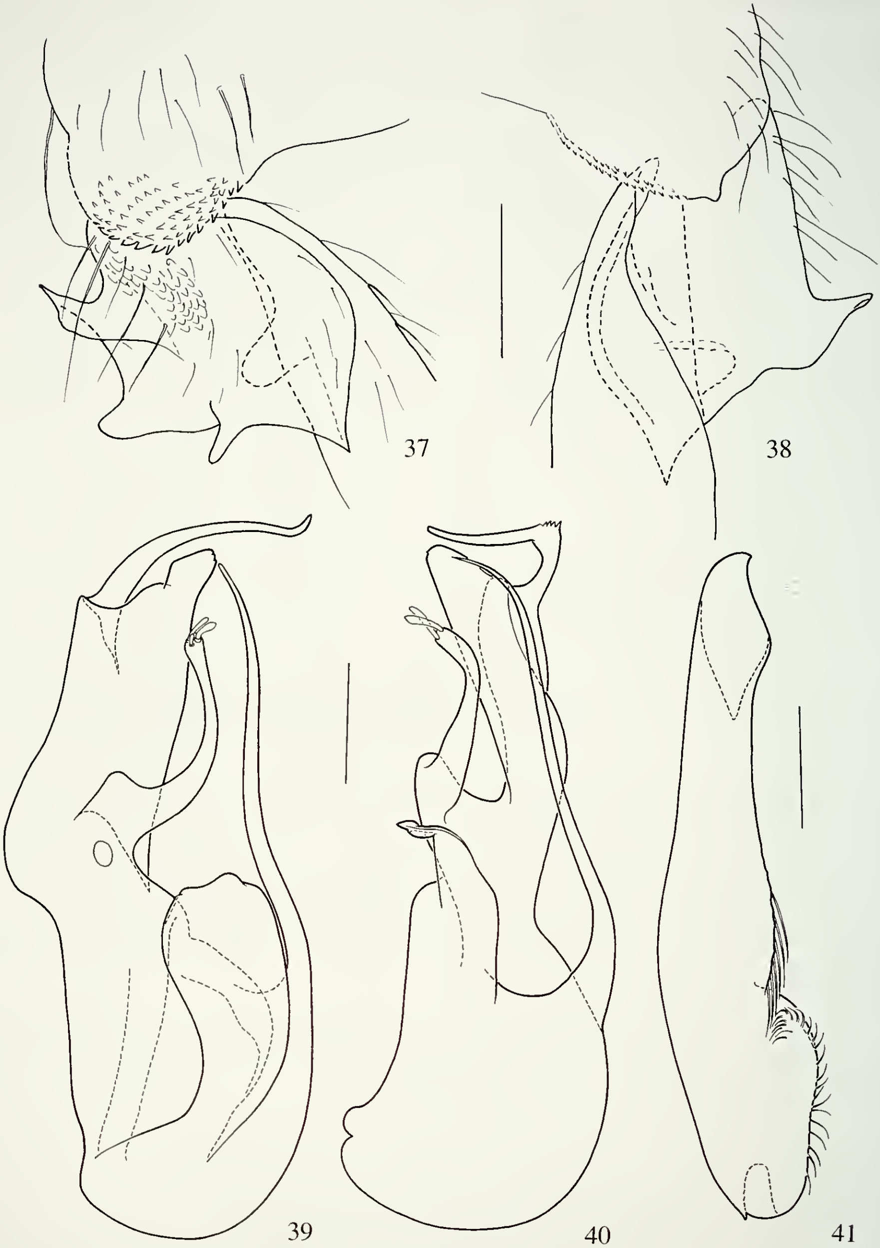
Male characters. Metasternum very deeply impressed. Mesotrochanters each with small, slender, basal apophysis. Mesotibiae straight, thickened from base to middle, from middle to apical fourth almost evenly thick, narrowed subapically (Fig. 32). Apical margin of metacoxae spinose on narrow area. Metatrochanters with anterior margin expanded to form smooth, arcuate lamina; denticulate at centre of apical margin (Fig. 38). Metatibiae almost straight and evenly slender in basal two fifth, in apical three fifth slightly curved and thickened, bearing bunch of long, robust apical setae. Sternite 5 flattened, with conspicuously dense punctation, middle part of apical margin convex. Aedeagus (Figs 35, 36) with basal bulb much wider than long, right dorsal process large, arcuate, obtusely angulate at middle of outer margin and acute at tip in ventral view.

Comments. This species may be easily distinguished from *V. sexualis* by the smooth pronotal humps and unmodified frons in male, and from *V. temporalis* by the very short discal carinae of the abdominal tergite 1.

Coryphomus Jeannel Fig. 42

Coryphomus Jeannel, 1949: 136; type species: *Batrisus gladiator* Raffray, 1913.

Leleup (1981) redescribed and also raised to genus rank the monospecific *Camptomites* Jeannel and *Camptomidius* Jeannel that Jeannel placed previously as subgenera of *Coryphomus*. This action was published somewhat cryptically and overlooked by subsequent workers. *Coryphomus* includes presently 35 valid species, all Afrotropical in distribution. Leleup (1976) found *Coryphomus* common in forested areas and expected tens of additional species to be discovered. *Coryphomus* is



FIGS 37 to 41

37: *Veddabatrus sexualis* gen. n., sp. n., male metatrochanter; 38: *V. asper* sp. n., male metatrochanter; 39 and 40: *Coryphomobatrus frater* gen. n., sp. n., aedeagus in dorsal (39) and lateral (40) views; 41: *Coryphomus adventus* sp. n., male metatibia. Scale bars = 0.1 mm.

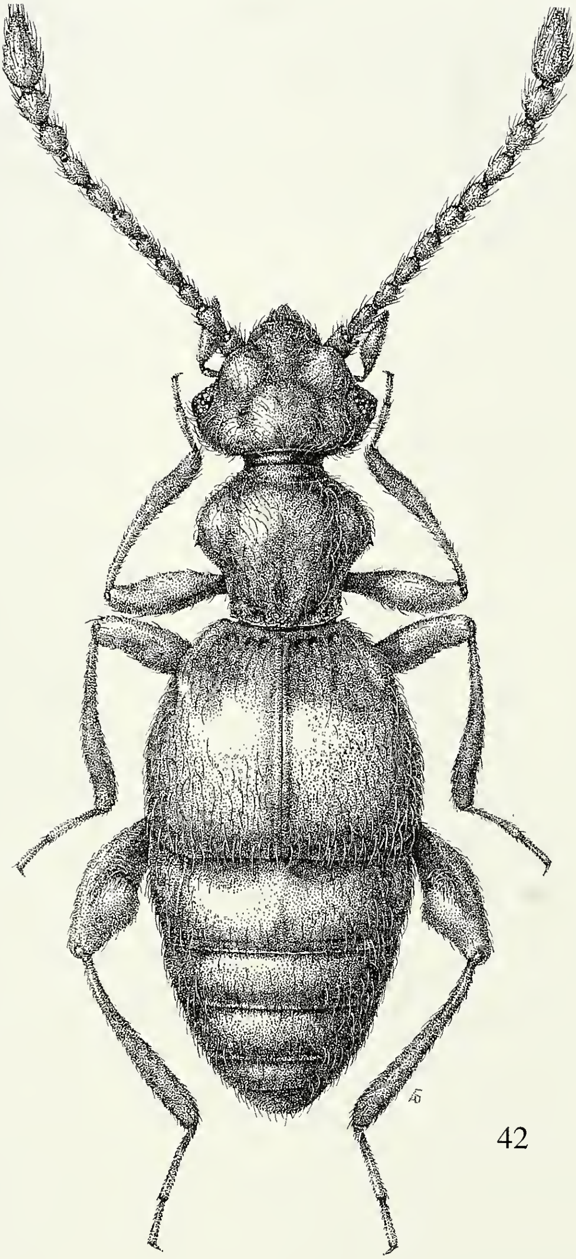


FIG. 42
Coryphomus adventus sp. n.

morphologically diverse and its constituent species are not linked by any known synapomorphy. However, the Sri Lankan species described below fits the description (Jeannel, 1949), the key characters (e.g., Jeannel 1959), and the Leuleup's 1981 redescription of *Coryphomus*. We have examined seven Afrotropical species of *Coryphomus* s. str. and failed to find convincing reasons not to include the new species within the group. In addition to *Coryphomus* s. str., *Coryphomellus* Jeannel is the only subgenus currantly recognized as valid. It includes three species with pronotal disc having tri-spinose carinae.

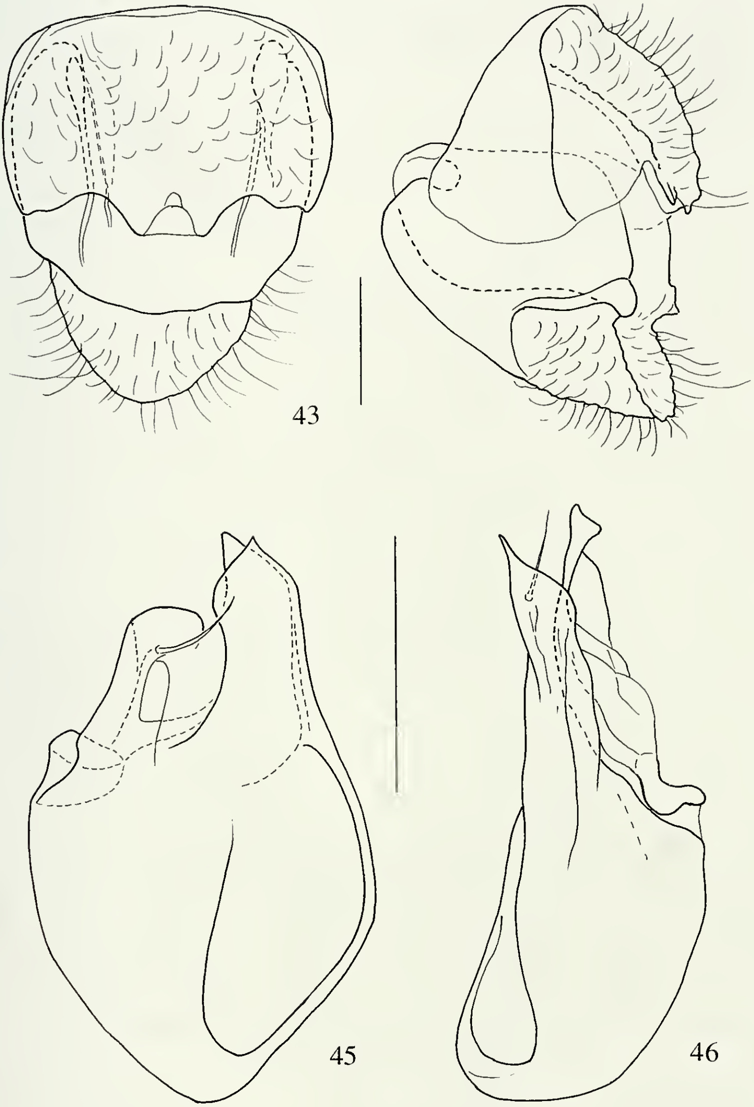
Coryphomus (Coryphomus) adventus sp. n. Figs 41, 42, 45, 46

Holotype ♂: Sri Lanka: North Western Prov.: Rajakadaluwa, sea level, coconut plantation, 31.I.70, ExpG # 36b (MHNG).

Paratypes: Sri Lanka: North Western Prov.: same data as holotype, 2 ♂, 7 ♀ (MHNG, PCSK).

Description. Habitus as Fig. 42. Length 1.65-1.70 mm. Body convex, slender. Punctation dense and fine, slightly finer on abdomen than on remainder of dorsal surface of body. Pubescence short, recumbent.

Head subrectangular, as long as wide, slightly narrowed than pronotum. Vertex raised mesally, forming hump delimited by vertexal foveae and semicircular sulcus. Posterior and lateral sides of vertex convex. Vertexal median carina very short, extending from up to highest point of vertex. Antennal fossa widely separated. Lateral frontal foveae absent. Interantennal bridge impressed. Frontoclypeus large, frontal lobe gradually inclined, throughout distinct in dorsal view. Antennal tubercles faint or weakly developed. Semicircular sulcus well delimited, narrow, with transverse section wide, only slightly arcuate. Lateral margins of head carinate; carinae sinuate, extending on to antennal tubercles and frontoclypeus, on frontoclypeus converging but not joined. Eyes large, prominent, multifaceted, with centres slightly anterior to line of vertexal foveae. Tempora long, strongly narrowed toward neck, without longer, erect setae. Ventral side of head not swollen, moderately inclined toward neck. Postgenae with basal row of long, erect setae orientated ventrally. Neck with dorsomedian carina. Antennae long, slender. Scape short, narrowed basally, flattened dorsally, with apical angles not expanded. Segments 2 to 8 similar in size; club distinctly 3-segmented. Antennal segment 2 almost twice as long as wide; segments 3 to 7 each as long as and slightly narrower than segment 2; segment 8 hardly smaller than segment 7; segment 9 symmetrical, 1.3 times as long as wide; segment 10 asymmetrical, almost as long as segment 9, slightly longer than wide; segment 11 slightly shorter than combined length of segments 9 and 10, about 1.6 times as long as wide. Maxillary palpi with segment 3 short, narrowed mesally; segment 4 with short basal stalk, widest anterior to mid-length. Pronotum moderately convex, as long as wide, as wide as head, widest at mid-length, abruptly narrowed posterior widest point, with short, almost faint median sulcus and two lateral sulci. Lateral humps distinct, each bearing marginal tubercle. Disc with two small antebasal thorns araising from minute tubercles and separated by impression, two pairs of laterobasal and one pair of lateral foveae. Lateral margins with acute denticle at widest point. Hypomera smooth, paranotal ridge entire. Elytra moderately convex dorsally, about in plan with pro-



FIGS 43 to 46

43 and 44: *Coryphomobatrus frater* gen. n., sp. n., female abdominal segment 5, ventral (43) and lateral (44) views, scale bar = 0.2 mm; 45 and 46: *Coryphomus adventus* sp. n., aedeagus in ventral (45) and lateral (46) views, scale bar = 0.1 mm.

notum, above plan of abdomen, moderately inclined toward apical margin, broadly rounded laterally, combined much wider than long; about 1.5 times as long as pronotum; about as long as combined length of tergites 1 to 3. Each elytron with sutural, discal and lateral striae and three basal foveae; subhumeral fovea lacking. Discal striae reaching to middle third of discal length; lateral striae almost reaching line of humeral protuberances, throughout parallel to margins; humeral protuberance distinct, rounded. Metasternum strongly convex, throughout punctate and pubescent, with median impression narrow and shallow; lateral metasternal foveae fairly close, lying posterior metasternal process, smaller than interval between them. Apical metasternal process prominent, narrow, bilobed. Legs slender. Femora curved, strongly narrowed basally, weakly narrowed apically. Tibiae slightly curved, thickened posterior midlength, near apex narrowed, lacking erect or longer setae, with dense, robust pubescence on mesal side of apical third or two fifth. Tarsi slender, with segments 2 and 3 about equally long. Abdomen with 5 tergites exposed in dorsal view, gradually narrowed apically. Tergites 1 to 3 almost in same plan, following two tergites inclined. Tergite 1 about as long as tergites 2 and 3 combined, impressed basally, lacking discal carinae, with inner and outer lateral carinae not raised and not reaching apical margin, and two pairs of basolateral foveae. Tergites 2 and 3 similar in length, lacking foveae, much shorter than tergite 1, slightly shorter than tergite 4, with short lateral carinae. Sternite 1 with two basomedian foveae lying posterior intercoxal process and two pairs of basolateral foveae; lacking carinae. Following sternites lacking foveae.

Male characters. Metafemora strongly widened toward middle, from middle part to apex gradually narrowed, at apex much wider than at base; widest part of femora with dorsal side flattened. Apicodorsal portion of metatibiae abruptly swollen to form a conspicuous tubercle (Fig. 41), with mesal ridge inclined toward base. Aedeagus (Figs 45, 46) weakly sclerotized, flat, with large ventral diaphragm, ventral process bearing long subapical seta, dorsal process articulated, acute at apex.

Habitat. The specimens were found in sieved rotten logs of coconut palms. The metathoracic wings are well developed in both sexes indicating easy dispersion.

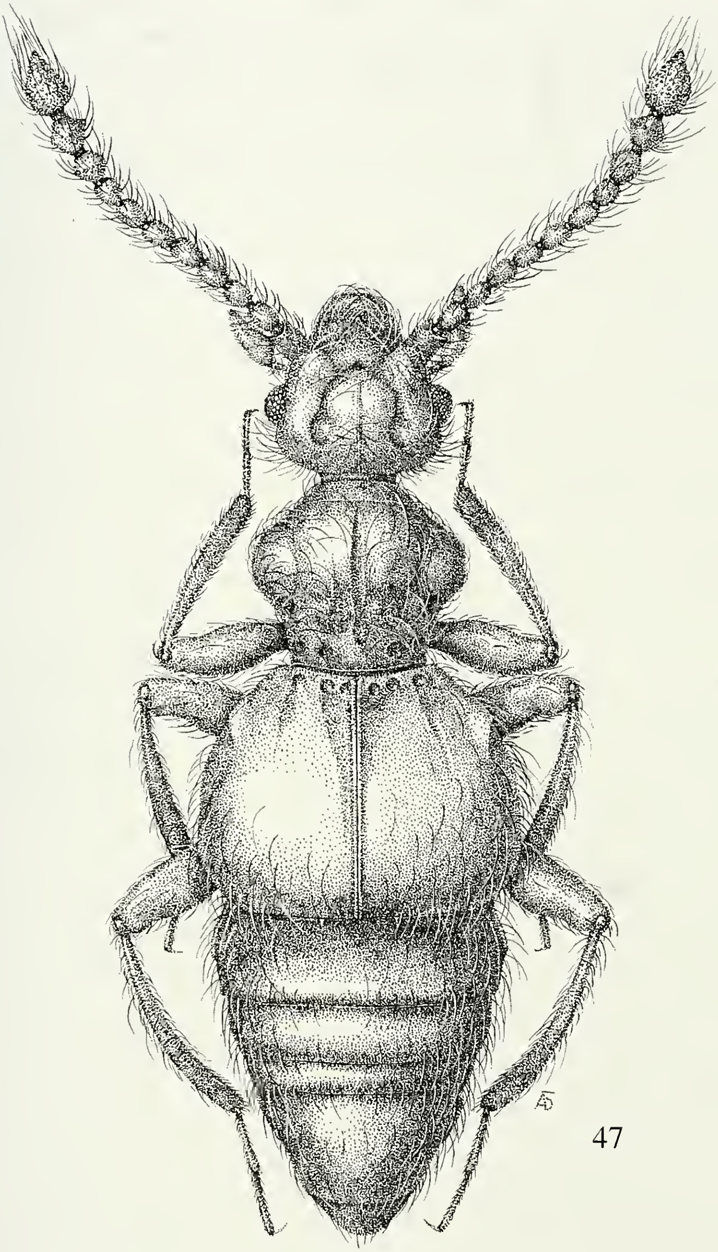
Comments. This species resembles *C. debeckeri* Leleup from Tanzania by the abdominal tergite 1 lacking discal carinae and the pronotum having a single pair of discal denticles. It differs from *C. debeckeri* by the elytra with three basal foveae, and from all members of *Coryphomus* by the male characters, in particular by the dorsoapically swollen metafemora, similar to those in *Eleodimerus* Jeannel.

Coryphomobatrus gen. n. Fig. 47

Type species: *Coryphomobatrus frater* sp. n. Gender: masculine.
Etymology: derived from the generic names *Coryphomodes* and *Batrisus*.

Description. Habitus as Fig. 47. Body convex, 2.8-3.0 mm long. Punctation mostly very fine and sparse. Pubescence long.

Head suboval, with eyes wider than long. Vertex with median hump large, well delimited by vertexal foveae and deep semicircular sulcus. Median vertexal carina well developed. Antennal fossae widely distant. Antennal tubercles distinct, gradually inflecting toward midline of interantennal bridge. Interantennal bridge and fronto-



47

FIG. 47
Coryphomobatrus frater gen. n., sp. n.

clypeus not separated, wide, almost in same plan, distinct from above. Lateral frontal foveae present, open laterally. Areas posterior antennal tubercles horizontal, convex laterally. Mandibular-ocular carinae bifid, with upper branch curved dorsally distant from eyes margin, lower branch reaching eye margin. Eyes with small facets. Tempora long, evenly convex. Occipital margin moderately raised above plan of neck, convex. Postgenae with perpendicular, long and sparse setae. Gular area not swollen, slightly inclined toward neck. Gular foveae in very deep foveiform impression. Neck with mediodorsal carina.

Antennae moderately long. Scape and pedicel subcylindrical, apical angles of scape not expanded and lacking glandular opening; segments 3 to 7 similar to pedicel. Club distinctly 3-segmented. Maxillary palpi with segment 2 curved and gradually thickened toward apex; segment 3 short, narrowed mesally, segment 4 without basal stalk, gradually narrowed apically.

Pronotum cordiform, about as long as wide, strongly convex, strongly narrowed anterior and posterior lateral humps, raising high above plan of head, with median and two lateral sulci, pair of robust antebasal tubercles, basomedian and two admesal carinae, two pairs of inner basolateral foveae, one pair of outer basolateral foveae and one pair of antebasal foveae. Lateral humps large, convex, lacking marginal denticles. Paranotal ridge strongly arcuate, not shortened.

Elytra convex dorsally and laterally, raising above plan of pronotum and abdomen, longer and much wider than pronotum, steeply inclined toward apical margin, each with three basal foveae, deep sutural, one discal and one lateral stria; subhumeral fovea absent. Base raised, fold-like above foveae.

Mesosternum with median foveae distinctly separated. Anterior forks of lateral mesosternal foveae as long as but narrower than posterior forks. Metasternum deeply impressed in middle, with lateral metasternal foveae close, in common impression posterior metasternal process.

Legs long. Femora straight, swollen in large middle part. Tibiae slender, with long, erect pubescence. Tarsi slender, with segments 2 and 3 about equally long.

Abdomen convex, longer than elytra, with 5 tergites exposed. Tergite 1 comparatively short, parallel-sided, impressed at base, raising toward apex, with pair of laterobasal foveae, two pairs of mediobasal foveae at each side of long discal carinae. Outer and inner marginal carinae of tergite 1 not raised, outer short, hardly reaching apical third of tergite, inner extending to apical margin. Tergites 2 and 3 similar in size, parallel-sided, combined about as long as tergite 1, each with three pairs of basal foveae. Mesal part of tergite 2 horizontal, that of tergite 3 slightly inclined posteriorly. Tergite 4 conspicuously large, longer than tergite 1, inclined posteriorly. Tergite 5 prominent. Sternite 1 with two deep, basoadmedian and two large, basolateral impressions covered by pubescence; six basal foveae lying at each end of basal impressions. Sternites 2 and 3 each with one pair of lateral foveae.

Male secondary sexual characters affecting legs and abdominal sternites. Aedeagus complex, strongly sclerotized, distal process of median lobe in same plan as basal bulb, bearing slender apophysis and modified setiform sensilla.

Habitats. Moist litter, in sub-montane evergreen forest zone.

Distribution. Sri Lanka.

Comments. Coryphomobatrus shares many characters with *Tribasodema* Jeannel, *Batrisodiola* Jeannel, *Veddabatrus* gen. n., *Tribasodites* Jeannel, and *Coryphomodes* Jeannel (see comments under *Veddabatrus*). In addition to their habitus, members of these genera are similar in having wide, moderately inclined frontoclypeus, long tempora, mesal vertexal hump, pronotum with acute antebasal tubercles or thorns, one mesal sulcus and one pair of lateral sulci, and each elytron with three basal foveae. *Coryphomobatrus* may be distinguished from these genera by the strongly enlarged abdominal tergite 4. This new genus differs from *Batrisodiola*, erroneously described as having only two basal foveae on each elytron (Jeannel, 1960b), by the presence of pronotal carinae anterior to antebasal tubercles, the absence of subhumeral foveae and the aberrant type of the aedeagus. *Batrisodiola* has the tergite 1 with marginal and discal carinae similar to those in *Coryphomobatrus* but the tergite 4 almost perpendicular to the body axis, about as long as two thirds of tergite 1. *Coryphomodes*, with tergite 1 comparatively short, much shorter than tergites 2 and 3 combined, shares the pattern of abdominal carinae with *Coryphomobatrus* and *Batrisodiola*. It may be separated from these two genera also by the flat elytra and by the lateral margin of pronotal humps bearing a denticle. *Tribasodema*, that lacks discal carinae on abdominal tergite 1, possesses pronotum with two pairs of acute discal tubercles and one pair of additional sulci.

Coryphomobatrus frater sp. n. Figs 39, 40, 43, 44, 47

Holotype ♂: SRI LANKA: UVA PROV.: Haputale, 1350m, 23.I.70, ExpG # 19a, forest litter in ravine (MHNG).

Paratypes: SRI LANKA: UVA PROV.: same data as holotype, 3 ♀ (MHNG, PCSK).

Description. Length 2.8-3.0 mm. Punctation very fine. Pubescence semi-erect on head and pronotum, erect on elytra, recumbent on abdomen. Abdomen with several particular, long setae. Head slightly longer than wide (ratio 48/45), with eyes distinctly wider than long. Vertexal hump raising above plan of antennal tubercles, almost horizontal in mid-line, convex and inclined anteriorly and laterally. Mesal carina robust, extending up to anterior section of semicircular sulcus. Lateral frontal foveae small, open laterally. Frontoclypeus with very dense, irregular punctation and low, inverted Y-shaped carina (faint in 2 females). Eyes large, prominent, and multifaceted. Tempora in male slightly less than twice as long as eyes, in female twice as long as eyes in dorsal view. Antennal segments 3 to 7 subequal, about as long and wide as pedicel; segment 8 slightly shorter than segment 7; segment 9 elongate; segment 10 as long as segment 9, almost as wide as long; segment 11 comparatively short, 1.5 times as long as wide. Pronotum about as long as wide, much longer than head (ratio 60/48), wider than head with eyes, at widest point 1.5 times as wide as at base. Mesal sulcus widened at base, touching basomedian carina, extending up to anterior fourth of disc. Antebasal tubercles acute, pointed dorsally. Median sulcus in impressed mesal portion, extending up to anterior fifth of pronotum. Admesal ridges low, short, undulate, lacking denticles. Elytra with adsutural areas raised; humeral protuberances distinct, rounded; discal striae reaching slightly posterior mid-length of disc. Protibiae and mesotibiae slightly arcuate. Mesotibiae flattened and bearing dense, short, robust setae on anterior and posterior sides of apical third. Metatibiae straight and evenly slender in basal half, curved and thickened in apical half, with dense, robust setae on mesal side of apical half. Abdomen with tergite 4 as long as combined length of tergite 1 and half of tergite 2 (male), or almost as long as combined length of tergites 1 and 2 (female). Discal carinae of tergite 1 as long as one third of tergal length.

Male characters. Mesotibiae with basomesal margin extended to form a lobe. Tergite 5 subtriangular, with apical margine thickened, folden lateroapically, emarginate apically. Sternite 2 flattened in middle part, with small, medioapical lobe raising ventrally. Middle parts of sternites 3 and 4 transversally swollen. Sternite 5 with large mesal impression deepest at sternal basis and with medioapical lobe, thickened apically to form circular surface perpendicular to abdominal axis. Aedeagus (Figs 39, 40) elongate. Median lobe with small process araising from left edge of ventral side, slender, sinuate apophysis araising from dorsal side of basal bulb, and large, complex apical portion bearing three processes. Ventral process expanded by narrow apophysis with two terminal, flat setae, dorsal process with subapical, strongly curved apophysis bearing minute denticles at widest point.

Female characters. Tergite 5 prominent, with apicoventral side flat, strongly sclerotized, conspicuously sculptured and pubescent. Sternite 5 with medio-apical process notched in middle (Figs 43, 44).

Nesiotomina Jeannel Fig. 48

Nesiotomina Jeannel, 1961: 431; type species: *Batrisus spinicollis* Motschulsky, 1858.

Description. Habitus as fig. 48. Body slender, 1.2–2.0 mm long. Punctation conspicuously coarse and dense on elytra, fine and sparse on pronotum and abdomen. Pubescence long, erect or semi-erect on pronotum and elytra, semi-erect or recumbent on abdomen.

Head about as long as wide or wider than long, about as wide as pronotum. Vertex moderately convex, with occipital margin rounded. Frontal lobe gradually inclined. Vertexal sulci broadly semicircular, joined to vertexal foveae, curved at interantennal faint bridge. Antennal tubercles distinctly raised. Lateral frontal foveae absent. Eyes usually small, prominent, not notched, with minute facets, anterior eyes margin about at mid-length of head. Tempora distinct, vertical. Surface above eyes vertical. Ocular-mandibular carina reaching eye margin. Venter swollen, lacking carina, transversely impressed posterior mentum. Postgenae with erect setae. Gular foveae close, in common impression. Ventral pubescence short and recumbent, on lateroposterior areas fairly long and erect.

Antennal scape elongate, subcylindrical, slightly asymmetrical, with apical angles equally prominent. Pedicel much smaller than scape, symmetrical, about as long as wide or elongate. Antennal segments 3 to 7 moniliform. Segment 8 similar to segment 7, or larger and asymmetrical. Segments 9 to 11 forming distinct club. Maxillary palpi moderately long; segment 3 small, about as long as wide, widened mesally, segment 4 wide basally, lacking stalk.

FIG. 48
Nesiotomina bellax sp. n.

Pronotum convex, raised slightly above plan of head. Disc with 5 longitudinal discal sulci and 6 smooth, basal foveae. Lateral pair of basal foveae not visible from above. Antebasal transverse ridge interrupted in middle, with two pairs of thorns araising each near basal end of lateral sulci. Lateral protuberances distinct. Additional ventrolateral sulci delimiting from below lateral protuberances. Hypomeral sulcus oblique at each side of prosternum. Hypomera indistinctly delimited.

Elytra convex, raised notably above plan of pronotum, arcuate laterally, each with three basal and one subhumeral foveae. Sutural and discal striae absent. Lateral carina well developed, joined to subhumeral fovea. Metathoracic wings reduced.

Median mesosternal foveae separated. Lateral mesosternal foveae with anterior forks almost as large as posterior forks. Metasternum strongly swollen, with apicomedian impression; apical metasternal process prominent, notched. Mesocoxal process of metasternum triangular. Lateral metasternal foveae in small impressions, with diameters about as large as interval between them.

Legs slender. Tarsal segments 2 and 3 similar in length.

Abdomen with four tergites visible in dorsal view. Tergite 1 large, longer than following tergites combined, with two pairs of basal foveae, basal transverse carina, entire lateral and marginal carinae. Following tergites with inconspicuous marginal carinae and one pair of minute, smooth, lateral foveae. Abdomen ventrally swollen. Sternite 1 large, with pair of foveae below basomedian process, pair of basodiscal and pair of basolateral foveae. Following sternites lacking foveae.

Male secondary sexual characters affecting antennal segments 7 to 11, with club segments strongly modified, and present eventually on elytra and legs. Eyes in males larger than in females, contours of male elytra eventually different from those in females. Aedeagus slightly sclerotized, elongate, flat, lacking sensilla, with distal process of median lobe narrow.

Habitat. Moist forest litter in wet evergreen lowland to montane ecosystem. Only one species, *N. bellax*, occurs in dry Chloroxylon ecosystem and is widely distributed.

Distribution. Sri Lanka and South India (the Indian record of a probably new species from Ponmuti Hill Resort, Kerala (PCPH) is unpublished).

Comments. Males of *Nesiotomina* exihit antennal club strongly modified, with a glandular socle, conspicuously similar to that in members of the Afrotropical Ambicocerina (Leleup, 1970). *Nesiotomina* differs drastically from Ambicocerina by the pronotum that is carinate in Ambicocerina, and by the elytra lacking sutural striae.

KEY TO SPECIES OF *NESIOTOMINA* OF SRI LANKA

1 Pronotum with tomentose stripes covering outer lateral sulci. Vertex convex posteriorly, without median fovea or sulcus . . . . *N. spinicollis* (Motschulsky)

- Pronotum without tomentose stripes 2

2 Antennal segment 3 distinctly elongate 3

- Antennal segment 3 as wide as long or wider than long 4

3 Pronotum with admesal intervals strongly narrowed anteriorly, narrower than anterior section of intervals between inner and outer lateral sulci. Antennal segments 4 and 6 each about as long as wide . . . . *N. transjugata* sp. n.

- Pronotum with admesal intervals weakly narrowed anteriorly, wider than anterior sections of intervals between inner and outer lateral sulci . . . . *N. longicollis* Jeannel

4 Vertex with median fovea or sulcus touching anterior end of median carina . 5

- Vertex without median fovea or sulcus 9

5 Vertex with median fovea not or slightly elongate, lying between dorsal tentorial foveae and not or slightly extending anterior to line of vertexal foveae 6

- Vertex with median sulcus extending far anterior to line of vertexal foveae . . 8

6 Lateral protuberances of pronotum impressed dorsobasally. Male mesotibiae without ventral tooth; antennal segment 9 strongly enlarged and modified, with upper side flattened 7

- Lateral protuberances of pronotum not impressed dorsally. Male mesotibiae with prominent tooth on ventral side. Male antennal segment 9 small, moderately modified, with upper side not flattened (Fig. 54) . . . . *N. foveifrons* sp. n.

7 Lateral portions of vertex very finely punctate above eyes. Outer sides of male antennal segments 9 and 10 equally long (Fig. 52). Male eyes very small, with 12 to 14 facets . . . . *N. difficilis* sp. n.

- Lateral portions of vertex coarsely punctate above eyes. Male antennal segment 9 much longer than segment 10 (Fig. 49). Male eyes large, multifaceted . . . . *N. appendiculata* sp. n.

8 Median sulcus of vertex extended to, or almost to, semicircular sulcus. Male profemora not thickened, similar to mesofemora . . . . *N. perbrincki* sp. n.

- Median sulcus of vertex shorter, ending fairly far from semicircular sulcus. Male profemora strongly thickened, much thicker than mesofemora . . . . *N. femoralis* sp. n.

9 Antennal segments 3 to 5 each about as long as wide. Male antennal segments 7 and 8 conspicuously widened (Fig. 51) . . . . . . *N. carinifrons* sp. n.

- Antennal segments 3 to 5 each notably wider than long. Male antennal segments 7 and 8 not conspicuously widened 10

10 Median vertexal carina extending to semicircular sulcus. Inner side of male mesotibiae strongly widened from base to middle, abruptly narrowed posterior middle, lacking prominent tooth . . . . *N. tibialis* sp. n.

- Median vertexal carina ending notably posterior semicircular sulcus. Inner side of male mesotibiae slightly arcuate, not widened; upper side of male mesotibiae with prominent, subapical tooth . . . . *N. bellax* sp. n.

Nesiotomina appendiculata sp. n. Figs 49, 61, 62

Holotype ♂: SRI LANKA: UVA PROV.: Diyaluma Falls, ca. 450m, 25.I.70, litter at waterfalls, ExpG # 26 (MHNG).

Description. Length 1.25 mm. Head with lateral contours subparallel, hardly narrowed anteriorly in dorsal view. Frontoclypeus strongly inclined. Punctation coarse and dense posterior and between antennal tubercles, and on frontoclypeus. Vertexal punctation sparse and very fine, almost obsolete. Vertex with central, slightly elongate median fovea between vertexal foveae, median carina extended from median fovea to occiput. Tempora rounded. Antennal segments 3 to 5 equally long, segment 4 slightly narrower than segments 3 or 5; segment 6 slightly smaller than preceding segment. Pronotum 0.30 mm long, 0.31 mm wide. Disc with mesal and inner lateral sulci almost equally deep and wide; inner and outer lateral sulci parallel, admesal intervals wider than intervals between inner and outer lateral sulci and almost flat. Lateral protuberances convex, with fairly large dorsobasal impression; outer lateral sulci not covered by pubescence. Inner antebasal thorns pointed obliquely backward and slightly curved. Abdominal pubescence recumbent.

Male characters. Eyes prominent, multifaceted, largest diameter of eyes about as interval between eyes and upper head margins, smaller than temporal length. Antennal segments 7 and 8 slightly widened, asymmetrical, narrowed at inner side. Segments 9 to 11 (Figs 49) strongly enlarged and asymmetrical. Segment 9 flattened dorsally, with dorsal side densely punctate, inner side obliquely truncate and smooth up to outer apical angles. Segment 10 shorter than segment 9, with outer side as long as half of outer side of segment 9, becoming longer toward inner side, inner side deeply notched. Segment 11 with large, curved, basal process extending basally anterior segment 10 and almost covering its excavation; tip of process narrow and curved. Humeral margins of elytra almost oblique, humeral protuberances low. Prolegs with trochanters slightly prominent, femora swollen and slightly asymmetrical (similar as in Fig. 83). Mesolegs and metalegs without obvious sexual characters. Metatibiae slender in basal half, distinctly curved and swollen in apical half. Aedeagus (Figs 61, 62) with distal process of median lobe sinuate laterally and slightly notched at apex in dorsal view, curved, very narrow and bidentate at apex in lateral view.

Comments. This species is similar, in exoskeletal characters and notably by the male antennae, to *N. difficilis*, *N. perbrincki* and *N. femoralis*. It may be distinguished from them by the long vertexal sulcus, the pattern of the vertexal punctation and the multifaceted eyes in male.

Nesiotomina bellax sp. n. Figs 48, 50, 63, 64, 86

Holotype ♂: SRI LANKA: UVA PROV.: Diyaluma Falls, ca 400m, 23.I.70, forest downstream waterfalls, ExpG # 21 (MHNG).

Paratypes: SRI LANKA: UVA PROV.: same data as holotype, 3 ♂, 10 ♀ (MHNG, PCSK); same but 450 m, 25.I.70, ExpG # 26, 2 ♂, 7 ♀; Diyaluma Falls, 600m, 17.I.65, R. Mussard, 2 ♂ (MHNG); 6 mls N Monaragala, 13.II.70, ExpG # 64, forest litter, 2 ♂, 2 ♀ (MHNG); Westminster Abbey, 25 mls ESE Bibile, 7.III.62, ExpL # 119:III, 1 ♂, 2 ♀ (MZLU); CENTRAL

Prov.: Hasalaka nr. Weragamtota, 250m, 11.II.70, ExpG # 59, forest litter, 1 ♂ (MHNG); Weragamtota, 300m, 2.I.64, R. Mussard, 2 ♂, 1 ♀ (MHNG); Mululla, 600m, 4.II.70, ExpG # 45, forest above Mululla, 1 ♂, 6 ♀ (MHNG); Kandy, 700m, 19.I.65, R. Mussard, 3 ♀ (MHNG); Madugoda, 1200 and 1500m, 28 and 30.I.64, R. Mussard, 17 ♂, 26 ♀ (MHNG, PCSK); Southern Prov.: Tissamaharama, 22.I.64, R. Mussard, 1 ♀ (MHNG); Sabagaramuwa Prov.: Karagal Oya at 1900ft 3mls ENE Belihul Oya, 2.III.62, ExpL # 110, 1 ♂ (MZLU).

Description. Length 1.45-1.60 mm. With external characters very similar to *N. tibialis* and *N. transjugata*. Head with frontoclypeal punctation finer than punctation posterior antennal tubercles, coarser than that on middle portion of vertex; median vertexal crest reaching up to or anterior to line of vertexal foveae, ending distant semicircular sulcus. Antennal segments 3 to 6 each wider than long; segment 5 slightly larger than segments 4 and 6. Pronotum 0.36-0.37 mm long and wide, with admesal intervals about as wide as intervals between inner and outer lateral sulci. Pubescence along outer lateral sulci as in *N. tibialis*. Median metasternal impression large, fairly shallow.

Male characters. Eyes multifaceted, with largest diameter distinctly exceeding interval between eye and upper head margin and temporal length. Antennal segments 7 and 8 slightly larger than segment 5; segment 8 slightly asymmetrical, with outer side longer than inner side. Club segments (Fig. 50) similar to those in *N. transjugata* and *N. tibialis*, segment 10 notably larger, segment 11 with sharply delimited, slightly prominent, nude, basoventral area. Protrochanters with minute tubercle in middle of ventral margin. Profemora swollen. Mesotrochanters with minute tubercle near base. Mesofemora impressed mesally and bearing large, slightly oblique tooth on upper posterior margin, at distal end of basal third of femoral length (Fig. 86). Mesotibiae flattened mesally, gradually widened toward apical fifth (lateral view), with robust tooth raising obliquely just anterior to apical fifth. Aedeagus (Figs 63, 64) with median lobe widened ventrally and abruptly curved at apex; internal sac curved apico-ventrally.

Female characters. Eyes small, with about 12 facets, largest eye diameter about as temporal length, exceeding interval between eye and upper head margin.

Comments. This species may be distinguished from its congeners by the vertex lacking median fovea or sulcus, in combination with the presence of a short vertexal carina and the male mesotibiae bearing a prominent, subapical tooth.

Nesiotomina carinifrons sp. n. Figs 51, 65, 66

Holotype ♂: Sri Lanka: Central Prov.: Kandy, ca 600m, 15.I.70, ExpG # 3c (MHNG).

Paratypes: Sri Lanka: Central Prov.: Madugoda, 30.I.64, 1200m, R. Mussard, 1 ♂ (MHNG); Kandy, Udawattekele Sanctuary, 600m, 2.I.70, ExpG # 81, 1 ♂ (MHNG).

Description. Length 1.55-1.65 mm. Head with lateral contours converging anteriorly. Frontoclypeus strongly inclined. Punctation coarse and dense on and posterior antennal tubercles, becoming fine posterior line of vertexal foveae, moderately coarse on frontoclypeus, very fine on large middle portion of vertex. Vertex slightly convex, not raised posteriorly, with median carina extended from occiput anterior to line of vertexal foveae, not reaching up to semicircular sulcus. Tempora subangulate. Antennal segments 3 to 6 equally long, segments 5 and 6 distinctly larger than segments 3 and 4, segment 6 slightly asymmetrical. Pronotum 0.37 mm long, 0.35-0.36 mm wide. Mesal and inner lateral sulci parallel and similar. Admesal intervals and intervals between inner and outer lateral sulci slightly convex, about equally wide. Lateral humps convex, not impressed on dorsal side, with dense row of fine, short, erect setae parallel to outer lateral sulci. Inner antebasal thorns almost perpendicular to pronotal axis, not curved. Outer antebasal thorns pointed laterally. Elytra with humeral areas arcuate; humeral protuberances obsolete. Metasternal impression deep and small, almost foveiform. Abdominal pubescence recumbent.

Male characters. Eyes multifaceted, much longer than tempora, reaching almost upper head margin. Antennal segments 7 and 8 strongly widened, asymmetrical, equally long, segment 8 slightly wider than segment 7; segment 9 similar to segment 8 but longer; segment 10 strongly enlarged, with basoventral cavity; segment 11 large, impressed ventrally, with basoventral lobe and prominent glandular socle (Fig. 51). Prolegs without obvious sexual characters. Mesotrochanters with conspicuous, blunt process at apical, posterior angle. Mesofemora strongly narrowed near base, with several short, strong setae inserted on posterior femoral side. Posterior, narrowed area of mesofemora delimited by angle bearing several robust, short, oblique setae. Mesotibiae with small apical denticle. Aedeagus (Figs 65, 66) with distal process of median lobe strongly arcuate dorsoventrally, expanded ventrally and more sclerotized on right side than on left side, with narrow, lobed, blunt tip. Internal sac comparatively narrow, curved apically.

Comments. This species may be distinguished by the vertex lacking median fovea or sulcus in combination with the shape of the very wide antennal segments 7 and 8 in male.

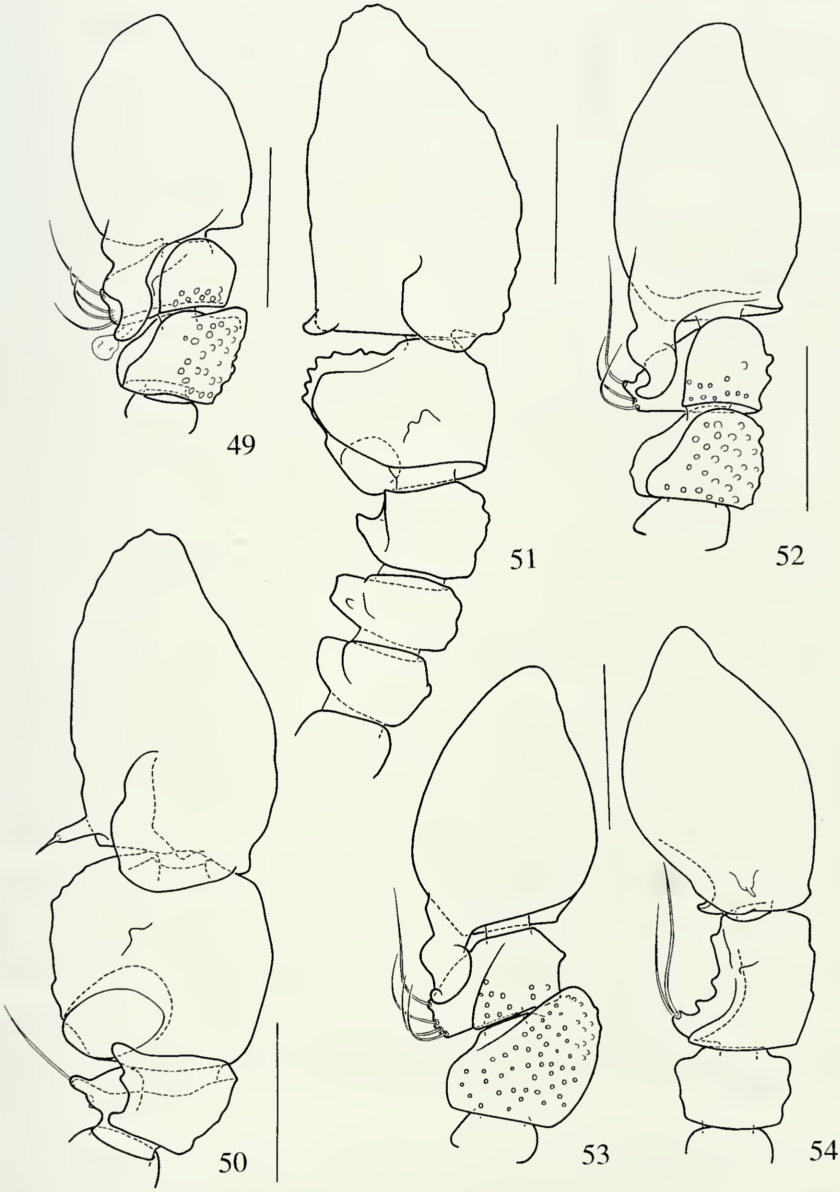
Nesiotomina difficilis sp. n. Figs 52, 67, 68

Holotype ♂: Sri Lanka: Central Prov.: Madugoda, 1500m, 30.I.64, R. Mussard (MHNG).

Paratypes: Sri Lanka: Central Prov.: same data as holotype, 3 ♂, 20 ♀ (MHNG, PCSK).

Description. Length 1.40-1.45 mm. Most characters as in *N. appendiculata*, but body larger, pronotum slightly wider (0.33-0.34 mm), eyes notably smaller, with about 12 – 14 facets in male, 8 facets in female, largest eyes diameter smaller than interval between eye margin and upper head margin, and less than half of temporal length. Antennal club as Fig. 52; segment 9 with inner side rounded; segment 10 longer than segment 9. Humeral margins of elytra arcuate in both sexes, humeral protuberance inconspicuous in male, absent from female. Metasternum with shallow, medio-apical impression. Profemora swollen, as Fig. 83. Aedeagus as Figs 67, 68, with distal process of median lobe wide, very weakly sclerotized, emarginate latero-apically in dorsal view, bilobed apically in lateral view; internal sac indistinct.

Comments. This species may be distinguished from the very similar *N. appendiculata* by the small eyes in both sexes in combination with the shape of the male antennal segments 9 and 10 (see comments under *N. appendiculata*).



Figs 49 to 54: *Nesiotomina* Jeannel, male antennal club
49: *N. appendiculata* sp. nov; 50: N. bellax sp. n.; 51: *N. carinifrons* sp. n., 52: *N. difficilis* sp. n., 53: *N. femoralis* sp. n.; 54: *N. foveifrons* sp. n. Scale bars = 0.1 mm.

Nesiotomina femoralis sp. n. Figs 53, 69, 70

Holotype ♂: SRI LANKA: SABARAGAMUWA PROV.: stream at 2500ft 5 mls NNW Belangoda, 22.II.62 ExpL # 96 (MZLU).

Paratypes: SRI LANKA: SABARAGAMUWA PROV.: same data as holotype, 3 ♂, 3 ♀ (MZLU, MHNG); Deerwood, Kuruwita 6 mls NNW Ratnapura, 16-21.II.62 ExpL # 90:III, indigenous forest, ravine with stream, 1 ♂, 1 ♀ (MZLU); same data but # 90:II:1, 1 ♂, 4 ♀ (MZLU, PCSK); 2 mls E Kalawana, 20.I.70, ExpG # 15, 2 ♂ (MHNG).

Description. Length 1.25-1.35 mm. Head contours subquadrate. Frontoclypeus strongly inclined. Punctation coarse and dense on frontoclypeus, on and posterior antennal tubercles, very fine on vertex, above and posterior eyes. Vertex flattened, slightly convex posterior line of vertexal foveae. Median vertexal crest short, inconspicuous, extending from occiput almost to level of vertexal foveae and touching deep and long median sulcus. Median sulcus extending close to semicircular sulcus. Tempora rounded. Antennal segments 3 and 4 about equally large, each as long as large; segment 5 slightly larger than segment 4, about as long as wide; segment 6 about as segment 4. Pronotum 0.30-0.32 mm long, 0.32-0.34 mm wide. Inner and outer lateral sulci similar, admesal intervals slightly convex; intervals between inner and outer sulci somewhat flattened, narrower than admesal intervals; lateral humps convex, each with large dorsobasal impression. Inner antebasal thorns strongly oblique, orientated backward, not curved. Elytra with humeral areas arcuate in both sexes. Metasternum with median impression elongate, becoming gradually deeper apically, apicomedian area conspicuously oblique. Abdominal pubescence recumbent.

Male characters. Eyes small, with 9 to 11 facets; largest eye diameter about as interval between upper eye margin and upper head margin, much smaller than temporal length. Antennal segment 7 slightly asymmetrical, slightly wider than segment 5; segment 8 shorter and wider than segment 7, with inner side asymmetrically narrowed; segment 9 large, strongly asymmetrical, flattened dorsally; segment 10 smaller than segment 9, with mesal side deeply incised; segment 11 with large basal process, finely carinate basal margin (Fig. 53). Humeral protuberance very small. Profemora strongly thickened. Protibiae and mesolegs lacking obvious sexual characters. Aedeagus (Figs 69, 70) with distal process of median lobe gradually widened, with lateral margin obtusely angulate near apex, tip broadly arcuate in ventral view, strongly arcuate in lateral view. Internal sac wide, lobed laterally.

Comments. See comments under *N. appendiculata. Nesiotomina femoralis* differs notably from resembling species by the thickened male profemora, in combination with the presence of a short vertexal sulcus.

Nesiotomina foveifrons sp. n. Figs 54, 71, 72

Holotype ♂: SRI LANKA: CENTRAL PROV.: Madugoda, 1500 m, 28.I.64, R. Mussard (MHNG).

Paratypes: SRI LANKA: CENTRAL PROV.: same data as holotype, 2 ♂, 3 ♀ (MHNG).

Description. Length 1.25-1.35 mm. Head with lateral contours slightly converging anteriorly. Punctation coarse and very dense posterior antennal tubercles, up to line of posterior eye margins, coarse but less dense on frontoclypeus, very fine on large central and posterior parts of vertex. Frontoclypeus strongly inclined. Posterior part of vertex distinctly raised, with median carina conspicuous, extended from occiput to line of posterior margin of vertexal foveae. Median sulcus deep, short, extending from vertexal carina to line of anterior eyes margins, ending distant from semicircular sulcus. Tempora rounded. Antennal segments 3 to 8 each wider than long, segments 3, 4 and 6 about equally large, segments 5, 7 and 8 slightly larger. Pronotum 0.30-0.32 mm long, 0.32-0.34 mm wide. Mesal and inner lateral sulci similar; intervals between sulci convex. Lateral pronotal humps convex, not impressed on dorsal side, with pubescence as sparse as that on remainder of discus, lacking rows of erect setae along sulci. Inner antebasal thorns straight, pointed obliquely backwards. Abdominal pubescence semi-erect. Metasternal impression small, shallow, oval. Abdominal pubescence recumbent.

Male characters. Eyes large, multifaceted, largest eye diameter exceeding almost twice temporal length and about 3 times interval between eye and upper head margins. Humeral margins of elytra oblique, humeral protuberances distinct. Antennal segments 7 to 9 almost symmetrical; segment 9 small; segment 10 deeply notched on ventral side, with basal tubercle; segment 11 impressed ventrally, with small basal lobe; glandular socle inconspicuous, distant from basal margin (Fig. 54). Prolegs without obvious sexual characters. Mesotrochanters with minute tubercle on posterior side. Mesofemora slightly swollen, bearing small, triangular denticle situated at end of basal third of posterior side. Mesotibiae with small apical denticle. Aedeagus (Figs 71, 72) with distal process of median lobe narrow, slightly narrowed in ventral view, strongly narrowed in lateral view, abruptly bent in apical portion. Internal sac slender, well sclerotized, curved posterior middle, sinuate in ventral view, strongly arcuate and tapering in lateral view.

Female characters. Eyes small, largest eye diameter about as temporal length, smaller than interval between eye and upper head margins. Humeral margins of elytra rounded.

Comments. This species may by distinguished by the lateral pronotal protuberances convex dorsally, the short median sulcus of the vertex, the comparatively short antennal segment 3, and the small male antennal segment 9.

Nesiotomina longicollis Jeannel Figs 55, 73, 74

Nesiotomina longicollis Jeannel, 1961: 432.

Type material. Holotype ♂, labelled: 464. Hatton 27.8.59, Pselap. (hand-written)/ Nesiotomina longicollis m (hand-written by Jeannel) /Nesiotomina longicollis Jeannel Löbl & Kurbatov det. (MNHN).

Description. Length 1.7 mm. Head contours slightly pyriform. Punctation very fine and sparse, but with few coarse punctures posterior antennal tubercles. Frontoclypeus moderately inclined. Vertex slightly convex, with long median carina extending from occiput about to line of anterior margins of vertexal foveae; median vertexal fovea or sulcus absent. Tempora subangulate. Antennal segments 3 to 6 elongate, segments 3, 4 and 6 subequal, segment 5 slightly larger. Pronotum 0.39 mm long, 0.37 mm wide. Mesal and inner lateral sulci similar. Admesal intervals and intervals between inner and outer lateral sulci strongly convex, latter narrower than former. Lateral humps narrow, convex, not impressed on dorsal side, each with dense puncture row parallel to sulcus (likely bearing short and erect setae, but pubescence strongly damaged on both sides of pronotum). Inner antebasal thorns straight, long, pointed obliquely backward. Elytra with humeral margins oblique. Abdominal pubescence recumbent.

Male characters. Eyes small, multifaceted, with largest diameter about 1.5 times exceeding interval to upper head margins and slightly longer than half of temporal length. Antennal segments 7 and 8 symmetrical, segment 7 about as long as segment 3 and longer than wide; segment 8 shorter and wider than segment 7, wider than long, segment 9 comparatively small, hardly modified; segment 10 with deep ventral incision; segment 11 with basal lobe and glandular socle (Fig. 55). Elytra lacking humeral protuberances. Anterior margins of protochanters with flat, triangular, pointed denticle. Profemora with anterior side straight in dorsal view, abruptly narrowed near base, and bearing minute denticle delimiting apically narrowed portion. Mesolegs lacking obvious sexual characters. Aedeagus (Figs 73, 74) with distal process of median lobe and internal sac strongly arcuate and narrowed toward apex, tip of median lobe abruptly curved, forming transverse lobe.

Comments. This species may be distinguished by the elongate antennal segment 3 and the admesal intervals of the pronotum weakly narrowed anteriorly.

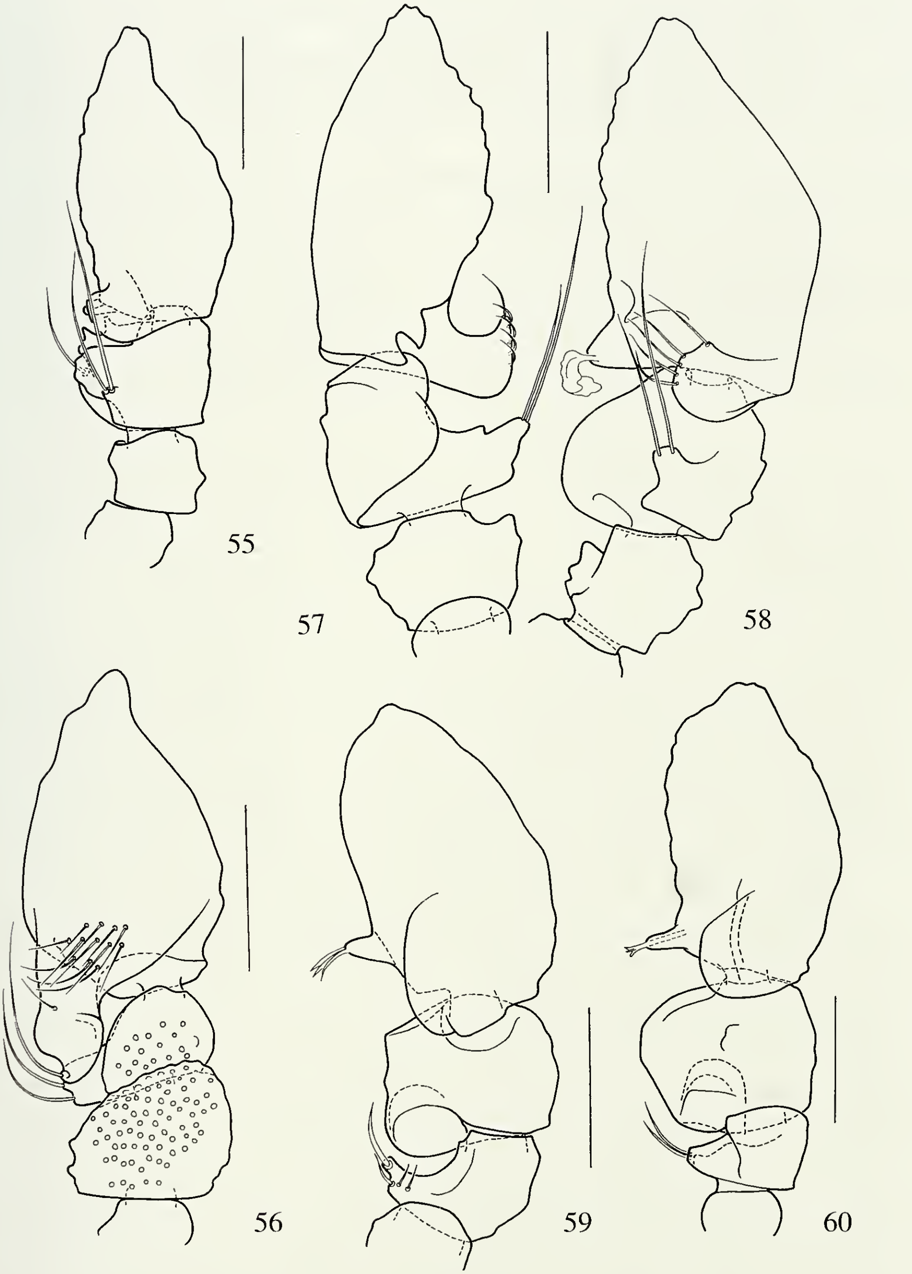
Nesiotomina perbrincki sp. n. Figs 56, 75, 76

Holotype ♂: Sri Lanka: Central Prov.: Hatton, 1400m, 9.II.70, ExpG # 55a (MHNG).

Paratypes: Sri Lanka: Central Prov.: same data as holotype, 10 ♂, 10 ♀ (MHNG, PCSK); Sabaragamuwa Prov.: Maratenna at 4500ft, 7 mls N Balangoda, 22.II.62, ExpL # 98, 2 ♂, 4 ♀ (MZLU, MHNG); Sri Lanka: Ceylon, Coll. Cl. Müller, 1 ♀ (ZSMC).

Description. Length 1.4-1.5 mm. Similar to *N. appendiculata* and *N. difficilis*, distinguished by: Head with median sulcus deep, extending from line of antennal tubercles up to raised posterior part of vertex, behind line of vertexal foveae. Vertexal carina slightly shorter than in *N. appendiculata* and *N. difficilis*, extended from median sulcus to occiput. Frontoclypeus moderately inclined. Eyes small and prominent. Antennal segments 3, 4 and 6 equally large, as long as wide; segment 5 distinctly larger than segment 3. Pronotum 0.30-0.31 mm long, 0.33-0.35 mm wide. Outer lateral sulci extended to form large impressions widened toward base; lateral protuberances convex dorsolaterally. Elytra with humeral margins oblique, humeral tubercles absent.

Male characters. Eyes small, with 9 to 12 facets, largest eye diameter smaller than interval to upper head margin and less than half of temporal length. Antennal segment 7 slightly enlarged. Antennal club as in Fig. 56, similar to that of *N. appendiculata*. Inner side of segment 9 rounded, segment 10 larger, with inner side more oblique, segment 11 impressed dorsobasally and with basal ridge. Legs lacking obvious sexual characters. Aedeagus (Figs 75, 76); median lobe widened apically, at apex very weakly sclerotized, trilobed in ventral view, curved in lateral view; inner sac hardly distinguishable, narrowed apically.



FIGS 55 to 60: *Nesiotomina* Jeannel, male antennal club
55: *N. longicollis* Jeannel; 56: *N. perbrincki* sp. n.; 57 and 58: *N. transjugata* sp. n.; 59: *N. tibialis* sp. n.; 60: *N. spinicollis* (Motschulsky). Scale bars = 0.1 mm.

Female characters. Eyes smaller than in male, with 6 or 7 facets. Humeral margins of elytra arcuate.

Comments. Nesiotomina perbrincki may be distinguished from similar species (see comments under *N. appendiculata*) by the long vertexal sulcus and the male profemora not thickened.

Nesiotomina spinicollis (Motschulsky, 1858) Figs 60, 81, 82, 87

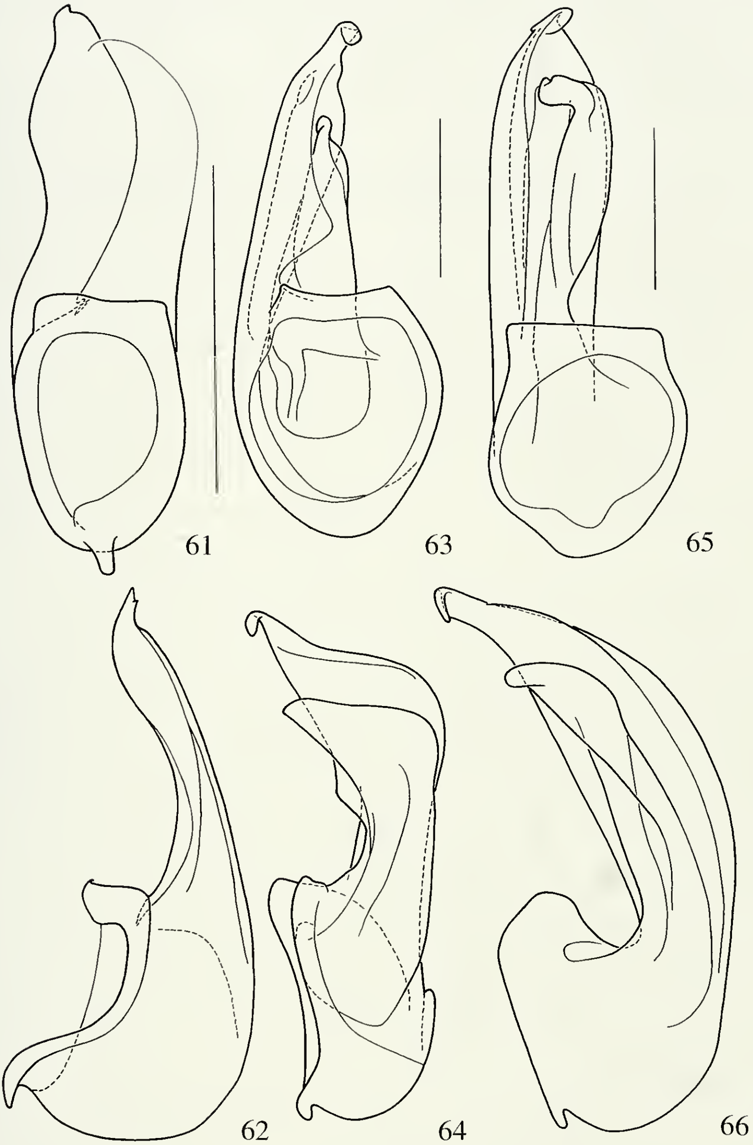
Batrisus spinicollis Motschulsky, 1858: 27.

Type material: Sri Lanka: Central Prov.: 1 ♀ labelled: Type (hand-written) /TYPUS (red)/ Batrisus spinicollis Motsch. Nuva-Ellia Ceylon (hand-written original label /Nesiotomina spinicollis Motsch. Det. Löbl 1969 (ZMUM).

Additional material: Sri Lanka: Central Prov.: Hatton, 1400m, 9.II.70, ExpG # 55a 1 ♂, 11 ♀ (MHNG, PCSK); Sabaragamuwa Prov.: Maratenna at 4500ft, 7 mls N Balangoda, 22.II.62, ExpL # 98, 5 ♂, 2 ♀ (MZLU, MHNG); Sri Lanka: Ceylon, Coll. Cl. Müller, 1 ♂, 2 ♀ (ZSMC).

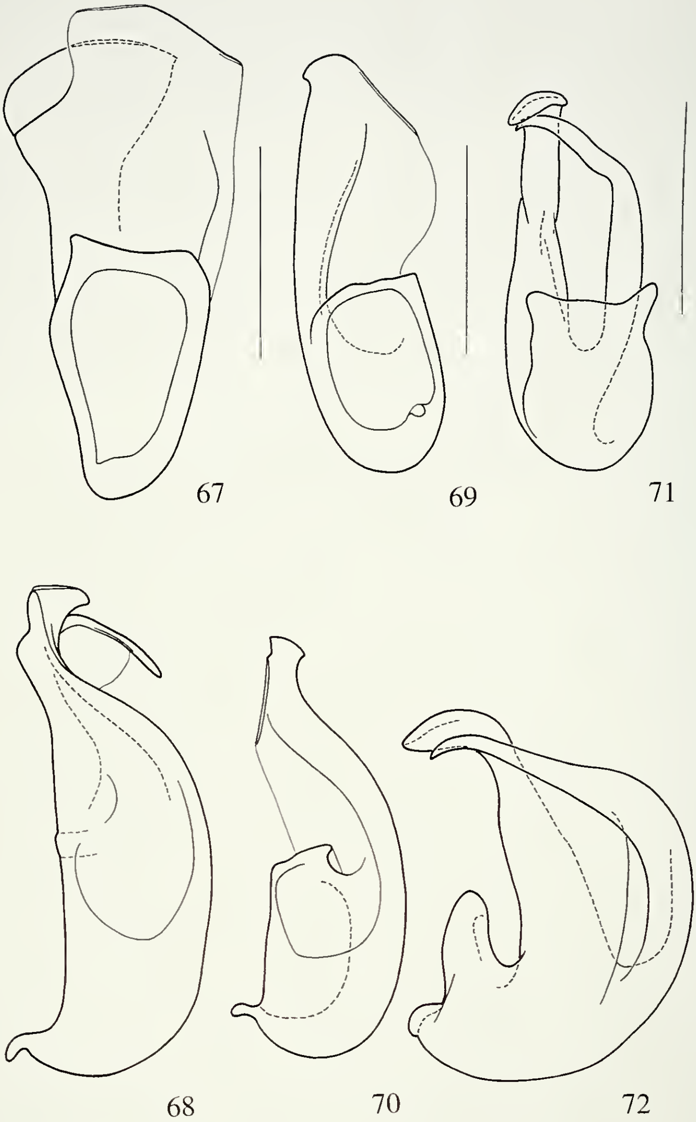
Description. Length 1.60-1.65 mm. Head in dorsal view gradually narrowed, with lateral contours oblique. Frontoclypeus raised above centre of semicircular sulcus, strongly inclined anteriorly. Punctation coarse and dense posterior antennal tubercles and on anterior side of antennal tubercles, sparse and very fine on large remainder of frons and vertex. Vertex convex and swollen posterior line of vertexal foveae, with median carina extending from line of vertexal foveae up to occiput. Tempora subangulate. Antennae with segments 3 to 6 equally wide; segments 3 and 5 each about as long as wide, segments 4 and 6 shorter, wider than long. Pronotum 0.37 mm long and wide. Mesal and inner lateral sulci similar. Admesal sulcus intervals slightly convex, narrower than lateral intervals. Lateral intervals flat, oblique; outer lateral sulci completely covered by short, white, very dense pubescence forming compact tomentum. Lateral humps flattened dorsally, strongly inclined. Inner antebasal thorns slightly oblique, orientated dorso-apically. Metasternal impression small, elongate, becoming gradually deeper toward apex. Abdominal pubescence recumbent.

Male characters. Eyes large, strongly prominent, multifaceted. Largest eye diameter about 3 times as long as interval from eye margin to upper head margin and about twice as long as tempora. Antennae with segment 7 symmetrical, about as long as and wider than segment 5, distinctly wider than long; segment 8 as wide as but shorter than segment 7, slightly asymmetrical; segments 9 to 11 (Fig. 60) strongly modified; segment 9 short and wide, with mesal side strongly notched; segment 10 large, gradually narrowed toward mesal margin, with carinate distal margin, convex upper and outer sides, deep basal cavity on mesal side; segment 11 impressed basoventrally, and with large, basal lamina and straight glandular socle perpendicular to axis of segment. Humeral margins of elytra oblique, humeral protuberances distinct. Prolegs and metalegs without obvious sexual characters. Mesofemora asymmetrically flattened on inferior side and bearing prominent denticle raising from posterior margin. Mesotibiae (Fig. 87) with sharp tooth perpendicular to tibial axis, situated in middle of mesal side. Latter flattened in apical half and with additional, oblique, sharp tooth. Aedeagus (Figs 81, 82) with distal process of median lobe gradually narrowed and tip slightly curved in dorsal view, arcuate in lateral view; internal sac almost straight, gradually narrowed toward apex.



Figs 61 to 66: *Nesiotomina* Jeannel, aedeagi

61 and 62: *N. appendiculata* sp. n., ventral (61) and lateral (62) views; 63 and 64: *N. bellax* sp. n., ventral (63) and lateral (64) views; 65 and 66: *N. carinifrons* sp. n., ventral (65) and lateral (66) views. Scale bars = 0.1 mm.



FIGS 67 to 72: *Nesiotomina* Jeannel, aedeagi

67 and 68: *N. difficilis* sp. n., ventral (67) and lateral (68) views; 69 and 70: *N. femoralis* sp. n., ventral (69) and lateral (70) views; 71 and 72: *N. foveifrons* sp. n., ventral (71) and lateral (72) views. Scale bars = 0.1 mm.

Comments. This species differs conspicuously from its congeners by the lateral sulci of pronotum covered by tomentose stripes.

Nesiotomina tibialis sp. n. Figs 59, 79, 80, 84

Holotype ♂: Sri Lanka: Central Prov.: Kandy, env. 600m, 15.I.70, ExpG #3c (MHNG).

Paratypes: Sri Lanka: Central Prov.: same data as holotype, 8 ♂, 6 ♀; same data but 14.II.70, # 67, 29 ♂, 13 ♀; Kandy, 16.I.64, R. Mussard, 1 ♂; Kandy, ca 600m, Udawattekele Sanctuary, 22.I.70, ExpG # 18, 4 ♂, 2 ♀; Peradeniya, ca. 550m, 19.I.70, ExpG # 10, 4 ♂, 1 ♀ (MHNG, PCSK).

Description. Length 1.60-1.65 mm. With most diagnostic characters similar to those of *N. transjugata*, distinguished from latter by: Punctation coarse and dense on lateral areas of head, between antennal tubercles and neck constriction, and throughout frontoclypeus. Median vertexal crest long, reaching semicircular sulcus. Eyes smaller. Antennal segment 3 slightly shorter, wider than long. Pronotum 0.36-0.37 mm long, 0.32-0.34 mm wide; admesal intervals wider than intervals between inner and outer lateral sulci, upper part of lateral humps bearing dense, short, erect setae not covering outer lateral sulci and not forming tomentose stripes. Metasternum with small, foveiform, medio-apical impression.

Male characters. Eyes multifaceted, largest eye diameter about twice as large as interval between eye margin and upper head margin, and almost twice as large as temporal length. Antennal segments 7 and 8 symmetrical. Antennal club as Figs 59. Humeral humps inconspicuous. Profemora with ventral side flattened, bearing minute denticle near anterior edge, slightly posterior basal third. Mesofemora with sharp tooth perpendicular to femoral axis, situated near upper edge of posterior side, near apical third of femoral length. Mesotibiae (Fig. 84) gradually widened toward distal third, obliquely truncate on mesal side, slender in distal fourth; oblique margin bearing spine. Aedeagus (Figs 79, 80) with tip of median lobe abruptly bent and hook-like; internal sac gradually narrowed apically, slightly curved.

Female characters. Eyes small, with 11 or 12 facets, largest eye diameter about as long as tempora and as interval between eye and upper head margin.

Comments. This species may be distinguished by the antennal segments 3 to 5 each distinctly wider than long and the vertex lacking a median fovea or sulcus in combination with the male mesotibiae strongly widened.

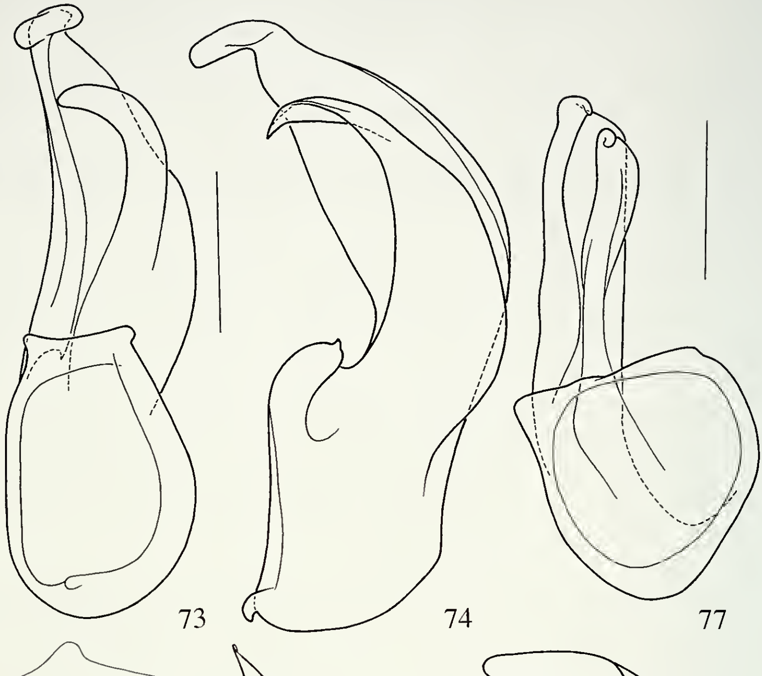
Nesiotomina transjugata sp. n. Figs 57, 58, 77, 78

Batrisus spinicollis; Raffray, 1894a: 446.
Nesiotomina spinicollis; Jeannel, 1961: 431.

Holotype ♂: Sri Lanka: Central Prov.: Hakgala, 1700m, 18.I.70, ExpG # 30d, (MHNG).

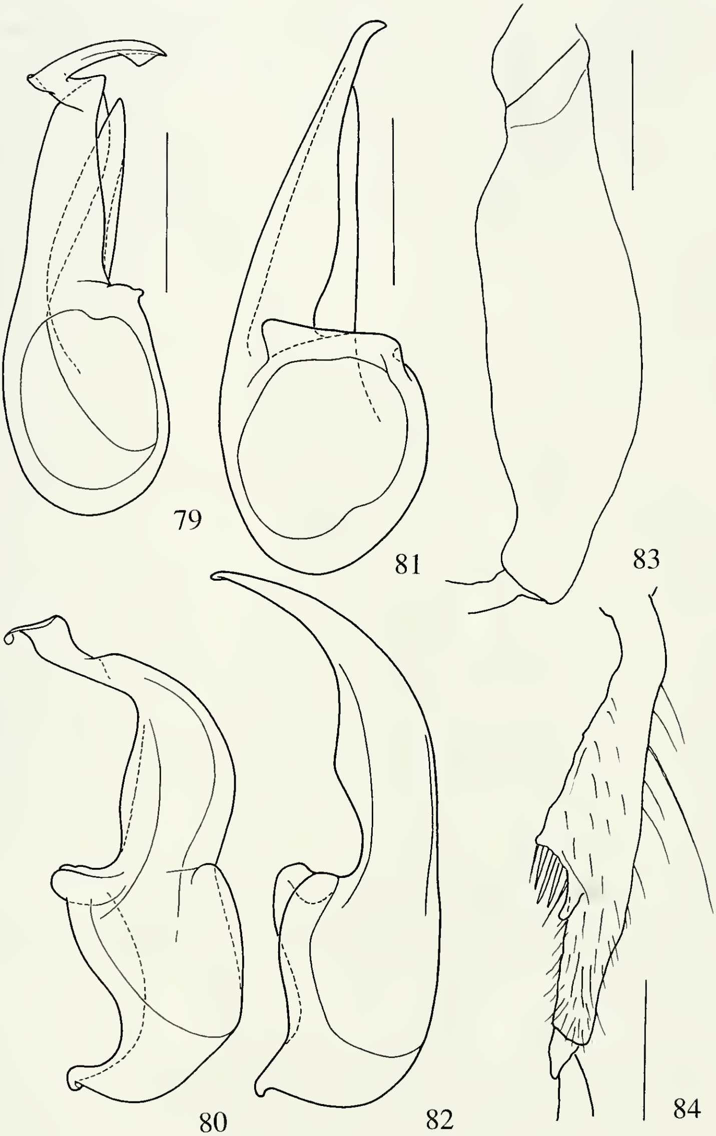
Paratypes: Sri Lanka: Central Prov.: Hakgala, 1700m, 18.I.70, ExpG # 30d, 1 ♂, 2 ♀ (MHNG, PCSK); Horton Plains, 2100m, 15.II.70, ExpG # 68, 1 ♂ (MHNG); "Nuwara Elia, Simon", 1 ♂ (MNHN); "Ceylan" 1 ♂ and 1 ♀, likely also taken by E. Simon at Nuwara Elia (MNHN).

Description. Length 1.8-2.0 mm. Head with lateral contours converging anteriorly. Punctation throughout sparse and very fine, or few coarse punctures present



Figs 73 to 78: *Nesiotomina* Jeannel, aedeagi

73 and 74: *N. longicollis* Jeannel, ventral (73) and lateral (74) views; 75 and 76: *N. perbrincki* sp. n., ventral (75) and lateral (76) views; 77 and 78: *N. transjugata* sp. n., ventral (77) and lateral (78) views. Scale bars = 0.1 mm.



Figs 79 to 84: *Nesiotomina* Jeannel

79 and 80: *N. tibialis* sp. n., aedeagus in ventral (79) and lateral (80) views; 81 and 82: *N. spinicollis* (Motschulsky), aedeagus in ventral (80) and lateral (82) views; 83: *N. difficilis* sp. n., profemur; 84: *N. tibialis* sp. n., male mesotibia. Scale bars = 0.1 mm.

posterior antennal tubercles. Posterior part of vertex slightly convex. Median vertexal carina extended from occiput to level of or slightly anterior to level of anterior margins of tentorial foveae; median vertexal fovea or sulcus absent. Frontoclypeus moderately inclined. Tempora angulate. Antennal segments 3 and 5 equally large, elongate; segment 4 as long as large, shorter than segment 3, segment 6 as long as large. Pronotum 0.39-0.42 mm long, 0.37-0.40 mm wide. Inner lateral sulci as deep as mesal sulcus and arcuate. Admesal intervals flattened, widened toward centre; intervals between inner and outer lateral sulci flattened, evenly broad, narrower than centres of admesal intervals. Lateral humps narrow, convex, not impressed dorsobasally, with dense puncture rows along sulcus, lacking short, erect setae. Inner antebasal thorns long, vertical, barely curved. Metasternal impression small, about as long as large, becoming gradually deeper apically, with posterior wall almost vertical. Abdominal pubescence recumbent.

Male characters. Antennal segments 7 and 8 symmetrical, about equally wide; segment 7 as long as segment 5, segment 8 shorter; segment 9 moderately enlarged, impressed ventrally; segment 10 deeply impressed, with setiferous apophysis on outer margin; segment 11 with basal process orientated toward apophysis of segment 10, large glandular socle at base of inner margin, and small hook-like process posterior glandular socle (Figs 57, 58). Elytra with humeral areas oblique, humeral humps inconspicuous. Ventral side of profemora emarginate and smooth near base, apical end of emargination angulate. Mesotrochanters with posterior angle prominent to form robust process orientated backward. Mesofemora deeply emarginate on ventral side, near base; emargination limited apically by minute ridge. Tibiae lacking obvious sexual characters. Aedeagus (Figs 77, 78) with distal process of median lobe almost evenly wide in ventral view, ventral lobe notched basally and arcuate in lateral view. Internal sac slender, comparatively strongly sclerotized, sinuate in ventral view, arcuate in lateral view.

Female characters. Eyes fairly large, with about 15 facets; largest eye diameter longer than interval between upper eye and upper head margins.

Comments. This species may be distinguished by the elongate antennal segment 3 in combination with the admesal intervals of the pronotum strongly narrowed anteriorly.

Batrisomalus Raffray Fig. 85

Batrisomalus Raffray, 1904: 60; type species *Batrisus microphthalmus* Raffray, 1894.
Cratnodes Jeannel, 1961: 433; type species *Cratnodes lewisi* Jeannel, 1961. - **Syn. n.**

Description. Habitus as Fig. 85. Length 1.6-2.7 mm. Body with dorsal side flattened. Head slightly below plan of pronotum; pronotum, elytra and tergite 1 in almost same plan. Punctation of body mostly dense and very fine. Pubescence variably long, particular long setae present in some species.

Head subquadrate, about as long as wide, with eyes narrower than pronotum. Lateral contours rounded. Frontal lobe about in same plan as lateral parts of vertex, impressed between antennal tubercles and inclined anteriorly. Antennal fossae distant, frontoclypeus wide, strongly inclined to vertical, hardly visible in dorsal view. Anten-

85

FIG. 85
Batrisomalus microphthalmus (Raffray).

nal tubercles very low. Vertexal foveae not in impressions. Vertexal sulci converging anteriorly, usually joined to vertexal foveae, not or weakly curved, extending on to anterior part of frontal lobe, and not joined. Vertex raised in middle to form a hump and bearing median carina. Lateral frontal foveae large, situated posterior antennal tubercles. Ocular-mandibular carina touching eye margin. Occipital margin of vertex truncate, convex, inclined toward neck. Eyes small, not notched, situated in middle part of head, usually with less than 15 facets. Tempora long. Ventral side of head fairly long, weakly convex, weakly inclined toward neck, lacking long postgenal setae. Gular foveae close, in common impression.

Maxillary palpi fairly short. Segment 2 thickened apically; segment 3 short, narrowed mesally; segment 4 with broad base, short stalk. Antennae moderately long. Scape cylindrical, with apicodorsal angles blunt, not prominent, lacking modified setae and glandular orifice. Segments 2 to 8 symmetrical and cylindrical. Pedicel elongate, smaller than scape. Segments 4, 6 and 8 smaller than adjoined segments. Club 3-segmented.

Pronotum flattened, wider than long, longer than head, cordiform, abruptly narrowed posterior lateral humps; lateral humps distinctly below plan of centre; with one mesal and two lateral sulci, two low discal carinae, antebasal ridge, four basal foveae, two lateral foveae and short basomesal carina. Lateral margins each usually with small marginal denticle. Discal tubercles or denticles absent. Paranotal ridges entire, sinuate in lateral view. Hypomera smooth, with basolateral foveiform impressions.

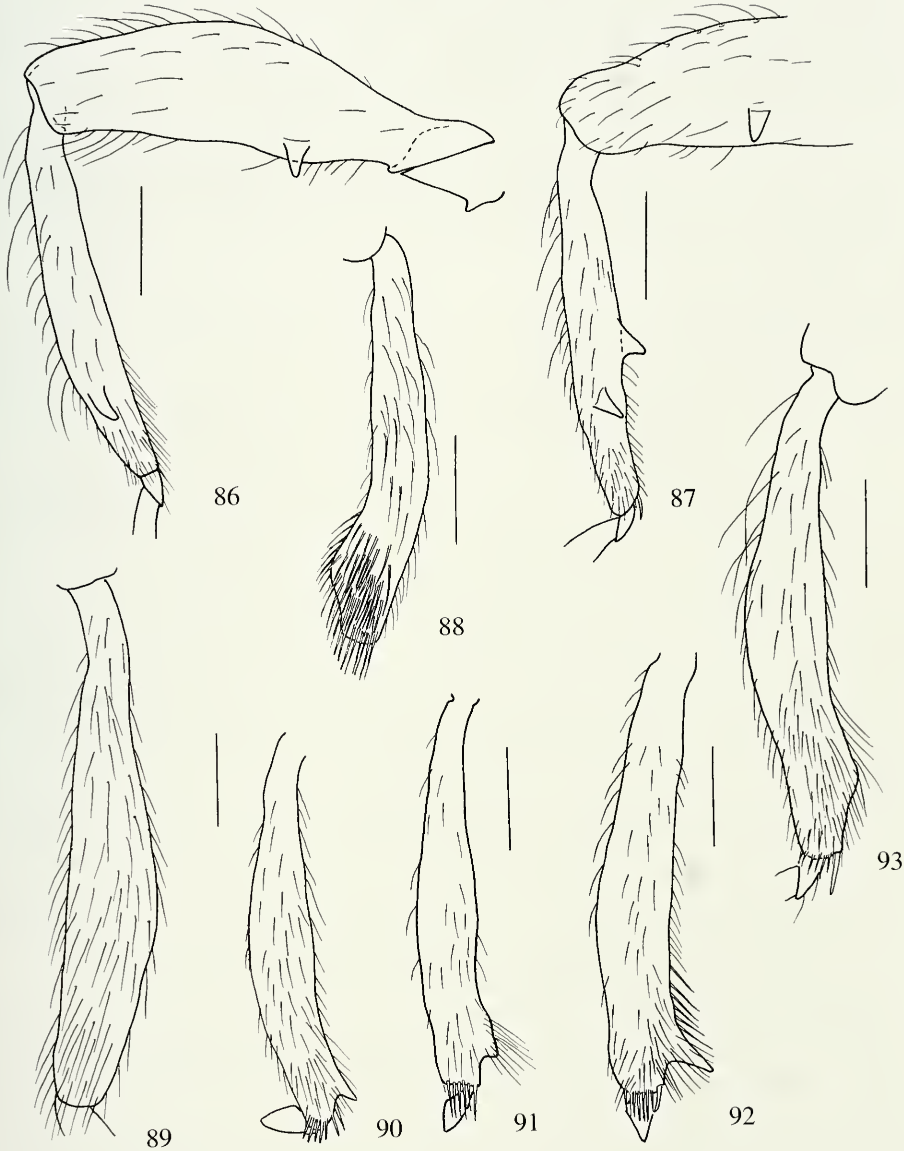
Elytra weakly convex to flat, comparatively short, usually combined much wider than long but in *B. pubis* as wide as long; each with two or three basal foveae, subhumeral fovea, sutural stria, short discal stria and lateral carina. Sutural striae rarely faints. Elytral punctation less fine than that of pronotum.

Metathoracic wings reduced. Metasternum with lateral metasternal foveae close, in common impression posterior intercoxal process; posterior intercoxal process prominent, with small median notch.

Legs moderately long. Tarsi fairly robust and short, tarsomeres 2 and 3 about equally long.

Abdomen convex, with 5 tergites visible in dorsal view. Tergite 1 usually longer than tergite 2, rarely about as long as tergite 2, gradually raised apically, not or slightly narrowed toward base, with lateral margins not raised, inner lateral carina extending up to apical margin, outer lateral carinae short, transverse basal ridge, one pair of laterobasal foveae situated in impressions. Tergites 2 and 3 margined laterally. Tergites 2 to 4 gradually narrowed and inclined, each with one pair of basolateral foveae. Sternite 1 with two pairs of deep, pubescent, basal impressions, ending at each side by one fovea; foveae in lateral impressions much larger than foveae in mesal impressions. Sternites 2 to 4 each with two pairs of small basal foveae.

Male sexual characters located on legs, eventually on abdominal sternites and antennae, in *B. hemipterus* also on frons. Eyes in males usually not distinctly larger than in females. Humeral tubercles similar in both sexes. Aedeagus moderately sclerotized, with basal bulb of median lobe expanded by ventral and dorsal processes lacking setiform sensilla. Ventral process flattened, conspicuously narrowed and cur-



FIGS 86 to 93: *Nesiotomina* Jeannel and *Batrisomalus* Raffray

86: *N. bellax* sp. n., male mesofemur and tibia; 87: *N. spinicollis* (Motschulsky), apical part of male mesofemur and tibia; 88: *B. hemipterus*, male mesotibia; 89 and 90: *B. microphthalmus* (Raffray), metatibia (89), protibia (90); 91: *B. lewisi* (Jeannel), male mesotibia; 92: *B. tuberculatus* sp. n., male mesotibia; 93: *B. foveolatus* sp. n., male mesotibia. Scale bars = 0.1 mm.

ved in apical portion. Dorsal process larger, usually arcuate. Internal sac membranous, sometimes partly sclerotized.

Habitat. Members of *Batrisomalus* were taken in indigenous forests, mostly at high elevation, from sieved moist debris, or found under stones.

Distribution. Hills and mountains in central Sri Lanka and South India.

Comments. The genus includes eleven species, four previously described from Sri Lanka and one, *B. infossus* Raffray, from South India. The original material of the Indian species was not available for study. However, the description (Raffray, 1904) is sufficient for its distinction from the congeners.

KEY TO THE SPECIES OF *BATRISOMALUS*

1	Elytra with three basal foveae	2
-	Elytra with two basal foveae	3
2	Elytra much shorter than abdomen, finely and densely punctate	*B. foveolatus* sp. n.
-	Elytra about as long as abdomen, densely and coarsely punctate (South India)	*B. infossus* Raffray
3	Abdominal tergite 1 slightly longer than tergite 2. Elytra with faint sutural striae. Large species 2.7 mm long	*B. pubis* sp. n.
-	Abdominal tergite 1 distinctly longer than tergite 2. Elytra with sutural striae distinct. Smaller species, length not exceeding 2.3 mm	4
4	Vertexal sulci faint. Antennal tubercles strongly raised, expanded, covered by conspicuous, coarse, very dense punctation	*B. tuberculatus* sp. n.
-	Vertexal sulci distinct. Antennal tubercles not or weakly raised, not expanded, impunctate or very finely punctate on top	5
5	Vertexal sulci subparallel near vertexal foveae	6
-	Vertexal sulci strongly converging anteriorly	7
6	Small species, 1.6 mm long	*B. hemipterus* (Raffray)
-	Larger species, 2.1 mm long. Male mesotibiae with long, acute, subapical tooth on mesal side	*B. currax* sp. n.
7	Abdominal tergites and metatibiae with several, particularly long setae. Antennal segment 10 distinctly longer than wide. Eyes multifaceted, in dorsal view about as long as tempora	8
-	Abdominal tergites and metatibiae lacking particular, long setae. Antennal segment 10 as long as wide or hardly longer than wide. Eyes with 9-15 facets, much shorter than tempora	9
8	Antennal segment 11 almost 3 times as long as wide. Male tibiae lacking denticles	*B. cautus* sp. n.
-	Antennal segment 11 about twice as long as wide. Male mesotibiae with subapical denticle	*B. lewisi* (Jeannel)
9	Vertex slightly impressed medioposteriorly, with distinct lateral carinae. Antennal segments 3, 4, 6 and 8 hardly or slightly longer than wide	*B. depressus* (Raffray)
-	Vertex not impressed medioposteriorly, usually without lateral carinae. Antennal segments 3, 4, 6, and 8 distinctly elongate	10

10 Male with protibiae bearing apical denticle, mesotibiae and metatibiae conspicuously curved, widened and lacking apical denticles
.... *B. microphthalmus* (Raffray)
- Male with tibiae hardly curved, protibiae and metatibiae lacking apical denticle, mesotibiae bearing apical denticle .... *B. obtectus* sp. n.

Batrisomalus cautus sp. n. Figs 94, 95

Holotype ♂: SRI LANKA: CENTRAL PROV.: Hakgala, 5 mls SE Nuwara Eliya, 3.III.62, ExpL 114:I, debris in jungle (ZMLU).

Description. Length 1.9 mm. Pubescence long, abdominal tergites with several particular, longer setae. Head with eyes much wider than long (ratio 44/32). Vertexal hump moderately high, obliquely raised toward occipital margin. Median carina not in impression. Occipital margin truncate in dorsal view. Lateral areas of vertex convex, lacking carina, gradually inclined toward occiput. Vertexal sulci inverted V-shaped, extending and strongly approximate on interantennal bridge, not clearly joined. Interantennal bridge deeply impressed between antennal tubercles, inclined, not clearly delimited from steep inferior part of frontoclypeus. Eyes large, with at least 35 facets, about as long as tempora in dorsal view. Antennal tubercles and lateral parts of vertex with irregular, fine and sparse punctures; vertexal hump very finely punctate, large area between vertexal sulci triangular, almost impunctate. Antennal segments 3, 4 and 6 equally large, each about 1.7 times as long as wide; segments 5 and 7 each slightly longer and hardly wider than segment 6; segment 8 as wide as but slightly shorter than segment 6, about 1.5 times as long as wide; segments 9 and 10 elongate, almost equally large, segment 11 nearly 3 times as long as wide, slightly shorter than segments 10, 9 and 8 combined. Pronotum slightly wider than head with eyes and moderately wider than long (ratio 45/40). Disc slightly above plan of vertex, distinctly below plan of elytra. Admesal areas flat, horizontal in middle, areas between admesal carinae and lateral sulci flat, very weakly inclined laterally. Lateral humps distinctly below plan of admesal areas, convex, each with small marginal denticle pointed dorsally. Median sulcus deep, hardly widened at basal end; basal end fairly distant from base and not touching basomedian carina. Discal punctation distinct, finer than that on vertexal hump. Elytra convex, fairly long and wide, about as long as abdomen, almost 1.2 times as wide as long, slightly more than 1.4 times as wide as pronotum. Lateral contours distinctly arcuate. Sutural and discal striae distinct, discal striae extending up to elytral mid-length. Humeral protuberances distinct, rounded. Punctation fairly fine, distinctly coarser than that on pronotum. Abdomen with punctation similar to that of elytra. Tergite 1 twice as long as tergite 2, widest at base, slightly narrowed apically, with lateral margins straight. Tergite 2 with lateral margins slightly arcuate, narrowed apically. Metatibiae with few particular, long setae.

Male characters. Abdominal sternites lacking obvious sexual characters. Tibiae slightly curved, lacking denticles. Protibiae gradually thickened toward middle, evenly thick between mid-length and apical fifth, slightly broader in apical fifth than in middle, dense, robust pubescence covering apical fourth of mesal side. Mesotibiae gradually thickened toward mid-length, flattened in apical half of mesal side, with dense, robust pubescence covering apical third of mesal side. Metatibiae gradually thickened toward apical third, flattened and with long, robust setae covering apical half of mesal side and forming small setal tuft at apex. Aedeagus (Figs 94, 95) with ventral process of median lobe narrowed toward apical third, abruptly bent at tip and flat (lateral view). Dorsal process fairly wide, with almost straight left margin and sinuate right margin, apical margin emarginate. Internal sac with distinct rod.

Comments. This species may be distinguished from its congeners having two basal elytral foveae by the strongly converging vertexal sulci, the abdominal tergites lacking long setae and the antennal segment 11 almost 3 times as long as wide.

Batrisomalus currax sp. n. Figs 96, 97

Holotype ♂: Sri Lanka: Central Prov.: Pidurutalagala, 2200m, 29.I.70, forest on south-western slope, ExpG # 32 (MHNG).

Description. Length 2.1 mm. Body with long pubescence. Head, eyes included, much wider than long (ratio 45/35). Vertexal hump high and flat. Median carina not in impression. Occipital margin rounded, not prominent in middle. Lateral areas of vertex rounded, gradually inflecting from antennal tubercles, lacking carina. Vertexal sulci parallel near vertexal foveae, obliquely converging toward interantennal bridge, not joined and not extending on interantennal bridge. Interantennal bridge rounded and gradually inclined, not clearly delimited from steep inferior part of frontoclypeus. Eyes small, with 12 facets, about as long as two thirds of tempora in dorsal view. Tip of antennal tubercles impunctate; punctation dense and fairly coarse on interantennal bridge and posterior antennal tubercles, sparse and very fine on vertexal hump. Antennal segments 3, 4 and 6 equally large, each about 1.5 times as long as wide, segment 5 slightly longer and hardly wider than adjoining segments; segment 7 as long as and slightly wider than segment 5, about 1.5 times as long as wide, segment 8 as long as but slightly wider than segment 3, about 1.2 times as long as wide; segment 9 slightly longer than wide; segment 10 wider than long, asymmetrically expanded apicomesally, with flat mesal side, widest at apical margin; segment 11 as long as segments 10 and 9 combined, about 1.5 times as long as wide. Pronotum hardly wider than head with eyes (ratio 47/45) and slightly wider than long (ratio 47/43). Disc slightly above plan of vertex and below plan of elytra. Admesal areas flat, horizontal in middle; areas between admesal carinae and lateral sulci slightly inclined laterally. Lateral humps distinctly below plan of admesal areas, convex, each with minute denticle at posterior margin. Mesal sulcus deep, widened at basal and anterior ends, basal end fairly distant from base, joined to basal margin by basomedian carina. Discal punctation very fine, similar to than on vertexal tubercle. Elytra moderately convex, long and narrow, widest near posterior angles, about as long as two thirds of abdomen, 1.2 times as wide as long and 1.2 times as wide as pronotum. Lateral contours conspicuously weakly arcuate. Sutural and discal striae distinct, discal striae extending to posterior third of elytra. Humeral protuberances absent. Punctation fairly coarse. Tibiae lacking conspicuous, long setae. Abdomen with punctation similar to that of elytra, lacking particular long setae. Tergite 1 about twice as long as tergite 2, hardly widened apically, with lateral margins straight.

Male characters. Abdominal sternite 1 flattened in middle. Protibiae becoming thicker from base to mid-length, evenly thick and slightly curved in apical half, with apical denticle minute, acute, pointed mesally. Mesotibiae almost straight, with large, oblique, subapical denticle pointed ventroapically; apical fifth of mesotibiae narrowed dorsoventrally, from denticle to apex. Metatibiae almost straight, becoming thicker from base to mid-length, about evenly wide in apical half, flattened in mesal side. Aedeagus (Figs 96, 97) with ventral process of median lobe gradually narrowed (ventral view) and hook-like at tip. Dorsal process fairly wide, narrowed apically, truncate at apex. Internal sac well sclerotized, thick basally, with apical portion long, flattened and in angle to basal portion.

Comments. The shape of the antennal segment 10 may be a male sexual character. It is diagnostic for this species.

Batrisomalus depressus (Raffray)

Batrisus depressus Raffray, 1894a: 448.
Batrisomalus depressus; Raffray, 1904: 103; Raffray, 1908: 182; Jeannel, 1961: 433.

Type material. Holotype ♀: SRI LANKA: CENTRAL PROV. labelled: 660 /1409 /Hakgala [Nak-Gala in Raffray, 1904] Simon (hand-written) / TYPE (red) / Batrisomalus Rffr depressus Rffray ♀ Type Ceylan (hand-written) /Batrisomalus depressus Raffr. det. Löbl 1978 (MNHN).

Additional material. SRI LANKA: CENTRAL PROV.: Hakgala 5 mls SE Nuwara Eliya, 5.III.62, ExpL # 114:I, jungle sieved in debris, 2 ♀ (MZLU, MHNG); Hakgala, 1700m, ravine on north-eastern slope, 28.I.70, ExpG # 30a, 1 ♀ (MHNG).

Description. Length 1.6 mm. Body finely punctate, with long pubescence. Head, eyes included, much wider than long (ratio 41/30). Vertexal hump low, flattened in middle, raised lateroposteriorly to form two tubercles at occipital margin. Median carina impressed. Occipital margin arcuate. Lateral areas of vertex flat, horizontal, almost in same plan as antennal tubercles, each with long carina extending from postantennal fovea to occipital margin. Vertexal sulci converging to interantennal bridge but not joined, their anterior arms parallel on interantennal bridge. Interantennal bridge rounded anteriorly, not clearly delimited from very steep inferior part of frontoclypeus. Eyes small, with 9 or 10 facets, about half as long as tempora in dorsal view. Tip of antennal tubercles impunctate; punctation on interantennal bridge and posterior antennal tubercles coarser than that on vertexal tubercle. Antennal segment 3, 4 and 6 equally large, each about 1.1 times as long as wide; segments 5 and 7 slightly longer and wider than segment 6; segment 8 hardly smaller than segment 6; segments 9 and 10 equally long, slightly longer than segment 7, segment 9 as long as wide, 10 wider than long; segment 11 almost twice as long as wide, slightly longer than segments 9 and 10 combined. Pronotum distinctly wider than head with eyes (ratio 46/40) and wider than long (ratio 45-46/39-40). Disc slightly raised above plan of head, almost in plan with elytra. Admesal area flat, horizontal; areas between admesal carinae and lateral sulci hardly below plan of admesal area, flat and horizontal; lateral humps distinctly below plan of admesal area, rounded. Median sulcus deep, fairly wide, starting fairly distant from basal margin; basomedian carina very short, inconspicuous, separated from median sulcus by flat interval. Margin of lateral humps each with acute denticle pointed dorsally. Discal punctation coarser than that on vertexal centre. Elytra convex, wide and short, about 1.3 times as wide as long, hardly 1.2 times as long as pronotum; shorter than abdomen (as long as combined length of abdominal tergites 1 to 3), with lateral margins arcuate. Sutural and discal striae distinct, discal striae extending slightly posterior elytral mid-length. Humeral tubercles very small. Punctation less fine than that on pronotum. Tibiae without particular, long setae. Abdomen with punctation similar to that on elytra, lacking particular long setae. Tergite 1 about 2.5 times as long as tergite 2, distinctly, gradually narrowed toward base, with lateral margins oblique. Tergite 2 slightly narrowed apically, with lateral margins arcuate.

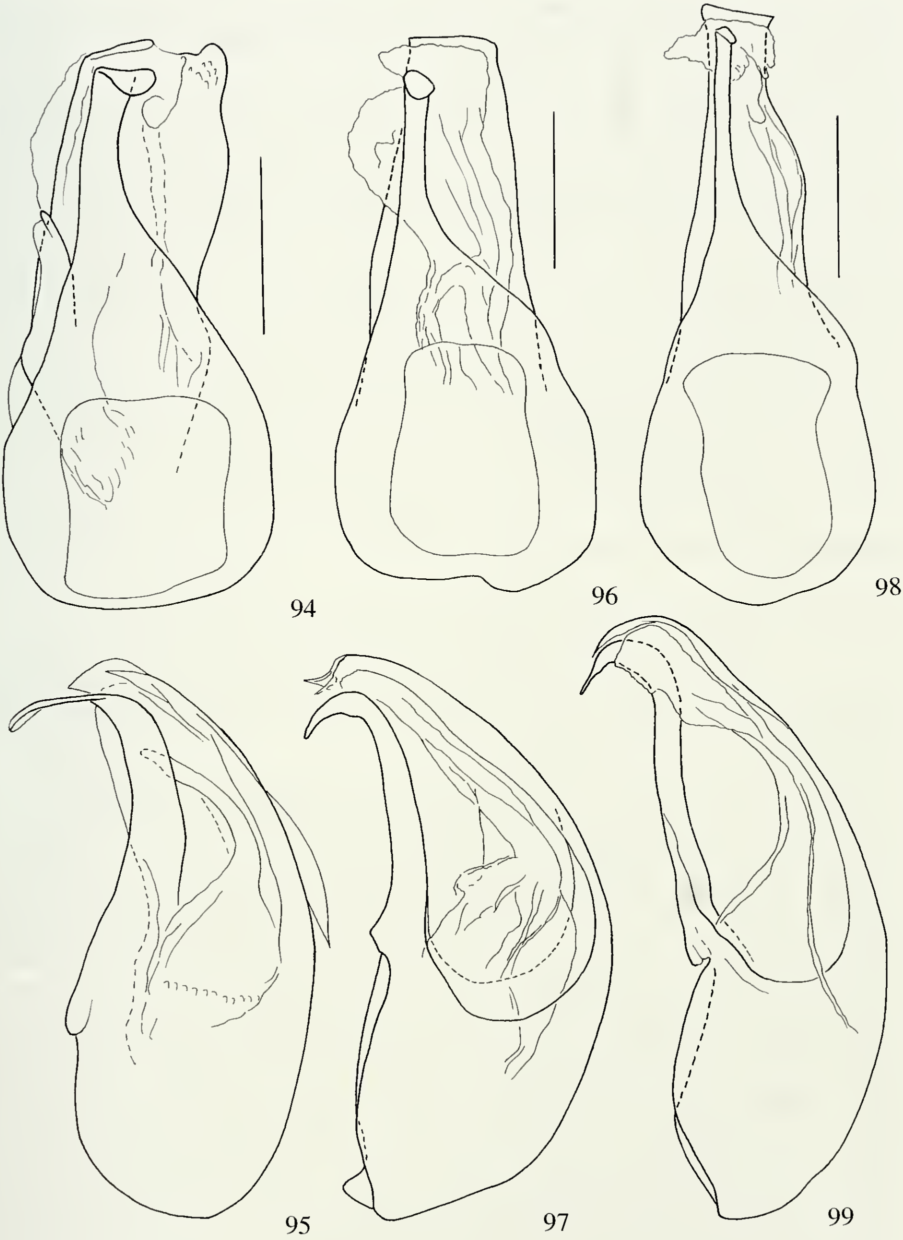
Comments. This species may be distinguished from other congeners having elytra with two basal foveae by the abdominal tergites bearing uniformy short pubenscence, the very small eyes, and the vertex distinctly carinate laterally.

Batrisomalus foveolatus sp. n. Figs 93, 98, 99

Holotype ♂: SRI LANKA: CENTRAL PROV.: Ramboda 7 mls NW Nuwara Eliya, 4.III.62, ravine with stream, under stones, ExpL # 118 (ZMLU).

Paratypes: SRI LANKA: CENTRAL PROV.: same data as holotype, 4 ♂, 4 ♀ (MZLU, MHNG); Foothills of Knuckle Mnts. 10 mls ENE Kandy, 11.III.62, jungle, ExpL #129, 1 ♂, 1 ♀ (MZLU).

Description. Length 2.0-2.15 mm. Body very finely punctate, with long pubescence. Head, eyes included, moderately wider than long (ratio 36/30). Vertexal hump moderately high, slightly raised posteriorly, flat, expanded above neck to form acute denticle (lateral view) at middle of occipital margin. Lateroposterior parts of vertex each rounded, gradually inclined posteriorly, with long carina joining frontal fovea. Vertexal sulci inverted V-shaped, joined on interantennal bridge. Interantennal bridge obliquely inclined, sharply delimited from steep inferior part of frontoclypeus by transverse carina. Frontoclypeus with median carina joining transverse carina to inferior margin of clypeus. Eyes fairly large, in both sexes with about 30 to 35 facets, and about as long as two thirds of tempora in dorsal view. Punctation on tip and anterior surfaces of antennal tubercles finer than on vertex. Antennal segments 3, 4 and 8 equally large, each as wide as long or slightly wider than long; segments 4, 5 and 6 equally wide, each as wide as but longer than segment 3 and slightly longer than wide; segment 9 slightly longer than wide; segment 10 as long as segment 9, as long as wide, segment 11 twice as long as wide, as long as segments 10, 9 and half of 8 combined. Pronotum slightly wider than long and slightly wider than head with eyes. Disc below plan of elytra, raised above plan of head. Median sulcus deep and wide, touching basomedian carina. Admesal areas convex, not inclined laterally. Areas between discal carinae and lateral sulci slightly inclined laterally. Margins of lateral humps rounded, without denticle; with one pair of small, lateral denticles, situated between outer antebasal and lateral foveae. Discal punctation very fine, similar to than of vertex. Elytra convex, short and wide, about 1.2 times as long as pronotum, combined much wider than long (ratio about 7/5), with lateral margins arcuate. Each elytron with 3 basal foveae, distinct sutural striae; discal striae almost faint, variably long; humeral humps distinct, angulate posteriorly. Punctation slightly coarser than on head. Abdomen with punctation slightly coarser than that of elytra;



FIGS 94 to 99: *Batrisomalus* Raffray, aedeagi

94 and 95: *B. cautus* sp. n., ventral (94) and lateral (95) views; 96 and 97: *B. currax* sp. n., ventral (96) and lateral (97 views; *B. foveolatus* sp. n., ventral (98) and lateral (99) views. Scale bars = 0.1 mm.

with several, particularly long setae. Tergite 1 with lateral margins slightly arcuate, at base about as wide as at apex, slightly more than twice as long as tergite 2. Tergite 2 narrowed apically.

Male characters. Elytra with humeral humps larger. Tibiae lacking denticles. Protibiae arcuate, thickened from base to mid-length, evenly robust in apical half. Mesotibiae robust, thickened from base to mid-length, in apical half slightly sinuate, forming blunt subapical angle (Fig. 93). Metatrochanters expanded, with impression bearing tuft of short setae on posterior side. Metatibiae slightly arcuate. Abdominal sternites without obvious sexual characters. Aedeagus (Figs 98, 99) with ventral process of median lobe strongly narrowed in apical two thirds, tip curved, forming short, acute hook. Dorsal process arcuate in lateral view, narrowed apically in ventral view, with truncate apex. Internal sac with sclerotized, arcuate rod.

Comments. This species may be readily distinguished from the other Sri Lankan members of *Batrisomalus* by the elytra each having three basal foveae. It shares this characters with *B. infossus* Raffray from South India, that differs by the parabolic vertexal sulci and the coarse and sparse elytral punctation.

Batrisomalus hemipterus (Raffray) Figs 88, 100, 101

Batrisus hemipterus Raffray, 1894a: 449.
Batrisomalus hemipterus; Raffray, 1904: 60 and 103; Raffray, 1908: 182; Jeannel, 1961: 433.

Type material: SRI LANKA: CENTRAL PROV.: 1 ♂ labelled: Simon Nuwara Elia (hand-written) /1410 / 662 / Batrisomalus Rffr hemipterus Rffray Type Ceylan (hand-written) / TYPE (red) / Batrisomalus hemipterus Raffr. Det. Löbl 1978 (MNHN); 2 ♀ from the same original slide, subsequently labelled: Ceylon Nuwara Eliya Simon / TYPE (red) /Batrisomalus hemipterus Raffr. Det. Löbl, 1978 (MNHN).

Description. Length 1.65 mm. Body finely punctate, with long pubescence. Head, eyes included, much wider than long (ratio 39/29). Vertexal hump high, not raised posteriorly, flat or weakly convex, not expanded above neck. Lateroposterior parts of vertex oblique and flattened, lacking carina. Vertexal sulci inverted U-shaped, parallel posteriorly. Mesal vertexal carina long, extending from neck up to anterior, inclined surface of vertexal hump. Interantennal bridge strongly modified in male, rim-like in female, lacking transverse carina. Frontoclypeus without median carina. Eyes small, in both sexes with 7 or 8 facets, slightly shorter than half of temporal length in dorsal view. Antennal tubercles smooth, impunctate, frons and vertex very finely punctate. Antennal segments 3 to 8 equally wide, segments 3, 5 and 7 each almost twice as long as wide, segments 4 and 6 shorter, about 1.5 times as long as wide, segments 8 and 9 each slightly longer than wide, segment 10 as long as wide, segment 11 about twice as long as wide, as long as segments 8 to 10 combined. Pronotum distinctly wider than long and wider than head with eyes. Disc and elytra at same plan, raised above plan of head. Median sulcus deep, narrow, touching basomedian carina. Admesal areas flat, not inclined laterally. Areas between discal carinae and lateral sulci slightly inclined laterally. Margins of lateral humps rounded, without denticle. Denticle between outer antebasal and lateral foveae absent. Discal punctation very fine, similar to than of vertex. Elytra convex, short and wide, about 1.2 times as long as pronotum, combined much wider than long (ratio about 5/4), with lateral margins arcuate. Each elytron with 2 basal foveae, distinct sutural striae; discal striae extending to apical third of elytral length; humeral humps distinct, angulate posteriorly. Punctation irregular, much coarser than on pronotum and head. Abdomen with punctation finer than that of elytra; with several, particularly long setae. Tergite 1 with lateral margins straight, at base slightly narrower than at apex, about twice as long as tergite 2. Tergite 2 narrowed apically.

Male characters. Frons with two conspicuous, flat and impunctate, almost semicircular plates at each side of anterior portion of vertexal hump. Frontal plates sharply delimited anteriorly by arcuate margins, posteriorly by deep, transverse sulci. Mesal, inclined part of frontoclypeus swollen, with conspicuously dense pubescence. Anterior, inclined surface of vertexal hump with conspicuously dense pubencence. Elytra with humeral humps hardly larger. Protibiae straight, with slightly arcuate outer side, bearing spine-like, subapical denticle at mesal side. Mesotibiae lacking denticle, straight and gradually thickened from base to apical third, in apical third curved and swollen mesally (Fig. 88). Metalegs and abdominal sternites without obvious sexual characters. Aedeagus (Figs 100, 101) with ventral process of median lobe strongly narrowed in apical two thirds, tip curved, forming short, acute hook. Dorsal process arcuate in lateral view, narrowed apically in ventral view, with truncate apex. Internal sac with sclerotized, arcuate rod.

Comments. This species may be readily distinguished from its congener by the shape of the vertexal sulci and by the conspicuously modified male frons.

Batrisomalus lewisi (Jeannel) comb. n. Figs 91, 102, 103

Cratnodes lewisi Jeannel, 1961: 433.

Type material. Holotype ♀: Sri Lanka: Central Prov.: labelled: Kandy, 1,546-1,727 ft.,6.IV.1882 /Ceylon G. Lewis. 1910-320 (NHML); paratype ♂: Central Prov.: Bogawantalawa, 4900-5200 ft, 21. III.-4.IV.1882, G. Lewis /Cratnodes Lewisi n sp (handwritten by Jeannel) / Batrisomalus lewisi (Jeannel) Löbl & Kurbatov det. (MNHN).

Additional material. Sri Lanka: Sabaragamuwa Prov.: Maratenna at 4500ft, 7 mls N Balangoda, 22.II.62, ExpL # 98, sieved in debris, 4 ♂, 3 ♀, (MZLU, MHNG); Sri Lanka: Ceylon, Coll. Cl. Müller, 2 (ZSMC).

Description. Length 1.9-2.0 mm. Body with long pubescence, abdominal tergites bearing several particularly long setae. Head, eyes included, much wider than long (ratio 43/33 to 45/30). Vertexal hump flattened, moderately raised toward occipital margin, at highest point slightly above plan of antennal tubercles. Median carina raised. Occipital margin arcuate. Dorsolateral parts of head rounded, gradually inclined from antennal tubercles toward occipital margin, with inconspicuous, longitudinal carina. Vertexal sulci obliquely converging toward interantennal bridge, with anterior arms parallel, not joined. Interantennal bridge gradually inclined anteriorly, not clearly separated from more inclined inferior part of frontoclypeus. Eyes fairly large, in male with about 35 facets and in dorsal view as long as tempora, in female with 16 or 17 facets and about as long as two thirds of tempora in dorsal view. Tip of antennal tubercles impunctate, most of head distinctly punctate, centre of vertex with punctation finer than that on lateral and anterior areas. Antennal segments 3 to 8 equally wide, segments 3 and 8 equally long, each about 1.2 times as long as wide; segments 4 and 6 slightly longer than segment 3; segments 5 and 7 equally large, about 1.7 times as long as wide, segment 9 distinctly longer than wide; segment 10 slightly longer than wide; segment 11 about twice as long as wide and as long as combined length of segments 10, 9 and half of 8. Pronotum and elytra similar to those in *B. depressus*; basomedian carina of pronotum extending to median sulcus or shortened; elytra 1.2-1.3 times as wide as long, as long as or longer than abdomen, with discal striae reaching mid-length or ending anterior to mid-length of disc. Metatibiae with several particularly long setae. Abdomen with punctation more dense than that of elytra. Tergite 1 parallel-sided, 2.3 to 3 times as long as tergite 2. Tergite 2 narrowed apically.

Male characters. Eyes larger, elytra longer than in female. Protibiae slightly curved, thickened from base to mid-length, in apical half evenly thick. Mesotibiae (Fig. 91) slightly curved, gradually thickened toward acute, subapical denticle on mesal side. Metatibiae lacking obvious sexual characters. Sternites 1 to 5 flattened in middle. Aedeagus (Fig. 102, 103) with ventral process of median lobe strongly narrowed in apical half, tip widened in ventral view, forming robust hook in lateral view. Dorsal process slightly arcuate in lateral view, almost evenly wide in ventral view.

Comments. This species may be distinguished from its congener of similar size and having two foveae at base of elytra by the strongly converging vertexal sulci, the abdominal tergites bearing several particularly long setae and the antennal segment 11 about twice as long as wide. Curiously, the holotype of *B. lewisi*, erroneously recorded as a male by Jeannel (1961), is the sole member of the genus found at Kandy, in spite of large collections made there by the Lund and Geneva expeditions.

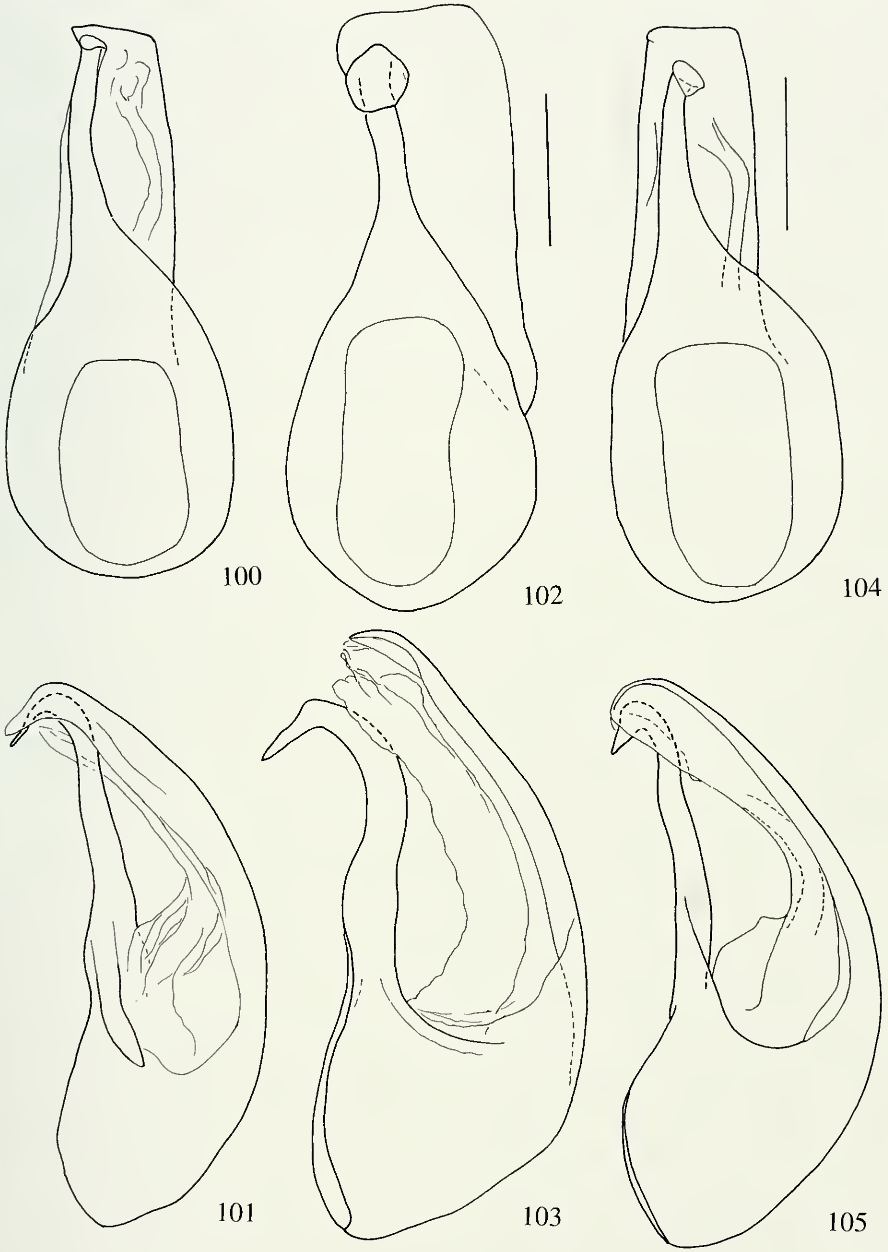
Batrisomalus microphthalmus (Raffray) Figs 85, 89, 90, 104, 105

Batrisus microphthalmus Raffray, 1894a: 448.
Batrisomalus microphthalmus; Raffray, 1904: 103; Raffray, 1908: 182; Jeannel, 1961: 433.

Type material. SRI LANKA: CENTRAL PROV.: 2 ♀ syntypes on same pin, labelled: 661 /1408 /Nuwara Elia Maturata (hand-written) /TYPE (red) /Batrisomalus Rffr microphthalmus Type Rffray Ceylan (hand-written) /Batrisomalus microphthalmus Raffr. det. Löbl 1978 (MNHN).

Additional material. SRI LANKA: CENTRAL PROV.: Pidurutalagala, 2500m, forest below summit, 29.I.70. ExpG # 31, 17♂, 26 ♀ (MHNG, PCSK); same but at 2200m, forest on south-western slope, 6 ♂, 6 ♀ (MHNG); Horton Plains, 2100m, forest, 15.II.70, ExpG # 68, 7 ♂, 9 ♀ (MHNG); Hakgala, 1700m, ravine, north-eastern slope, 28.I.70, ExpG # 30a, 15 ♂, 15 ♀ (MHNG, PCSK); Horton Plains, 6700ft, 11 mls SSE Nuwara Eliya, indigenous forest, 19-20.III.62, ExpL # 162, 2 ♂, 2 ♀ (MZLU, MHNG); Hakgala, forest, 5 mls SE Nuwara Eliya, 3.III.62, ExpL # 114:I, 1♂, 1 ♀ (MZLU); same data but ExpL # 114:II, 1 ♀ (MZLU).

Description. Length 2.0-2.25 mm. Body with long pubescence, lacking particular long setae. Head, eyes included, much wider than long (ratio 43-47/34-35). Vertexal hump hardly flattened, raising above plan of antennal tubercles, not raised apically. Median carina hardly raised. Occipital margin truncate. Dorsolateral parts of head rounded, not or hardly inclined posteriorly, lacking carina. Vertexal sulci inverted V-shaped, joined anteriorly. Interantennal bridge gradually inclined anteriorly, delimited from inferior, vertical part of frontoclypeus by oblique carinae or angles.



FIGS 100 to 105: *Batrisomalus* Raffray, aedeagi

100 and 101: *B. hemipterus* (Raffray), ventral (100) and lateral views (101); 101 and 103: *B. lewisi* (Jeannel), ventral (102) and lateral (103) views; 104 and 105: *B. microphthalmus* (Raffray), ventra (104) and lateral (105) views. Scale bars = 0.1 mm.

Eyes small, in female with 9 to 11 facets and in dorsal view about as long as half of tempora, in male with 14 or 15 facets and slightly longer than half of tempora, not exceeding length of two thirds of tempora. Tip of antennal tubercles usually impunctate, punctation on and around antennal tubercles and on dorsolateral surface of head dense and fairly coarse, finer and less dense on middle portion. Antennal segments 3 to 8 equally wide, segments 3 and 8 almost even, each about 1.3 times as long as wide; segments 4 to 7 each distinctly longer than segment 8, about 1.4 to 1.6 times as long as wide; segment 9 distinctly longer than wide; segment 10 hardly longer than wide; segment 11 as long as segments 9 and 10 combined and twice as long as wide. Pronotum wider than head, eyes included, and wider than long (ratio 51-54/43-45). Disc slightly above plan of head, about in same plan as elytra. Admesal area flat, horizontal, areas between admesal carinae and lateral sulci slightly below plan of admesal area and slightly obliquely inclined; lateral humps distinctly below plan of admesal area, convex. Median sulcus deep and fairly wide, starting fairly close to base; basomedian carina extending to median sulcus, sometimes becoming very low anteriorly. Margins of lateral humps with small, acute denticle pointed dorsally. Discal punctation fine, similar to that on vertexal centre. Elytra moderately convex, wide and short, about 1.2 times as wide as long, hardly 1.3 times as long as pronotum; much shorter than abdomen, about as length of tergites 1 and 2 combined, with lateral margins arcuate and two large basal foveae. Sutural and discal striae distinct, discal striae ending anterior to elytral mid-length. Humeral tubercles distinct. Punctation coarser than that on pronotum. Tibiae lacking particular long setae. Abdomen with punctation similar to that of elytra, lacking particular long setae. Tergite 1 about 1.5-1.8 times as long as tergite 2, shorter than tergites 2 and 3 combined, gradually narrowed toward base, with lateral margins oblique. Tergite 2 slightly narrowed apically, with lateral margins oblique.

Male characters. Eyes slightly larger than in female. Metasternum and sternites without particular characters. Profemora swollen. Protibiae (Fig. 90) distinctly curved, gradually thickened from base to mid-length, evenly wide in apical half, with acute, apical denticle on mesal side. Mesotibiae straight and gradually thickened toward fourth fifth, curved in apical two fifth, with mesal side slightly convex, outer side concave. Metatrochanters flattened and bearing straight, short setae on posterior side. Metatibiae (Figs 89) straight near base, conspicuously curved between basal fourth and apex, widened from base to middle, from middle to apex slightly narrowed, with mesal side concave and flattened, outer side convex. Aedeagus (Figs 104, 105) with ventral process of median lobe strongly narrowed in proximal part and slightly widened near tip in ventral view, sinuate and hook-like at apex in lateral view. Dorsal process of median lobe flat, almost parallel-sided, truncate apically. Internal sac moderately sclerotized.

Comments. This species may be easily distinguished from its congener of similar size and having elytra with two basal foveae by the male mesotibiae and metatibiae which are widened and conspicuously curved, and lack denticles.

Batrisomalus obtectus sp. n. Figs 106, 107

Holotype ♂: Sri Lanka: Central Prov.: Hakgala, 1700m, 28.I.70, ExpG # 30a (MHNG).

Description. Length 2.25 mm. With most characters as *B.microphthalmus* but conspicuously different by male sexual characters. Head (width/length ratio 50/35) with eyes hardly wider than in *B. microphthalmus*, vertexal hump more raised and flattened, median vertexal carina more prominent, lateral portion of vertex distinctly inclined and with longitudinal crest. Eyes with 12 or 13 facets. Antennal segments 3, 4 and 8 even, each about 1.3 times as long as wide, segments 5, 6 and 7 even, each slightly longer than segment 4 and about 1.4 times as long as wide; segment 9 hardly longer than wide, segment 10 as wide as long; segment 11 not quite twice as long as wide, slightly longer than segments 9 and 10 combined. Pronotum distinctly wider than head with eyes, and much wider than long (ratio 55/45). Tergite 1 about 1.6 times as long as tergite 2.

Male characters. Abdominal ventrites without obvious sexual characters. Profemora not swollen. Protibiae thickened in apical two thirds, with outer side slightly convex, mesal side very weakly concave; dense, robust pubescence covering apical half of mesal side. Mesotibiae gradually thickened from base to mid-length, outer side posterior middle flattened, mesal side slightly concave, with dense, robust pubescence extending from apex almost to mid-length, and with slightly curved, apical denticle. Metatibiae straight and gradually thickened from base to apical third, flattened and slightly curved in apical third, with robust, very dense pubescence completely covering apical fourth of mesal side and forming narrow, apicoventral setal bunch extending posterior tarsomere 1. Aedeagus (Figs 106, 107) with ventral process of median lobe strongly narrowed posterior middle, thickened to form acute subapical tooth (lateral view) and strongly curved at end. Dorsal process of median lobe wide, with right margin strongly sclerotized, left margin weakly sclerotized, truncate at apex. Internal sac strongly sclerotized basally, sinuate and gradually narrowed in lateral view.

Comments. This species is very similar to *B. microphthalmus* from which it differs notably by the mesotibiae hardly curved and bearing each an apical denticle.

Batrisomalus pubis sp. n. Figs 108, 109, 110

Holotype ♂: Sri Lanka: Central Prov.: Pidurutalagala, 2200m, forest on south-western slope, 29.I.70, ExpG # 32 (MHNG).

Paratype: Sri Lanka: Central Prov.: Horton Plains, forest at 2100m, 15.II.70, ExpG # 68, 1 ♂ (MHNG).

Description. Length 2.7 mm. Body finely punctate, with long pubescence. Head, eyes included, much wider than long (ratio 44/32). Vertexal hump moderately raised, rounded laterally. Occipital margin arcuate. Dorsolateral areas of head inclined from antennal tubercles toward occipital margin, each with short carina joined to postantennal fovea. Vertexal sulci inverted Y-shaped, with anterior arm narrow and separating obliquely inclined interantennal bridge. Interantennal bridge angulate anteriorly, well delimited from very steep inferior part of frontoclypeus. Eyes small, with about 16 facets, in dorsal view about as half of temporal length. Punctation on antennal tubercles coarser than on centre of vertex. Antennal segments 3 and 4 equally large, each about 1.3 times as long as wide; segment 5 distinctly longer and slightly wider than segment 4, about 1.6 times as long as wide; segments 6 and 7 even, each as long as and hardly wider than segment 4; segment 8 shorter than and as wide as segment 7, slightly longer than wide; segments 9 and 10 each as long as segment 7, segment 9 slightly longer than wide, segment 10 as long as wide; segment 11 twice as long as wide, slightly longer than segments 9 and 10 combined. Pronotum slightly wider than head with eyes (ration 46/44) and slightly wider than long. Disc raised above plan of elytra and head. Admesal areas of disc almost horizontal, slightly inclined anteriorly. Disc distinctly inclined from admesal carinae toward lateral margins. Median sulcus wide and deep, starting close base, separated from basal margin by small tubercle. Margin of lateral humps angulate posteriorly, with denticles very low, inconspicuous. Discal punctation very fine, similar to than on middle portion of vertex. Elytra comparatively elongate and narrow, about as long as combined wide, 1.5 times as long as pronotum, shorter than abdomen (as long as combined length of tergites 1, 2 and half of 3), each with 2 basal foveae. Sutural striae faint. Discal striae indicated by shallow impressions, extending almost to mid-length of disc. Humeral tubercles very small, angulate. Punctation less fine than that on pronotum. Metatibiae with numerous, particularly long setae. Abdomen with punctation similar to that on elytra, lacking particular long setae. Tergite 1 gradually, slightly narrowed toward base, slightly longer than tergite 2; tergite 2 about as wide at base as at apex, with lateral margins slightly arcuate.

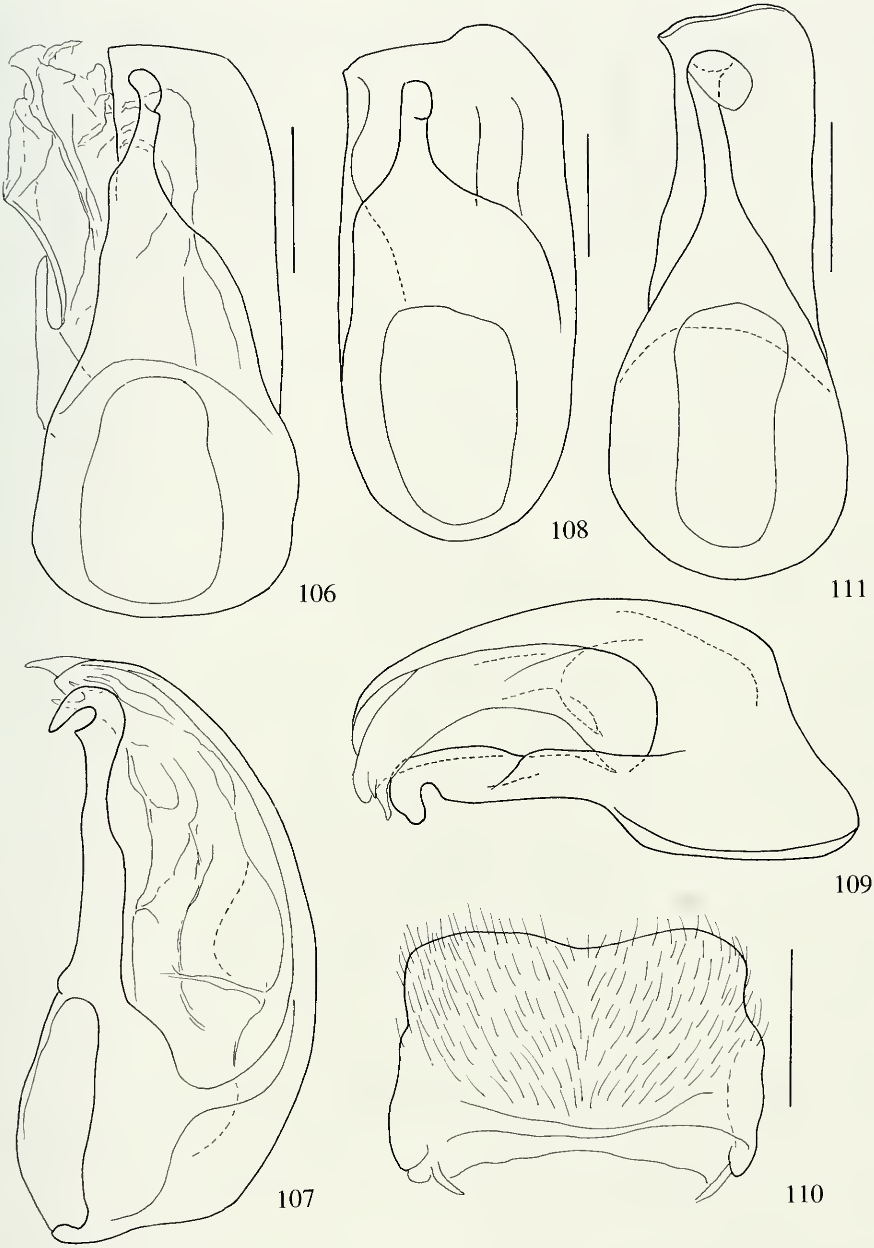
Male characters. Profemora strongly swollen, meso and metafemora moderately swollen. Protrochanters abruptly flattened on mesal side. Protibiae slightly arcuate, gradually thickened apically, with minute apical carina on mesal side. Mesotibiae curved posterior mid-length, gradually thickened apically. Abdominal sternites 1 to 4 impressed mesally. Sternite 5 concave, expanded apicolaterally and bilobed (Fig. 110). Aedeagus (Figs 108, 109) with ventral process of median lobe abruptly narrowed in apical half (ventral view), deep subapical notch and blunt apex. Dorsal process very wide, moderately expanding posterior ventral lobe, subparallel in ventral view, apical margin arcuate at right side, oblique at left side. Internal sac with sclerotized rods.

Comments. This species is characterized by the large size of the body and the male abdominal sternite 5 which is expanded, concave and bilobed apically.

Batrisomalus tuberculatus sp. n. Figs 92, 111

Holotype ♂: Sri Lanka: Central Prov.: Hakgala, 5 mls SE Nuwara-Eliya, 3.III.62, ExpL # 114:I (MZLU).

Description. Length 1.65 mm. Body with punctation mostly fine, pubescence long. Head, eyes included, much wider than long (ratio 40/30). Vertexal hump flat, oblique, raised at each side at occipital margin, with few very fine punctures and in part impunctate. Occipital margin truncate. Dorsolateral areas of head inclined from antennal tubercles toward occipital margin, each with carina above eye, not joined to



FIGS 106 to 111: *Batrisomalus* Raffray

106 and 107. *B. obtectus* sp. n., aedeagus in ventral (106) and lateral(107) views; 108 to 110: *B. pubis* sp. n., aedeagus in ventral (108) and lateral (109) views, abdominal sternite 5 (110); 111: *B. tuberculatus* sp. n., aedeagus in ventral view. Scale bars = 0.1 mm (106 to 109, 111) and = 0.2 mm (110).

postantennal fovea. Vertexal sulci inverted V-shaped, faint, indicated by smooth, arcuate margins delimiting strongly raised antennal tubercles. Interantennal bridge very narrow, deeply impressed, horizontal. Inferior, vertical part of frontoclypeus delimited by transverse crest. Eyes small, with 13 facets, in dorsal view about as long as half of tempora. Antennal tubercles conspicuously large, flattened and covered by coarse, very dense, partly confluent punctation. Antennal segments 3, 4 and 8 equally large, each about 1.2 times as long as wide; segments 5, 6 and 7 even, distinctly longer and slightly wider than segment 4, each about 1.6 times as long as wide; segments 9 and 10 each hardly longer than segment 7, segment 9 distinctly longer than wide, segment 10 slightly longer than wide; segment 11 twice as long as wide, as long as combined length of segments 10, 9 and half of 8. Pronotum distinctly wider than head with eyes (ratio 45/40) and wider than long (ratio 45/38). Disc raised above plan of head, below plan of elytra. Admesal areas of disc almost horizontal, slightly inclined anteriorly, hardly inclined toward lateral sulci. Median sulcus deep, narrow, widened at basal end but not at anterior end, starting distant from base, joined to base by basomedian carina. Margins of lateral humps each with acute denticle. Discal punctation very fine, similar to than on lateroposterior portion of vertex. Elytra comparatively short and wide, about 1.3 times as wide as long, about 1.2 times as long as pronotum and as long as abdomen. Each elytron with 2 basal foveae, distinct sutural stria and discal stria extending to mid-length of disc. Humeral tubercles small, angulate. Punctation fairly coarse. Metatibiae with numerous, particularly long setae. Abdomen with punctation finer than that on elytra, lacking particular long setae. Tergite 1 gradually, slightly narrowed toward apex, longer than tergites 2 and 3 combined (in dorsal view longer than remainder of abdomen); tergite 2 narrowed apically, with lateral margins slightly arcuate.

Male characters. Protibiae almost straight, widened from base to mid-length, from mid-length to apex evenly thick; outer side slightly convex and mesal side slightly concave from mid-length to apex. Mesotibiae (Fig. 92) gradually widened from base about to mid-length, from apical third to apex narrowed, with acute, setose, subapical denticle; outer margin mostly rounded, mesal margin slightly concave posterior tomiddle. Metatibiae straight, slightly widened toward mid-length, posterior to middle almost evenly thick. Aedeagus (Fig. 111) with ventral process of median lobe strongly narrowed toward middle, evenly narrow up to curved and widened apical portion. Dorsal process of median lobe fairly wide, with slightly sinuate lateral margins and obliquely sinuate apical margin. Internal sac membranous.

Comments. This species may be easily distinguished from its congeners by the flattened, coarsely and very densely punctate antennal tubercles. The aedeagus was accidentally lost while remounting for illustration in lateral view.

Batribolbus Raffray — Fig. 112

Batribolbus Raffray, 1904: 60 type species *Eubatrisus dentipes* Raffray, 1894.

Description. Habitus as Fig. 112. Length 1.35-2.0 mm. Body with dorsal side convex. Head below plan of pronotum, elytra raised above plan of vertex and abdomen. Punctation of body and appendages dense, mostly very fine. Pubescence variably long, particularly long setae present in some species.

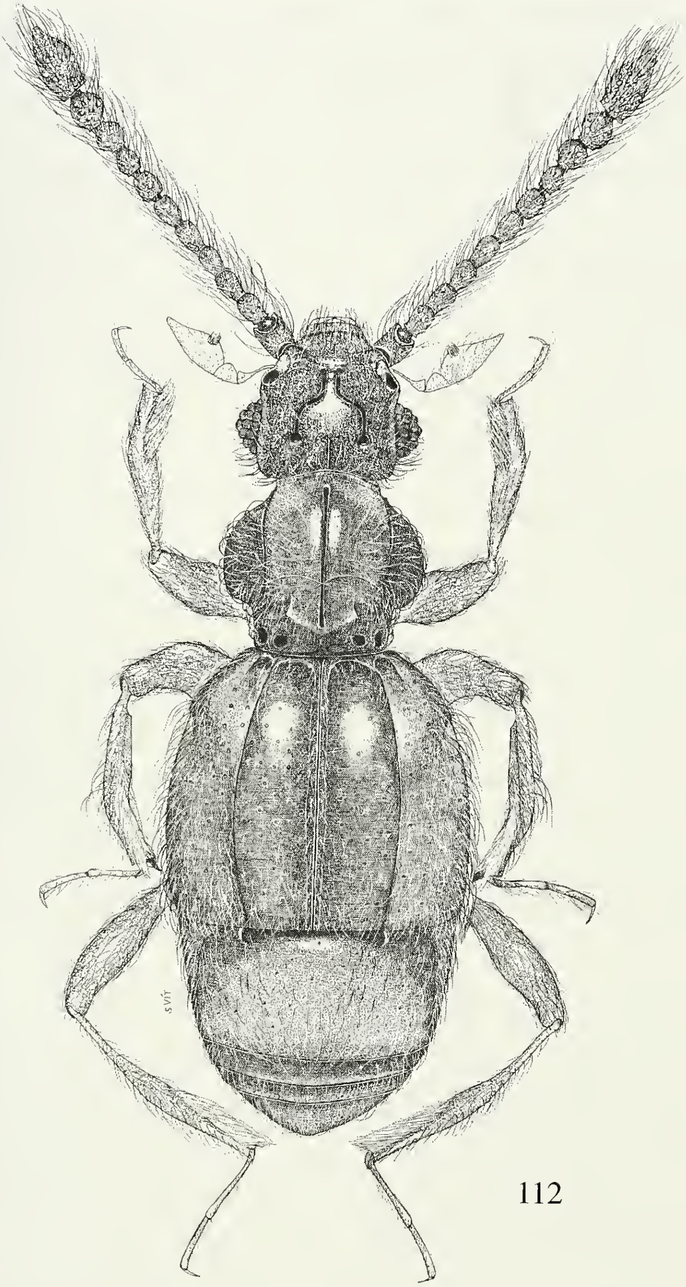


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FIG. 112
Batribolbus dentipes sp. n.

Head subpentagonal, about as long as wide, with eyes narrower than pronotum. Lateral contours parallel or almost parallel-sided. Frontal lobe slightly below plan of vertex, impressed between antennal tubercles and inclined toward arcuate anterior margin of frontoclypeus. Antennal fossae distant, frontoclypeus wide, obliquely inclined, distinct in dorsal view. Antennal tubercles very low. Vertexal foveae not in impressions. Posterior arms of vertexal sulcus joined to vertexal foveae, anterior arms curved mesally antennal tubercles, parallel or subparallel on interantennal impression, not joined. Vertex with median carina. Lateral frontal foveae large, situated posterior antennal tubercles. Ocular-mandibular carina touching eye margin. Occipital part of vertex transverse or slightly concave, inclined convexly toward neck. Eyes large, not nochted, situated in posterior half of head, multifaceted, facets large. Tempora very short. Ventral side of head fairly long, moderately convex, moderately inclined toward neck, lacking long postgenal setae. Gular foveae close, in common impression, fused in *B. palpator*.

Antennae fairly long. Scape cylindrical, with dorsoapical angles blunt, not prominent, lacking modified setae and glandular orifice. Segments 2 to 8 symmetrical. Pedicel cylindrical, longer than wide, smaller than scape. Segments 4, 6 and 8 slightly smaller than adjoined segments; club 3-segmented. Maxillary palpi fairly long, segment 3 short, narrowed mesally; segment 4 with broad base, short stalk.

Pronotum convex, about as long as wide, cordiform, with one mesal and two lateral sulci, antebasal ridge, four inconspicuous basal foveae, short basomesal carina extending from basal margin to mesal sulcus. Paranotal ridges sinuate in lateral view, shortened. Hypomera smooth, with basolateral foveiform impressions.

Elytra convex, moderately long, longer than pronotum, combined wider than long. Lateral contours broadly arcuate. Each elytron with pair of basal foveae, one subhumeral fovea, entire sutural stria, long discal stria, lateral carina curved anteriodorsally to join subhumeral fovea and usually extending above fovea up to humeral angle. Basal ridge distinct.

Metasternum swollen, with large median impression. Apical intercoxal margin truncate or concave, lacking prominent process and lacking median notch. Lateral metasternal foveae separated by interval about as large as foveal diameter.

Legs slender, tarsi with segment 2 and 3 similar in length.

Abdomen with 4 tergites visible in dorsal view. Tergite 1 large, longer than tergites 2 to 4 combined, inclined and slightly narrowed apically, not constricted basally, with one pair of lateral carinae at each side, basal impression and two pairs of basal foveae; outer and inner basal foveae close, separated by basodiscal carinae. Tergites 2 to 4 strongly inclined, with single lateral fovea and lacking impressions. Sternite 1 with two pairs of basal foveae, outer and inner foveae widely separated, and with one basodiscal carina araising from near outer basal fovea.

Male sexual characters located on segment 4 of maxillary palpi, mesolegs, rarely also prolegs, metasternum and abdominal sternites. Aedeagus with two ventral and one dorsal processes. Ventral process (possibly homologous to parameres) possesses usually one to three sensory setae. Membranous structure bearing conspicuous bunch of sclerotized, long spiculae (absent from *B. punctatus*) appears associated to left ventral lobe or internal sac. Dorsal process typically arcuate.

Females eyes smaller and elytra shorter than those of males. Abdominal tergite 5 with spine-like projection in *B. pubescens*.

Habitat. Members of *Batribolbus* are founds in a variety of habitats including forest floor litter, rotten wood, under bark and on sandy banks of streams where they may be common. They occur from sea level up to 1950 m above sea level. Several species were collected exclusively at light traps and are represented by males only.

Distribution. Known only from Sri Lanka.

Comments. Several characters support the monophyly of *Batribolbus*, in particular the form of the vertexal sulci, the presence of longitudinal carinae on the first sternite, and the aedeagus usually bearing a spicular bunch. The aedeagal characters indicate monophyletic species groups. Five species, *B. aemulus*, *B. carinatus*, *B. hystrix*, *B. pubescens*, and *B. trebax* possess right ventral process expanded by two lobes, smaller marginal and larger central, and a pair of long setae araising from an area between these lobes; the dorsal process is strongly widened in apical part, the bunch of spiculae is distinct. A second group consists of *B. abas*, *B. dentipes*, *B. furcipes*, *B. incurvus*, *B. onustus*, *B. pertubator* and *B. punctatus*. They have the right ventral process simple, elongate, bearing one to three subapical setae, and the dorsal process narrowed apically, as in the former group. An exception is *B. pertubator* which has the apical part of the dorsal process strongly widened. The bunch of spiculae is also as in the former group, except that in *B. dentipes* which has a distinctive inner lobe bearing wide and poorly sclerotized spiculae. The remaining three species, *B. gracilipes*, *B. mussardi*, and *B. palpalis* lack setae and each of them may represent a distinct group. *Batribolbus gracilipes* has the right ventral process notched, a narrow dorsal process and a distinct spicular bunch. *Batribolbus mussardi* has also a distinct bunch of spiculae but differs by the complex dorsal process. *Batribolbus palpator* is characterized by the reduced number of wide and weakly sclerotized spiculae and very long left ventral process. The latter species is distinctive also by the fused gular foveae and bifurcate lateral mesosternal foveae. Other species (*B. dentipes*, *B. furcipes* and *B. punctatus*) have separate gular foveae and simple lateral mesosternal foveae.

KEY TO SPECIES OF *BATRIBOLBUS*

1 Antennal segments 4 to 8 each about as long as wide. Dorsum of body without additional, particularly long setae (unknown in *B. trebax*) 2
\- Antennal segments 4 to 8 each, or some of them, longer than wide 6
2 Pronotal punctation coarse. Male mesotibiae with large, sinuate process araising from middle of mesal side (Fig. 135). Male sternite 1 with two vertical, admesal processes . . . . *B. furcipes* sp. n.
\- Pronotal punctation different. Male mesotibiae without large process. Male sternite 1 lacking processes 3
3 Pronotal punctation throughout fine 4
\- Pronotal punctation coarser on area between sulci than on remainder of disc . 5
4 Male mesotibiae fairly abruptly narrowed in apical third. Aedeagus with middle ventral process slightly arcuate and strongly widened at tip; spiculae diverging, araising from wide process (Fig. 154) . . . *B. carinatus* sp. n.

- Male mesotibiae angulate at mid-length and gradually narrowed from middle to apex. Aedeagus with middle ventral process strongly arcuate and narrow at tip; spiculae converging, araising from left ventral process (Fig. 181) . . . . *B. trebax* sp. n.

5 Female tergite 5 with basomedian, spine-like process. Mesal edge of male mesotrochanters with basal process and apical tubercle. Apical part of dorsal process of aedeagus expanded to form two lobes (Fig. 174) . . . . *B. pubescens* (Raffray)

- Female tergite 5 without process or protuberance. Mesal edge of male mesotrochanters with basal process, lacking apical tubercle. Apical part of dorsal process of aedeagus expanded, forming large lobe (Fig. 152) . . . . *B. aemulus* sp. n.

6 Antennal segments 4, 6 and 8 each as long as wide or wider than long, segments 5 and 7 each longer than wide. Dorsum of body without additional, particular long setae 7

- Antennal segments 4 to 7 or to 8 each longer than wide. Dorsum of body with additional, particularly long setae (unknown in *B. incurvus*) 9

7 Punctation between pronotal sulci distinctly coarser than on elytra and on posterior part of vertex. Male mesofemora curved and flattened on mesal side (Fig. 142), mesotibiae sinuate, with large apical denticle (Fig. 147). Male mesotrochanters with basal spine-like process, mesofemora lacking denticle or spine-like process. Male metasternal ridges dense pubescence . . . . *B. mussardi* sp. n.

- Punctation on pronotum even, very fine, similar to that on elytra and posterior part of vertex. Male mesofemora straight, male mesotibiae with small apical denticle, or lacking denticle 8

8 Male with segment 4 of maxillary palpi swollen, flattened and granulate dorsally and bearing basodorsal process (Figs 130, 131); mesotrochanters with short process at middle of mesal margin (Fig. 177) . . . . *B. palpator* (Raffray)

- Male with segment 4 of maxillary palpi lacking obvious sexual characters (Fig. 116); mesotrochanters with long process at base of mesal margin . . . . *B. hystrix* sp. n.

9 Body length 1.75-2.0 mm. Male mesofemora with basal spine on mesal side (Fig. 134). Male segment 4 of maxillary palpi with basodorsal bunch of modified setae (Fig. 117) . . . . *B. dentipes* (Raffray)

- Body length 1.35-1.75 mm. Male mesofemora lacking spine, or with basal spine-like process. Male segment 4 of maxillary palpi usually without bunch of modified setae 10

10 Male with segment 4 of maxillary palpi strongly modified, flattened dorsally, conic apically (Figs 127, 128); mesal side of mesotibiae bearing, in addition to apical spine-like denticle, spine araising from close to tibial mid-length (Fig. 144); mesotrochanters with large, curved, subapical process (Fig. 143) . . . . *B. onustus* sp. n.

\- Male segment 4 of maxillary palpi not flattened dorsally and conic apically; male mesotibiae with apical denticle, lacking spine on mesal side; mesotrochanteral process different 11

11 Male mesotrochanters lacking spine-like process. Male mesofemora with basomesal process 12

\- Male mesotrochanters with spine-like process. Male mesofemora lacking process 13

12 Pronotum conspicuously coarsely punctate between mesal and lateral sulci . . . . *B. incurvus* sp. n.

\- Pronotum throughout very finely punctate . . . . *B. abas* sp. n.

13 Vertex throughout coarsely punctate. Male mesotrochanters with bifid process araising from middle of mesal side (Fig. 145) . . . . . *B. punctatus* sp. n.

\- Posterior part of vertex very finely punctate. Male mesotrochanters with single, simple process 14

14 Male mesotrochanters with basal, curved process (Fig. 138), male mesotibiae with apical hook-like process (Fig. 139) . . . . . . *B. pertubator* sp. n.

\- Male mesotrochanters with process araising from middle of mesal margin and additional small denticle at centre of ventral side (Fig. 136). Male mesotibiae with oblique apical denticle (Fig. 137) . . . *B. gracilipes* sp. n.

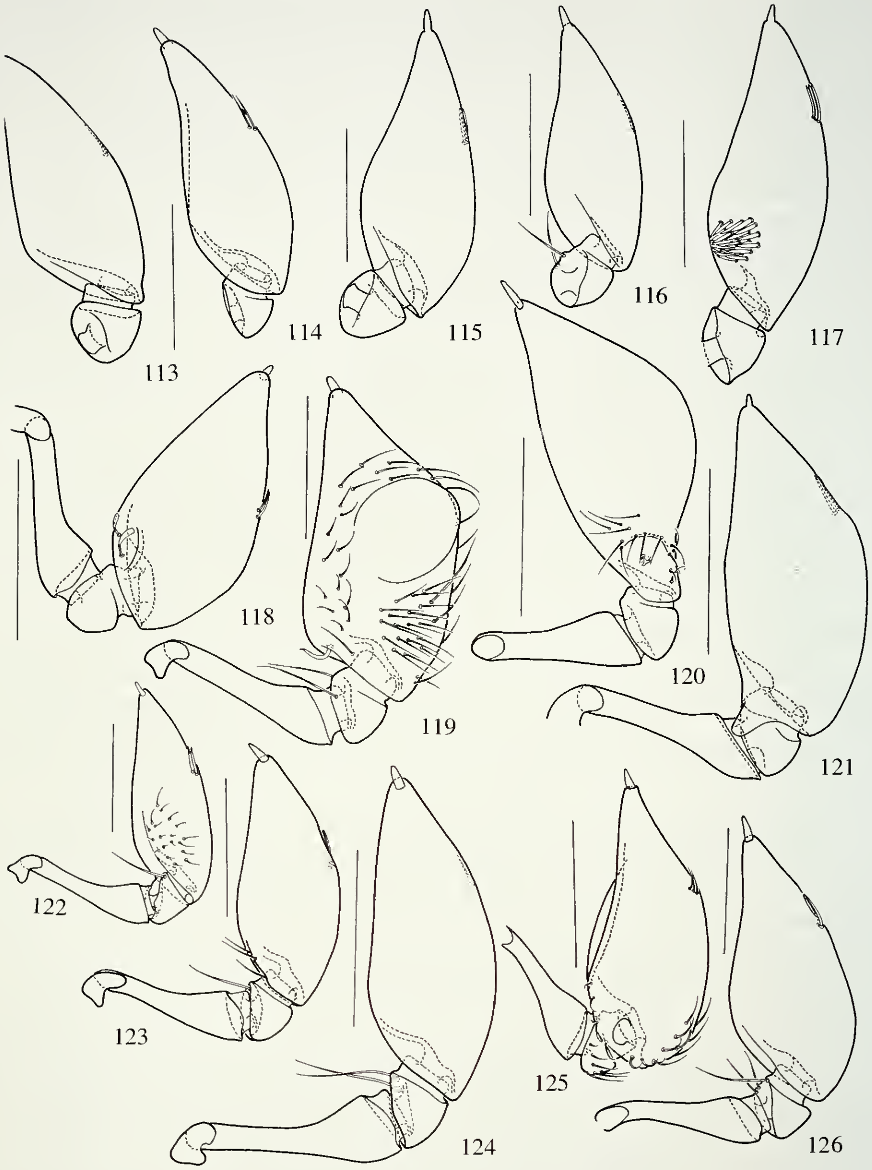
Batribolbus abas sp. n. Figs 148 - 151

Holotype ♂: Sri Lanka: Sabaragamuwa Prov.: Deerwood, Kuruwita 6 mls NNW Ratnapura, 18.II.62, ExpL # 90:II:1, indigenous forest, sieved from leaves, on forest floor (MZLU).

Paratypes: Sri Lanka: Sabaragamuwa Prov.: same data as holotype, 2 ♂, (MZLU, MHNG).

Description. Length 1.75 mm. Head with lateral contours concave; anterior arms of frontal sulci extending on to interantennal impression and slightly converging or parallel; vertexal carina ending in minute impression anterior to line of anterior margin of vertexal foveae; punctation fairly dense and coarse on most of anterior surface, very fine between sulci and throughout vertex. Punctation even on antennal tubercles. Antennal segments 4, 6 and 8 slightly longer than wide or segment 8 as long as wide; segments 3, 5 and 7 distinctly longer than wide, segment 9 elongate. Pronotum 0.40 long, 0.43 mm wide; median sulcus extending up to anterior seventh of disc; punctation coarse and very dense on large areas between sulci, sparse and very fine on lateral humps. Humeral angles of elytra carinate. Punctation on elytra and abdominal terga finer that on vertex. Pubescence long, additional long setae on head, pronotum, elytra and abdomen.

Male characters. Segment 4 of maxillary palpi with slightly impressed basal side, convex outer side, concave mesal side. Metasternum very finely punctate, bearing short, recumbent pubescence. Mesal area of metasternum swollen, with two shallow admesal impressions. Area laterally admesal impressions raised to form two ridges inclined steeply toward apical margin, close to metacoxal edges. Profemora slightly swollen, with flattened mesal side. Mesotrochanters without obvious sexual characters. Mesofemora curved, swollen, with mesal side concave, and with large,



FIGS 113 to 126. *Batribolbus* Raffray, male maxillary palpi
113: *B. mussardi* sp. n.; 114: *B. pubescens* (Raffray); 115: *B. carinatus* sp. n.; 116: *B. hystrix* sp. n., 117: *B. dentipes* (Raffray); 118: *B. punctatus* sp. nov; 119: 120: *B. gracilipes* sp. n.; 121: *B. palpator* (Raffray); 122: *B. trebax* sp. n.; 123: *B. incurvus* sp. n.; 124: *B. pertubator* sp. n.; 125: *B. furcipes* sp. n.; 126: *B. aemulus* sp. n. Scale bars = 0.1 mm.

straight, spine-like process araising from base, near tip of trochanters (Fig. 151). Mesotibiae widened, curved, with flattened mesal side and large, slightly curved, apical denticle (Fig. 150). Metalegs without obvious sexual characters. Abdominal sternites 1 to 5 slightly flattened in middle. Aedeagus (Figs 148, 149) with ventral process extended by righ lobe bearing two subapical setae and narrow, left lobe. Setae grouped in to two tufts partly overlapping. Dorsal process arcuate, widened and trilobed apically.

Comments. This species is characterized by the lack of long setae on the dorsal side of the body, the comparatively elongate flagellar segments, the fine pronotal punctation, and the pattern of the male characters on the metasternum and legs.

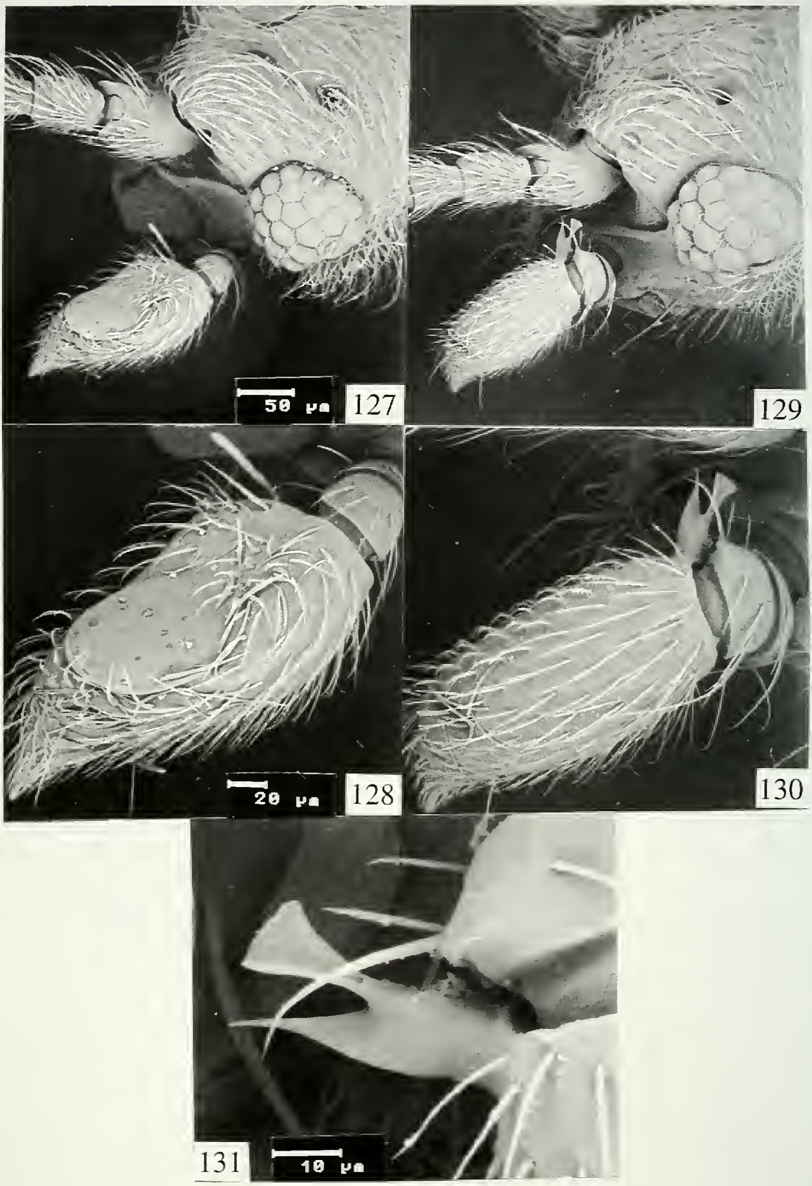
Batribolbus aemulus sp. n. Figs 126, 132, 152, 153

Holotype ♂: Sri Lanka: Western Prov.: Colombo Dist., Beyegama, sea level, 20-21.VIII.73, G. Ekis (NMNH).

Paratypes: Sri Lanka: Western Prov.: Colombo Dist., Hanwella Resthouse, 200ft, black light, 2.X.76, 200 ft, G. F. Hevel, R. H. Dietz, S. Karunanatne, D. W. Balasooriya, 1 ♂ (NMNH); Sabaragamuwa Prov.: Ratnapura Dist., Gilimale Lumbert Hill, 7.VIII.73, 115 feet, G. Ekis, 2 ♂ (NMNH, MHNG); same but black light, G. F. Hevel, R. H. Dietz, S. Karunanatne, D. W. Balasooriya, 1 ♂ (MHNG).

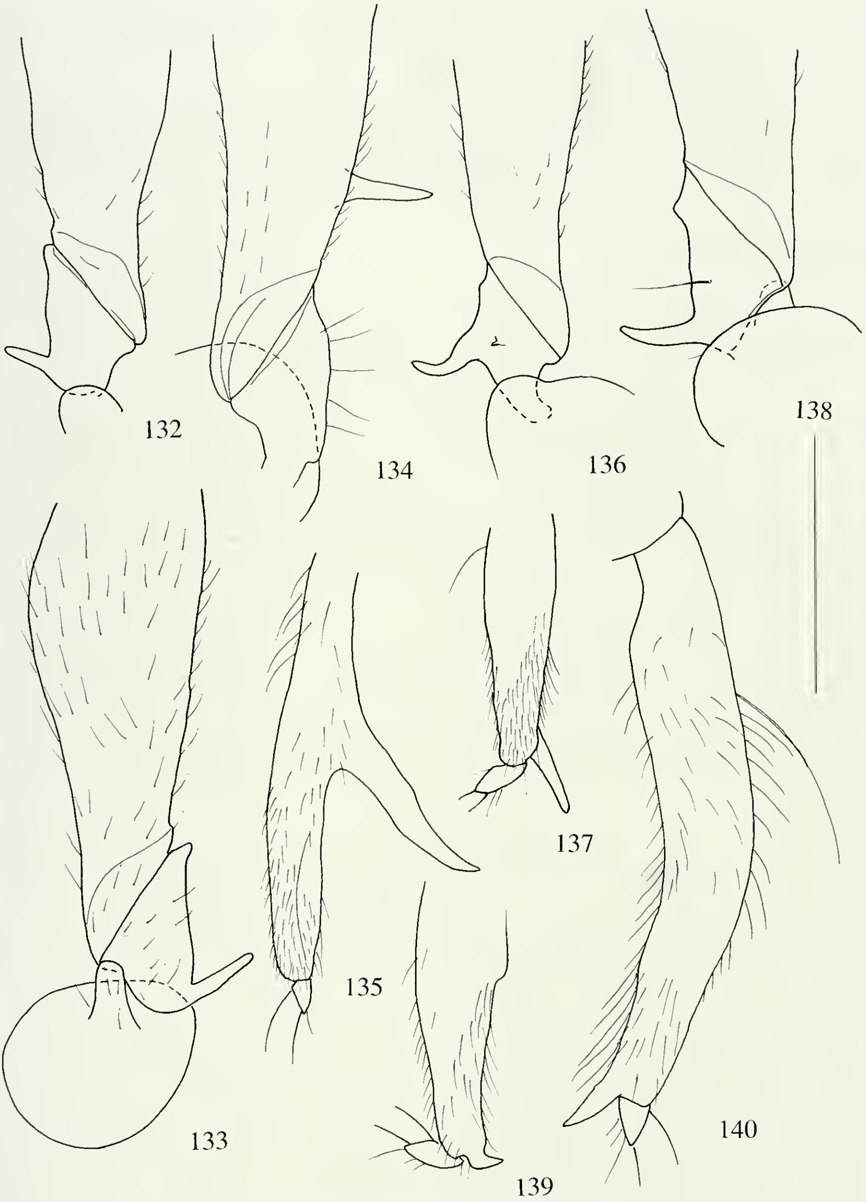
Description. Length 1.6-1.7 mm. Head with lateral contours slightly concave; anterior arms of frontal sulci extending on to interantennal impression and parallel or slightly converging; vertexal carina ending in minute impression, about in same line as anterior margin of vertexal foveae; punctation dense, fairly coarse on most of anterior surface, very fine between sulci and throughout vertex. Antennal tubercles with punctation denser on mesal side than on dorsal side and on frontoclypeus. Antennal segments 3 to 8 each about as long as wide, segments 4, 6 and 8 subequal, slightly smaller than segments 5 and 7; segment 9 globular, as long as wide; segment 10 slightly wider than long. Pronotum 0.39-0.42 mm long and wide; median sulcus extending up to anterior sixth of disc; punctation fairly dense and very fine near longitudinal sulci and on lateral humps, distinctly coarser on large areas between sulci. Humeral angles of elytra carinate. Punctation on elytra and abdominal terga almost as fine as that on vertex. Pubescence uniformly long, additional long setae absent.

Male characters. Segment 4 of maxillary palpi with flattened basal side, slightly concave mesal side, convex outer side (Fig. 126). Median part of metasternum impressed, very finely punctate, bearing short, recumbent pubescence. Metasternum with two large, apical processes araising from near inner margin of metacoxa, orientated apicoventrally, curved near tip ventrally. Prolegs and metalegs without obvious sexual characters. Mesotrochanters with ventral, elongate ridge joined to basal, straight or slightly curved, spine-like process (Fig. 132). Apical angle of mesotrochanters slightly prominent and rounded. Mesofemora moderately swollen. Mesotibiae thickened toward middle, moderately narrowed apically, with small, blunt, apical tooth. Abdominal sternite 1 flattened in middle, sternites 2 and 3 slightly impressed in middle, sternite 5 deeply impressed toward mesal line. Aedeagus (Figs 152, 153) with lateral lobes of right ventral process almost perpendicular to axis of median lobe, central lobe large, gradually narrowed (in specimens from Gilimale Lumbert Hill



FIGS 127 to 131: *Batribolbus* Raffray, males

127 and 128: *B. onustus* sp. n., head at laterodorsal view, with basal segments of antenna and maxillary palpus, scale bar = 50 µm (127), segment 4 of maxillary palpus, scale bar = 20 µm (128); 129 to 131: *B. palpator* (Raffray), head at laterodorsal view, with basal antennal segments and maxillary palpus, scale bar = 50 µm (129), segment 4 of maxillary palpus, scale bar = 20 µm (130), basodorsal apophyse of segment 4 of maxillary palpus, scale bar = 10 µm (131).



FIGS 132 to 140: *Batribolbus* Raffray, males

132: *B. aemulus* sp. n., mesotrochanter and base of femor; 133: *B. carinatus* sp. n., mesotrochanter with coxa and basal part of femur; 134 and 140: *B. dentipes* sp. n., mesotrochanter and basal part of femur (134), mesotibia (140); 135: *B. furcipes* sp. n., mesotibia; 136 and 137: *B. gracilipes* sp. n., mesotrochanter and basal part of femur (136), apical part of mesotibia (137); 138 and 139: *B. pertubator* sp. n., mesotrochanter with base of femur (138), apical part of mesotibia (139). Scale bar = 0.2 mm.

narrower than in other specimens), left ventral process short, overlapped by setal tuft. Pair of long setae araising from area between lateral and central processes. Dorsal process flat, curved, widened in apical part.

Comments. This is one of the species having comparatively short flagellar segments. It may be distinguished from congener with similar antennae by the uneven pronotal punctation, the male mesotrochanter lacking an apical tubercle and the female abdomen lacking an apical process.

Batribolbus carinatus sp. n. Figs 115, 133, 154, 155

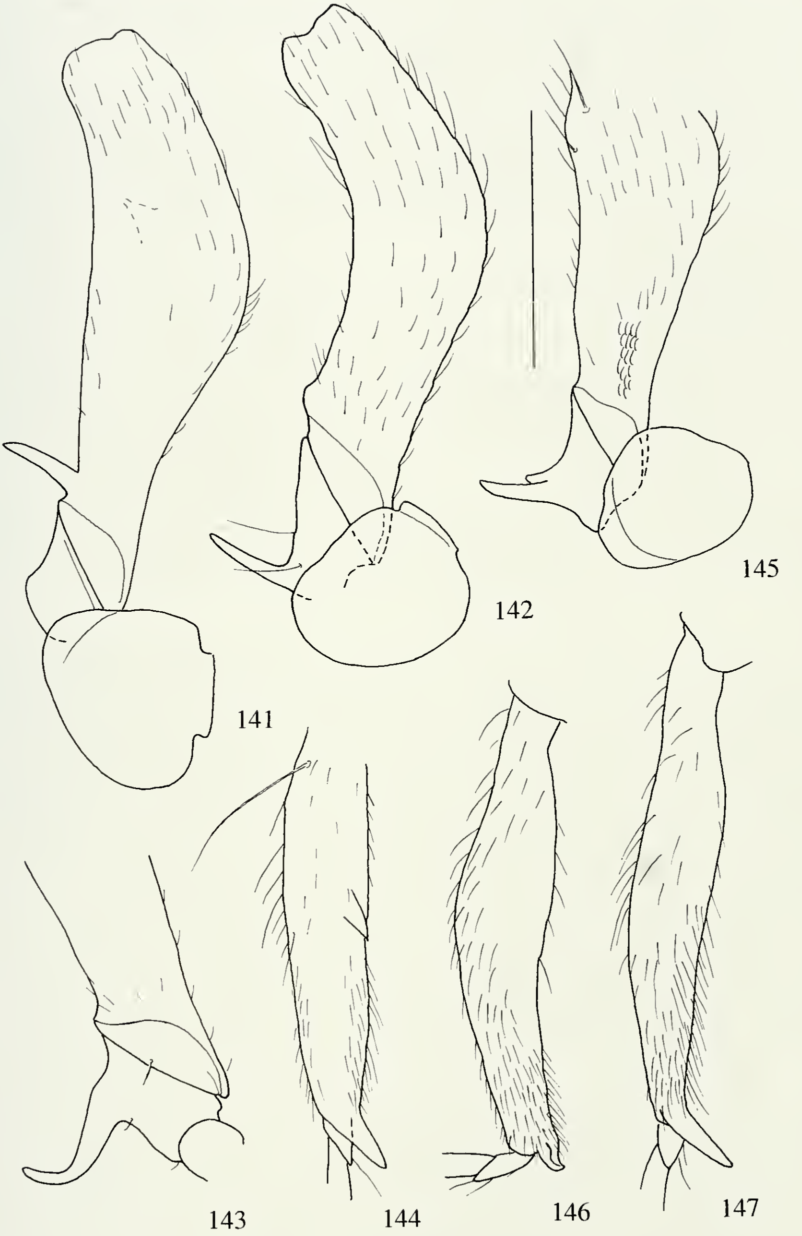
Holotype ♂: Sri Lanka: Central Prov.: above Talatuoya, 850-1000m, forest remnants, 27.I.70, ExpG # 27a (MHNG).

Paratypes: Sri Lanka: Central Prov.: Madugoda, 1200m, 30.I.64, R. Mussard, 3 ♂, 5 ♀ (MHNG, PCSK); same data but 1500m, 2 ♂, 2 ♀ (MHNG).

Description. Length 1.7-1.8 mm. Head with lateral contours hardly concave; anterior arms of frontal sulci extending on to interantennal impression, parallel; vertexal carina ending in small, central, foveiform impression, slightly anterior to line of vertexal foveae. Punctation dense and coarse on antennal tubercles and on anteriolateral portions of vertex up to line of vertexal foveae, consisting of punctures about as large as or larger than puncture intervals; frontoclypeus with punctation dense but slightly finer. Punctation on large central and posterior parts of vertex fairly dense and very fine. Antennal segments 3 to 8 each as long as wide, segments 4, 6 or 8 subequal, slightly smaller that segments 5 and 7; segment 9 about as long as wide; segment 10 distinctly wider than long. Pronotum 0.39-0.42 mm long, 0.42-0.44 mm wide; median sulcus extending up to anterior seventh of disc. Humeral angles of elytra carinate. Pronotum, elytra and abdominal tergites with punctation fairly dense and very fine, similar to that on posterior part of vertex. Pubescence uniformly long, additional long setae absent.

Male characters. Segments 4 of maxillary palpi with basoventral impression (Fig. 115). Metasternum concavely impressed in middle portion, flat between metacoxae. Mesal metasternal impression delimited laterally by margins raising gradually apically to form each longitudinal tubercle above metacoxae. Metasternal punctation very fine, sparse anteriorly, dense posteriorly and on tubercles; pubescence fairly long. Prolegs and metalegs without obvious sexual characters. Mesotrochanters with basomesal, slender, curved, spine-like process; apical angle extended to form small tooth (Fig. 133). Mesotibiae slightly curved, becoming gradually thicker apically, rather abruptly narrowed in apical third of mesal side; with short, robust, apical denticle. Abdominal sternites 1 and 2 flattened in middle, sternite 3 slightly impressed in middle, sternite 5 deeply impressed toward median line. Aedeagus (Figs 154, 155) with lateral lobe of right ventral process small, oblique; middle lobe widened apically, forming acute angle; left process small, overlapped by bunch of spiculae. Pair of long setae araising from interval between right and middle lobes. Dorsal process flat, widened apically.

Comments. This species may be distinguished by the fine pronotal punctation, the comparatively short flagellar segments and the male mesotibiae fairly abruptly narrowed apically.



FIGS 141 to 147: *Batribolbus* Raffray, males

141 and 146: *B. incurvus* sp. n., mesofemur with trochanter (141), mesotibia (146); 142 and 147: *B. mussardi* sp. n., mesofemur with trochanter (142), mesotibia (147); 143 and 144: *B. onustus* sp. n., mesotrochanter with base of femur (143), mesotibia (144); 145: *B. punctatus* sp. n., mesotrochanter with basal part of femur. Scale bar = 0.2 mm.

Batribolbus dentipes (Raffray) Figs 112, 117, 134, 140, 156, 157

Eubatrisus dentipes Raffray, 1894a: 450.
Batribolbus dentipes; Raffray, 1904: 102; Jeannel, 1961: 435.

Type material. Two syntypes, 1 ♂, 1 ♀: Sri Lanka: Central Prov.: Nuwara Eliya, E. Simon (MNHN).

Additional material examined. Sri Lanka: Central Prov.: Nuwara Eliya, 1800-1950m, at foot of Pidurutalagala, 29.I.70, ExpG # 33, 1 ♀ (MHNG); same data but ca 1950m, 15.II., ExpG # 69b, 10 ♂, 14 ♀ (MHNG, PCSK); Nuwara Eliya, 1800m, I.65, R. Mussard, 8 ♂, 26 ♀ (MHNG); Hakgala, 1700m, 28.I.70, sandy bank of a stream, ExpG # 30b, 1 ♂, 3 ♀ (MHNG); Horton Plains, forest, 17.IV.73, Troquet, 1 ♀ (MHNG); Horton Plains, 6700 ft, 11 mls SSE Nuwara Eliya, indigenous forest slope, sieven in debris, 19-20.III.62, ExpL # 162, 1 ♂ (MHNG); hill east of Hatton, 1400m, along irrigation canal, 9.II.70, ExpG # 55b, 5 ♂, 1 ♀ (MHNG); Mahaweli Ganga 8 mls WSW Nuwara Eliya, 18-19.III.62, at light, ExpL # 159, 1 ♂ (MZLU); Madugoda, 1400m, 28.I.64, R. Mussard, 1 ♂ (MHNG); Dikoya, 1500m, 24-31.3.73, G. Benick, 1 ♂ (MHNG); Mudduk, 5500 ft., 5 mls NW Nuwara Eliya, 4. III. 62, at small stream, ExpL # 117, 1 ♂ (MZLU); Ramboda, 7 mls NW Nuwara Eliya, ravin with stream, under stones, 4.III.62, ExpL # 118, 1 ♂ (MZLU); Foothill of Knuckle Mts, 10 mls ENE Kandy, at spring under stones, 11.III.62, ExpL # 129, 2 ♂ (MZLU); Knuckle Mts, 15 mls NE Kandy, 11. III. 62, ravine with stream, at light, ExpL # 132, 2 ♂ (MZLU, MHNG); Uva Prov.: Haputale, 1350m, 23.I.70, ExpG # 19b, sandy bank of a stream, 2 ♂, 3 ♀ (MHNG); Sabaragamuwa Prov.: Maratenna at 4500 ft., 7 mls N Balangoda, 22.II.62, ExpL # 98, sieved in debris, 5 ♂, 5 ♀ (MZLU); Rakwana, 27-28.II.62, ExpL # 100, light trap, 1 ♂ (MZLU); Karagal Oya at 1900 ft., 3 mls ENE Belihul Oya, 2.III.63, ExpL # 110, sieved in debris, 1 ♂ (MHNG); Sri Lanka: Ceylon, Coll. Cl. Müller, 1 ♂ (ZSMC).

Description. Length 1.75-2.0 mm. Head with lateral contours parallel, straight; anterior arms of frontal sulci parallel, extending on to interantennal depression; vertexal carina extending up to line or slightly anterior to line of anterior margins of vertexal foveae, not ending in impression, sometimes raised to form minute point. Mesal and posterior sides of antennal tubercles with fairly dense and coarse punctation, frontoclypeus and vertex with very fine and sparse punctation. Antennal segments 3 to 8 each slightly longer than wide, segments 3, 4, 6 and 8 subequal, segments 5 and 7 equally large, larger than adjoining segments; segment 9 distinctly elongate; segment 10 about as long as wide. Pronotum 0.42-0.46 mm long, 0.47-0.50 mm wide; median sulcus extending on to anterior sixth of disc. Humeral angles of elytra carinate. Punctation of pronotum, elytra and abdomen very fine. Pubescence long; head, pronotum, elytra and abdomen with several additional, very long setae.

Male characters. Segment 4 of maxillary palpi comparatively slender, bearing antebasal, setose patch (Fig. 117). Metasternum swollen in middle, strongly inclined toward margin of metacoxal process. Median portion of metasternum very finely punctate, with fairly long, semi-erect pubescence forming two dense, admesal patches. Protrochanters angulate. Protibiae thickened in middle portion, curved in apical half, with inner side flattened in apical portion. Mesotrochanters flattened, with row of perpendicular, marginal setae (Fig. 134). Mesofemora swollen, curved, in apical half almost evenly broad, with large spine on mesal side near base (Fig. 134) and robust pubescence in apical fourth. Mesotibiae abruptly narrowed near base, evenly wide and straight toward apical third, curved and narrowed in apical third, with robust and curved apical denticle (Fig. 140). Metalegs without obvious sexual characters. Abdominal sternites lacking particular sexual characters. Aedeagus (Figs

156, 157) with right ventral process very long, arcuate, denticulate in middle, bearing two subapical setae, lacking lobes; left ventral process moderately long, blunt. Dorsal process large, curved, flat.

Comments. This species is characterized by the male mesofemora bearing a large spine, the presence of a setose patch at base of the segment 4 of the maxillary palpi in combination with the comparatively large size of the body, the presence of long dorsal setae and the elongate flagellar segments.

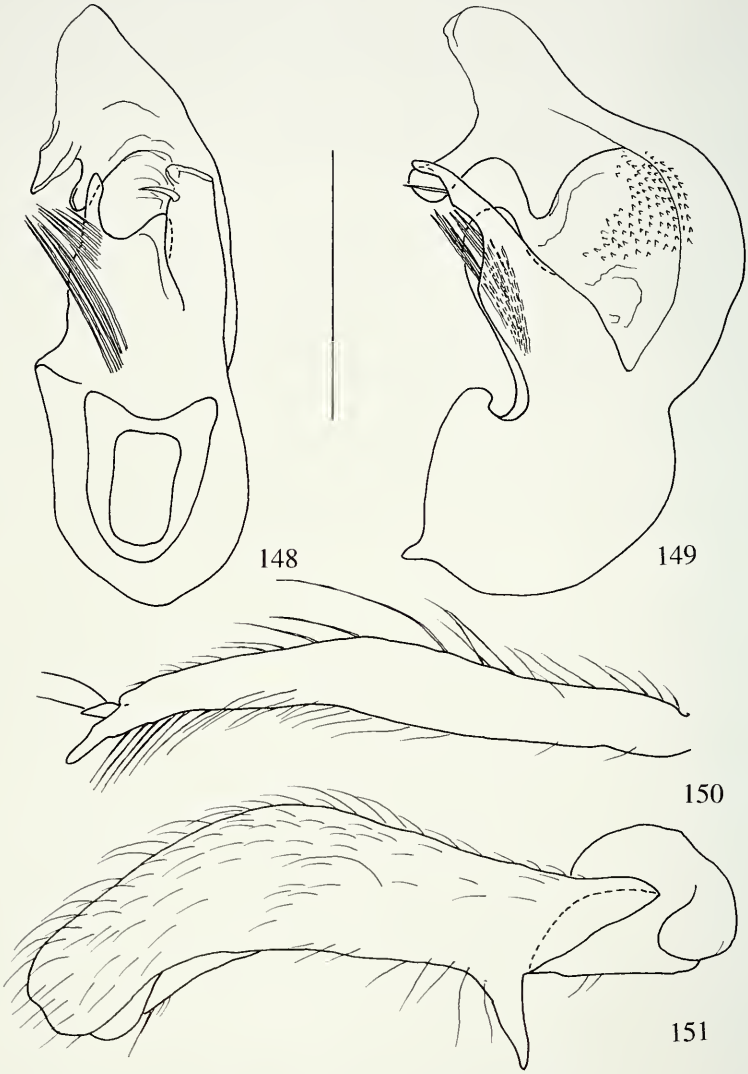
Batribolbus furcipes sp. n. Figs 125, 135, 158, 159

Holotype ♂: SRI LANKA: CENTRAL PROV.: forest at Hasalaka, near Weragamtota, ca 250m, 11.II.70, ExpG # 59 (MHNG).

Paratypes: SRI LANKA: CENTRAL PROV.: same data as holotype, 12 ♂, 9 ♀ (MHNG, PCSK); same data but 18.I., ExpG # 9, 1 ♀ (MHNG); Weragamtota, 21.I.65, R. Mussard, 5 ♂, 13 ♀ (MHNG, PCSK); UVA PROV.: Diyaluma Falls, forest below Waterfalls, ca 400m, 23.I.70, ExpG # 21, 5 ♂, 12 ♀ (MHNG); same data but 25.I., ca 450m, sieved litter at Waterfalls, ExpG # 26, 7 ♂, 6 ♀ (MHNG); Diyaluma Falls, 600m, 17.I.65, 6 ♂, 22 ♀, R. Mussard (MHNG); forest above Wellawaya, 300m, 25.I.70, ExpG # 25, 6 ♂, 1 ♀ (MHNG); Wellawaya, 300m, 17.I.65, R. Mussard, 2 ♀ (MHNG); Westminster Abbey 25 mls ESE Bibile, 7.III.62, ExpL 119:III, 12 ♂, 19 ♀ (MZLU, MHNG); Yalakumbura, 1300 ft., 5 mls SSW Bibile, ravine with small stream, 13.III.62, ExpL # 140, 1 ♂, 1 ♀ (MZLU); Badulla Dist., 5 mls E Mahiyangana Hasalaka, 200 ft., 16.XI.74, C. Gans, P. Fernando & S. Farook, 1 ♂ (NMNH); Ella, 16.III.73, M. Tronquet, 1 ♂ (MHNG); SABARAGAMUWA PROV.: Belihul Oya, 14.III.77, M. Tronquet, 3 ♂, 1 ♀ (MHNG).

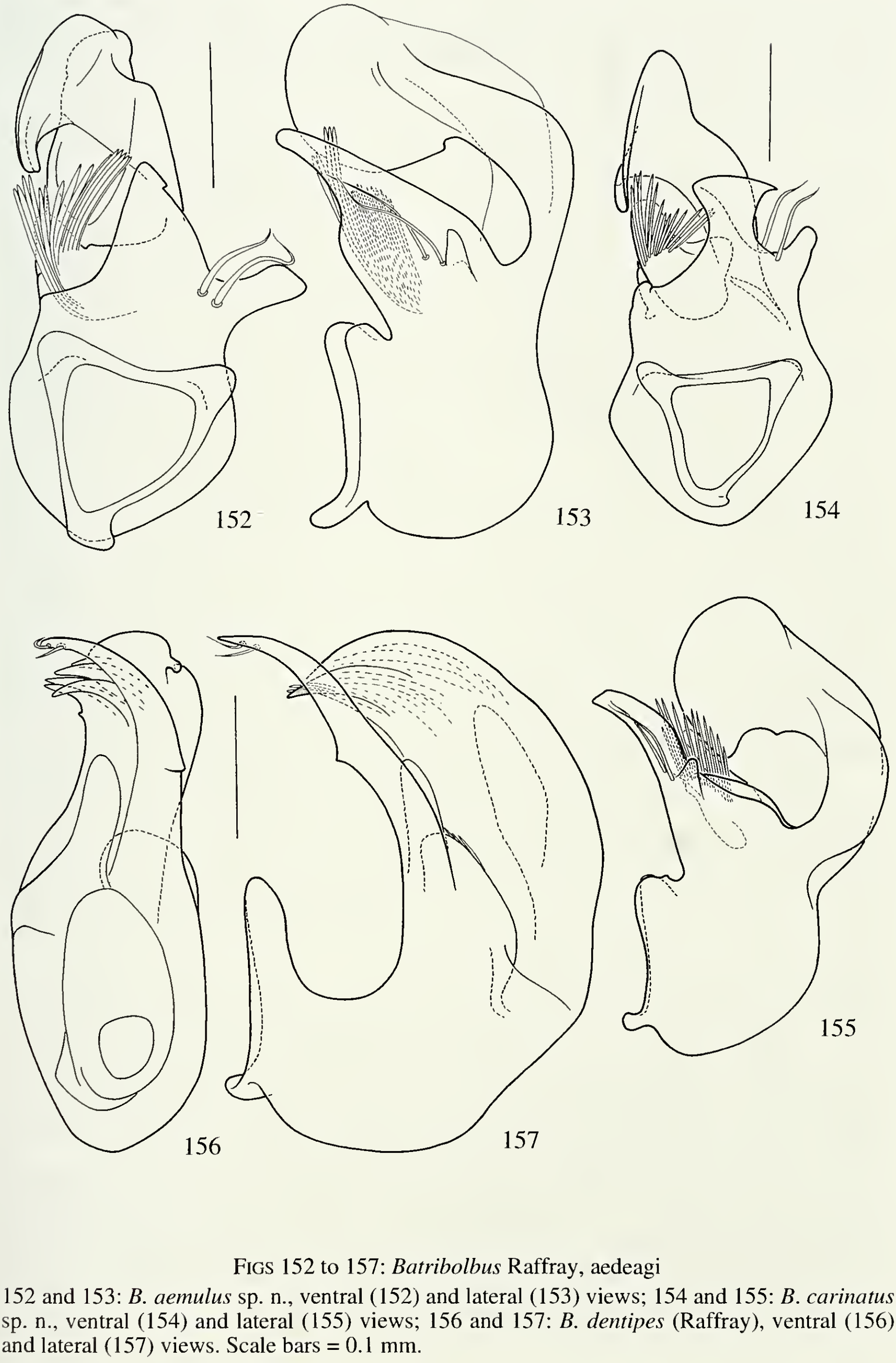
Description. Length 1.60-1.75 mm. Head with lateral contours hardly concave; anterior arms of frontal sulci extending on to interantennal impression and parallel; vertexal carina reaching slightly anterior to line of vertexal foveae. Punctation evenly coarse and dense, or slightly finer on vertex than on and near antennal tubercles. Antennal segment 3 longer than wide, segment 4 to 8 each as long as wide; segment 5 and 7 slightly larger than segments 4 and 6; segment 9 about as long as wide; segment 10 distinctly wider than long. Pronotum 0.34-0.36 mm long, 0.36-0.38 mm wide; median sulcus extending up to apical seventh of disc. Pronotal punctation dense and coarse, as coarse as or coarser than vertexal punctation, on lateral humps distinctly finer and sparser; median sulcus extending onto anterior seventh of disc. Humeral angles of elytra carinate. Elytral punctation dense and coarse, consisting of punctures not well delimited. Abdominal punctation distinctly finer than that on elytra and pronotum, consisting of well-delimited punctures. Pubescence long, without additional, particularly long setae.

Male characters. Segment 4 of maxillary palpi (Fig. 125) with basodorsal, sharply delimited foveiform impression adjoining shallow, smooth, transverse impression. Metasternum with median portion almost evenly convex, subapical impression small and shallow. Metasternal pubescence short, recumbent. Prolegs and metalegs without obvious sexual characters. Mesotrochanters lacking denticles or processes. Mesofemora swollen. Mesotibiae robust, sinuate, with conspicuously long, sinuate process raising from middle of mesal side (Fig. 135). Abdominal sternite 1 with pair of large, admesal processes. Admesal processes vertical, gradually narrowed toward tip, triangular in lateral view, bearing very short setae at tip. Surface between and posterior processes smooth. Sternites 2 to 4 slightly impressed in middle. Sternite 5



FIGS 148 to 151: *Batribolbus abas* sp. n.

148 and 149: Aedeagus in ventral (148) and lateral (149) views; 150: male mesotibia; 151: male mesofemur with trochanter. Scale bar = 0.2 mm.



FIGS 152 to 157: *Batribolbus* Raffray, aedeagi

152 and 153: *B. aemulus* sp. n., ventral (152) and lateral (153) views; 154 and 155: *B. carinatus* sp. n., ventral (154) and lateral (155) views; 156 and 157: *B. dentipes* (Raffray), ventral (156) and lateral (157) views. Scale bars = 0.1 mm.

flat. Aedeagus (Figs 158, 159) with right ventral process narrowed in middle, bearing subapical seta, lacking lobes; left process longer, arcuate, partly overlapped by bunch of spiculae. Dorsal process narrow, arcuate, separated distally in one simple and acute arm and one bifid arm.

Comments. See under *B. mussardi*.

Batribolbus gracilipes sp. n. Figs 120, 136, 137, 160, 161

Holotype ♂: Sri Lanka: Western Prov.: Galle Dist. Kanneliya Jungle, 13-16 August 72, K.V. Krombein, P. B. Karunaratna (NMNH).

Paratype ♂: Sri Lanka: Sabaragamuwa Prov.: Deerwood, Kuruwita 6 mls NNW Ratnapura, 17-22.II.62 ExpL # 90:1 (MZLU).

Description. Length 1.35-1.50 mm. Head with lateral contours straight, parallel-sided; anterior arms of frontal sulci not extending on to interantennal impression; vertexal carina extending anterior to line of vertexal foveae, central vertexal impression absent. Frontoclypeus and lateral portions of vertex with coarse and dense punctation, punctures partly larger than puncture intervals. Middle and posterior portions of vertex sparsely and very finely punctate. Antennal segments 3 to 8 each longer than wide, segments 3 and 4 equally large, segments 5 and 7 about 1/9 longer than segments 3 or 4, segment 6 slightly shorter than segment 4; segment 8 as long as and wider than segment 4; segment 9 elongate; segment 10 as long as wide, globular. Pronotum 0.35-0.36 mm long, 0.37 mm wide; median sulcus extending almost up to apical sixth of disc; punctation very fine and sparse near median sulcus, more dense and less fine more laterally; comparatively coarse pronotal punctures smaller than coarse punctures on head. Humeral angles of elytra carinate. Elytra and tergites very finely punctate, with short pubescence and several additional long setae.

Male characters. Segment 4 of maxillaxy palpi (Fig. 120) thick, with antebasal, round, sharply delimited impression on mesal side; mesal side slightly concave posterior impression, outer side convex. Middle portion of metasternum shallowly impressed, bearing sparse and very short, recumbent pubescence; with pair of almost vertical spines each bearing two apical setae. Metasternal spines situated at each side of median impression, close to lateral metasternal foveae. Prolegs and metalegs without obvious sexual characters. Mesotrochanters with central spine raising ventrally and bearing apical setae, and long, narrow, sinuate process araising from centre of posterior edge (Fig. 136). Mesotibiae straight, thickest anterior to apical third, with long, oblique, apical denticle (Fig. 137). Middle part of abdominal sternites 1 to 3 flattened. Aedeagus (Figs 160, 161) with right ventral process short and broad, deeply notched at apex; left process narrow, hook-like, partly overlapped by spicular bunch. Dorsal process slender, curved, with subapical spine-like tooth.

Comments. This species may be distinguished by the male mesotrochanters bearing a spine-like process and a small denticle and the male mesotrochanters with an oblique apical denticle, in combination with the comparatively small size of the body, the absence of long setae on the dorsum, and the flagellar segments 4 to 7 each longer than wide. See also comments under *B. pertubator*.

Batribolbus hystrix sp. n. Figs 116, 162, 163

Holotype ♂: SRI LANKA: SABARAGAMUWA PROV.: Ratnapura Dist., Nivitigala, Kiribatagala Estate, 4.VIII.73, 300 ft, G. Ekis (NMNH).

Description. Length 1.6 mm. Head with lateral contours very weakly sinuate; anterior arms of frontal sulci converging up to interantennal impression; vertexal carina extending slightly anterior to level of anterior margins of vertexal foveae, reaching minute, central impression. Punctation fine or very fine and fairly dense on frontoclypeus and on large, central part of vertex, dense and less fine on lateral portions of vertex and on antennal tubercles. Antennal segments 4, 6 and 8 subequal in size, each about as long as wide; segments 3, 5 and 7 slightly longer than segments 4 or 6, each slightly longer than wide; segment 9 slightly longer than wide; segment 10 subglobular, about as long as wide. Pronotum 0.32 mm long, 0.33 mm wide; median sulcus extending up to anterior eighth of disc. Humeral angles of elytra carinate. Punctation evenly very fine on pronotum, elytra and abdomen; elytral and abdominal pubescence short, additional long setae absent.

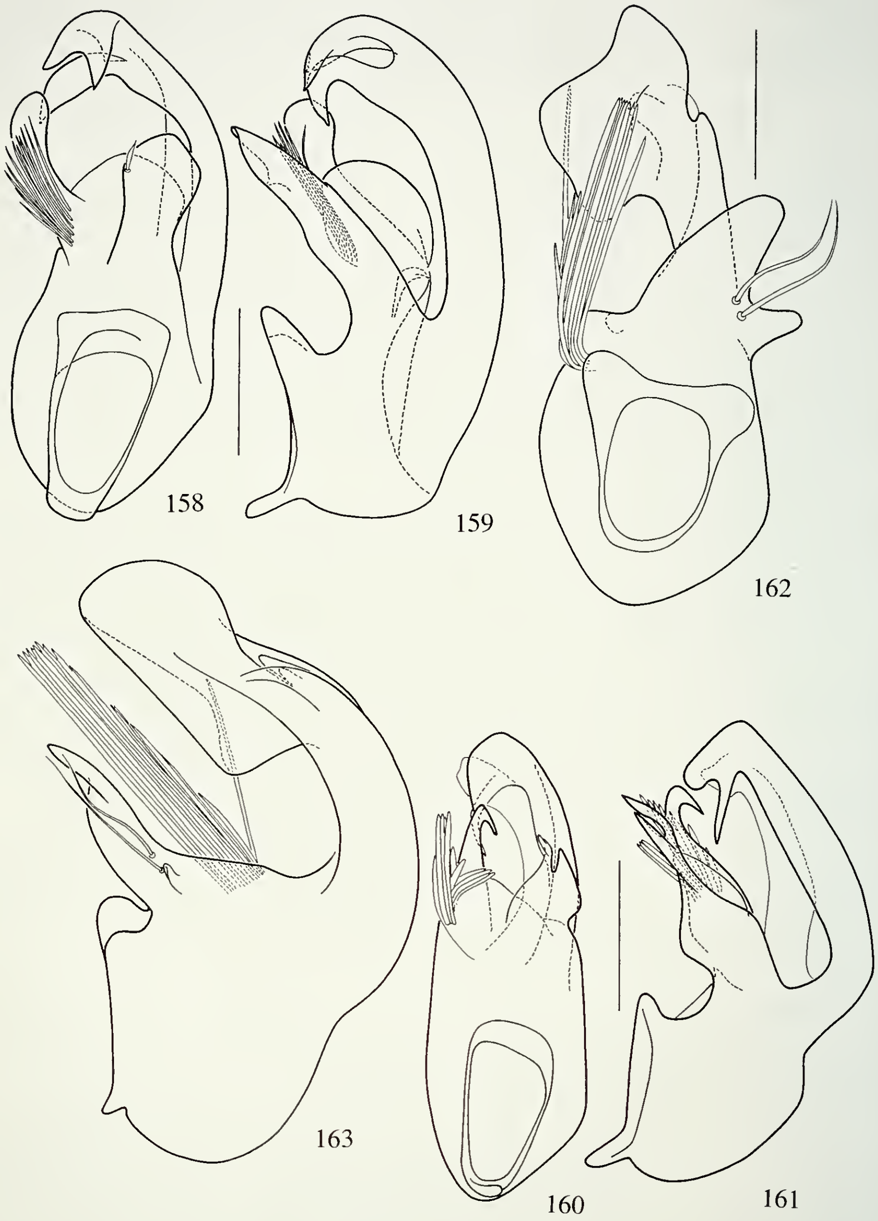
Male characters. Segment 4 of maxillary palpi without particular characters (Fig. 116). Metasternal centre with large, fairly deep and pubescent impression and two large, cylindrical processes raising from posterior edge. Metasternal processes touching inner margin of each coxa, truncate at apex, orientated apically. Prolegs and metalegs without obvious sexual characters. Mesotrochanters with robust, curved, basal process raising from mesal edge. Mesotibiae gradually thickened from base toward mid-length, narrowed on mesal side of apical half, with small, narrow, curved, apical denticle. Middle part of abdominal sternites 1 to 3 flattened. Aedeagus (Figs 162, 163) with right ventral process extended by two oblique, blunt, ventral lobes; one pair of long setae araising from notch between processes. Bunch of very long spiculae araising from near left side of basal bulb. Dorsal process large, widened apically.

Comments. This species is characterized by the palpi lacking obvious sexual characters, the male mesotrochanters bearing a long basal process, in combination with the presence of long setae on the dorsal side of the body and the antennal segments 4 and 6 each as long as wide.

Batribolbus incurvus sp. n. Figs 123, 141, 146, 164, 165

Holotype ♂: SRI LANKA: SABARAGAMUWA PROV.: Maratenna at 450 ft., 7 mls N Balangoda, 22.II.62, ExpL # 98, sieved in debris (MZLU).
Paratype ♂: SRI LANKA: SABARAGAMUWA PROV.: same data as holotype (MHNG).

Description. Length 1.7 mm. Head with lateral contours concave; anterior arms of frontal sulci slightly extending on to interantennal impression and converging; vertexal carina extending to line of anterior margins of vertexal foveae; punctation fine and dense on mesal and posterior sides of antennal tubercles, very fine and dense on frontoclypeus and vertex. Antennal segments 3 to 8 elongate; segments 3, 4, 6 and 8 subequal, each about 1.4 times as long as wide; segments 5 and 7 distinctly longer and slightly wider than adjoined segments, each about 1.6 times as long as wide; segments 9 and 10 distinctly elongate. Pronotum 0.40 mm long, 0.41 mm wide; median sulcus extending up to anterior fifth of disc; discal punctation dense and very



FIGS 158 to 163: *Batribolbus* Raffray, aedeagi

158 and 159: *B. furcipes* sp. n., ventral (158) and lateral (159) views; 160 and 161: *B. gracilipes* sp. n., ventral (160) and lateral (161) views; 162 and 163: *B. hystrix* sp. n., ventral (162) and lateral (163) views. Scale bars = 0.1 mm.

fine. Humeral angles of elytra rounded. Elytral punctation fine, consisting of punctures larger than those on pronotum. Abdominal punctation very fine. Pubescence long, damaged; presence of additional, long setae unknown.

Male characters. Segment 4 of maxillary palpi moderately swollen, with basodorsal, foveiform impression (Fig. 123). Metasternum with medio-apical area flattened and smooth, and two large ridges bearing short pubescence on their tips and outer sides. Metasternal ridges almost touching metacoxae, becoming gradually lower anteriorly, abruptly ending posteriorly. Mesotrochanters swollen, lacking processes or denticles. Mesofemora swollen, with straight, basomesal spine (Fig. 141). Mesotibiae thick, sinuate, flattened on mesal side, with hook-like apical denticle (Fig. 146). Abdominal sternites 1 to 5, prolegs and mesolegs without obvious sexual characters. Aedeagus (Figs 164, 165) with long, right ventral process bearing two subapical setae and wide left ventral process apparently bearing row of long spiculae. Dorsal process narrow, with acute apex and acute subapical tooth.

Comments. This species may be distinguished by the pronotum conspicuously punctate between the mesal and lateral sulci, the elongate flagellar segments and the male sexual characters on the mesolegs.

Batribolbus mussardi sp. n. Figs 113, 142, 147, 166, 167

Holotype ♂: Sri Lanka: Uva Prov.: Diyaluma Falls, ca 400m, below waterfalls, 23.I.70, ExpG # 21, leaf litter (MHNG).

Paratypes: Sri Lanka: North Prov.: Garden Varuniya, 14.II.62, ExpL # 81, at light, 1 ♂ (ZMLU); North Central Prov.: Sigiriya, 26.3.73, black light, M. Tronquet, 1 ♂ (MHNG); Anuradhapura, 150m, 23.I.65, R. Mussard, 1 ♂ (MHNG); Polonnaruwa, 12-14.I.65, R. Mussard, 12 ♂, 19 ♀ (MHNG, PCSK); Alut Oya, sandy river bank, 3.II.70, ExpG # 43a, 1 ♂, 2 ♀ (MHNG); Anuradhapura, 23.I.65, R. Mussard, 2 ♀ (MHNG); Eastern Prov.: Maha Oya, sandy river banks, 11.II.70, ExpG # 60, 1 ♂ (MHNG); Southern Prov.: Tissamaharama, 21 and 22. I.64, R. Mussard, 4 ♂, 3 ♀ (MHNG, PCSK); Uva Prov.: Diyaluma Falls, ca 450, near falls, 25.I.70, ExpG # 26, sieved debris, 3 ♂ (MHNG); Sabaragamuwa Prov.: Ratnapura Dist., Uggalkaltota 350 ft., Irrigation bulgalow, 31.I.-8.II.70, D. R. Davis & W. Rowe, 1 ♂ (NMNH).

Description. Length 1.50-1.60 mm. Head with lateral contours hardly concave; anterior arms of frontal sulci extending on to interantennal impression and parallel; vertexal carina extending anterior to line of vertexal foveae, ending in minute impression. Punctation dense and coarse on frontoclypeus and lateral parts of vertex, with punctures mostly larger than puncture intervals. Punctation sparse and very fine on middle part of vertex. Antennal segment 3, 5 and 7 each slightly longer than wide and slightly longer than segments 4, 6 and 8; segments 4 and 6 about as long as wide; segment 8 usually slightly wider, wider than long; segment 9 slightly wider than long, segment 10 distinctly wider than long. Pronotum 0.37-0.39 mm long, 0.38-0.40 mm wide; median sulcus reaching anterior sixth of disc. Humeral angles of elytra carinate. Punctation on pronotum dense and coarse, similar to that on frons, usually finer on lateral humps and close to median sulcus. Elytral punctation dense, slightly finer, abdominal punctation distinctly finer than that on pronotum. Pubescence moderately long, additional long setae absent.

Male characters. Segment 4 of maxillary palpi moderately swollen, lacking impressions, tubercles or apophyses (Fig. 113). Metasternum with narrow, smooth median impression delimited laterally by two ridges slightly diverging posteriorly and bearing fairly long setae. Prolegs and metalegs without obvious sexual characters. Mesotrochanters with curved, slender, basomesal process and low mesal ridge (Fig. 142). Mesofemora swollen, curved, with outer side convexly rounded. Mesal side of mesofemora concave, with basal tubercle. Mesotibiae sinuate, flattened mesally, with long and oblique apical denticle (Fig. 147). Abdominal sternite 1 hardly flattened in middle; sternite 2 with minute, central denticle or tubercle; sternites 3 and 4 flattened in middle; sternite 5 very shallowly impressed in middle. Aedeagus (Figs 166, 167) with ventral process large, abruptly inclined apically. Bunch of short spiculae araising from small central lobe. Dorsal process large, curved.

Comments. This species has conspicuously modified male mesolegs and may be easily distinguished in male sex. The males of *B. mussardi* and *B. furcipes* differ strongly, but the females of these species may be distinguished only by subtle antennal characters.

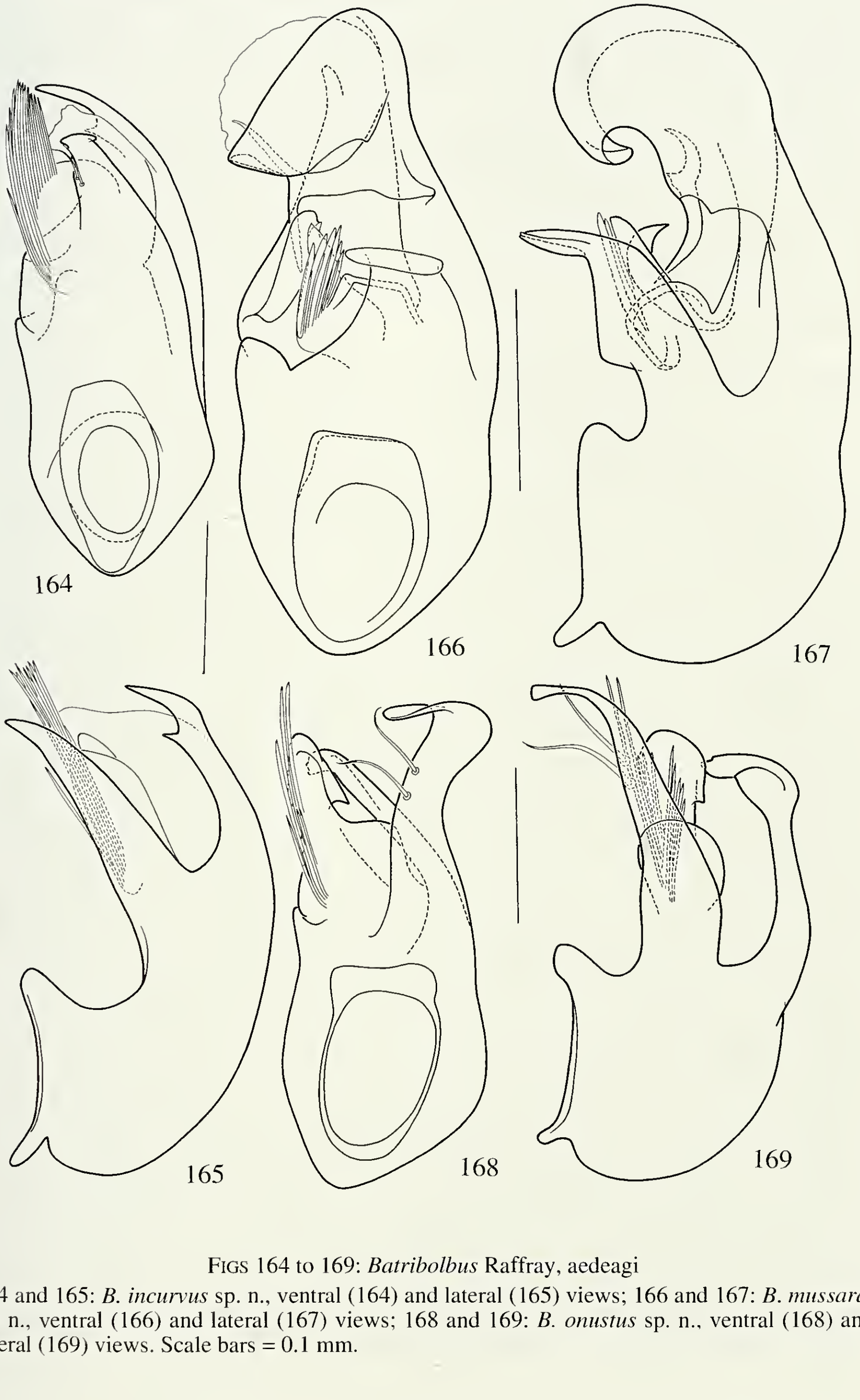
Batribolbus onustus sp. n. Figs 119, 127, 128, 143, 144, 168, 169

Holotype ♂: SRI LANKA: SOUTHERN PROV.: Galle Dist., Udugama, Kanneliya jungle, 400 ft., 6-12.X.73, at black fight, K. V. Krombein, P. B. Karunaratne, P. Fernando, J. Ferdinando (NMNH).

Paratypes: SRI LANKA: SOUTHERN PROV.: same data as holotype, 7 ♂ (NMNH; MHNG); same data but 16.V.74, Gans & Prasanna, 4 ♂ (NMNH, MHNG); same data but 13-16.VIII.72, K. V. Krombein & P. B. Karunaratne, 4 ♂ (NMNH); SABARAGAMUWA PROV.: Ratnapura Dist., Gilimale Lumber Mill, 115 ft, black light, 20-25.X.76,G. F. Hevel, R. E. Dietz, S. Karunaratne & D. W. Balasooruiya, 4 ♂ (NMNH, MHNG).

Description. Length 1.65-1.75 mm. Head with lateral contours parallel; anterior arms of frontal sulci extending on to interantennal impression and parallel; vertexal carina extending slightly anterior to line of vertexal foveae, slightly thickened at end. Punctation coarse and dense on frontoclypeus and lateral parts of vertex, fine and less dense on central part of vertex. Antennal segments 3 to 8 each distinctly elongate; segments 3, 4 and 6 subequal, segments 5 and 7 equally large, each hardly wider and about 1.2 times longer than segment 6; segments 9 and 10 distinctly elongate. Pronotum 0.40 mm long, 0.42 mm wide; median sulcus extending on to anterior eighth of discus. Humeral angles of elytra carinate. Pronotal punctation coarse and dense on anterior inclined portion of disc and on anterior parts of areas between sulci; punctation distinctly finer on lateral humps and most of surfaces between sulci. Elytral and abdominal punctation fine. Pubescence fairly long, additional long setae on pronotum, elytra and abdomen present.

Male characters. Segment 4 of maxillary palpi swollen, flattened and with well delimited oval impression on dorsal side, abruptly conic apically (Figs 119, 127, 128). Metasternum smooth and conspicuously glabrous posteriorly, medio-apical smooth surface extending from apical margin up to metasternal mid-length, slightly impressed mesally. Metasternum with two large, subtriangular, vertical processes almost touching metacoxae. Each metasternal process with one long seta at anterior margin and short pubescent on tip. Pubescence of anterior portion of metasternum dense and short. Prolegs and metalegs without obvious sexual characters. Mesotrochanters with long, slender, curved process raising from mesal margin, posterior to middle



Figs 164 to 169: *Batribolbus* Raffray, aedeagi

164 and 165: *B. incurvus* sp. n., ventral (164) and lateral (165) views; 166 and 167: *B. mussardi* sp. n., ventral (166) and lateral (167) views; 168 and 169: *B. onustus* sp. n., ventral (168) and lateral (169) views. Scale bars = 0.1 mm.

(Fig. 143). Mesofemora with basal angle slightly prominent. Mesotibiae flattened, hardly curved, widest in middle, gradually narrowed toward apex, with small, mesal, spine-like denticle araising posterior tibial mid-length, and with large, oblique, apical, spine-like denticle (Fig 144). Abdominal sternites 1 to 4 without obvious sexual characters. Sternite 5 shallowly impressed. Aedeagus (Figs 168, 169) with two ventral processes. Right process sinuate, expanded apically, bearing two subapical setae; left process bearing long spiculae, rounded apically. Dorsal process of median lobe narrow, moderately expanded at apex.

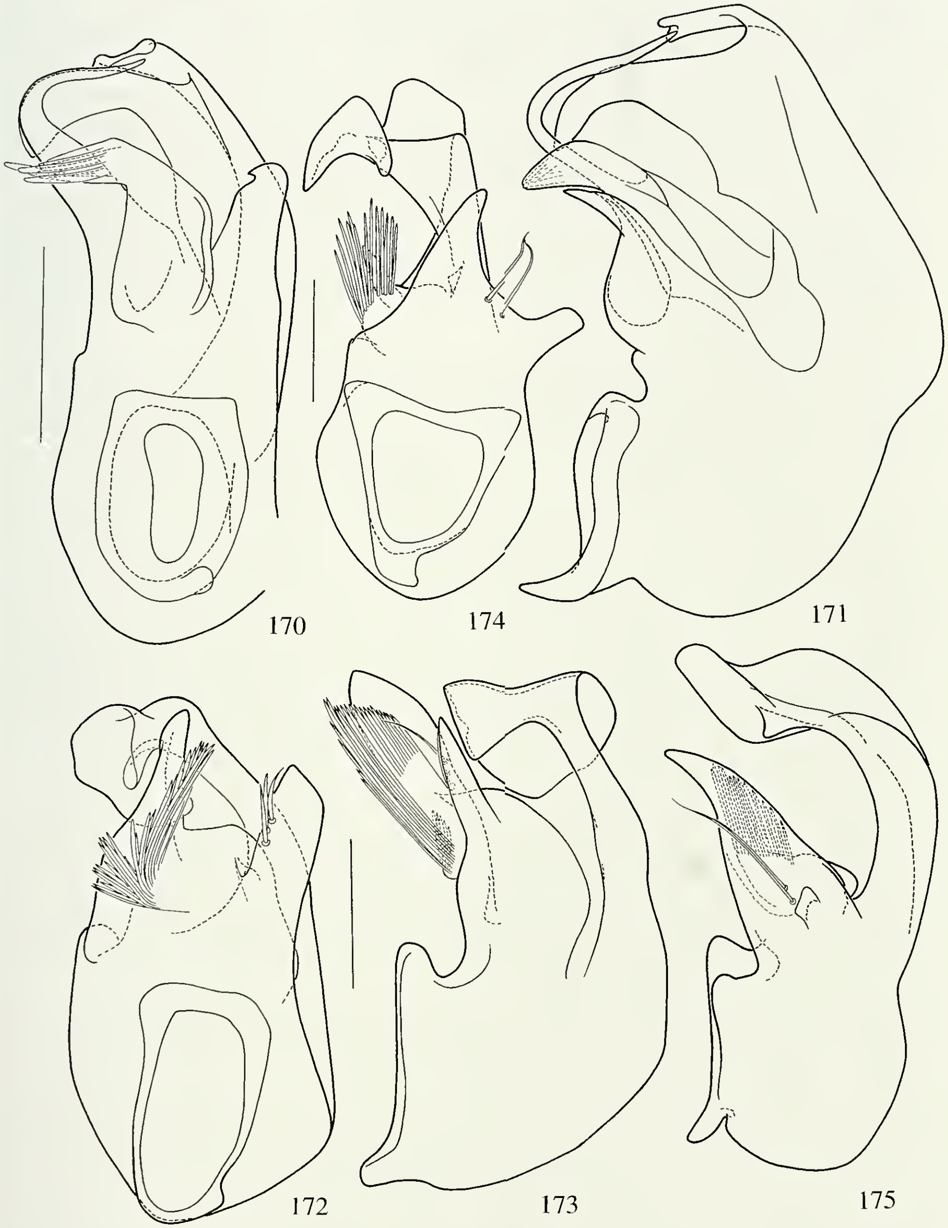
Comments. This species may be easily distinguished from its congeners by the segment 4 of maxillary palpi which is conspicuously flattened and conical apically.

Batribolbus palpator (Raffray) Figs 121, 129 to 131, 170, 171, 177

Eubatrisus palpator Raffray, 1894a: 451.
Batribolbus palpator; Raffray, 1904: 60, 102; Jeannel, 1961: 435.

Type material. Syntypes 1 ♂ and 1 ♀ from SRI LANKA, SOUTHERN PROV: Wakwele [=Wakwella], E. Simon (MNHN).

Material examined: SRI LANKA: SOUTHERN PROV.: Galle Dist., Udugama, Kanneliya Jungle, 400ft, 6-12.X.73, at black light, K. V. Krombein, P. B. Karunaratre, J. Fernando, 35 ♂ (NMNH, MHNG); Kanneliya Jungle, 13-16. VIII.72, K. V. Krombein & P. B. Karunaratne, 59 ♂ (NMNH, NMCC, MHNG, PCSK); Galle Dist., 11 mls E Udugama, Kanneliya Jungle, 11.X.73, at black light, K. V. Krombein, P. B. Karunaratre, J. Fernando, 1 ♂ (NMNH); Galle Dist., Kanneliya Jungle, 300 ft, 28.VII.73, black light, G. Ekis, 2 ♂ (NMNH); Galle Dist., Kanneliya Jungle, Hiniduma, 500 ft, 11-12.III.72, K. V. Krombein, 2 ♂ (NMNH); Western Prov., Yakkala, 18 mls NE Colombo, 14-31.I.62, al light, ExpL # 10, 4 ♂ (MZLU); Colombo Dist., Malawana, sea level, 22.VIII. 1973, at black light, G. Ekis, 1 ♂ (NMNH); Colombo Dist., Beyagama, sea level, 20-21.VIII. 73, G. Ekis, at black light, 9 ♂ (NMNH, MHNG); Colombo Dist., Hanwella Resthouse, 200 ft., black light, 2.X.76, G. F. Hevel, R. E. Dietz, V. S. Karunaratne & D. W. Balasooriya, 5 ♂ (NMNH); Amp. Dist., Inginiyagala, blacklight trap, 6-7.IX.75, D. M. Davies, S. Karunarati & D. W. Balasooriya, 1 ♂ (NMNH); same but 7-8.IX., 1 ♂ (NMNH); CENTRAL PROV.: Kandy Dist., Peradeniya, Botanical Garden, 3.V.74, black light, Gans & Prasanna, 3 ♂ (NMNH); same but 28.III.71, P. & P. Spangler, 9 ♂ (NMNH); Kandy, 1800 ft., Peak View Motel, 15-24.I.70, D. R. Davis & W. Rowe, 2 ♂ (NMNH); Kandy (Roseneath), 25.III.71, P. & P. Spangler, 1 ♂ (NMNH); Kandy Dist., 5 mls NW Mahiyangana, 30. III.- 9.IV.71, P. & P. Spangler, black light Hasalaka irritation, 1 ♂ (NMNH); Kandy, Mahaweli Ganga, moist sandy banks, ca 450m, 1.II.70, ExpG # 38a, 34 ♂, 68 ♀ (MHNG, PCSK); Bad. Dist., 5 mls E Mahiyangana, Hasalaka, 200 ft, 16.XI.74, C. Gans & P. Fernado, 3 ♂ (NMNH); same but 15.VIII.73, G. Ekis, 11 ♂ (NMNH, MHNG); Mahaweli Ganga, 7 mls below Kandy, ca 450m, 30. I. 70, moist sandy banks of the river, ExpG # 44, 39 ♂, 91 ♀ (MHNG, PCSK); same but 10. II., veget. debris on river bak, ExpG # 57b, 8 ♂, 37 ♀ (MHNG, PCSK); affluent of Mahaweli Ganga. 10 mls below Kandy, ca 450m, 30.I.70, sandy river banks, ExpG # 35, 2 ♀ (MHNG); Matale Dist., Bandarapola, 13.V.74, Gans & Prasanna, 4 ♂ (NMNH); 2 mls S Dambulla, 7.II.70, moist sandy banks of a stream, ExpG # 54, 1 ♂ (MHNG); Ginigathena, ca 650 m, 9.II.70, sandy banks of Mahaweli Ganga, ExpG # 56, 9 ♂, 42 ♀ (MHNG); Pidurutalagala 2 mls NW Nuwara-Eliya, 4.III.62, jungle, under logs, ExpL # 116:I, 1 ♂ (MZLU); Uva Prov., Monaragala, blacklight trap, 5-6.IX.75, D. M. Davies, S. Karunarati & D. W. Balasooriya, 8 ♂ (NMNH, MHNG); SABARAGAMUWA PROV.: Ambepussa, 5.XII.72, ExpG # 62, 9 ♂, 20 ♀ (MHNG); between Ambepussa and Polganawela, 16. I. 70, ExpG # 4, 1 ♂ (MHNG); Allerton, 1 mi SW Rakwana, 28.II.62, ExpL # 105, 1 ♂ (MZLU); same but Rakwana, 27. II. ExpL # 100, 1 ♂ (MZLU); Ratnapura Dist., Ratnapura, Resthouse, 200-300 ft., 24.X.76, black light, G. F. Hevel, R. E. Dietz, V. S. Karunaratne & D. W. Balasooriya, 4 ♂ (NMNH); Ratnapura, 22.II.62, at light, ExpL # 95, 13 ♂ (MZLU, MHNG); Ratnapura Dist., Gilimale Lumber Mill, 115 ft., black light, 20-25.X.76, G. F. Hevel, R. E. Dietz, V. S.



FIGS 170 to 175: *Batribolbus* Raffray, aedeagi
170 and 171: *B. palpator* (Raffray), ventral (170) and lateral (171) views; 172 and 173: *B. pertubator* sp. n., ventral (172) and lateral (173) views; 174 and 175: *B. pubescens* (Raffray), ventral (174) and lateral (175) views. Scale bars = 0.1 mm.

Karunaratne & D. W. Balasooriya, 6 ♂ (NMNH, MHNG); same but 7.VIII.73, G. Ekis, 16 ♂ (NMNH, MHNG); Deerwood, Kuruwita, 6 mls NNW Ratnapura, 17-22.II.62, at light, ExpL # 90:1, 2 ♂ (MZLU); Ratnapura Dist., Nivitagala, Kiribatagala Estate, 4.VIII.73, 300 ft., G. Ekis, 1 ♂ (MHNG); Ratnapura Dist., Uggalkaltota, 350 ft., Irrigation bulgalow, 31.I –8.II. 70, D. R. Davis & W. Rowe, 4 ♂ (NMNH, MHNG); Uva Prov., Westminster Abbey 25 mls ESE Bibile, 7.III.62, ExpL # 119:III sieved in debris, 1 ♂ (MZLU); UVA PROV.: Inginiyagala, 12.II.70, along a canal, ExpG # 63d, 1 ♂ (MHNG); EASTERN PROV.: Kantalai, 2. II.70, forest near Resthouse, 2.II.70, ExpG # 40b, 1 ♂ (MHNG); Maha Oya, sandy baks of a river, 11.II.70, ExpG # 60, 1 ♂, 4 ♀ (MHNG); NORTH CENTRAL PROV.: Ambagaswewa, 3. II. 70, ExpG # 44, 1 ♂, 1 ♀ (MHNG); Alut Oya, sandy banks of a river, 3.II.70, ExpG # 43a, 3 ♀ (MHNG); NORTH WESTERN PROV.: Rajakadaluwa, coconut plantation, sea level, 31.I.70, under bark and in rotten wood, ExpG # 36b, 1 ♂ (MHNG); Bibila, 4.V.74, at black light, Gans & Prasanna, 1 ♂ (NMNH); Kitulgala, 14. VII. 79, G. de Rougemont, 4 ♀ (MHNG); SRI LANKA: Ceylon, Coll. Cl. Müller, 4 ♂ (ZSMC).

Description. Length 1.45-1.60 mm. Head with lateral contours very weakly converging anteriorly; anterior arms of frontal sulci converging, not extending on to interantennal impression; vertexal carina extending about to line of anterior margins of vertexal foveae, its anterior end not in impression. Punctation dense and coarse on and posterior antennal tubercles, very fine and sparse on frontoclypeus and on most of vertex. Antennal segments 3 and 5 elongate; segments 4 and 6 each as wide as and shorter than segments 3 or 5, about as long as wide; segment 7 elongate, slightly wider than preceding flagellar segments; segment 8 as long as wide, about as wide as segment 7; segment 9 slightly longer than wide; segment 10 about as long as wide. Pronotum 0.34-0.35 mm long and wide; median sulcus short, usually not reaching anterior fourth of pronotum. Pronotal, elytral and abdominal punctation very fine and sparse, anterior part of pronotum sometimes more coarsely punctate. Humeral angles of elytra carinate. Pubescence on dorsal side of body short, particular long setae absent.

Male characters. Maxillary palpi flattened and granulate dorsally, with bifid, basodorsal process raising dorsally (Figs 121, 129 to 131). Metasternum with median impression moderately deep, not clearly delimited, very finely punctate and pubescent; mesosternal ridges and processes absent. Prolegs and metalegs without obvious sexual characters. Mesotrochanters with small, pointed tooth in middle of mesal side. Metafemora flattened on posterior side, with antebasal patch of brick-wall like microsculpture (Fig. 177). Mesotibiae with straight mesal side, slightly rounded outer side, widest in middle, small, acute apical denticle. Abdominal sternite 1 evenly rounded. Sternites 2 to 4 flattened in middle. Sternite 5 very weakly impressed in middle. Aedeagus (Figs 170, 171) with ventral processes lacking setae. Right process large, notched subapically. Left process very long and narrow, strongly arcuate, partly overlapped by distinct, comparatively well sclerotized lobe bearing spiculae. Dorsal process with large, bifid apex.

Comments. Batribolbus palpator is characterized and may be easily distinguished by the male maxillary palpi bearing a dorsobasal process. The species was found in a variety of habitats, including debris in forests from sea level up to mountains, rotten coconut palm, and banks of streams. Most specimens in both sexes were found on moist sandy banks with sparse vegetation of Mahaweli Ganga.

Batribolbus pertubator sp. n. Figs 124, 138, 139, 172, 173

Holotype ♂: Sri Lanka: Sabaragamuwa Prov.: Rakwana, 27-28.II.62, light trap, ExpL # 100 (MZLU).

Description. Length 1.75 mm. Head with lateral contours very weakly concave; anterior arms of frontal sulci extending on interantennal impression, parallel; vertexal carina long, ending distinctly anterior to line of anterior margins of vertexal foveae, its anterior portion not in impression. Punctation sparse and very fine on most of frontoclypeus and vertex, fairly dense and coarse on and around antennal tubercles. Antennal segment 3 and 4 subequal, slightly longer than wide; segments 5 and 7 elongate, each about 1.5 times as long as wide, slightly wider than segments 3 and 4; segments 6 and 8 shorter than segment 5, each about 1.2 times as long as wide; segments 9 and 10 each distinctly longer than wide. Pronotum 0.39 mm long, 0.40 mm wide; median sulcus extending on to anterior eighth of disc. Punctation on pronotum fairly sparse, distinctly coarser than that on vertex, that on elytra and abdominal terga very fine. Humeral angles of elytra carinate. Pubescence fairly long, additional long setae present on pronotum (elytral and abdominal pubescence strongly damaged).

Male characters. Segment 4 of maxillary palpi hardly swollen, with dorsobasal carina (Fig. 124). Metasternum with deep median impression, delimited lateroposteriorly by strongly raised, arcuate, sharp ridge; pubescence absent from most of median area, dense, short and recumbent near mesocoxal process, dense, fairly long and recumbent on inner side of each ridge. Abdominal sternites 1 to 4 impressed in middle. Abdominal sternite 1 with microsculptured, apicomesal patch. Impression on sternite 5 deeper than those on other sternites. Prolegs and metalegs without obvious sexual characters. Mesotrochanters with basal process slender, curved, similar to that in *B. pubescens*, mesal margin angulate subapically (Fig. 138). Metafemora swollen, with strongly convex anterior side, slightly concave posterior side. Mesotibiae widest posterior mid-length, strongly narrowed apically, with hook-shaped apical denticle (Fig. 139). Aedeagus (Figs 172, 173) with right ventral lobe oblique, fairly wide, bearing three subapical setae; left lobe gradually narrowed and partly overlapped by bunch of spicular. Dorsal lobe narrow in middle, abruptly, strongly widened in apical part.

Comments. This species is similar to *B. gracilipes* from which it may be easily distinguished by the male mesotibiae bearing an apical hook-like process.

Batribolbus pubescens (Raffray) Figs 114, 174 - 176

Eubatrisus pubescens Raffray, 1894a: 451.
Batribolbus pubescens; Raffray, 1904: 60, 102; Jeannel, 1961: 435.

Type material. Syntypes, 3 ♂, 3 ♀ from Sri Lanka: Central Prov.: Kandy, E. Simon (MNHN).

Additional material. Sri Lanka: Central Prov.: above Talatuoya, 850-1000m, 27.I.70, forest remnants, ExpG # 27a, 7 ♂, 3 ♀ (MHNG); same data but on soil along a small stream, ExpG 27b, 2 ♂, 6 ♀ (MHNG, PCSK); Kandy, ca 450m, sandy banks of Mahaweli Ganga, 1.II.70, ExpG # 38a, 1 ♂ (MHNG); Kandy, hill forests south lake, rotten log, 14.II.70, ExpG # 67a, 2 ♂, 5 ♀ (MHNG); Kandy, 26.I.64, R. Mussard, 2 ♂, 1 ♀ (MHNG); Kandy, 1-

15.III.71, Piyadasa & Somapala, 1 ♂ (MHNG); Kandy Dist., Peradeniya, Botanical Garden, 28.III.1971, blacklight, P. & P. Spangler, 7 ♂ (NMNH, MHNG, PCSK); same data but 3.V.74, Gans & Prasanna, 1 ♂ (MHNG); Hatton, 27.VIII.1959, P. Rémy, 1 ♂, 3 ♀ (MNHN); Ramboda, 7 mls NW Nuwara Eliya, 4.III.62, ravine with stream, under stones, ExpL # 118, 3 ♀ (MZLU, MHNG); SABARAGAMUWA PROV.: Deerwood, Kuruwita, 6 mls NNW Ratnapura, 17-22.II.62, at light, ExpL 90:I, 1 ♂ (MZLU); Bopathella Falls, 9 mls NNW Ratnapura, 19.II.62, ExpL # 91:I, sieved in debris, 1 ♂ (MZLU); Ratnapura, at light, 22.II.62, ExpL # 95, 2 ♂ (MZLU, MHNG).

Description. Length 1.75-2.0 mm. Head with lateral contours hardly concave; anterior arms of frontal sulci slightly extending on to interantennal impression, short, almost parallel; vertexal carina extending up to or slightly anterior to line of anterior margins of vertexal foveae, ending in small impression. Punctation dense and fairly coarse on and between antennal tubercles, very fine on inclined frontoclypeus and on vertex. Antennal segment 3 slightly longer than wide; segments 4 to 8 each about as long as wide; segment 4, 6 8 subequal, segments 5 and 7 slightly larger than adjoined segments; segment 9 about as long as wide, segment 10 slightly wider than long. Pronotum 0.38-0.40 mm long, 0.42-0.45 mm wide; median sulcus extending on to anterior sixth of disc; punctation dense and comparatively coarse on central areas between median and lateral sulci, sparse and very fine on most of discal surface. Humeral angles of elytra carinate. Punctation on elytra and abdominal tergites dense and fine. Pubescence long, dense semi-erect on head, pronotum, elytra and abdominal tergites, additional particular long setae absent.

Male characters. Segment 4 of maxillary palpi with oval, basodorsal impression and small tubercle raising from apical part of impression (Fig. 114). Metasternum flattened near mesocoxal process, with wide, fairly shallow median impression not clearly delimited laterally and two large, apical processes raising from near inner side of metacoxae. Metasternal processes orientated apicoventrally, gradually narrowed, slightly curved at tip. Median part of metasternum with dense and very fine punctation and short, recumbent pubescence. Prolegs and metalegs without obvious sexual characters. Mesotrochanters each with mesal margin carinate and slightly angulate, basal angle with large, curved, spine-like process and subapical tubercle (Fig. 176). Mesotibiae gradually widened toward middle, moderately narrowed in apical half, with short, narrow, apical denticle (Fig. 176). Abdominal sternites 1 to 3 flattened in middle; sternite 4 impressed and with carinate apical margin in middle; sternite 5 very deeply impressed toward mid-line. Aedeagus (Figs 174, 175) with right ventral lobe expanded by oblique, ventral processes; two long setae araising from area between processes. Right process truncate at apex (in ventral view); left process gradually narrowed. Spiculae araising from small lamina. Dorsal lobe arcuate, with apical part expanded and separated in two parts.

Female characters. Tergite 5 with large, spine-like basomedian projection.

Comments. This species differs conspicuously from its congeners by the modified sternite 5 in female.

Batribolbus punctatus sp. n. Figs 118, 145, 178 - 180

Holotype ♂: SRI LANKA: CENTRAL PROV.: Kandy, ca 700m, hills south lake, leaf litter, 14.II.70, ExpG # 67 (MHNG).

Paratypes: SRI LANKA: CENTRAL PROV.: same data as holotype, 33 ♂, 75 ♀ (MHNG, PCSK); Kandy, forest near Chalet Guesthouse, ca 600m, sieved litter, 15.I.70, ExpG # 3c, 36 ♂, 18 ♀ (MHNG); Kandy, 24.I.64, R. Mussard, 2 ♂, 2 ♀ (MHNG); same data but 19.I., 3 ♀ (MHNG); Kandy, 1800 ft., Peak View Motel, 7-14.I.70, D. R. Davis & W. Rowe, 2 ♂ (NMNH, MHNG); Madulkele, 27.I.64, R. Mussard, 2 ♂, 10 ♀ (MHNG); same data but 30.I., 7 ♂, 6 ♀ (MHNG); Madugoda, 30.I.64, R. Mussard, 1 ♂, 1 ♀ (MHNG); Matale Dist., Bandarapola, 13.V.74, Gans & Prasanna, 2 ♂ (NMNH); UVA PROV.: Ella, 16.III.73, M. Tronquet, sieved humus, 1 ♀ (MHNG).

Description. Length 1.35-1.50 mm. Head with lateral contours hardly concave or straight; anterior arms of frontal sulci extending on to interantennal impression and parallel; vertexal carina long, extending far anterior to line of vertexal foveae; punctation throughout coarse, very dense on and mesally antennal tubercles, sparser on middle part of vertex. Antennal segments 3, 4, 6 and 8 subequal, each about as long as wide or hardly longer than wide, segment 8 usually somewhat shorter than segment 6; segments 5 and 7 distinctly longer and slightly wider than adjoined segments, each about 1.3 times as long as wide; segment 9 slightly longer than wide; segment 10 about as long as wide. Pronotum 0.34 mm long, 0.37-0.38 mm wide; median sulcus extending on to anterior sixth of disc; punctation dense and coarse, except smooth narrow areas along sulci. Humeral angles of elytra carinate. Punctation on elytra and abdomen comparatively coarse and dense. Pubescence fairly long, additional long setae present on head, pronotum, elytra and abdomen.

Male characters. Segment 4 of maxillary palpi moderately swollen, lacking impressions, with short basodorsal fold and flat setae (Fig. 118). Median part of metasternum throughout smooth and shiny. Medio-apical portion of metasternum impressed and inclined toward apical margin; impression delimited latero-anteriorly by pair of small, flat protuberances bearing short setae. Mesotrochanters with bifid process raising from middle of mesal margin (Fig. 145). Mesofemora swollen, with subbasal patch of brickwall-like microsculpture. Mesotibiae almost straight, thickened toward middle, narrowed from middle to apex on mesal side, with distinct apical spine-like denticle (Fig. 178). Abdominal sternite 1 with shallow median impression; punctation very fine in impression, coarse posterior impression. Sternites 2 to 5 flat in middle. Prolegs and metalegs without obvious sexual characters. Aedeagus (Figs 179, 180) with large right ventral process, wide and very short lobe overlapping partly a narrow apophysis, bearing two subapical setae. Dorsal process oblique, with acute tip. Spiculae absent.

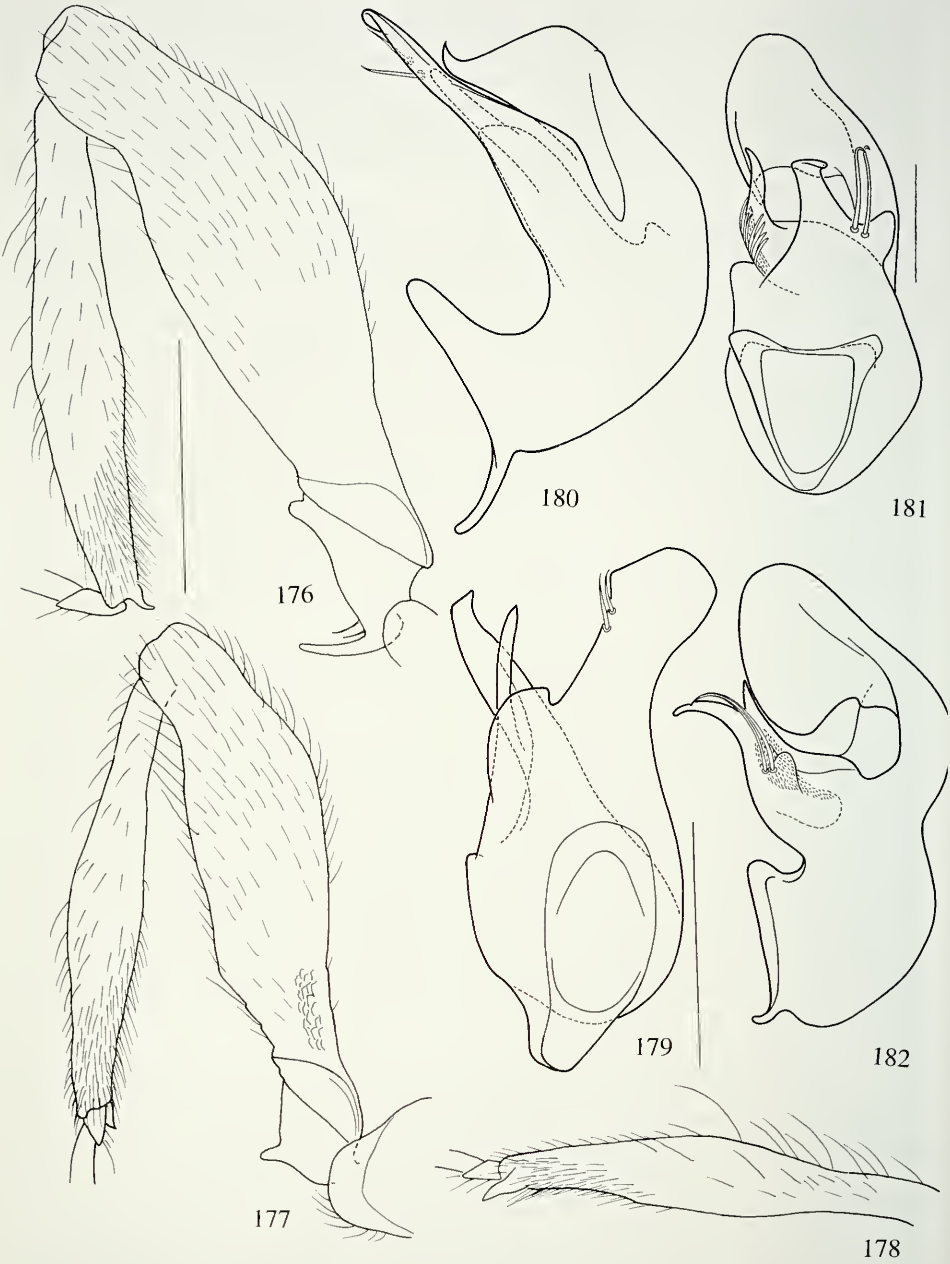
Comments. This species may be distinguished by the head and pronotum coarsely punctate, the dorsum of the body bearing long setae, the antennal segments 5 and 7 elongate, and the male mesotrochanters bearing a bifid process.

Batribolbus trebax sp. n. Figs 122, 181, 182

Holotype ♂: SRI LANKA: CENTRAL PROV.: Kandy, 700m, 19.I.65, R. Mussard (MHNG).

Paratypes: SRI LANKA: CENTRAL PROV.: same data as holotype, 1 ♂ (MHNG); Kandy, 1800 ft., Peak View Motel, 7-14.I.70, D. R. Davis & W. Rowe (NMNH).

Description. Length 1.7 mm. Head with lateral contours converging anteriorly; anterior arms of frontal sulci extending on to impression between antennal tubercles, parallel; vertexal carina reaching anterior level of vertexal foveae, with anterior



FIGS 176 to 182: *Batribolbus* Raffray

176: *B. pubescens* (Raffray), mesoleg; 177: *B. palpator* (Raffray), mesoleg; 178 to 180: *B. punctatus* sp. n., mesotibia (178), aedeagus in ventral (179) and lateral (180) views; 181 and 182: *B. trebax* sp. n., aedeagus in ventral (181) and lateral (182) views. scale bar = 0.2 mm. 176 to 178, scale bar = 0.2 mm; 179 to 182, scale bars = 0.1 mm.

portion slightly raised from minute impression. Punctation sparse and very fine on frontoclypeus and large central and posterior parts of vertex, dense and coarse on lateral portions of vertex. Antennal segments 3 to 8 about as long as wide or slightly wider than long; segments 5 and 7 slightly larger than preceding segments; segments 9 and 10 distinctly wider than long. Pronotum 0.40 mm long, 0.42 mm wide; mesal sulcus extending up to anterior eighth of disc. Pronotal, elytral and tergal punctation dense and equally very fine. Pubescence long; additional, very long setae apparently absent (pubescence damaged in all specimens).

Male characters. Segment 4 of maxillary palpi with elongate basomesal impression (Fig. 122). Humeral angle of elytra denticulate. Metasternum with deep median impression flattened in middle, pubescence in impression very short and recumbent; margins of impression raised posteriorly to form robust, short ridges. Prolegs and metalegs without obvious sexual characters. Mesotrochanters each with mesal edge bearing slender, curved, digitiform process and flat, triangular denticle; apical angle prominent. Mesotibiae slightly curved, gradually thickened toward middle, mesal side narrowed from middle to apical third, in apical third equally wide. Abdominal sternites 1 to 3 flattened in middle. Aedeagus (Figs 181, 182) with three ventral processes. Right ventral process expanded by short, oblique, rounded lateral lobe, middle process much longer, curved at apex; left ventral process narrow, sinuate, with acute tip. Pair of long setae araising from base of right process. Dorsal process arcuate, strongly expanded in apical part.

Comments. This species is similar to *B. carinatus*. It is characterized by the comparatively short flagellar segments, the throughout fine pronotal punctation and the male protibiae gradually narrowed apically.

Batrisiella Raffray Fig. 183

Batrisiella Raffray, 1904: 59; type species *Eubatrisus caviventris* Raffray, 1894.
Arthromelinus Jeannel, 1952: 98; type species *Batrisus angulatus* Raffray, 1892. Synonymized by Jeannel (1960b).

Description. Habitus as Fig. 183. Length 1.6-2.6 mm. Body with dorsal side convex. Head below plan of pronotum, elytra raised above plan of vertex and abdomen. Punctation of body an appendages dense, mostly very fine. Pubescence variably long, particularly long setae present in some species.

Head subpentagonal, longer than wide including eyes, usually narrowed posteriorly and narrower than pronotum. Lateral contours slightly concavely arcuate or parallel-sided. Frontal lobe below plan of vertex, impressed between antennal tubercles and inclined toward arcuate anterior margin of frontoclypeus. Antennal fossae distant, frontoclypeus wide, obliquely inclined, distinct in dorsal view. Antennal tubercles distinct. Vertex with foveae not or in impressions, lacking semicircular sulcus, with median carina separated from frons by transverse, V-shaped or arcuate sulcus. Lateral frontal foveae inconspicuous, shallow and small, situated on antennal tubercles. Ocular-mandibular carina arcuate close eye margin. Occipital part of vertex transverse, convexly inclined toward neck. Eyes large, not notched, situated at posterior half of head, multifaceted, facets large. Tempora short, rounded. Ventral

FIG. 183
Batrisiella srilankana sp. n.

side of head fairly long, convex, moderately inclined toward neck, lacking long postgenal setae. Gular foveae close, in common impression.

Antennal length variable. Scape cylindrical in dorsal view, curved in lateral view, with ventral side arcuate, dorsoapical angles acute, slightly prominent, lacking modified setae and glandular orifice. Segments 2 to 8 symmetrical, subcylindrical or cylindrical. Pedicel longer than wide, smaller than scape. Segments 5 and 7 longer than adjoined segments. Club 3-segmented. Maxillary palpi fairly long, segment 3 short, longer than wide, slightly widened toward apex; segment 4 lacking stalk, with base narrow, swollen from base toward middle.

Pronotum convex, about as long as wide, widest in middle part, strongly narrowed basally and apically, with one mesal and two lateral sulci, antebasal transverse sulcus crossed by mesal sulcus and joined to lateral sulci, lateral sulci extended ventrally and surrounding completely lateral humps, four distinct basal foveae, one pair of lateral foveae at joints of antebasal and lateral sulci, lacking carinae and tubercles or denticles. Paranotal ridges replaced anteriorly by sulci bent obliquely dorsally. Hypomera smooth, with basolateral foveiform impressions.

Elytra convex, fairly long, longer than pronotum, combined much wider than long. Lateral contours broadly arcuate. Each elytron with basal ridge, two basal foveae, subhumeral fovea, entire sutural stria, long discal stria, lateral carina joined to subhumeral fovea and curved dorsally, extending posterior to humeral angle.

Metasternum swollen, not or weakly impressed in middle, with basomedian foveiform impression or median sulcus. Lateral metasternal foveae separated by tubercle larger or about as large as foveal diameter.

Legs slender, protarsi and mesotarsi with segments 2 and 3 similar in length, metatarsi usually with segment 2 distinctly longer than segment 3.

Abdomen with 4 tergites visible in dorsal view. Tergite 1 large, longer than tergites 2 to 4 combined, usually parallel-side and not inclined apically, not constricted basally, with single, short, lateral carina at each side, transverse basal ridge, two pairs of close basal foveae and pair of basodiscal carinae touching inner basal foveae. Tergites 2 to 4 strongly inclined, lacking foveae and impressions. Tergites 2 and 3 not separated from sternites by sutures or carinae. Tergite 4 separated by sutures from sternite, usually about as long as combined length of tergites 2 and 3, much shorter than tergite 1. Sternite 1 narrowed mesally, in middle moderately to much longer than sternite 2, with carinate basomesal process, two pairs of basal foveae, two basodiscal carinae each touching margin of basolateral fovea, and one pair of lateral sulci, each starting at impression at basolateral fovea. Following sternites lacking foveae.

Sexual characters. Secondary sexual characters located usually on tergite 1, mesotrochanters and mesotibiae, rarely on prolegs and metalegs, metasternum and eventually abdominal sternites 1 and 5. Eyes and elytra similar in both sex. Aedeagus with ventral stalk of basal bulb projecting proximally and articulated process inserted at dorsal side, usually at left margin, seldom at right margin (*B. caviventris*); setae absent.

Habitats. Sri Lankan species inhabit mainly litter and banks of streams, savannahs and dry forest ecosystems. *Batrisiella caviventris* occurs in high altitude wet forests. Many species are represented only by males found in light traps.

Distribution. Southeast Asia.

Comments. Jeannel (1952) erected a new subgenus of *Arthromelus* Jeannel, *Arthromelinus*, for *Batrisocenus angulatus* Raffray and for two new species from Vietnam. He (Jeannel, 1952) stated that the group is species-rich and comprises the species that Raffray (1904) had placed in his "*Batrisocenus* group XVIII". This group included originally also *A. optatus* (Sharp), *A. elongatus* (Raffray) and *A. abdominalis* Raffray that Jeannel (1958, 1959) placed later in *Arthromelodes* Jeannel and in *Arthromelus* Jeannel, respectively. Hence, the "*Batrisocenus* group XVIII" as defined by Raffray would be polyphyletic. Most of the 36 members of the "*Batrisocenus* group XVIII" are Oriental and were not studied by modern authors. Later Jeannel (1960b) synonymized *Arthromelinus* with *Batrisiella*, described five new species of *Batrisiella* from India and included the South Indian *Batrisocenus protervus* Raffray in *Batrisiella*. We consider difficult to follow Jeannel (1952) and to hold all those species that were not explicitely transferred from *Batrisocenus* to *Arthromelinus* or *Batrisiella* as members of *Batrisiella*.

Key to the species of *Batrisiella* of Sri Lanka

1 Punctation of pronotum and head conspicuously dense and coarse, much coarser than that on elytra. Vertexal carina short, not reaching occiput. Pubescence long. Antennae short. . . . . *B. aulica* sp. n.
\- Punctation of pronotum and usually also of head fine, not conspicuously coarse, similar to that of elytra. Vertexal carina long, reaching occiput 2
2 Antennae short, segment 7 about 1.4 to 1.5 times as long as wide 3
\- Antennae long, segment 7 about 1.8 to 2 times as long as wide 7
3 Male with simple abdominal tergite 1 and strongly modified, widened metatibiae (Fig. 196) . . . . *B. puberula* Jeannel
\- Male with abdominal tergite 1 excavated, metatibiae slender, unmodified . . . 4
4 Excavation of male abdominal tergite 1 slightly raised mesally, not clearly delimited laterally, with two foveiform impression at bottom (Fig. 193) . . . . *B. saucia* (Raffray)
\- Excavation of male tergite 1 strongly raised medio-apically to form tubercle, well delimited laterally, without foveiform impressions at bottom . . 5
5 Male tergite 1 impressed between excavation and lateral margins . . . . *B. shinghalensis* (Raffray)
\- Male tergite 1 convex or slightly flattened at each side of excavation, lacking lateral impressions 6
6 Abdominal tergite 1 with discal carinae separated by about half of tergal width. Male with two foveae and impressions anterior tergal excavation (Fig. 189) . . . . *B. favea* sp. n.
\- Abdominal tergite 1 with discal carinae separated by less than one third of tergal width. Male lacking foveae and not impressed anterior tergal excavation (Fig. 195) . . . . *B. srilankana* sp. n.
7 Excavation of male abdominal tergite 1 about as wide as third of tergite, sharply delimited laterally 8

\- Excavation of male abdominal tergite 1 wider than half of tergite, not sharply delimited laterally 9

8 Discal carinae of abdominal tergite 1 separated by almost half of tergal width. Male abdominal sternite 1 with median ridge. Mesal side of male mesotrochanters expanded and bearing setal tuft. Anterior wall of tergal excavation with central tubercle . . . . *B. caviventris* (Raffray)

\- Discal carinae of abdominal tergite 1 separated by fifth of tergal width. Abdominal sternite 1 not modified sexualy. Mesal side of male metatrochanters with apical denticle. Anterior wall of tergal excavation without tubercle . . . . *B. lewisi* Jeannel

9 Male abdominal sternite 1 not modified. Smaller species, 1.7 to 1.9 mm long 10

\- Male abdominal sternite 1 with robust transverse ridge raised horn-like laterally. Larger species, 2.15 to 2.25 mm long 11

10 Bottom of excavation of male abdominal tergite 1 with low median tubercle and two carinae converging anteriorly (Fig. 191) . *B. illecebrosa* sp. n.

\- Bottom of excavation of abdominal tergite 1 moderately raised in middle and with two foveiform impressions (Fig. 187) . . . . *B. dryas* sp. n.

11 Male with apical tooth of mesotibiae very long, its length about as twice of tibial width. Bottom of excavation of tergite 1 without transverse carina anterior semicircular carina . . . . *B. remyi* Jeannel

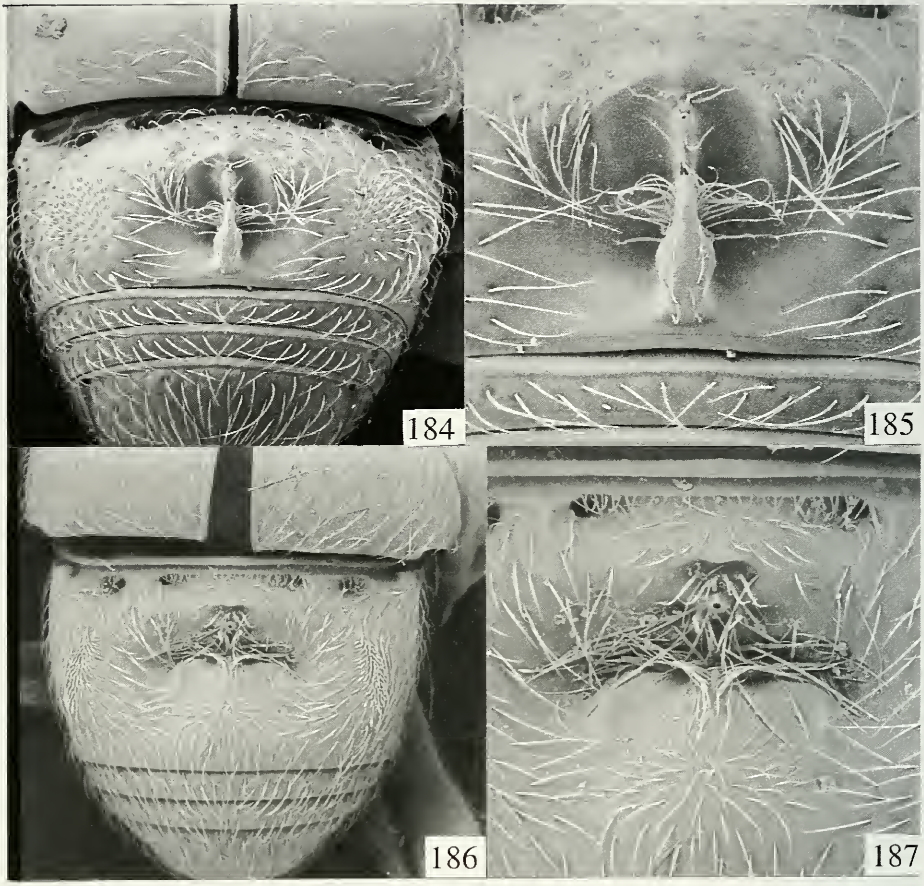
\- Male with apical tooth of mesotibiae about as long as tibial width. Bottom of excavation of tergite 1 with transverse carina anterior semicircular carina . . . . *B. retusa* sp. n.

Batrisiella aulica sp. n. Figs 184, 185, 198

Batrisiella caviventris; Jeannel, 1961: 437.

Holotype ♂: Sri Lanka: North Central Prov.: Anuradhapura, 150m, 23.I.65, R. Mussard (MHNG).

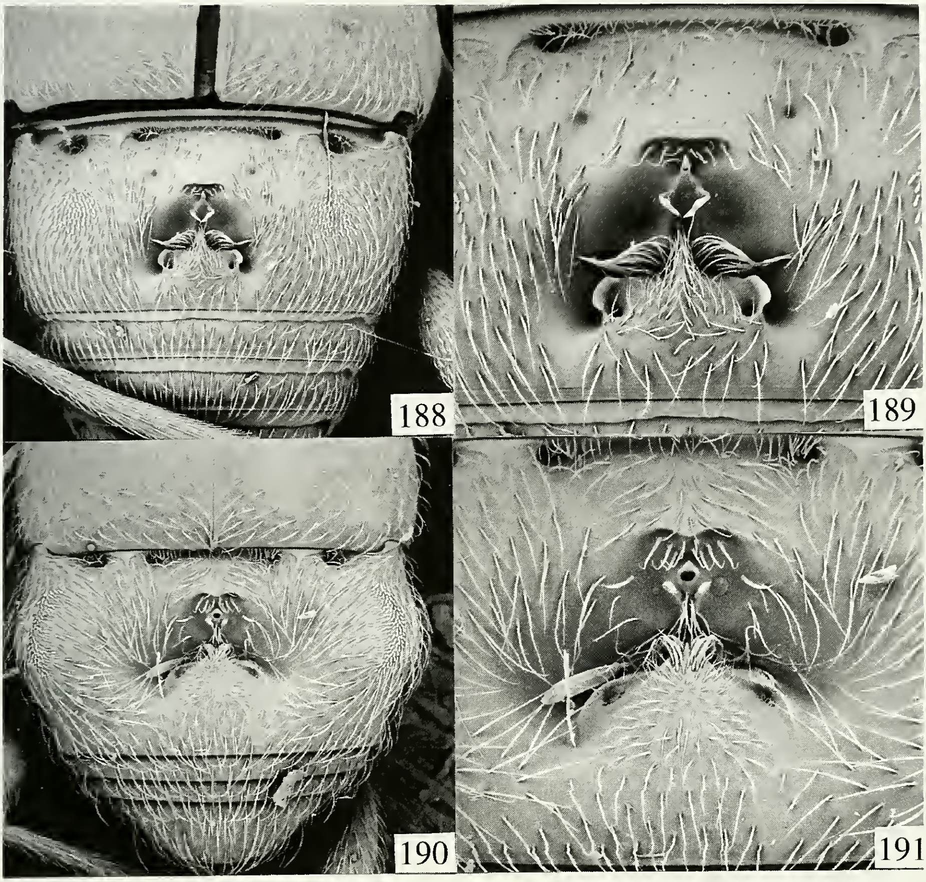
Paratypes: Sri Lanka: Northern Prov., forest 4-5 mls NE Mullaitivu, 6.II.70, ExpG # 50b, 6 ♂, 5 ♀ (MHNG); 2 mls NE Puliyan Kulam, 6.II.70, ExpG 48b, 2 ♂, 4 ♀ (MHNG); Murunkan, 5.II.70, savanna, ExpG # 46, 2 ♂ (MHNG); Madhu Road, forest, 5.II.70, ExpG # 47, 3 ♂, 8 ♀ (MHNG); Nedunleni, 6.II.70, ExpG # 49, 1 ♀ (MHNG); Giant's Tank 10 mls SE Mannar, pond, grassy ground, 15.II.62, ExpL # 83, 1 ♂ (MZLU); North Central Prov.: Anuradhapura, 150m, 23.I.65, R. Mussard, 17 ♂, 33 ♀ (MHNG); Polonnaruwa, 12. and 14.I.65, R. Mussard, 1 ♂, 3 ♀ (MHNG); Mihintale, 7.II.70, ExpG # 52, 6 ♀ (MHNG); Put. Dist., Wilpattu Park, 100ft, Talawila,9-10.IV.73, black light, Bauman & Cross, 1 ♂ (NMNH); Wilpattu N.P. Maradan Maduwa, 23 mls Wanuradhapura, 2.II.62, at light, ExpL # 48, 1 ♂ (MZLU); Anu. Dist., Hunuwilagema, near Wilpattu, 200ft, black light, 28.X.-3.XI.76, 2 ♂, G. F. Hevel, R. E. Dietz, S. Karunaratne, D. W. Balasooriya, 2 ♂ (NMNH); Anu. Dist., Wildlife Soc. Bungalow, Hunuwilagama, Wilpattu, 10-19.III.70, D. R. Davis & W. Rowe, 378 ♂ (NMNH, NMCC, MHNG, PCSK); Anu. Dist., Padaviya, 180ft, 2-8.XI.70, O. S. Flint Jr., 1 ♂ (NMNH); Anu. Dist., Irrigation Bungalow Padaviya, 180 ft., 27.II.-9.III.70, D. R. Davis & W. Rowe, 1 ♂ (NMNH); forest 2 mls N Medawachchiya, 6.II.70, ExpG # 51b, 14 ♂, 22 ♀ (MHNG, PCSK); Sigiriya, 26.III.73, light trap, M. Tronquet, 15 ♂ (MHNG); Central Prov.: Dambulla, 200m, 9.I.65, 3 ♀, R. Mussard (MHNG); same but 12.I.65, 1 ♀ (MHNG); Kan. Dist., 5 mls NW Mahiyangana, 30.III.-9.IV.71, P. & P. Spangler, 2 ♂ (NMNH); Eastern Prov.: Kantalai, 2.II.70, ExpG # 40, 1 ♀ (MHNG); Uva Prov.: Inginiyagala, 12.II.70, ExpG #



FIGS 184 to 187: *Batrisiella* Raffray, male abdominal excavation
184 and 185: *B. aulica* sp. n.; 186 and 187: *B. dryas* sp. n.;

63, 1 ♀ (MHNG); SABARAGAMUWA PROV.: Rat. Dist., Uggalkaltota, 350ft, Irrigation Bungalow, 31.I.-8.II.70, D. R. Davis & W. Rowe, 2 ♂ (NMNH); WESTERN PROV., Yakkala, 18 mls NE Colombo, 14-31.I.62, at light, ExpL # 10, 1 ♂ (MZLU); SOUTHERN PROV.: Tissamaharama, 22.I.64, M. Mussard, 1 ♂, 6 ♀ (MHNG); Tissamaharama, Resthouse, 23.I.70, light trap, ExpG # 22, 9 ♂ (MHNG); Galle, 22.I.64, R. Mussard, 1 ♂, (MHNG); Palatupana near entrance of Yala Nat. Park, dry savanna, 24.I.70, ExpG # 23, 7 ♂, 10 ♀ (MHNG); Lunuganwehera, cultivated land, 24.I.70, ExpG # 24, 3 ♂, 2 ♀ (MHNG).

Description. Length 1.80-2.05 mm. Punctation coarse and dense on head, most of pronotum and femora, very fine on elytra and abdomen. Coarse punctures mostly larger than puncture intervals. Pubescence on body and tibiae long, erect or semi-erect. Head with few particularly long setae. Head with median vertexal carina low, extending from frontal sulcus to plan of vertexal foveae. Vertexal foveae in impressions. Frontal sulcus moderately arcuate. Antennae short; pedicel about as long as



FIGS 188 to 191: *Batrisiella* Raffray, male abdominal excavation
188 and 189: *B. favea* sp.n.; 190 and 191: *B. illicebrosa* sp. n.;

segment 3 and half of segment 4 combined; segments 4, 6 and 8 each slightly longer than wide; segment 7 about 1.3 to 1.4 times as long as wide. Pronotum with median sulcus deep and short, narrowed anteriorly, ending between mid-length and anterior third of pronotal disc. Elytra with discal stria deep anteriorly, becoming shallow apically, extending about up to apical fourth. Discal carinae of abdominal tergite 1 usually covered by elytra, about as long as one fifth to one sixth of tergal length, separated by about half of tergal width.

Male characters. Metasternum not impressed in medio-anterior part, with foveiform medio-apical impression small, deep, and elongate. Metasternal pubescence sparse. Mesotrochanters with mesal impression bearing short setal tuft, partly overlapped from below by crest. Abdominal tergite 1 (Figs 184, 185) with excavated sexual patch longer than wide, about as wide as sixth of tergal width and longer than half of maximal tergal length; well delimited in anterior half by sharp margin and separated by low median carina; apical half of impression not clearly delimited laterally, with median carina strongly raised to form flat keel. Flat, oblique area with patch of conspicuously dense punctation and short, modified setae at each side, between excavation and lateral margins of tergite. Abdominal sternites 1 and 5 lacking obvious sexual characters. Aedeagus (Fig. 198) with dorsal process of median lobe elongate, weakly sclerotized, with shallow apical notch at left side and prominent right side of apical part. Articulated process inserted at left side of basal bulb, slender, strongly curved in basal and subapical portions, consisting of two or three rods in subapical portion, narrow and pointed basally in apical portion.

Comments. See under *B. caviventris*.

Batrisiella caviventris (Raffray) Figs 199, 200

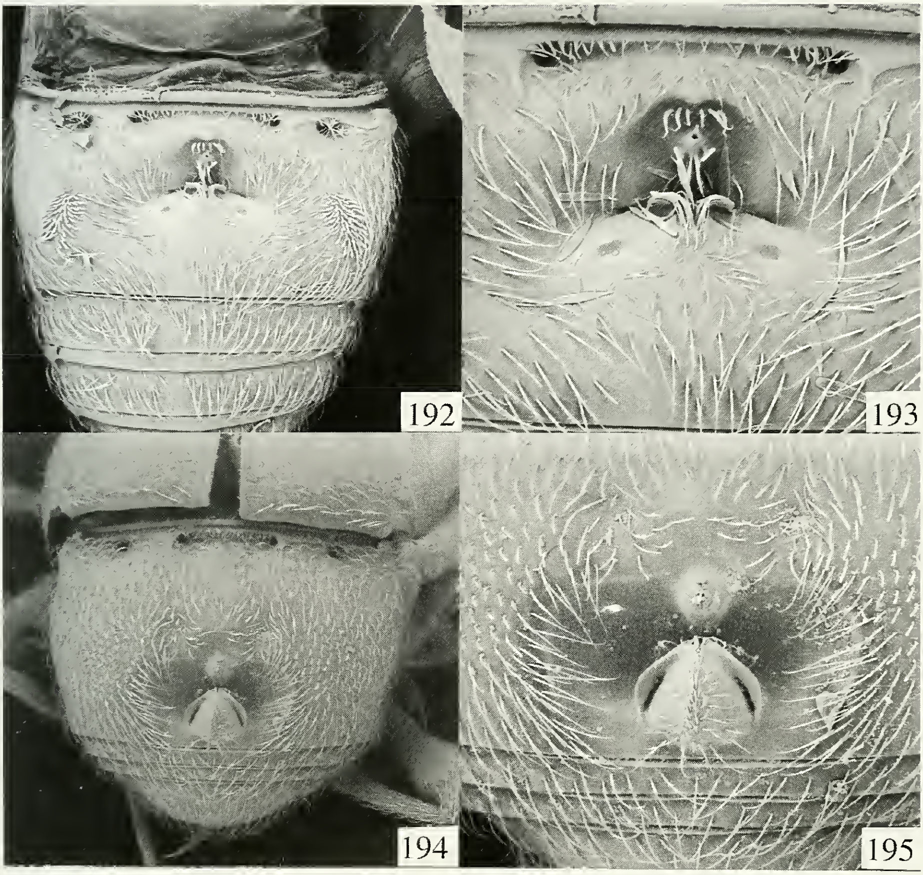
Eubatrisus caviventris Raffray, 1894a: 452.
Batrisiella caviventris; Raffray, 1904: 102.

Type material. Syntypes: 3♂, 3 ♀ from SRI LANKA: CENTRAL PROV.: Nuwara-Eliya, E. Simon (MNHN). One male bears the original hand-written labels "Simon Nuwara Elia"/ 1403 /Batrisiella caviventris ♂ ♀ Typ. Rffray Ceylan", the remaining five specimens are from the same Raffray's original slide and bear the locality and identification labels written subsequently by the senior author.

Additional material. SRI LANKA: CENTRAL PROV.: Hakgala, 1700m, north-eastern slope, forest litter, 28.I.70, ExpG # 70, 2 ♂, 3 ♀ (MHNG); Hakgala, 5 mls SE Nuwara Eliya, 3.III.62, forest debris, ExpL # 114:I, 3 ♂, 1 ♀ (MZLU); Horton Plains, 2100m, forest litter, 14.II.70, ExpG # 68, 4 ♂, 6 ♀ (MHNG, PCSK); Horton Plains, 7000 ft, 11 mls SSE Nuwara Eliya, 19-20.III.62, indigenous forest, sieved debris, ExpL # 162, 163, 1 ♂, 3 ♀ (MZLU, MHNG); Nuwara Eliya, 1800m, 11.I.65, R. Mussard, 8 ♂, 4 ♀ (MHNG).

Description. 2.2-2.6 mm. Punctuation dense and fairly coarse on most of head, fine and dense near vertexal foveae and throughout body. Pubescence long, particular long setae present on head, pronotum, elytra and abdomen. Head with vertexal carina fairly high, robust anteriorly, extending from frontal sulcus to neck. Vertexal foveae in impressions. Frontal sulcus V-shaped to arcuate. Antennae long; pedicel as long as combined length of segment 3 and half of segment 4; segments 4, 6 and 8 each distinctly longer than wide; segment 7 about 1.6 to 1.9 times as long as wide. Pronotum with median sulcus deep and long, usually slightly widened anteriorly, extending up to anterior ninth or tenth of pronotal disc. Elytra with discal stria fairly shallow, not clearly delimited, extending about up to apical third. Wings completely reduced. Discal carinae of abdominal tergite 1 about as long as one sixth to fifth of tergal length, separated by almost half of tergal width. Metasternum with medio-apical, foveiform impression.

Male characters. Metasternum not impressed, with inconspicuous, sparse, long and recumbent pubescence. Femora slightly swollen. Mesotrochanters expanded at middle of mesal side and bearing tuft of oblique setae. Mesotibiae with robust, flat, apical denticle. Abdominal tergite 1 with excavated sexual patch deep, about twice as wide as long, almost as wide as half of tergal width and about as long as half of tergal length; anterior margin sharply delimited by prominent laminae at each side of centre; anterior wall vertical with small tubercle at centre bearing modified setae orientated



FIGS 192 to 195: *Batrisiella* Raffray, male abdominal excavation
192 and 193: *B. saucia* (Raffray); 194 and 195: *B. srilankana* sp. n.

apically. Bottom of excavation with subapical, semicircular ridge bearing at inner side two setal tufts orientated perpendicularly to body axis, and one central, pubescent tubercle at outer side. Lateral patches of very short, modified setae absent. Abdominal sternite 1 with median area raised to form inverted V-shaped ridge bearing very dense, recumbent pubescence; sternite 5 without obvious sexual characters. Aedeagus (Figs 199, 200) with dorsal process of median lobe short, narrowed in subapical part, abruptly widened in apical portion, hook-like at left side, with subapical fold at right side. Articular process inserted at right side, robust, arcuate, divided in two arms. Left arm partly exposed in ventral view and bifid or trifid at apex. Right arm of articular process below dorsal process in dorsal view, truncate or slightly arcuate at apex.

Comments. Jeannel (1961) examined a specimen from Anuradhapura that he identified as *B. caviventris*. Raffray (1894a) based the description of his *caviventris* on six specimens from Nuwara Eliya that were not examined by Jeannel. The Jeannel's *caviventris* is the common *B. aulica* described above. *B. aulica* is widely distributed but obviously absent from higher elevations and wet forest ecosystems. It has the pronotum, as the head, conspicuously densely and coarsely punctate. The true *caviventris* is from wet forest ecosystem at high elevation (Nuwara Eliya) and has the pronotum as noted by Raffray "plus minusve disperse punctato". The specimens recorded above are consistent with the description Raffray gave. A confusion of this species is unlike because no other species of *Batrisiella* known to occur in the Central Highlands exhibits such characters.

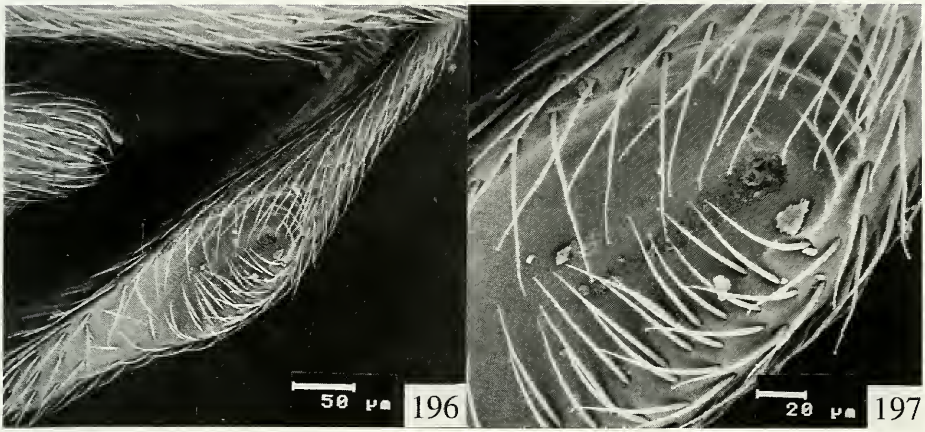
Batrisiella dryas sp. n. Figs 186, 187, 201

Holotype ♂: SRI LANKA: CENTRAL PROV.: Mahaweli Ganga, 7 mls downstream Kandy, ca 450m, sandy river banks, 30.I.70, ExpG # 34 (MHNG).

Paratypes: SRI LANKA: NORTH CENTRAL PROV.: Ritigala, sandy stream banks, 7.II.70, ExpG # 53, 15 ♂, 13 ♀ (MHNG, PCSK); Anu. Dist., Irrigation Bungalow Padaviya 180 ft, 27.II.-9.III.70, D. R. Davis & W. Rowe, 23 ♂ (NMNH, MHNG); Alut Oya, sandy river banks, 3.II.70, ExpG # 43a, 1 ♂ (MHNG); EASTERN PROV.: Maha Oya, sandy river banks 11.II.70, ExpG # 60, 7 ♂, 8 ♀ (MHNG); CENTRAL PROV.: same data as holotype, 4 ♂, 14 ♀ (MHNG); same data but 11.II.70, ExpG # 57b, 1 ♀ (MHNG); Bad. Dist., 5 mls E Mahiyangana Hasalaka, 200ft, 16.XI.74, C. Gans, P. Fernando, S. Farook, 83 ♂ (NMNH, NMCC, MHNG, PCSK); SABARAGAMUWA PROV.: Ambepussa, 5.XII.72, ExpG # 62, 1 ♂ (MHNG); 2 mls S Dambulla, 7.II.70, sandy river banks, ExpG # 54, 12 ♂, 18 ♀ (MHNG, PCSK).

Description. Length 1.8-1.9 mm. Punctuation almost throughout very fine and dense, often less fine posterior antennal tubercles and on frontoclypeus than on remainder of body and appendages. Pubescence short, particular long setae present on head and pronotum. Head with median vertexal carina low, extending from frontal sulcus to neck. Vertexal foveae not in impressions. Frontal sulcus slightly arcuate. Antennae short; pedicel almost as long as combined length of segments 3 and 4; segments 4, 6 and 8 each distinctly longer than wide; segment 7 about 1.6 to 2 times as long as wide. Pronotum with median sulcus deep and long, not narrowed anteriorly, extending up to anterior fifth or sixth of pronotal disc. Elytra with discal stria fairly deep, delimited by carina, extending about up to apical fifth. Discal carinae of abdominal tergite 1 about as long as one sixth to fifth of tergal length, separated by almost half of tergal width. Metasternum with median sulcus.

Male characters. Metasternum with median part impressed, bearing inconspicuous, dense, short and recumbent pubescence. Mesotrochanters expanded, with mesal side truncate and bearing oblique setae. Mesotibiae with minute apical denticle. Abdominal tergite 1 with excavated sexual patch (Figs 186, 187) deep and large, much wider than long, about as wide as five sixth of tergal width and longer than half of tergal length, with anterior margin in middle sharply delimited; anterior wall steep, with small tubercle in centre and several particular, horizontal setae orientated apically. Bottom of excavation separated by slightly raised middle bearing recumbent setae forming V-shaped pattern, and with two small, shallow, foveiform impressions. Lateral parts of excavation oblique, not clearly delimited, with oval patches of very short, modified setae; posterior part almost horizontal, not clearly delimited. Abdo-



FIGS 196 and 197
Batrisiella puberula Jeannel, male metatibia, scale bar = 50 µm (196), dtto, mesal patch of pores, scale bar = 20 µm (197).

minal sternite 1 lacking obvious sexual characters, sternite 5 with short, transverse row of robust setae delimited at each side by minute lobe. Aedeagus (Fig. 201) with dorsal process of median lobe wide, bilobed at apex, left lobe membranous and bearing minute spicules. Articular process inserted at left side, curved and gradually narrowed in basal portion, slender and slightly arcuate in apical portion, in ventral view completely overlapped by dorsal process.

Comments. This species may be distinguished from its congeners with similar, long antennae and fine puctation by the shape of the tergal excavation in male, in particular by the presence of foveiform impressions at each side of the excavation.

Batrisiella favea sp. n. Figs 188, 189, 202

Holotype ♂: SRI LANKA: NORTHERN PROV.: Murunkan, litter in savanna, 5.II.70, ExpG # 46 (MHNG).

Paratypes: SRI LANKA: NORTH CENTRAL PROV.: Alut Oya, 3.II.70, ExpG # 43a, 1 ♂ (MHNG); Medawachchiya, Resthouse at light, 6.II.70, ExpG # 51a, 3 ♂ (MHNG); Vavuniya Dist., Parayanalankulam Irrigation Canal, 25 mls NW Medawachchiya, 100ft, 20-25.III.70, D. R. Davis & W. Rowe, 1 ♂ (NMNH); Anu. Dist., Wildlife Soc. Bungalow, Hunuwilagama, Wilpattu, 200 ft, 10-19.III.70, D. R. Davis & W. Rowe, 10 ♂ (NMNH, MHNG, PCSK); Anu Dist., Hunuwilagama near Wilpattu, 200 ft, black light, 28.X.-3.XI.76, G. F. Hevel, R. E. Dietz, S. Karunaratne, D. W. Balasooriya, 3 ♂ (NMNH, MHNG); Anu. Dist., Padaviya, 180 ft, 2-8.XI.70, O. S. Flint Jr., 3 ♂ (NMNH); Irrigation Bungalow Padaviya 180 ft, 27.II.-9.III.70, D. R. Davis & W. Rowe, 9 ♂ (NMNH, MHNG); CENTRAL PROV.: Kandy Dist., 5 mls NW Mahiyangana, 30.III.-9.IV.71, blacklight at Hasalaka Irrigation Bungalow, P. & P. Spangler, 1 ♂ (NMNH, MHNG); Kandy, 1800 ft, Peak View Motel, 15-24.I.70, D. R. Davis & W. Rowe, 1 ♂ (MHNG); Bad. Dist., 5 mls E Mahiyangana Hasalaka, 200ft, 16.XI.74, C. Gans, P. Fernando, S. Farock, 4 ♂ (NMNH, MHNG); SABARAGAMUWA PROV.: Rat. Dist., Uggalkaltota Irrigation Bungalow, 350 ft, 31.I.-8.II.70, D. W. Davis & W. Rowe, 1 ♂ (NMNH).

Description. Length 1.90-1.95 mm. Punctuation almost throughout very fine and dense, usually few punctures posterior to antennal tubercles coarser than those on remainder of body. Pubescence short, particular long setae absent. Head with median vertexal carina low, extending from frontal sulcus to neck. Vertexal foveae in impressions. Frontal sulcus almost transverse. Antennae short; pedicel almost as long as combined length of segments 3 and 4; segments 4, 6 and 8 each slightly longer than wide; segment 7 about 1.4 times as long as wide. Pronotum with median sulcus deep and long, not narrowed anteriorly, extending up to anterior fifth or sixth of pronotal disc. Elytra with discal stria throughout deep and delimited by carina, extending about up to apical eighth. Discal carinae of abdominal tergite 1 about as long as one sixth to fifth of tergal length, separated by almost half of tergal width. Metasternum with median sulcus.

Male characters. Metasternum with median part impressed, bearing conspicuous, dense, fairly long and recumbent pubescence. Mesotrochanters expanded, with mesal side truncate and bearing oblique setae. Mesotibiae with short apical denticle. Abdominal tergite 1 (Figs 188, 189) with excavated sexual patch deep, about as long as wide, about as wide as third of tergal width and as long as half of tergal length; anterior margin in middle sharply delimited. Posterior part raised to form a large, pubescent tubercle narrowed toward mid-line to form keel and delimited laterally by ridges; anterior wall of tubercle bearing setal tufts orientated laterally. Anterior wall of excavation steep, with two parallel carinae and minute tubercle bearing modified setae. Disc anterior to excavation with two small foveiform impressions; lateral patches of very short, modified setae small and round. Abdominal sternites lacking obvious sexual characters. Aedeagus (Fig. 202) with dorsal process of median lobe wide, produced at right side of apical part to form large apophysis with acute distal tip and blunt proximal tip, and with left side produced to form small, subapical point. Articular process inserted at left side, arcuate, with simple, slender apical part.

Comments. This species may be distinguished by the short antennae and the widely separated carinae of the tergite 1, in combination with the tergal excavation as wide as half of the tergite and the presence of foveae and impressions anterior the tergal excavation.

Batrisiella illicebrosa sp. n. Figs 190, 191, 203

Holotype ♂: SRI LANKA: NORTH CENTRAL PROV.: Polonnaruwa, 150m, 13.I.65, R. Mussard (MHNG).

Paratypes: SRI LANKA: NORTH CENTRAL PROV.: Polonnaruwa, 3.III.72, K. V. Krombein & P. B. Karunaratna, 2 ♂ (NMNH); WESTERN PROV.: Yakkala, 18 mls NE Colombo, 1-8.III.62, at light, ExpL # 10, 1 ♂ (MZLU); Col. Dist., Beyagama, sea level, 20-21.VIII.73, G. Ekis, 8 ♂ (NMNH, MHNG); Col. Dist., Hanwella Resthouse, 200ft, black light, 2.X.76, G. F. Hevel, R. E. Dietz, S. Karunaratne, D. W. Balasooriya, 1 ♂ (NMNH); Col. Dist., Malawana, sea level, 22.VIII.73, at black light, G. Ekis, 1 ♂ (MHNG); SABARAGAMUWA PROV.: Ratnapura, at light, 22.II.62, ExpL # 95, 2 ♂ (MZLU, MHNG); Ratnapura, Resthouse, 200-300 ft, 24.X.76, black light, G. F. Hevel, R. E. Dietz, S. Karunaratne, D. W. Balasooriya, 4 ♂ (NMNH, MHNG, PCSK); Rat. Dist., Gilimale Lumber Mill, 115 ft, black light, 20-25.X.76, G. F. Hevel, R. E. Dietz, S. Karunaratne, D. W. Balasooriya, 1 ♂ (NMNH); UVA PROV.: Westminster Abbey 25 mls ESE Bibile, 7.III.62, ExpL # 119:III, 1 ♂ (MZLU); Amp. Dist., Inginiyagala, 250 ft, black light, 21-24.XI.76, G. F. Hevel, R. E. Dietz, S. Karunaratne, D. W. Balasooriya, 1 ♂ (NMNH);); SOUTHERN PROV.: Gal. Dist., Udugama, Kanneliya Jungle, 400 ft, 6-12.X.73, at black light, K. V. Krombein, P. B. Karunaratne, P. Fernando, J. Ferdinando, 2 ♂ (NMNH, MHNG); Gal. Dist., Kanneliya jungle, 400m, 13-16.VIII.72, K. V. Krombein & P. B. Karunaratne, 2 ♂ (NMNH, MHNG).

Description. Length 1.7-1.8 mm. Punctuation almost throughout very fine and dense, coarser posterior to antennal tubercles than on remainder of body. Pubescence long, head, pronotum and abdomen with several particular long setae. Head with median vertexal carina fairly high, extending from frontal sulcus to neck. Vertexal foveae in impressions. Frontal sulcus broadly U-shaped to almost transverse. Antennae fairly long; pedicel almost as long as combined length of segments 3 and 4; segments 4, 6 and 8 each distinctly longer than wide; segment 7 almost twice as long as wide. Pronotum with median sulcus deep and long, not or hardly narrowed anteriorly, extending up to anterior fifth or sixth of pronotal disc. Elytra with discal stria throughout deep and delimited by carina, extending about up to apical fourth. Discal carinae of abdominal tergite 1 about as long as one eighth to seventh of tergal length, separated by almost half of tergal width. Metasternum with elongate, medio-apical impression.

Male characters. Metasternum with median part impressed, bearing inconspicuous, short, recumbent pubescence. Mesotrochanters expanded, with basal part of mesal side truncate and bearing oblique setae. Mesotibiae with robust apical denticle. Abdominal tergite 1 (Figs 190, 191) with excavated sexual patch deep and very large, extended almost to lateral margins and from basis almost to apical margin of tergite; basomedian part of disc moderately impressed, delimited by sharp, transverse carina with slightly prominent and acute centre, surface below transverse carina vertical, laterally carina steeply inclined toward bottom of impression. Centre of vertical wall with minute tubercle and horizontal, modified setae. Bottom of impression swollen mesally, with dense, short pubescence and with two arcuate, fairly high, admesal carinae. Lateral patches of very short, modified setae situated along lateral margins of tergite, long and narrow. Abdominal sternite 1 lacking obvious sexual characters, sternite 5 impressed, with small mediobasal tubercle bearing erect setae. Aedeagus (Fig. 203) with dorsal process of median lobe strongly narrowed apically, subapical notch separating short lamina, acute apex, and flat, hook-like apophysis at right side, near apex. Articular process inserted at left side, hardly arcuate, with simple, curved apical part.

Comments. This species resembles *B. dryas* from which it differs notably by the presence of two carinae at the bottom of the tergal excavation.

Batrisiella lewisi Jeannel Fig. 204

Batrisiella lewisi Jeannel, 1961: 439.

Type material. Holotype ♂, Sri Lanka, Western Prov., labelled: Colombo. On Coast level. 7-27.IV.82. / Ceylon. G. Lewis 1910-320. / Type (red) Batrisiella Lewisi Jean. (hand-written) R. Jeannel det., 195 / Batriesiella lewisi Jeannel, det. Löbl, 2000 (NHML).

Paratypes: 1 ♀, labelled Kandy 1,546-1,27 ft., 6.IV.82 /Ceylon G. Lewis 1910-320 (NHML) in poor condition (most of the thorax, the metalegs and the abdomen are lost), and 1 ♀, labelled Bogawantalawa. 4,500-5,200 ft. 21.III.4.IV.82 / Ceylon. G. Lewis. 1910-320 / Arthromelus Lewisi n (hand-written by Jeannel) (NHML). These two females are similar to the holotype but we cannot confirm their conspecificity.

Description. Length 2.15 mm. Punctuation very fine and sparse on most of head and throughout pronotum and elytra. Punctuation on antennal tubercles and frontoclypeus dense and fairly coarse. Abdominal punctuation less fine than elytral and pronotal punctuation. Pubescence long on head, pronotum and elytra, short on abdomen. Head, pronotum, elytra and abdomen with several particular long setae. Head with median vertexal carina fairly high, extending from frontal sulcus to neck. Vertexal foveae in impressions. Frontal sulcus broadly V-shaped. Antennae long; pedicel distinctly shorter than combined length of segments 3 and 4; segments 4, 6 and 8 each about 1.5 times as long as wide; segment 7 twice as long as wide. Pronotum with median sulcus deep and long, not narrowed anteriorly, extending up to anterior fifth of pronotal disc. Elytra with discal stria throughout deep and delimited by carina, extending about up to apical fourth. Discal carinae of abdominal tergite 1 broadly triangular, very short, about as long as one tenth of tergal length, separated by about fifth of tergal width. Basolateral impressions of tergite 1 comparatively deep. Tergites 2 and 3 with subbasal, transverse carinae, area between subbasal carina and basal margin of tergite 2 impressed. Metasternum small, shallow, mediobasal impression.

Male characters. Metasternum with median part flattened, bearing short, recumbent pubescence. Profemora swollen. Mesal side of mesotrochanters flattened and with small, basal denticle. Mesotibiae with straight, apical denticle. Abdominal tergite 1 with excavated sexual patch deep, 1.4 times as wide as long, about as long as two thirds of tergite and as wide as half of tergal width. Two shallow, smooth impression present between each discal carina and excavation. Anterior part of excavation less deep than posterior part, separated by sharp, transverse carina. Middle of excavation raised to form robust, mesal ridge. Centre of transverse carina touching mesal ridge and raised to form small plate bearing short, very dense tuft of setae curved apically. Mesal ridge joined with two ridges diverging posteriorly and delimiting two small, round impressions. Bottom of excavation smooth. Lateral margins of excavation bearing setae directed mesally. Lateral patches of modified setae absent. Abdominal sternites lacking obvious sexual characters (characters of strongly damaged sternite 5 unknown). Aedeagus (Fig. 204) with dorsal process of median lobe notched apically to form narrow apical apophysis and fairly wide lamina. Articular process inserted at left side, arcuate, gradually narrowed toward conspicuously slender apical part.

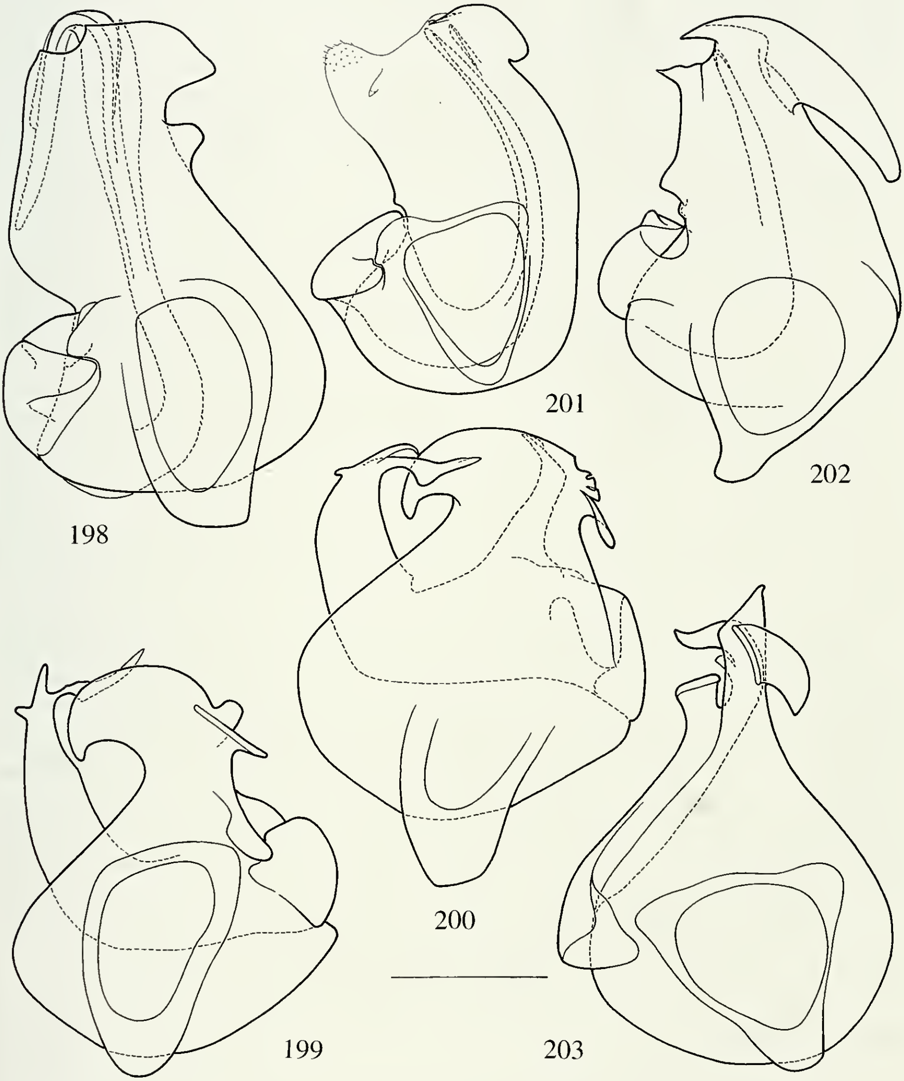
Comments. This species is similar to *B. caviventris* from which it may be easily separated by the close discal carinae of the tergite 1 and the unmodified male sternite 1.

Batrisiella puberula Jeannel Figs 196, 197, 205

Batrisiella puberula Jeannel, 1961: 437.

Type material. One ♂, labelled: 506.Lunawa 16.9.59 Pselaph. /Batrisiella puberula n. (hand-written by Jeannel) (MNHN). This specimen was not labelled as a type. Jeannel (1961) stated that his description is based on a single male, lacking sexual characters on the abdominal tergite 1. The published type data are consistent with the labels and the characters of the specimen. We consider this specimen to be the holotype also because no other Sri Lankan species of *Batrisiella* lacks the tergal sexual patch.

Additional material. Sri Lanka: Northern Prov.: 4-5 mls SW Mullaittivu, forest litter, 6.II.70, ExpG # 50b, 1 ♂ (MHNG); North Western Prov.: Medawachchiya, 6.II.70, ExpG # 51, 1 ♂ (MHNG); Western Prov.: Colombo, Colpetty, 5-13.I.62, ExpL # 2, 3 ♂ in



FIGS 198 to 203: *Batrisiella* Raffray, aedeagi in ventral view
198: *B. aulica* sp. n.; 199 and 200: *B. caviventris* (Raffray); 201: *B. dryas* sp. n.; 202: *B. favea* sp. n.; 203: *B. illicebrosa* sp. n. Scale bar = 0.1 mm.

garden, 1 ♂ at light (MZLU, MHNG); Yakkala, 18 mls NE Colombo, 14-31.I.62, at light, ExpL # 10, 10 ♂ (MZLU, MHNG, PCSK); same data but 1-28.II.62, 1 ♀ (MZLU); SABARAGAMUWA PROV.: Ratnapura, at light, 22.II.62, ExpL # 95, 4 ♂ (MZLU); Rat. Distr., Uggalkatota, 350 ft, Irrigation Bungalow, 31.I.-8.II. 70, D. R. Davis & W. Rowe, 1 ♂ (NMNH); Rat. Dist., Gilimale Lumber Mill, 7.VII.73, 115 ft, G. Ekis, 1 ♂ (MHNG); CENTRAL PROV.: Pidurutalagala 2 mls NW Nuwara Eliya, 4.III.62, indigenous bamboo forest, in the shrub layer, sieved in debris, ExpL # 116:I, 1 ♂ (MZLU); UVA PROV.: Inginiyagala, Resthouse at light, 12.II.70, ExpG # 63, 1 ♂ (MHNG); Amp. Dist., Inginiyagala, black light trap, 7-8.IX.75, D. M. Davies, S. Karunaratne, D. W. Balasooriya, 2 ♂ (NMNH, MHNG); SOUTHERN PROV.: Gal. Dist., Udugama, Kanneliya Jungle, 400 ft, 6-12.X.73, at black light, K. V. Krombein, P. B. Karunaratne, P. Fernando, J. Ferdinando, 1 ♂ (NMNH); Pattuvil, 1-12.VII.83, O. Mehl, 1 ♂ (PCPH); SRI LANKA: Ceylon, Coll. Cl. Müller, 8 ♂ (ZSMC).

Description. Length 1.90-1.95 mm. Punctuation almost throughout very fine and dense, that on and posterior to antennal tubercles usually more dense and less fine than on remainder of body, on elytra still finer than on pronotum and abdomen. Pubescence short, particular long setae absent. Head with median vertexal carina low, extending from frontal sulcus to neck. Vertexal foveae in impressions. Frontal sulcus inverted V-shaped, open. Antennae short; pedicel slightly longer than segment 3; segments 4, 6 and 8 each slightly longer than wide; segment 7 about 1.2 times as long as wide. Pronotum with median sulcus deep and long, not or slightly narrowed anteriorly, extending up to anterior eighth or ninth of pronotal disc. Elytra with discal stria throughout deep and delimited by carina, extending about up to apical ninth. Discal carinae of abdominal tergite 1 almost as long as one third of tergal length, separated by about one fourth to one third of tergal width.

Male characters. Metasternum with sparse and short pubescence, deep and elongate mesal impression. Mesotrochanters with acute, curved denticle at base of mesal side. Mesotibiae with oblique, fairly robust apical denticle. Metatibiae abruptly widened in apical two third, with flattened mesal side; apical half of outer side deeply impressed, with mesal pores (Figs 196, 197). Abdominal tergites and sternites lacking obvious sexual characters. Aedeagus (Fig. 205) with dorsal process of median lobe hardly narrowed apically, with apical margin obliquely truncate and short, subapical lamina at right side. Articular process inserted at left side, strongly arcuate, gradually narrowed, separated in to two rods.

Comments. This species my be easily separated from its congeners by the widened metatibiae and lack of tergal excavation in male.

Batrisiella remyi Jeannel Fig. 206

Batrisiella remyi Jeannel, 1961: 439.

Type material. Jeannel (1961) stated "Type: Hatton (Mus. Paris)" but mentioned 1 ♂ and 1 ♀ from Hatton, collected by Rémy on 27.VIII.59. Implicitly, but not explicitly, the male was designated as holotype. Other specimens mentioned by Jeannel are 1 ♂ and 1 ♀ from Dikoya and 1 ♂ from Colombo. We have examined the ♂ from Hatton, labelled "456. Hatten 27.8.59. Pselaph. (hand-written)/1/Arthromelus Remyi n" (hand-written by Jeannel) (MNHN) and the aedeagus of the specimen from Colombo (NHML).

Additional material. SRI LANKA: UVA PROV.: Haputale, 1350m, 23.I.70, ExpG # 19, 10 ♂, 19 ♀, (MHNG, PCSK); Haputale, 1500m, 17.I.65, R. Mussard, 1 ♀ (MHNG); Stream 2 mls NW Haldummulla, 3600ft, 2.III.62, ExpL # 111, 1 ♂ (MZLU).

Description. Length 2.15-2.20 mm. Punctation dense and very fine on most of body and appendages. Frons and most of vertex with coarse, very dense, partly confluent punctation. Punctation on narrowed, apical portion of femora much denser than that on remainder of femora. Pubescence fairly short, head, pronotum and abdomen with several particularly long setae. Head with median vertexal carina fairly high, extending from frontal sulcus to plan of vertexal foveae. Vertexal foveae not in impressions. Frontal sulcus weakly arcuate. Antennae long; pedicel slightly longer than segment 3; segments 4, 6 and 8 each much longer than wide; segment 7 about twice as long as wide. Pronotum with median sulcus deep and long, not narrowed anteriorly, extending up to anterior eighth of disc. Elytra with discal stria very deep, delimited by carina, extending about to apical fourth of discal length. Discal carinae of abdominal tergite 1 short, usually exposed, about as long as one sixth of tergal length, separated by half or slightly more than half of tergal width.

Male characters. Median part of metasternum impressed, with deep, elongate, medio-apical fovea. Metasternal pubescence consisting of dense, recumbent, shorter and longer setae. Mesotrochanters with acute denticle in middle of mesal side. Mesotibiae with long, flat, apical denticle, exceeding twice tibial width. Metafemora curved apically. Abdominal tergite 1 with excavated sexual patch wider than long, about as wide as half of tergal width and as long as two third of maximal tergal length; with contours not clearly delimited, except in middle of anterior and posterior margins. Middle portion with two deeply impressed areas; anterior impressed area circular, with raised anterior margin and centre of posterior margin, posterior impressed area semicircular, with anterior margin raised. Anterior impression with low central tubercle bearing two erect, slightly diverging setal tufts; posterior impression with high tubercle pubescent at tip and bearing horizontal setae araising from its anterior edge. Middle part of sternite 1 raised to form transverse ridge strongly projected at edges ventrally, to form pair of large, horn-like processes. Following sternites slightly impressed in middle. Aedeagus (Fig. 206) with dorsal process of median lobe hardly very wide, with apical margin oblique and slightly sinuate, minute point at left apical angle, lobed at right apical edge. Articular process inserted at left side, robust, angulate in middle, gradually narrowed posterior to middle, with two or three slender, acute apophysis and strongly narrowed apex.

Comments. This species may be distinguished from its congeners, *B. retusa* excepted, having long antennae and wide tergal excavation in male, by the male sternite 1 bearing a transverse ridge. It differs notably from *B. retusa* by the long metatibial denticle in male.

Batrisiella retusa sp.n. Fig. 207

Holotype ♂: Sri Lanka: Central Prov.: Madulkete, 1000m, 27.I.64, R. Mussard (MHNG).

Paratypes: Sri Lanka: Central Prov.: same data as holotype, 1 ♂ (MHNG); Madulkete, 30.I.64, R. Mussard, 1 ♂, 1 ♀ (MHNG).

Description. Length 2.25 mm. Very similar to *B. remyi* but differs by the head with comparatively coarse punctation limited on to frontoclypeus, antennal tubercles and, eventually, minute areas posterior to antennal tubercles. Discal carinae of tergite 1 shorter, about as long as one tenth of tergite. Male sexual characters diagnostic.

Male with profemora slightly, mesofemora strongly swollen. Mesotibiae with robust, flattened, apical denticle about as long as tibial wide. Tergite 1 with transverse carina separating anterior and posterior impression of sexual excavation. Transverse ridge of abdominal sternite 1 higher and more robust than in *B. remyi*, less raised at lateral edge, with posterior side vertical, bearing rows of horizontal setae. Aedeagus (Fig. 207) with dorsal process of median lobe strongly narrowed apically, apical margin sinuate, angulate at left edge, prominent at right edge. Articular process inserted at left side, robust, arcuate, widened at apex, and with horn-like apical apophysis.

Comments. See comments under *B. remyi*.

Batrisiella saucia (Raffray) Figs 192, 193, 208

Batrisodes saucius Raffray, 1901: 27
Batrisocenus saucius; Raffray, 1908: 172.
Batrisiella saucia; Jeannel, 1961: 438.

Type material. Lectotype, implicitly designated by Jeannel (1961) labelled: Ceylon Horn/Trincomalee/TYPE (red)/Muséum Paris 1917 coll. A. Raffray/B.saucius A. Raffray det./Cratnodes saucius Raffr. (handwritten by Jeannel)/ Batrisiella saucia (Raffray) det. Löbl & Kurbatov (MNHN).

Additional material. SRI LANKA: NORTH CENTRAL PROV.: Polonnaruwa, 150m, 14.I.65, R. Mussard, 1 ♂ (MHNG); Polonnaruwa, 25.IV.73, at light, M. Tronquet, 1 ♂ (MHNG); Anu. Dist., Irrigation bungalow Padaviya, 180ft, 27.II.-9.III.70, D. R. Davis & W. Rowe, 7 ♂ (NMNH, MHNG); Anu. Dist., Padaviya, 180ft, 2-8.XI.70, O. S. Flint Jr., 5 ♂ (NMNH); Habarana, 7-8.II.62, at light, ExpL # 55, 1 ♂ (MZLU); Wilpattu N. P., Maradan Maduwa, 23 mls NW Anuradhapura, 2.II.62, at light, ExpL # 48, 2 ♂ (MZLU, MHNG); Anu. Dist., Wildlife Soc. Bulgalow, Hunuwilagama, Wilpattu, 200ft, 10-19.III.70, D. R. Davis & W. Rowe, 54 ♂ (NMNH, MHNG, PCSK); Hunuwilagama near Wilpattu, 200 ft, black light, 28.X-3.XI.76, G. F. Hevel, R. E. Dietz, S. Karunaratne, D. W. Balasooriya, 2 ♂ (NMNH, MHNG); Sigiriya, 26.III.73, M. Tronquet, 2 ♂ (MHNG); CENTRAL PROV.: Bad. Dist., 5mi E Mahiyangana, Hasalaka, 200ft, 16.XI.74, C. Gans, P. Fernando, S. Farock, 16 ♂ (NMNH, MHNG); Ban. Dist., 5 mls E Mahiyangana, 30.III.-9.IV.71, blacklight at Hasalaka Irrigation Bulgalow, P. & P. Spangler, 11 ♂ (NMNH, MHNG); Kan. Dist., Madugoda ca 2600ft, 1.IV.73, at black light, Baumann & Cross, 1 ♂ (NMNH); UVA PROV.: Diyaluma Falls, ca 450m, 25.I.70, ExpG # 26, 1 ♂ (MHNG); SABARAGAMUWA PROV.: Rat. Dist., Uggalkaltota 350 ft, Irrigation bulgalow, 31.I.-8.II.70, D. R. Davis & W. Rowe, 21 ♂ (NMNH, MHNG); WESTERN PROV.: Yakkala, 18 mls NE Colombo, 14.I.62, at light, ExpL # 10, 1 ♂ (MZLU); SOUTHERN PROV.: Tissamaharama, 23.I.70, Resthouse at light, ExpG # 22, 1 ♂ (MHNG).

Description. Length 1.65-1.75 mm. Punctation dense and very fine on most of body and appendages. Antennal tubercles, lateral areas posterior to antennal tubercles and frontoclypeus with punctation fairly coarse and denser than on remaining surface. Pubescence short, particularly long setae absent. Head with median vertexal carina low, extending from frontal sulcus to plan of vertexal foveae. Vertexal foveae in impressions. Frontal sulcus moderately arcuate. Antennae short; pedicel about as long as segment 3 and half of segment 4 combined; segments 4, 6 and 8 each slightly longer than wide; segment 7 about 1.4 times as long as wide. Pronotum with median sulcus deep and long, not or hardly narrowed anteriorly, extending up to anterior fourth or fifth of disc. Elytra with discal stria deep, delimited by carina, extended about to apical sixth of elytral length. Discal carinae of abdominal tergite 1 short, usually exposed, about as long as one sixth of tergal length, separated by slightly less than half of tergal width. Abdominal sternite 1 with basomedian ridge flat, about as long as one third of mesal length of sternite.

Male characters. Metasternum with large, foveiform, medio-apical impression; median metasternal area near mesocoxae flattened. Metasternal pubescence inconspicuous, very short, dense, recumbent. Mesal side of mesotrochanters with oval projection bearing short pubescence. Mesotibiae with acute apical denticle. Abdominal tergite 1 (Figs 192, 193) with excavated sexual patch wider than long, about as wide half of tergal width and as long as third of maximal tergal length. Excavation well delimited anteriorly, with vertical anterior wall, not clearly delimited posteriorly and laterally. Bottom of excavation almost horizontal, slightly raised toward mid-line, with minute tubercle bearing two setal tuft and one small foveiform impression at each side of tubercle. Foveiform impressions sharply delimited anteriorly. Setal tufts curved and orientated latero-anteriorly. Anterior wall of excavation with mesal ridge bearing setae orientated posteriorly. Small, flat, oblique areas with patch of conspicuously short pubescence at each side of excavation. Abdominal sternites without obvious sexual characters. Aedeagus (Fig. 208) with dorsal process of median lobe narrow, angulate subapically, with apical portion expanded, almost anchor-like. Articular process inserted at left side, slender, sinuate, gradually narrowed apically, with acute tip.

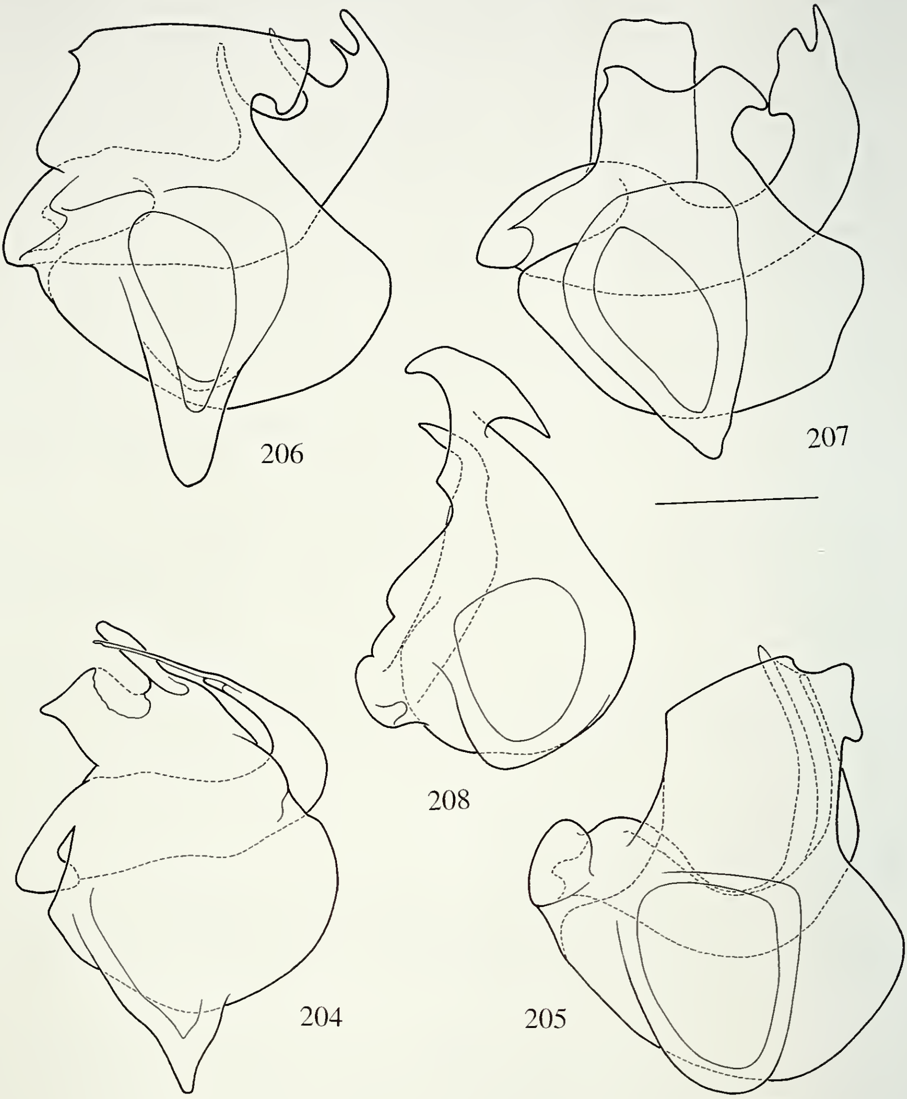
Comments. This species may be distinguished by its short antennae in combination with the male tergal excavation not well delimited laterally, slightly raised mesally and with two foveiform impressions at bottom.

Batrisiella shinghalensis (Raffray) Fig. 211

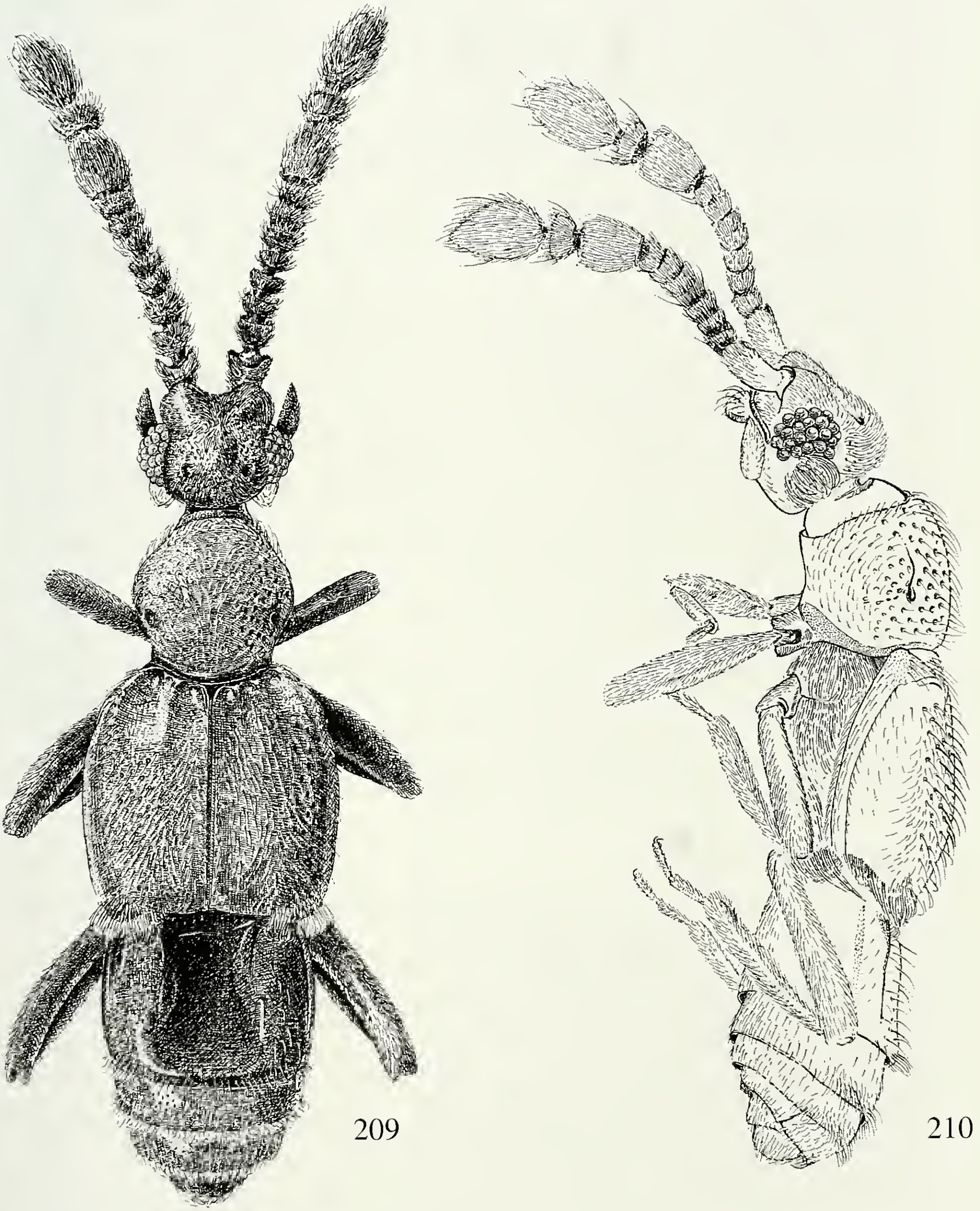
Batrisodes shinghalensis Raffray, 1901: 27.
Batrisocenus singhalensis Raffray, 1908: 172.
Batrisiella singhalensis; Jeannel, 1961: 438.

Type material. Lectotype, implicitly designated by Jeannel (1961), labelled: Bandarawella/ Horn/ Muséum Paris 1917 coll. A. Raffray/TYPE (red) /B.singhalensis A.Raffray det./ Cratnodes singalensis (hand-written by Jeannel)/ Batrisiella shinghalensis (Raffray) det. Löbl & Kurbatov (MNHN).

Description. Length 1.9 mm. Punctation dense and coarse on and posterior to antennal tubercles, very fine and fairly dense on remainder of head, and on pronotum, elytra and femora. Basal portion of abdominal tergite 1 with punctation similar to that of elytra, remainder of tergal surface with fairly coarse and very dense punctation. Pubescence apparently fairly long (strongly damaged) on body, short on appendages. Presence of particular long setae unknown. Head with median vertexal carina fairly high, extending from neck to frontal sulcus. Vertexal foveae in impressions. Frontal sulcus broadly V-shaped. Antennae short; pedicel about as long as segment 3 and half of segment 4 combined; segments 4, 6 and 8 each slightly longer than wide; segment 7 about 1.4 times as long as wide. Pronotum with median sulcus evenly deep and narrow, reaching anterior to seventh of disc. Elytra with discal stria throughout well delimited, extending about up to apical fifth. Discal carinae of abdominal tergite 1



FIGS 204 to 208: *Batrisiella* Raffray, aedeagi in ventral view
204: *B. lewisi* Jeannel; 205: *B. puberula* Jeannel; 206: *B. remyi* Jeannel; 207: *B. retusa* sp. n.; 208: *B. saucia* (Raffray). Scale bar = 0.1 mm.



FIGS 209 and 210
Baceysus preciosus gen. n., sp. n.

about as long as one fifth of tergal length, separated at base by slightly less than half of tergal width.

Male characters. Middle part of metasternum slightly convex; with medio-apical, deep, foveiform impression. Metasternal pubescence fairly long, sparse, inconspicuous. Mesotrochanters with fairly large, curved, blunt denticle araising from middle of mesal edge. Mesotibiae with minute, flat apical denticle. Abdominal tergite 1 with excavated sexual patch as wide as long, about as wide as one third of tergite and almost as long as half of maximal tergal length. Excavation deep, well delimited anteriorly and laterally by sharp margin, situated on obliquely inclined posterior part of tergite. Anterior, vertical wall of excavation with mesal ridge gradually raised upward to form a small tubercle bearing few very short setae. Bottom of excavation with large, medio-apical tubercle surrounded by high, sinuate carina; centre of carina bearing short setal tuft orientated anteriorly. Medio-apical tubercle with short pubescence. Tergal disc impressed between excavation and lateral margins and with patch of very dense punctation and very short pubescence close to lateral margins. Abdominal sternites lacking obvious sexual characters. Aedeagus (Fig. 211) with dorsal process of median lobe very short, fairly narrow, truncate obliquely, bearing two narrow apophysis at right side. One apophysis short, curved proximally, second apophysis slightly arcuate, orientated posteriorly, bearing small membranous lobe at apex. Articular process inserted at left side, robust at base, gradually narrowed apically, arcuate, apparently divided in two close rods, with tip extending posterior to median lobe.

Comments. Bandarawela is a locality in the Uva province close to places from which extensive collections were gathered. It is therefore surprising that subsequent workers have not found this species. The species is characterized by the short antennae in combination with the male tergite 1 impressed laterally of the excavation and the latter bearing a medio-apical tubercle.

Batrisiella srilankana sp. n. Figs 183, 194, 195, 212

Holotype ♂: Sri Lanka: Eastern Prov.: Maha Oya, 11.II.70, on sandy banks and under vegetation along stream, ExpG # 60 (MHNG).

Paratypes: Sri Lanka: Northern Prov.: forest 4-5 mls NW Mullaittivu, 6.II.70, ExpG # 50b, 3 ♂, 6 ♀ (MHNG); Western Prov.: Col. Dist., Beyagama, sea level, 20-21.VII.73, G. Ekis, 1 ♂ (MHNG); Yakkala, 18 mls NE Colombo, 14.I.62, at light, ExpL # 10, 1 ♂ (MZLU); Eastern Prov.: Maha Oya, 11.II.70, on sandy banks and under vegetation along stream, ExpG # 60, 5 ♂, 11 ♀ (MHNG, PCSK); Central Prov.: Kan. Dist., 5 mls NW Mahiyangana, Hasalaka Irrigation Bungalow, 30.III.-9.IV.71, black light, P. & P. Spangler, 1 ♂ (NMNH); Sabaragamuwa Prov.: Rat. Dist., Gilimale Lumper Mill, 115 ft, 7.VIII.73, G. Ekis, 1 ♂ (NMNH); Uva Prov., Amp. Dist., Inginiyagala, 250ft, black light, 21-24.XI.76, G. F. Hevel, R. E. Dietz, S. Karunaratne, D. W. Balasooriya, 1 ♂ (NMNH); Inginiyagala, at light, 12.II.70, ExpG # 63b, 1 ♂ (MHNG).

Description. Length 1.60-1.65 mm. Punctation very fine and fairly dense on head, pronotum, elytra and femora. Basal portion of abdominal tergite 1 with punctation similar to that of elytra, remainder of tergal surface with fairly coarse and very dense punctation. Pubescence on body and appendages very short, particular long setae absent. Head with median vertexal carina well developed, extending from neck to frontal sulcus. Vertexal foveae in impressions. Frontal sulcus broadly V-shaped. Antennae short; pedicel about as long as segment 3 and half of segment 4 combined; segments 4, 6 and 8 each slightly longer than wide; segment 7 about 1.4 times as long as wide. Pronotum with median sulcus evenly deep and narrow, reaching anteriorly to seventh or eighth of disc. Elytra with discal stria throughout well delimited, extending about up to apical fourth. Discal carinae of abdominal tergite 1 distinct, almost as long as one fifth to one fourth of tergal length, separated at base by about third of tergal width.

Male characters. Middle part of metasternum flattened, with mesal impression deep, elongate and widened posteriorly. Metasternal pubescence dense, short and inconspicuous. Mesotrochanters with acute mesal margin and small, pubescent denticle at basomesal angle. Mesotibiae with small apical denticle. Abdominal tergite 1 (Figs 194, 195) with excavated sexual patch wider than long, about as wide as one third of tergal width and as long as one third of maximal tergal length. Excavation deep, well delimited anteriorly and laterally by sharp margin, bearing below meso-anterior margin small, vertical ridge with minute setal tuft orientated posteriorly, and at meso-apical margin large, pubescent protuberance delimited by semicircular carina. Tergal disc not impressed laterally of excavation, patch with conspicuously dense punctation at each side of excavation. Abdominal sternites lacking obvious sexual characters. Aedeagus (Fig. 212) with dorsal process of median lobe very short, fairly narrow, truncate obliquely, with narrow subapical notch producing small lobe at right side, and with arcuate apophysis araising from dorsal side. Articular process inserted at left side, robust, strongly curved in middle, moderately narrowed from middle to apex, consisting of three joined rods near tip.

Comments. This species is similar to *B. favea* from which it may be easily distinguished by the close discal carinae of the tergite 1 and lack of impressions between the tergal base and the excavation.

Baceysus gen. n. Figs 209, 210

Type species *Baceysus pretiosus* sp. n. Gender: masculine.
Etymology: the name is an arbitrary combination of letters.

Description. Habitus as Figs 209 and 210. Length about 2 mm. Head, pronotum and elytra about in same plan, abdomen distinctly below plan of elytra.

Head constricted in middle, with rounded angles. Antennal insertions close. Frontoclypeus very narrow, vertical, overlapped by frontal lobe. Antennal tubercles distinct, lateral frontal foveae absent. Vertex with pair of foveae, lacking sulci. Occipital margin rounded in upper part, vertical below. Eyes very large, occupying most of lateral surface of head, deeply notched posteriorly, with large facets. Ocular-mandibular carinae angulate below eye, oblique along anterior eye margin. Venter of head flat, gular foveae in deep basomedian impression, basal margin abruptly constricted to form vertical wall below neck.

Antennae fairly long; scape short, thickened apically, with deep dorso-apical notch, apical angles not expanded and lacking glandular orifices. Segments 2 to 8 symmetrical. Pedicel small, conspicuously short, about twice as wide as long.

Segments 3 to 8 very short, wider than long. Club 3-segmented, large. Maxillary palpi short; segment 3 very short, much wider than long, narrowed mesally; segment 4 with broad basis.

Pronotum slightly longer than wide, widest in middle, disc slightly convex dorsally, anterior margin broadly rounded. Sulci, carinae, tubercles, spines and foveae lacking, except for one pair of outer antebasal foveae. Paranotal sulci absent.

Elytra comparatively long, flattened, not raised above level of pronotum, each with slightly arcuate lateral margins, strongly inclined near apical margins, basal ridge, four basal foveae, one subhumeral fovea and lateral carina. Lateral carina curved upward at subhumeral fovea, arcuate and extended posteriorly. Sutural striae lacking. Apical margins each bearing trichome.

Prosternum flat, short, with lateral foveae nude. Metasternum with median impression, metaxocal process V-shaped, notched a middle. Lateral metasternal foveae pubescent, close, larger than interval between them.

Legs fairly long. Procoxae comparatively short and cylindrical. Femora equally slender, subcylindrical. Tibiae gradually, slightly thickened toward apex. Tarsi slender, segments 2 and 3 about equally long.

Abdomen with five tergites visible in dorsal view, narrower and longer than elytra. Tergite 1 lying notably below level of elytral disc, much longer than following tergite, widest in middle, slightly narrowed toward base, with large, nude mediobasal foveae. Tergites 2 and 3 almost horizontal, with short inner marginal carinae. Tergite 4 inclined, with small, digitiform process between marginal carina and basolateral fovea. Tergite 5 (Fig. 214) with smooth central area. Sternite 1 with eight pubescent basal foveae. Outer basal foveae large, in basolateral impression, remaining six foveae much smaller than lateral foveae, equally large, grouped to pairs. Intercoxal process prominent, with mesal ridge, separated by narrow carina. Following sternites lacking foveae. Tip of sternite 6 (morphological sternite 8) exposed, forming opercle (Fig. 215). Aedeagus reduces to simple, plate like structure, with large ventral membrane of basal bulb.

Comments. Baceysus resembles the monospecific *Cylindroma* Raffray, with *C. excavata* Raffray from Sumatra, and to a lower degree, *Oxyomera* Raffray, with two species from Singapore and Sumatra. It shares notably with them the shape of the body, the very large eyes, the vertex lacking sulcus, the pronotum with a single pair of antebasal foveae, the comparatively long elytra, the elongate and impressed abdominal tergite 1, and the presence of abdominal trichomes. It may be easily separated from *Cylindroma* and *Oxyomera* by the short antennal segments 3 to 8 (moniliform in *Cylindroma* and *Oxyomera*), the club segments strongly enlarged, the vertex constricted, the pronotum lacking sulci, the foveal pattern of elytra (*Cylindroma* and *Oxyomera* have elytra each with two basal foveae, lack the subhumeral fovea and the lateral stria), and the foveal pattern of sternite 1. *Cylindroma* lacks foveae at the base of the sternite 1, *Oxyomera* has the sternite 1 with only one pair of basolateral foveae. In addition, *Oxyomera* may by easily distinguished from *Baceysus* and *Cylindroma* by the pronotum having discal and lateral spines, and the abdominal tergite 1 possessing a median ridge.

Baceysus pretiosus sp. n. Figs 209, 210, 213 – 216

Holotype ♂: Sri Lanka: Central Prov.: Kan. Dist., 5 mls NW Mahiyangana, black light at Hasalaka Irrigation Bungalow, 30.III.-9.IV.1971, P. & J. Spangler (NMNH).

Description. Length 1.95 mm. Body moderately convex, narrow. Head with punctation very dense and mostly fairly coarse, additional, scattered fine punctures on intervals between coarse puncture. Pubescence on dorsal and ventral side very short and recumbent, postgenae with conspicuous, dense bunch of comparatively long, white setae orientated apically and curved ventrally. Head slightly longer than wide, eyes not included in width (ratio 22/20), distinctly shorter and narrower than pronotum, width with eyes about as that of pronotum. Vertex swollen medially, raised slightly above level of antennal tubercles. Vertexal foveae nude, small, with posterior margins slightly anterior to level of posterior eye margins. Frontal lobe as wide as vertex, impressed medially, with anterior margin bisinuate in dorsal view. Eyes with 20 facets. Median neck ridge not expanding on vertex. Antennal segments 3 to 6 even, each about twice as wide as long. Segments 7 hardly larger than preceding segments; segment 8 about as segment 3 to 6. Segment 9 strongly swollen, cylindrical, as long as combined length of segments 6 to 8, slightly longer than wide; segment 10 much shorter and slightly narrower than segment 9, much wider than long, segment 11 slightly longer than segments 9 and 10 combined, distinctly broader than segment 9. Pronotum 0.43 mm long, 0.40 mm wide, with base slightly broader than anterior margin. Outer antebasal foveae situated just anterior to basal third of lateral length. Punctation coarse and dense and almost even, including on lateral, inclined sides. Fine punctures on intervals absent. Base narrowly impressed, impunctate, with conspicuous, striate microsculpture reaching up to procoxal cavities; microsculptured area becoming wider on inclined sides toward procoxae. Pubescence mostly longer than that of vertex, recumbent along anterior margin, semi-erect on most of disc, almost erect and much longer on mediobasal area of disc. Elytra with basal foveae grouped two by two in common, smooth impressions extended apically to level of posterior edge of humeral protuberances. Disc slightly swollen between smooth impressions. Humeral margin oblique. Humeral protuberances distinct, with sharply defined posterior margins. Lateral sulci extended anteriorly beyond subhumeral fovea and curved dorso-apically to meet humeral protuberances, and sharply delimiting latter from outer side. Disc slightly raised along suture. Outer half of apical margins prominent and bearing large, dense trichomes. Punctation consisting of coarse and very fine punctures. Coarse punctures slightly smaller and less dense than those of pronotum, absent from inclined lateral sides. Fine punctures on intervals between coarse puncture. Pubescence mostly short and recumbent, additional long, erect setae forming longitudinal rows along suture and on elytral disc. Apical margins truncate between suture and outer half, prominent in outer half and bearing large, dense trichome; outer margins with lateral trichomes oblique. Metasternum moderately convex, with median sulcus extending from apex to mid-length. Metasternal pubescence very short and recumbent, becoming long toward outer posterior angles. Legs with dense, short pubescence, lacking longer, raised setae. Profemora straight, mesofemora and metafemora slightly curved. Abdomen with tergite 1 impressed in median portion. Impression as wide as 3/8 of tergite, abrupt and very deep at base, with mediobasal foveae at anterior, vertical wall. Impression becoming gradually less deep toward apical margin of tergite, ending close before apical margin. Base at both sides of impression bearing large, very compact trichome with setae orientated anteriodorsally. Inner marginal carinae low, reaching apical forth of tergite. Punctation very fine and sparse laterally impression, extremely fine and very scattered in impression, dense and less fine near apical margin of tergite. Pubescence mostly short and recumbent, with scattered, long, erect setae and oblique to erect setae along apical margin. Tergites 2 to 4 with punctation consisting of fairly coarse and very fine punctures, larger punctures finer than those on elytra, more coarse than those on tergite 1. Pubescence on tergites 2 to 4 mostly short and recumbent, but fairly long and partly oblique along apical margins. Pubescence on mesal portions of sternites as that on metasternum. Large lateral parts of sternite 1 lacking pubescence.

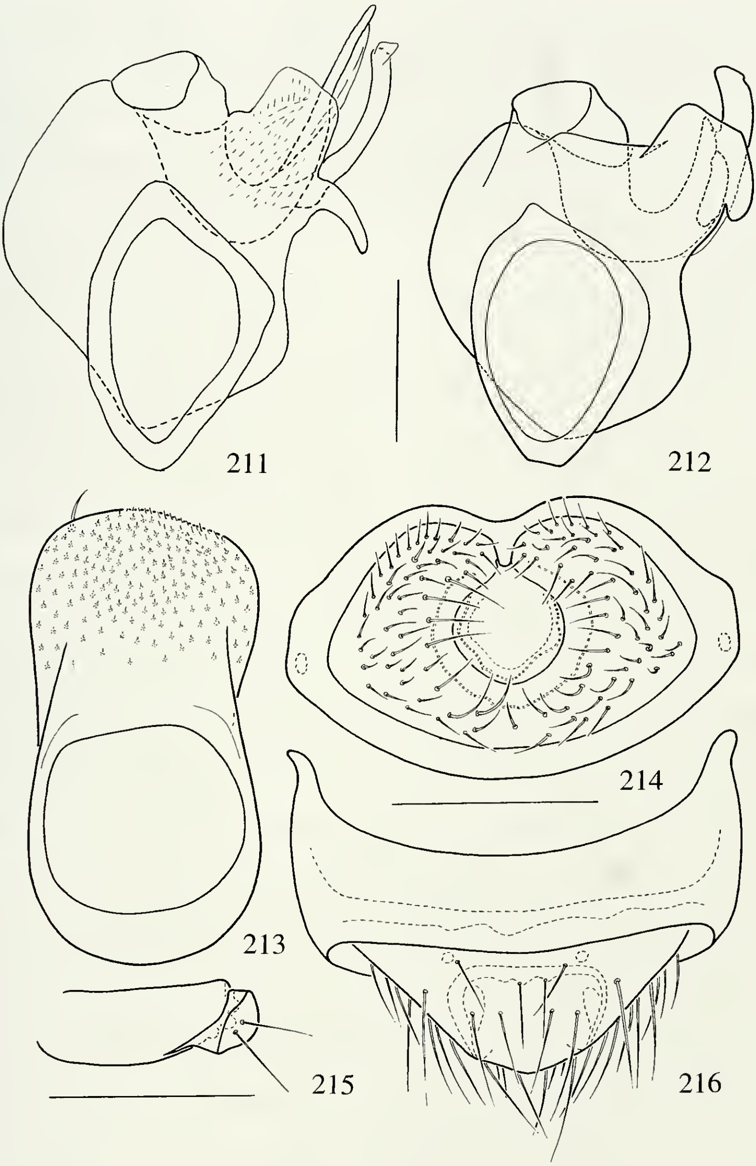
Male characters. Antennal club segments strongly enlarged. Mesocoxae with ventral margins carinate. Aedeagus (Fig. 213) wide and flat, moderately widened apically, with arcuate apical margin, single apical seta and large number microsensilla.

Habitat. Unknown, the examined specimen was attracted by light. The trichomes indicates myrmecophily.

Comments. *Baceysus pretiosus* is decidedly one of the more unusual pselaphines of Sri Lanka. The male secondary sexual characters, as quoted above, are hypothetical in absence of females.

ACKNOWLEDGEMENTS

Late Robert Mussard, a remarkable Geneva personality and enthusiastic entomologist, encouraged the senior author to study the singhalese pselaphines. He made in 1964 and 1965 two trips to Ceylon during which he collected a large number of pselaphines, all donated to the Muséum d'histoire naturelle, Geneva. Later, he partly granted the 1970 and 1972 expeditions of the Department of Entomology of the Geneva Museum to Sri Lanka and South India. Without his enthusiasm this study would not have been realised. Our thanks are also due to the curators N. Berti, Muséum National d'Histoire Naturelle, Paris, M. Baehr, Zoologische Staatssammlungen, München, M. Brendell, The National History Museum, London, M. De Meyer, Musée royal de l'Afrique centrale, Tervuren, N. B. Nikitskiy, Zoological Museum, Moscow, P. Brinck, University Lund, and K. V. Krombein and G. F. Hevel, United States National Museum, Washington who responded loan requests or submitted unidentified material from the collections in charge. Additional material was provided by G. de Rougemont, London, P. Hlaváč, Ružomberok, M. Tronquet, Marly le Roi and the late G. Benick, Lübeck. The habitus illustrations were produced by the artists Mrs. N. Lavoyer, Mr. S. Vít, both from Geneva, and Mr. A. Brinev, Moscow State Pedagogical University. We thank Jean Wüest, Geneva, for assistance with the SEM micrographs and B. Merz and P. Schwendinger, Geneva, for commenting parts of the manuscript.



FIGS 211 to 216: *Batrisiella* Raffray and *Baceysus* gen. n.

211: *Batrisiella shinghalensis* (Raffray); aedeagus in ventral view; 212: *B. srilankana* sp. n., aedeagus in ventral view; 213: *Baceysus pretiosus* gen. n. sp. nov, aedeagus; 214 and 216: dtto, male abdominal apex, in caudal (214) and ventral (216) views; 215: dtto, 6th male abdominal sternite. Scale bars = 0.1 mm.

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Nuove specie del genere *Gyrophaena* Mannerheim del Monte Kinabalu (Borneo) (Coleoptera, Staphylinidae)[1]

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New species of the genus *Gyrophaena* Mannerheim from Mount Kinabalu (Borneo) (Coleoptera, Staphylinidae). - Thirty-seven new species of the Staphylinid genus *Gyrophaena* (subfamily Aleocharinae) are described and illustrated from Mt. Kinabalu (Borneo). A key to all species of Borneo is provided.

Key-words: Coleoptera – Staphylinidae – Aleocharinae – *Gyrophaena* – taxonomy – Borneo.

INTRODUZIONE

Il genere *Gyrophaena* Mannerheim, 1831, comprende specie fungicole diffuse in tutte le regioni zoogeografiche. Finora del Borneo erano note solo tre specie: *G. bryanti* Cameron, 1945, del Monte Matang, *G. metallescens* Cameron, 1928 del fiume Tutoh e *G. borneensis* Cameron, 1943, di Sandakan. Esse sono elencate anche nel lavoro di Hammond (1984). Nessuna specie di questo genere è stata segnalata sul Monte Kinabalu, nemmeno sul lavoro di Cameron (1933) dedicato agli Stafilinidi di questo massiccio.

Le intense e ripetute ricerche in varie località del M. Kinabalu, condotte dal Dr. Aleš Smetana del "Centre for Land and Biological Resources Research" di Ottawa, del Dr. Burckhardt e del Dr. Ivan Löbl, entrambi del Museo di Storia Naturale di Ginevra, hanno permesso di raccogliere importante materiale, anche relativo al genere *Gyrophaena*. Affidatomi in esame, mi ha permesso di riconoscere 37 specie nuove per la Scienza, oggetto del presente lavoro. A questo vasto materiale ho aggiunto alcuni esemplari datomi in esame dal Dr. Volker Assing di Hannover e dal collega Guillaume de Rougemont di Londra.

Gli olotpi delle nuove specie sono conservati nel Museo di Storia Naturale di Ginevra (MHNG) e nel Museo Regionale di Scienze Naturali di Torino (MRSN). Paratipi sono conservati negli stessi Musei e in collezione Assing (Hannover).

METODO

Furono Strand (1935) e Wüstoff (1937) che per primi indicarono il corretto metodo di studio delle specie del genere *Gyrophaena*, grazie ai loro contributi alla

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[1] 163° Contributo alla conoscenza delle Aleocharinae.

Manoscritto accettato il 08.03.2001

conoscenza delle specie europee del genere. Essi posero in primo piano l'importanza, per la tassonomia, dell'osservazione dell'edeago e del sesto urotergo libero del maschio. Infatti, molti caratteri di queste due parti anatomiche informano per lo più con evidenza, sull'affinità filogenetica tra le specie. Ciò si osserva anche nelle specie del M. Kinabalu. Avendo esaminato la quasi totalità dei tipi delle specie del genere geograficamente vicine al Borneo (dallo Sri Lanka, all'India e all'Indonesia) descritte da Cameron, è ora possibile riconoscere gruppi di specie aventi origine filogenetica comune. Scopo del presente lavoro, tuttavia, non è quello di creare il cladogramma filogenetico delle specie del genere *Gyrophaena* del Borneo, ancora cosa prematura, ma quella di offrire conoscenza di materiale utile per questo scopo.

Per rendere evidenti le affinità tra le specie, anche non provenienti dal Borneo, nel presente lavoro ho dato ampio rilievo, come fecero i due autori citati, all'illustrazione dei caratteri dell'edeago e del sesto urotergo libero del maschio e della femmina. Tale figurazione non lascia dubbi sull'identificazione delle specie trattate. La descrizione dell'habitus è qui ridotta ai caratteri della microscultura, della granulosità, della punteggiatura e al colore del corpo o alla sua brillantezza, caratteri questi non riproducibili chiaramente nei disegni dati del corpo "in toto". La diversa lunghezza degli antennomeri, il rapporto lunghezza/larghezza del pronoto e delle elitre, sono quelli rilevabili nelle figure "in toto" di ciascun olotipo disegnato mediante oculare micrometrico. Gli edeagi e gli uroterghi illustrati sono stati montati in preparato microscopico con balsamo del Canadà e disegnati con reticolo oculare. Nel presente lavoro, in sostituzione delle note comparative, è data una chiave delle specie.

A conclusione dell'esame delle specie qui descritte, si percepisce la conferma che l'insularità del Borneo è stata un singolare laboratorio dell'evoluzione anche delle specie del genere *Gyrophaena*.

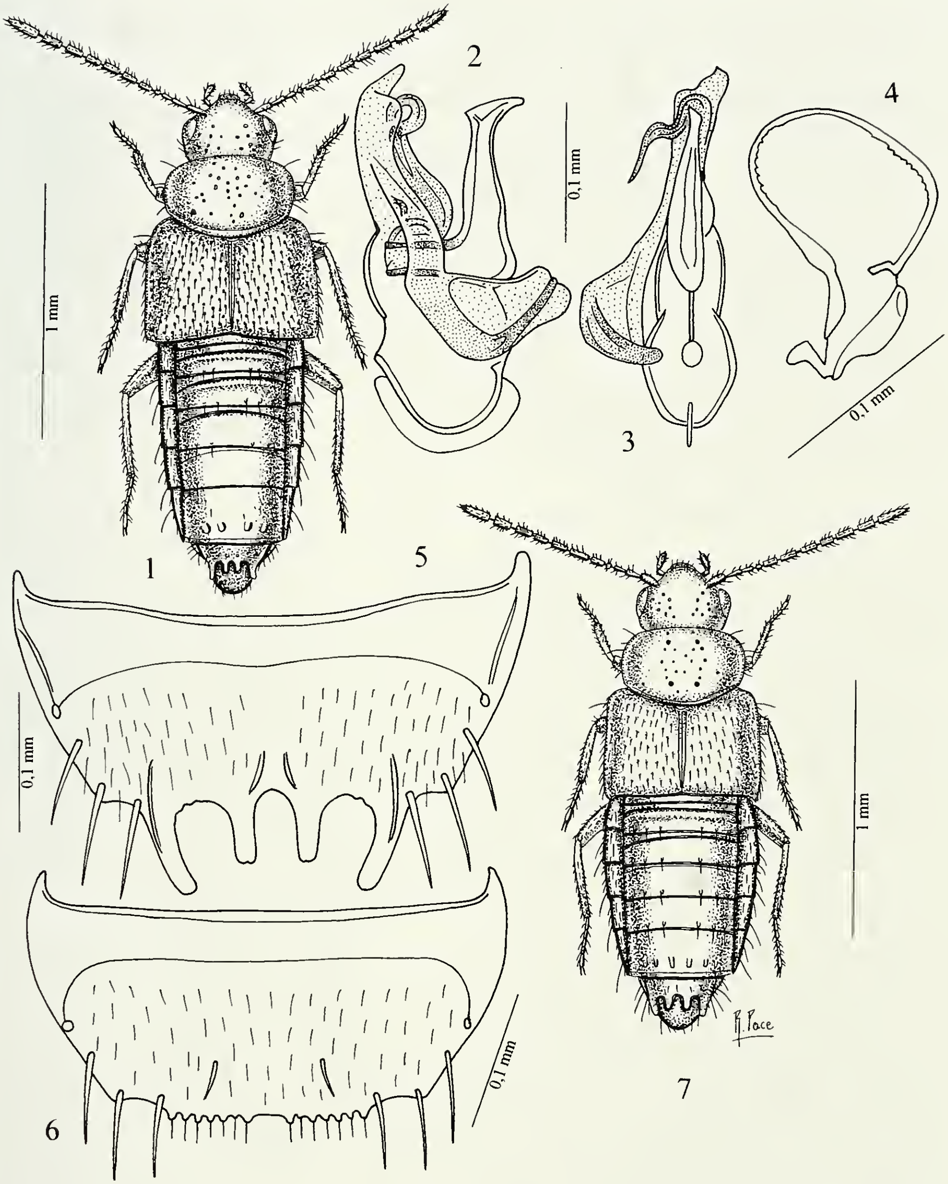
DESCRIZIONI

Gyrophaena* (*Gyrophaena*) *asymmetrica sp. n. Figg. 1-6

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu N.P., HQ Mempening trail, 1600 m, 17.V.1987, A. Smetana leg. (MHNG).

Paratypi: 3 ♀♀, stessa provenienza; 1 ♀, Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, area below Langanan Fall, 850-900 m, 14.V.1987, A. Smetana leg.; 1 ♀, Borneo, Sabah, Mt. Kinabalu N.P., HQ at Liwagu Rv., 1500 m, 25.IV.1987, A. Smetana leg.; 19 es., Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, Langanan Falls, 900-950 m, 12.V.1987, Burckhardt & Löbl leg.; 4 es. Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, Langanan River, 850 m, 14.V.1987, Burckhardt & Löbl leg.; 1 ♂ e 4 es. Borneo, Sabah, Mt. Kinabalu N.P., HQ Silau-Silau tr., 1550 m, 2.IX.1988, A. Smetana leg.; 4 ♀♀, Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, 500 m, 11.V.1987, Burckhardt & Löbl leg.

DESCRIZIONE. Lungh. 1,8 mm. Corpo lucido e bruno-rossiccio, con elitre brune e addome rossiccio con uriti liberi terzo e quarto bruni; antenne brune con i tre antennomeri basali di un giallo sporco; zampe gialle. La reticolazione della superficie del capo è assente, quella del pronoto è superficiale e quella delle elitre e dell'addome è distinta. La punteggiatura delle elitre è distinta. Edeago figg. 2-3, spermateca fig. 4, sesto urotergo libero del ♂ fig. 5, sesto urotergo libero della ♀ fig. 6.



FIGG. 1-7

Habitus, edeago in visione laterale e ventrale, spermateca, sesto urotergo libero del ♂ (5) e della ♀ (6). 1-6: *Gyrophaena (Gyrophaena) asymmetrica* sp. n.; 7: *Gyrophaena (Gyrophaena) incredibilis* sp. n.

Etimologia. La base di un paramero dell'edeago è strettamente legata ai pezzi copulatori interni, pertanto risulta un edeago asimmetrico che dà il nome alla specie.

Gyrophaena (Gyrophaena) incredibilis sp. n. Figg. 7-11

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, Langanan Fall, 900-950 m, 12.V.1987, Burckhardt & Löbl leg. (MHNG).

Paratypi: 12 es., stessa provenienza.

Descrizione. Lungh. 1,7 mm. Corpo lucido e bruno, con addome giallo-rossiccio avente gli uriti liberi terzo e quarto rossicci; antenne bruno-rossicce con i tre antennomeri basali gialli; zampe gialle. La reticolazione del capo e delle elitre è superficiale, quella del pronoto è molto svanita e quella dell'addome è distinta, con squame confuse alla base di ciascun urotergo. La punteggiatura delle elitre è poco profonda. Edeago figg. 8-9, spermateca fig. 10, sesto urotergo libero del ♂ fig. 11.

Etimologia. La lama sternale dell'edeago, a forma di punta di "apriscatole", ha suggerito il nome di "incredibile" alla nuova specie.

Gyrophaena (Gyrophaena) involuta sp. n. Figg. 12-16

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, Langanan Falls, 900-950 m, 12.V.1987, Burckhardt & Löbl leg. (MHNG).

Paratypi: 8 es., stessa provenienza; 1♂ e 1 ♀, Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, Langanan River, 850 m, 14.V.1987, Burckhardt & Löbl leg.

Descrizione. Lungh. 1,9 mm. Corpo lucido e bruno con addome bruno-rossiccio; antenne giallo-rossicce con i tre antennomeri basali gialli; zampe giallo-rossicce. La reticolazione del capo è superficiale, quella del pronoto è assente, quella delle elitre è estremamente svanita e quella dell'addome è distinta, composta di maglie trasverse. La punteggiatura delle elitre è distinta. Edeago figg. 14-15, spermateca fig. 16, sesto urotergo libero del ♂ fig. 13.

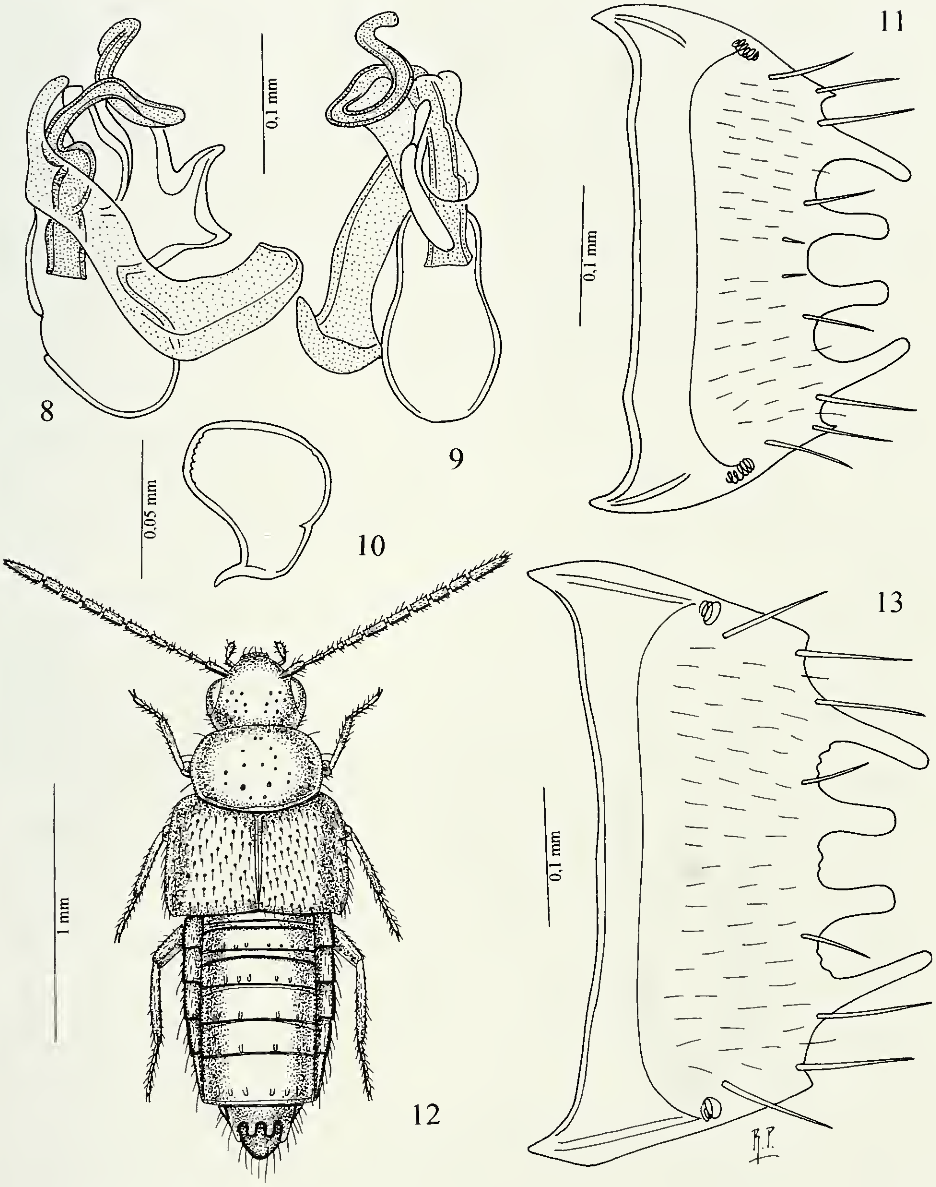
Etimologia. La lama sternale dell'edeago, intrecciata con i pezzi copulatori dell'edeago, ha dato l'idea del nome della specie che significa "aggrovigliata".

Gyrophaena (Gyrophaena) insulsitatis sp. n. Figg. 17-22

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu N.P., HQ Silau-Silau tr., 1550 m, 2.IX.1988, A. Smetana leg. (MHNG).

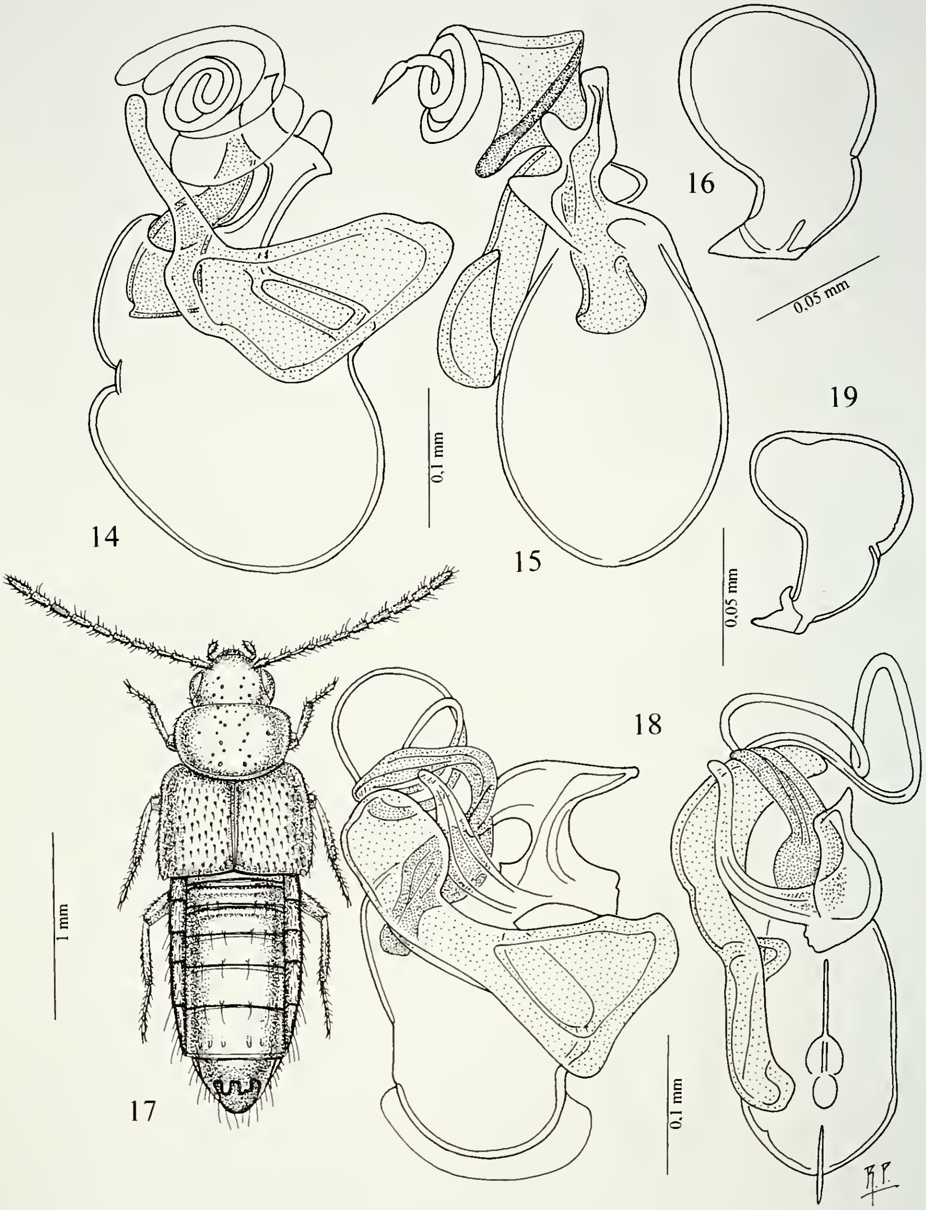
Paratypi: 1 ♂, Borneo, Sabah, Mt. Kinabalu N.P., HQ at Liwagu Rv., 1495 m, 23.V. 1987, A. Smetana leg.; 2 ♀♀, Borneo, Sabah, Mt. Kinabalu N.P., HQ at Liwagu Rv., 1500 m, 1.IX.1988, A. Smetana leg.; 1 ♀, Borneo, Sabah, Mt. Kinabalu N.P., HQ at Liwagu Rv., 1580 m, 17.V.1987, A. Smetana leg.; 2 ♂♂ e 1 ♀, Borneo, Sabah, Mt. Kinabalu N.P., HQ at Liwagu Rv., 1520 m, 11.VIII.1988, A. Smetana leg.; 1 ♂, Borneo, Sabah, Mt. Kinabalu N.P., 1430 m, 22.V.1987, Burckhardt & Löbl leg.; 1 ♂, Borneo, Sabah, Mt. Kinabalu N.P., Crocker Range, 1600 m, 18.V.1987, Burckhardt & Löbl leg.

Descrizione. Lungh. 2,4 mm. Corpo lucido e nero-bruno; antenne brune con i tre antennomeri basali gialli e i due successivi, quarto e quinto, giallo-rossicci; zampe gialle. La reticolazione del capo e del pronoto è assente, quella delle elitre e dell'addome è distinta, trasversa sull'addome. La punteggiatura delle elitre è distinta. Edeago fig. 18, spermateca figg 19 e 22, sesto urotergo libero del ♂ fig. 20, sesto urotergo libero della ♀ fig. 21.



FIGG. 8-13

Edeago in visione laterale e ventrale, spermateca, habitus e sesto urotergo libero del ♂. 8-11: *Gyrophaena (Gyrophaena) incredibilis* sp. n.; 12-13: visione laterale e ventrale, spermateca, habitus e sesto urotergo libero del ♂. 12-13: *Gyrophaena (Gyrophaena) involuta* sp. n.



FIGG. 14-19

Edeago in visione laterale e ventrale, spermateca e habitus. 14-16: *Gyrophaena (Gyrophaena) involuta* sp. n.; 17-19: *Gyrophaena (Gyrophaena) insulsitatis* sp. n.

Etimologia. La forma poco "razionale" dei pezzi copulatori e della lama sternale dell'edeago ha suggerito il nome della specie che significa "della sciocchezza".

Gyrophaena (Gyrophaena) subinsulsitatis sp. n. Figg. 23-25

Holotypus ♀, Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, area blw. Langanan Fall, 850-900 m, 14.V.1987, A. Smetana leg. (MHNG).

Descrizione. Lungh. 2,1 mm. Corpo lucido e bruno, con i due uriti basali gialli; antenne brune con i tre antennomeri basali di un giallo sporco; zampe gialle. La reticolazione della superficie del corpo è estremamente superficiale. La punteggiatura delle elitre è netta. Spermateca fig. 23, sesto urotergo libero della ♀ fig. 24.

Etimologia. Per le antenne allungate, la nuova specie, a un'osservazione superficiale, sembra *G. insulsitatis*, nuova specie sopra descritta, pertanto è chiamata "vicina a *insulsitatis*".

Gyrophaena (Gyrophaena) borneocicatricosa sp. n. Figg. 26-29

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu N.P., HQ at Liwagu Rv., 1500 m, 25.IV.1987, A. Smetana leg. (MHNG).

Paratypi: 1 ♂, stessa provenienza; 1 ♂, Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, Langanan Falls, 900-950 m, 12.V.1987, Burckhardt & Löbl leg.

Descrizione. Lungh. 1,9 mm. Corpo lucido e nero; antenne brune con i tre antennomeri basali gialli; zampe di un giallo sporco. La reticolazione del capo, del pronoto e del quinto urotergo libero addome è superficiale, quella del pronoto e degli uroterghi primo, secondo, terzo e quarto, è assente. La punteggiatura del capo è profonda. Le elitre sono coperte di granuli grossolani verso la base e verso la sutura. Edeago figg. 27-28, sesto urotergo libero del ♂ fig. 29.

Etimologia. In base alla forma dell'edeago, la nuova specie si mostra sicuramente affine a *G. cicatricosa* Motschulsky, 1857, dello Sri Lanka e dell'India (esemplari tipici esaminati). Per questo motivo prende il nome di "*cicatricosa* del Borneo".

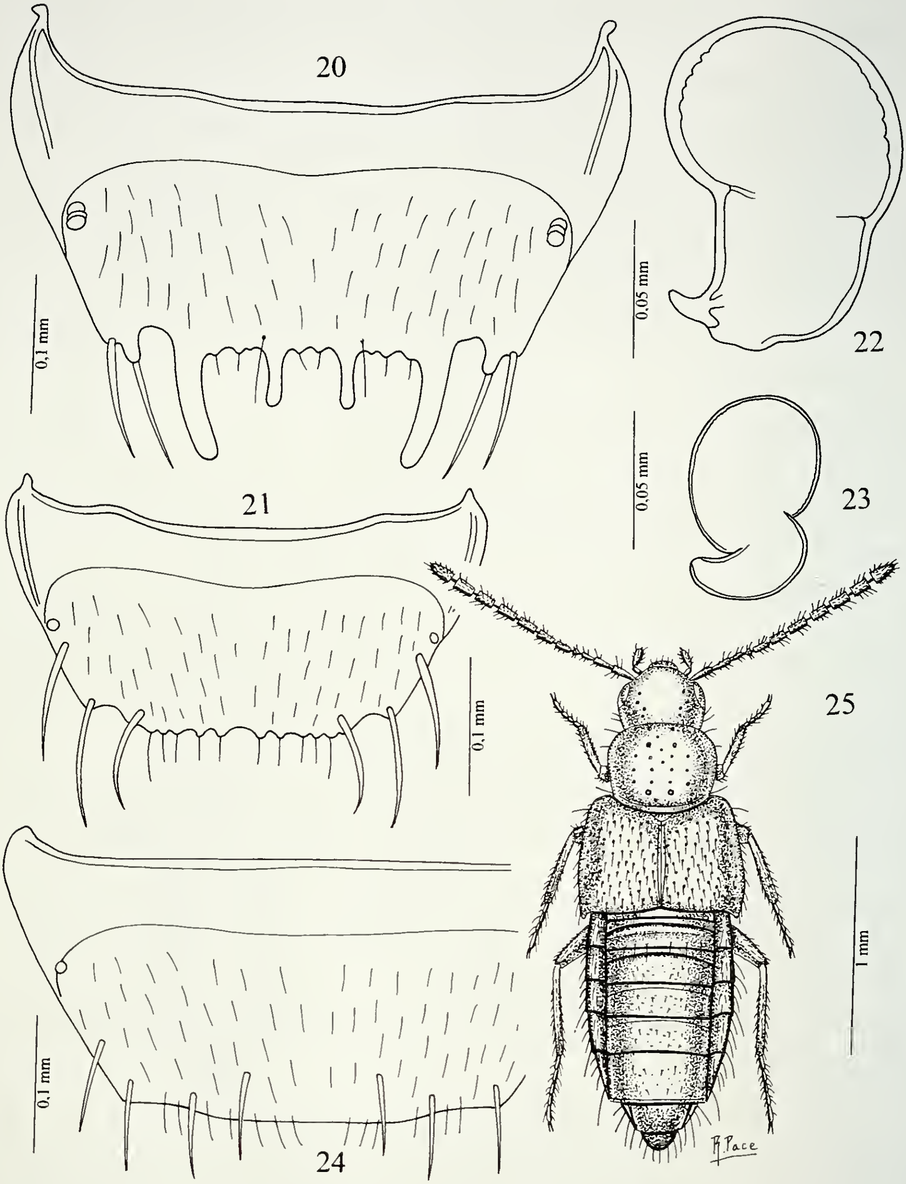
Gyrophaena (Gyrophaena) microcicatricosa sp. n. Figg. 30-34

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, area Kipungit Crk, 530 m, 26.VIII.1988, A. Smetana leg. (MHNG).

Paratypi: 10 es., stessa provenienza; 11 es., Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, Langanan Falls, 550-950 m, 9-14.V.1987, Burckhardt & Löbl leg.; 1 ♀, Borneo, Sabah, Mt. Kinabalu N.P., Kibongol V., 7 Km N Tambunan, 700 m, 20.V.1987, Burckhardt & Löbl leg.

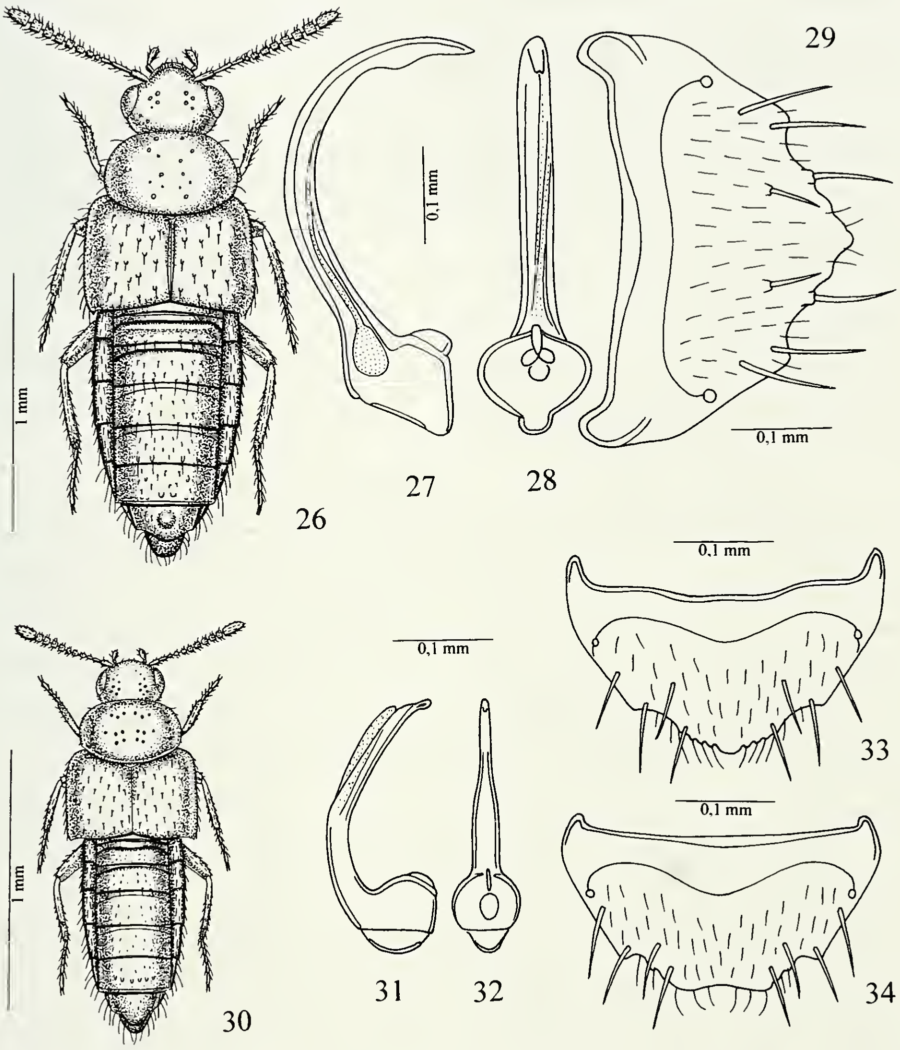
Descrizione. Lungh. 1,4 mm. Corpo lucido e nero; antenne brune con i tre antennomeri basali giallo-bruni; zampe giallo-brune. Il capo e il pronoto non presentano reticolazione. Le elitre mostrano una reticolazione ondulata trasversa superficiale. La reticolazione dei quattro uroterghi basali è svanita, quella del quinto e del sesto è distinta e a maglie un po' trasverse. Edeago figg. 31-32, sesto urotergo libero del ♂ fig. 33, sesto urotergo libero della ♀ fig. 34, spermateca non sclerificata, perciò non visibile.

Etimologia. Anche questa specie, come la precedente, in base alla forma dell'edeago, è affine a *G. cicatricosa* Mannh. dello Sri Lanka e India. Dato che ha taglia corporea molto ridotta, è chiamata "piccolissima *cicatricosa*".



FIGG. 20-25

Sesto urotergo libero del ♂ (20) e della ♀ (21 e 24), spermateca e habitus. 20-21: *Gyrophaena (Gyrophaena) insulsitatis* sp. n.; 22-25: *Gyrophaena (Gyrophaena) subinsulsitatis* sp. n.



FIGG. 26-34

Habitus, edeago in visione laterale e ventrale, sesto urotergo libero del ♂ (29 e 33) e della ♀ (34). 26-29: *Gyrophaena (Gyrophaena) borneocicatricosa* sp. n.; 30-34: *Gyrophaena (Gyrophaena) microcicatricosa* sp. n.

Gyrophaena (Gyrophaena) biplicatella sp. n. Figg. 35-38

Holotypus ♂, Borneo, Sabah, [Mt. Kinabalu N.P.], Kibongol V., 7 Km N Tambunan, 700 m, 20.V.1987, Burckhardt & Löbl leg. (MHNG).
Paratypus: 1 ♂, stessa provenienza.

Descrizione. Lungh. 1,7 mm. Corpo lucido e nero-bruno; antenne brune con i tre antennomeri basali di un giallo sporco; zampe pure di un giallo sporco. La reticolazione del capo e delle elitre è molto superficiale, quella del pronoto e dell'addome è svanita. Le elitre sono coperte di granuli fini e poco salienti. Edeago figg. 36-37, sesto urotergo libero del ♂ fig. 38.

Etimologia. La nuova specie prende nome dalle due pliche del quinto urotergo libero del ♂.

Gyrophaena (Gyrophaena) magnilobata sp. n. Figg. 39-43

Holotypus ♂, Borneo, Sabah, Crocker Ra., Km 60 Kota Kinabalu-Tambunan, 1350 m, 17.V.1987, Burckhardt & Löbl leg. (MHNG).
Paratypi: 2 ♂♂ e 1 ♀, stessa provenienza.

Descrizione. Lungh. 2,2 mm. Corpo lucido e bruno con addome bruno rossiccio, margine posteriore degli uroterghi rossiccio; antenne rossicce con i due antennomeri basali, la base del terzo e l'apice dell'undicesimo gialli; zampe giallo-rossicce. La reticolazione del capo e del pronoto manca, quella delle elitre e dell'addome è molto superficiale. Le elitre sono coperte di granuli superficiali. Edeago figg 40-41, sesto urotergo libero del ♂ fig. 42, sesto urotergo libero della ♀ fig. 43, spermateca non sclerificata, perciò non visibile.

Etimologia. Il grande lobo posteriore del sesto urotergo libero del ♂ ha suggerito il nome della specie che significa "dal grande lobo"

Gyrophaena (Gyrophaena) seraphim sp. n. Figg. 44-46

Holotypus ♀, Borneo, Sabah, Crocker Ra., Km 63 rte. Kota Kinabalu-Tambunan, 1200 m, 19.V.1987, Burckhardt & Löbl leg. (MHNG).
Paratypus: 1 ♀, stessa provenienza.

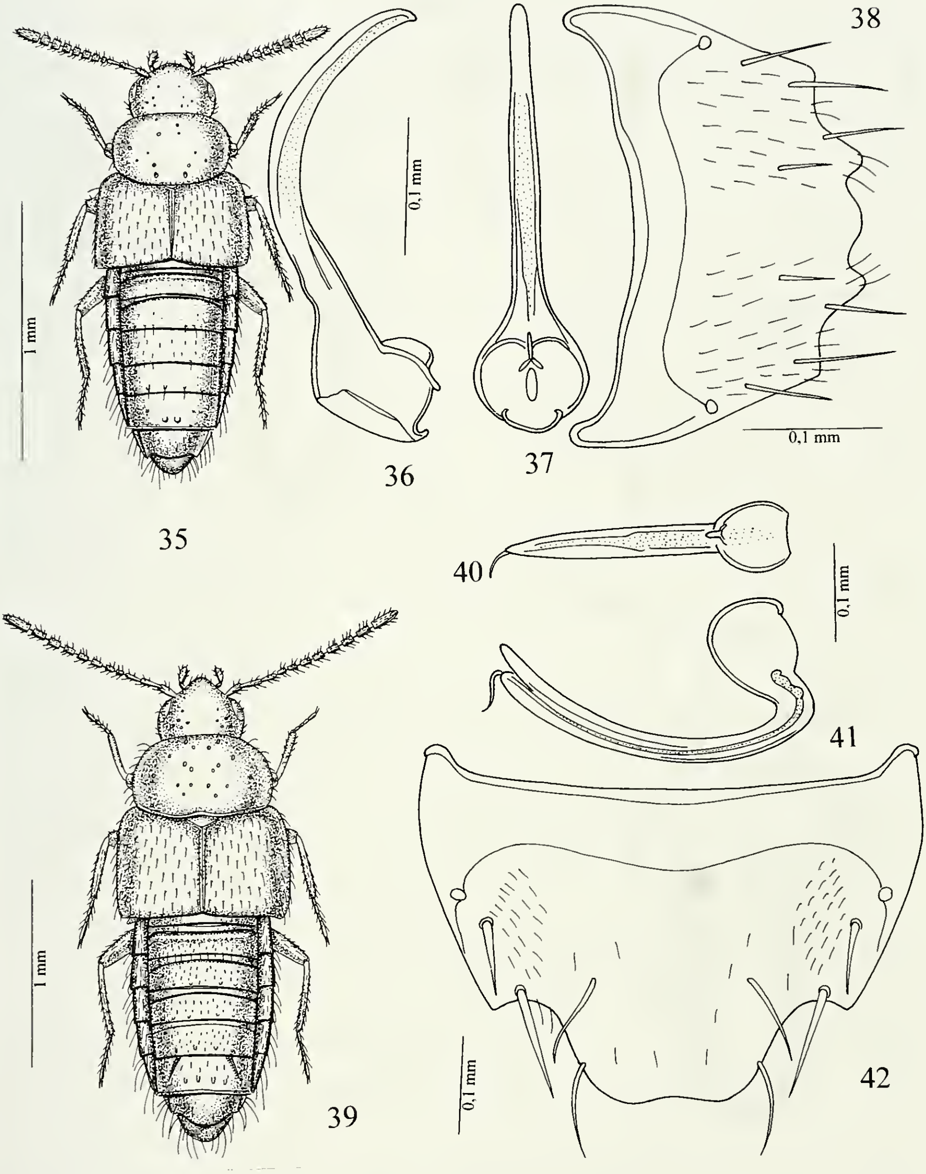
Descrizione. Lungh. 1,1 mm Corpo lucido e giallo-bruno con quarto urite libero bruno; antenne brune con i tre antennomeri basali gialli; zampe gialle. Il capo e il pronoto non mostrano reticolazione. Quella delle elitre è netta e composta da maglie molto trasverse, quella dell'addome è distinta, composta di maglie poligonali irregolari. La punteggiatura delle elitre è indistinta. Spermateca fig. 45, sesto urotergo libero della ♀ fig. 46.

Etimologia. Nell'istante in cui mi sono reso conto di essere in presenza di questa nuova specie, ascoltando contemporaneamente su disco il celebre *Te Deum* di M.A. Charpentier (1643-1704), ho udito la parola "seraphim" cantata dal coro.

Gyrophaena (Gyrophaena) botulitheca sp. n. Figg. 47-49

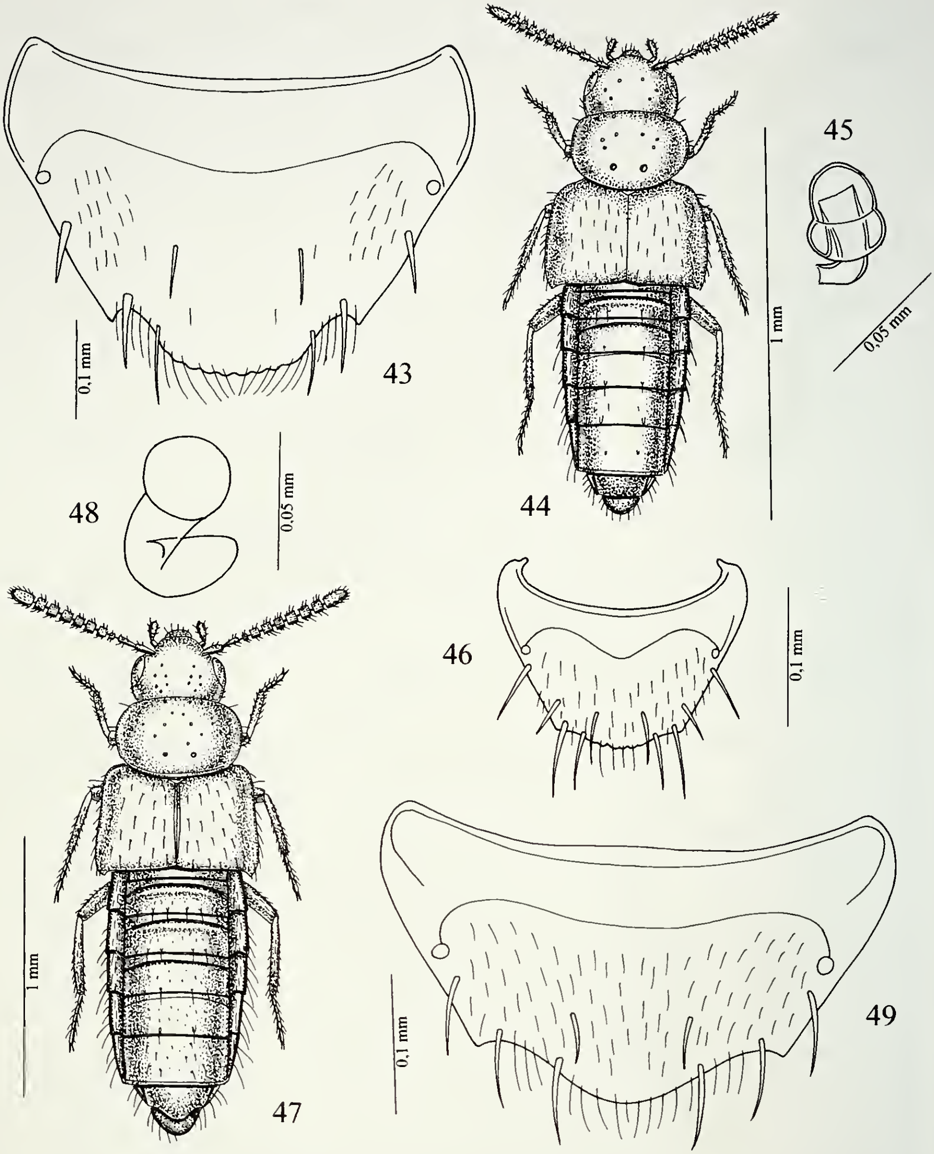
Holotypus ♀, Borneo, Sabah, Mt. Kinabalu, 1580 m, 27.IV.1987, Burckhardt & Löbl leg. (MHNG).

Descrizione. Lungh. 1,9 mm. Corpo lucido e bruno-rossiccio; antenne rossicce con i tre antennomeri basali gialli; zampe gialle. L'intera superficie del corpo è



FIGG. 35-42

Habitus, edeago in visione laterale e ventrale e sesto urotergo libero del ♂. 35-38: *Gyrophaena (Gyrophaena) biplicatella* sp. n.; 39-42: *Gyrophaena (Gyrophaena) magnilobata* sp. n.



FIGG. 43-49

Sesto urotergo libero della ♀, spermateca e habitus. 43: *Gyrophaena (Gyrophaena) magnilobata* sp. n.; 44-46: *Gyrophaena (Gyrophaena) seraphim* sp. n.; 47-49: *Gyrophaena (Gyrophaena) botulitheca* sp. n.

coperta di reticolazione molto superficiale, quella del pronoto e delle elitre è molto trasversa e quella dell'addome lo è meno. Le elitre sono coperte di granuli poco salienti. Spermateca fig. 48, sesto urotergo libero della ♀ fig. 49.

ETIMOLOGIA. La spermateca della nuova specie ha forma di salsiccia, perciò prende il nome di "spermateca a salsiccia".

Gyrophaena (Gyrophaena) microdentata sp. n. Figg. 50-55

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu N.P., HQ Silau-Silau tr., 1560 m, 3.VIII. 1988, A. Smetana leg. (MHNG).

Paratypi: 36 es., Borneo, Sabah, Mt. Kinabalu N.P., 1750 m, 27.IV.1987, Burckhardt & Löbl leg.; 1 ♀, Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, Bat Cave, 600 m, 10.V.1987, Burckhardt & Löbl leg.

DESCRIZIONE. Lungh. 1,7 mm. Corpo lucido e nero-bruno; antenne nere con i due antennomeri basali gialli; zampe gialle. Solo sul capo è visibile una reticolazione, che però è estremamente superficiale, sul resto della superficie del corpo la reticolazione è assente. La punteggiatura del pronoto è molto superficiale, quasi indistinta. Le elitre sono coperte di granuli superficiali. Edeago figg. 51- 52, sesto urotergo libero della ♀ fig. 54, sesto urotergo libero del ♂ fig. 55.

ETIMOLOGIA. I minuscoli denti al margine posteriore del sesto urotergo libero del ♂, danno il nome della specie che significa "dai denti microscopici".

Gyrophaena (Gyrophaena) longiqua sp. n. Figg. 56-59

Holotypus ♂, Borneo, Sabah, [Mt. Kinabalu N.P.], Poring Hot Springs, nr. Bat Cave, 600 m, 10.V.1987, Burckhardt & Löbl leg. (MHNG).

DESCRIZIONE. Lungh. 1,6 mm. Corpo lucido e giallo-bruno, con elitre brune e addome giallo-rossiccio; antenne brune con i tre antennomeri basali gialli; zampe gialle. La reticolazione dell'avancorpo è molto svanita, quella dell'addome è distinta. Evidenti granuli coprono la superficie delle elitre. Edeago figg. 57-58, sesto urotergo libero del ♂ (denti laterali amputati) fig. 59.

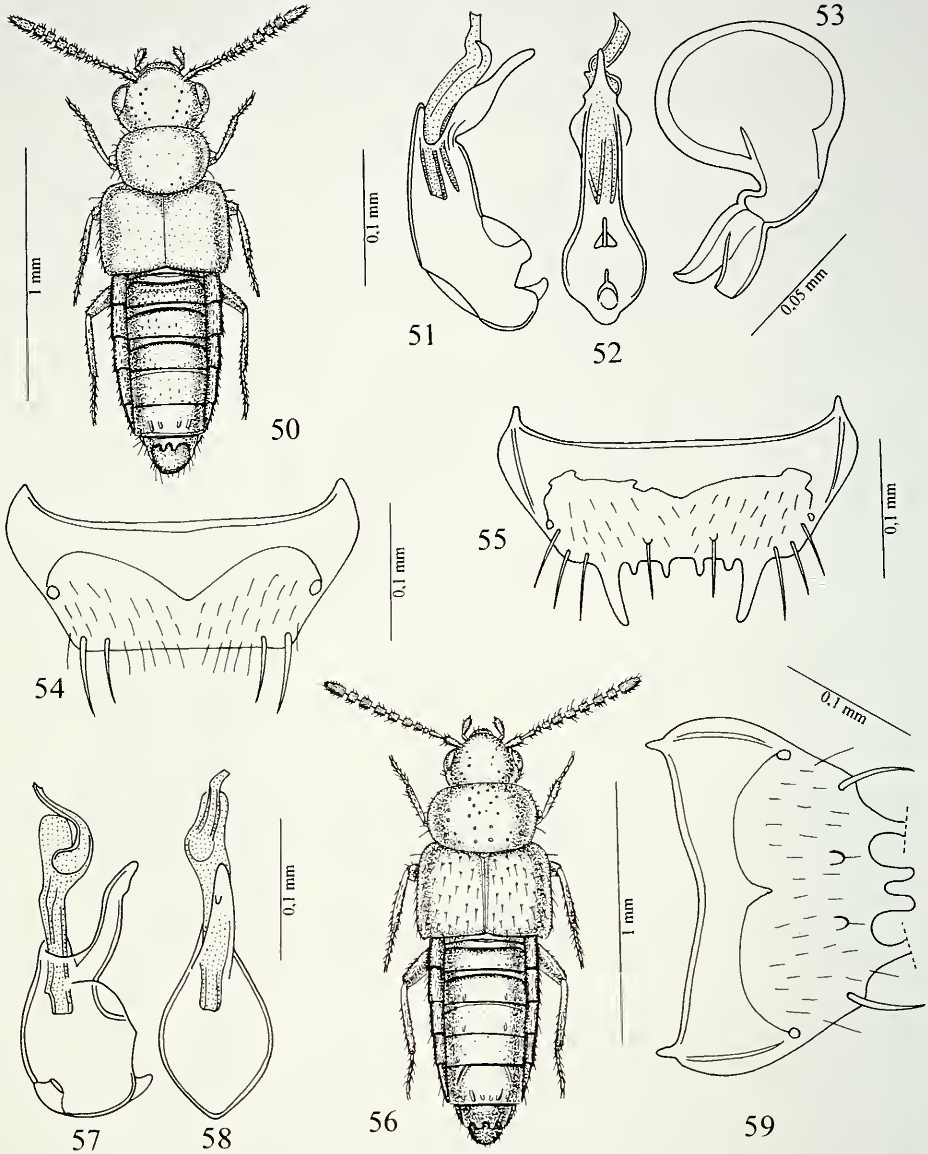
ETIMOLOGIA. Il nome della nuova specie significa "lontana" perché il pezzo copulatore interno dell'edeago è lontano dalla lama sternale.

Gyrophaena (Gyrophaena) piceicornis sp. n. Figg. 60-63

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu N.P., HQ Liwagu River, 1490 m, 10.VIII. 1988, A. Smetana leg. (MHNG).

DESCRIZIONE. Lungh. 1,7 mm. Corpo lucido e rossiccio con elitre bruno-rossicce; antenne brune con i tre antennomeri basali gialli; zampe giallo-rossicce. La reticolazione del capo e del pronoto è assente, quella delle elitre e dell'addome è distinta: solo sul quinto urotergo libero è netta. Le elitre sono coperte di granuli superficiali. Edeago figg. 61-62, sesto urotergo libro del ♂ fig. 63.

ETIMOLOGIA. Le antenne bruno-pece, tranne alla base, danno il nome alla nuova specie.



FIGG. 50-59

Habitus, edeago in visione laterale e ventrale, spermateca, sesto urotergo libero del ♂ (55 e 59) e della ♀. 50-55: *Gyrophaena (Gyrophaena) microdentata* sp. n.; 56-59: *Gyrophaena (Gyrophaena) longiqua* sp. n.

Gyrophaena* (*Gyrophaena*) *tactilis sp. n. Figg 64-69

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu N.P., HQ Liwagu River tr., 1520 m, 11.VIII.1988, A. Smetana leg. (MHNG).

Paratypi: 2 ♀♀, stessa provenienza; 4 es., Borneo, Sabah, Mt. Kinabalu N.P., HQ Silau-Silau tr., 1550 m, 2.IX.1988, A. Smetana leg.; 6 es., Borneo, Sabah, Mt. Kinabalu N.P., 1550-1650 m, 24.IV.1987, Burckhardt & Löbl leg; 1 ♀, Borneo, Sabah, Mt. Kinabalu N.P., Kibongol V., 7 Km N Tambunan, 700 m, 20.V.1987, Burckhardt & Löbl leg.

Descrizione. Lungh. 1,8 mm. Corpo lucido e bruno; antenne brune con i tre antennomeri basali gialli; zampe gialle. Superficie del corpo senza reticolazione. La punteggiatura delle elitre è superficiale. Edeago figg. 65-66, spermateca fig. 67, sesto urotergo libero del ♂ fig. 68, sesto urotergo libero della ♀ fig. 69.

Etimologia. Il nome della nuova specie significa “tangibile” data l’evidenza della sua diversità in base alla forma dell’edeago.

Gyrophaena* (*Gyrophaena*) *aculeus sp. n. Figg. 70-75

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, Langanan Falls, 900-950 m, 12.V.1987, Burckhardt & Löbl leg. (MHNG).

Paratypus: 1 ♀, stessa provenienza.

Descrizione. Lungh. 1,7 mm. Corpo lucido e bruno con addome giallo-rossiccio sporco; antenne nere con i tre antennomeri basali gialli; zampe gialle. La reticolazione della superficie del capo e del pronoto è distinta, quella delle elitre e dell’addome è netta. Le elitre sono coperte di granuli fini e salienti. Edeago figg. 71-72, sesto urotergo libero del ♂ fig. 73, sesto urotergo libero della ♀ fig. 74.

Etimologia. Il nome della nuova specie significa “punta di freccia” a motivo della forma dell’apice dell’edeago, in visione ventrale.

Gyrophaena* (*Gyrophaena*) *apiciflagellum sp. n. Figg. 76-79

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, Langanan Falls, 900-950 m, 12.V.1987, Burckhardt & Löbl leg. (MHNG).

Descrizione. Lungh. 1,7 mm. Corpo lucido e giallo-rossiccio sporco con elitre giallo-brune; antenne giallo-brune con i tre antennomeri basali gialli; zampe gialle. La reticolazione del capo e del pronoto è estremamente superficiale, quella dell’addome è distinta. Le elitre sono coperte da granulosità distinta e piuttosto fitta. Edeago figg. 77-78, sesto urotergo libero del ♂ fig. 79.

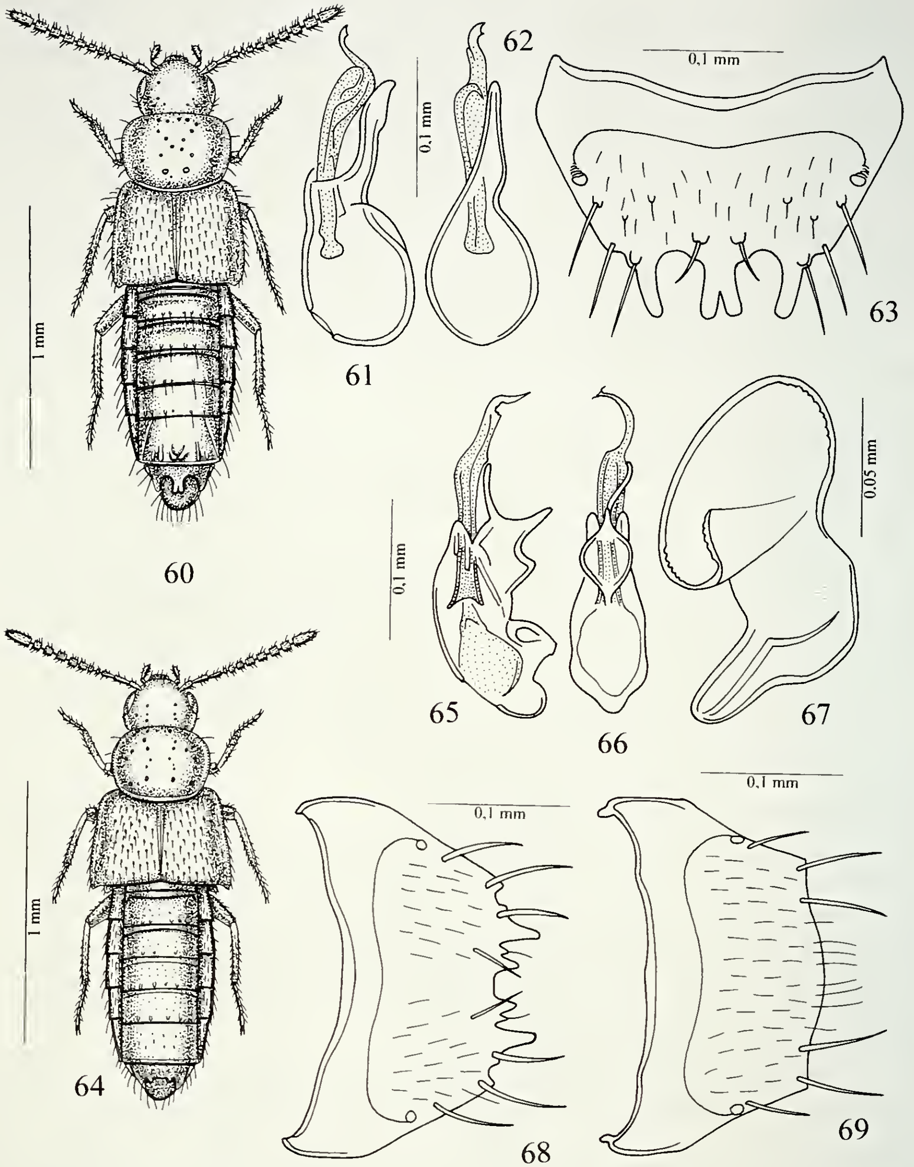
Etimologia. Il nome della nuova specie significa “staffile dell’apice” a motivo di un’appendice simile alla forma di uno staffile presso l’apice dell’edeago.

Gyrophaena* (*Gyrophaena*) *uncus sp. n. Figg. 80-84

Holotypus ♂, Borneo, Sabah, Crocker Ra., Km 63 r.te Kota Kinabalu-Tambunan, 1200 m, 19.V.1987, Burckhardt & Löbl leg. (MHNG).

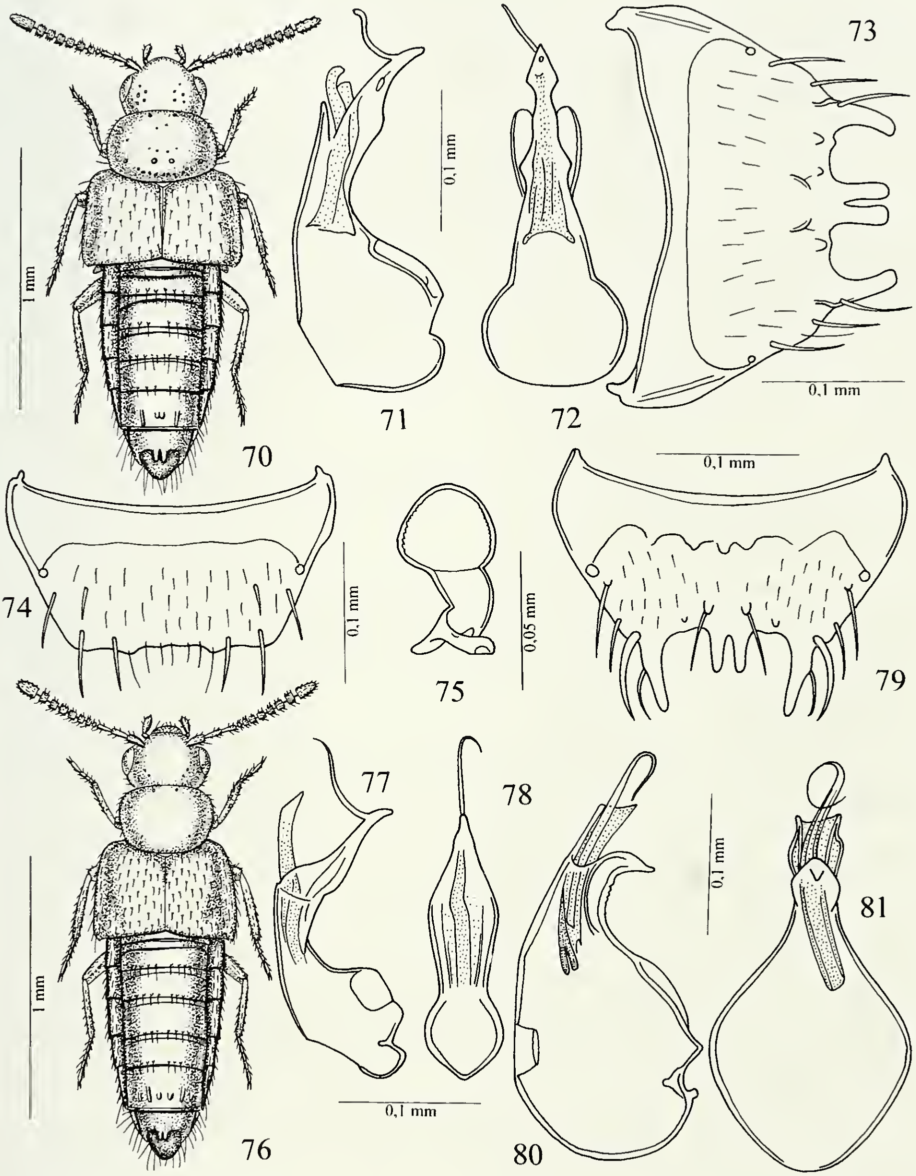
Paratypus: 1 ♀, stessa provenienza.

Descrizione. Lungh. 1,8 mm. Corpo lucido e rossiccio con elitre brune tranne la loro base che è rossiccia; antenne brune con i tre antennomeri basali gialli; zampe gialle. L’avancorpo è privo di reticolazione, l’addome ne è distintamente coperto. Le elitre sono distintamente, ma un po’ confusamente microgranulate. Edeago figg. 80-81, spermateca fig. 83, sesto urotergo libero del ♂ fig. 84.



FIGG. 60-69

Habitus, edeago in visione laterale e ventrale, spermateca, sesto urotergo libero del ♂ (63 e 68) e della ♀. 60-63: *Gyrophaena (Gyrophaena) piceicornis* sp. n.; 64-69: *Gyrophaena (Gyrophaena) tactilis* sp. n.



FIGG. 70-81

Habitus, edeago in visione laterale e ventrale, spermateca, sesto urotergo libero del ♂ (73 e 79) e della ♀. 70-75: *Gyrophaena (Gyrophaena) aculeus* sp. n.; 76-79: *Gyrophaena (Gyrophaena) apiciflagellum* sp. n.; 80-81: *Gyrophaena (Gyrophaena) uncus* sp. n.

Etimologia. Il nome della nuova specie significa "uncino" a motivo dell'edeago ricurvo come uncino.

Gyrophaena (Gyrophaena) robusta sp. n. Figg. 85-90

Holotypus ♂, Borneo, Sabah, 1900 m, 26.IV.1987, Burckhardt & Löbl leg. (MHNG).
Paratypus: 1 ♀, Borneo, Sabah, 1750 m, 27.IV.1987, Burckhardt & Löbl leg.

Descrizione. Lungh. 1,8 mm. Corpo lucido e bruno; antenne brune con i tre antennomeri basali gialli; zampe brune con tarsi rossicci. L'avancorpo è privo di reticolazione, quella dell'addome è superficiale, tranne sul quinto urotergo su cui è vigorosa. Le elitre sono coperte di granuli distinti. Spermateca fig. 86, edeago figg. 87-88, sesto urotergo libero del ♂ fig. 89, sesto urotergo libero della ♀ fig. 90.

Etimologia. Il corpo e l'edeago della nuova specie sono robusti, perciò essa prende il nome assegnatole.

Gyrophaena (Gyrophaena) validicornis sp. n. Figg. 91-92

Holotypus ♀, Borneo, Sabah, Mt. Kinabalu N.P., HQ Liwagu River, 1500 m, 16.V. 1987, A. Smetana leg. (MHNG).
Paratypus: 1 ♀, stessa provenienza.

Descrizione. Lungh. 1,9 mm. Corpo lucido e nero-bruno; antenne nere con i tre antennomeri basali giallo-rossicci; zampe bruno-rossicce. La reticolazione è assente su tutta la superficie dorsale del corpo. Le elitre presentano una punteggiatura finissima tra alcuni robusti e sparsi punti. Sesto urotergo libero della ♀ fig. 92; spermateca non visibile.

Etimologia. Nonostante l'assenza di una spermateca sclerificata, la nuova specie, per i caratteri delle antenne, risulta valida ed è chiamata "colei che ha antenne valide".

Gyrophaena (Gyrophaena) nigrolucida sp. n. Figg. 93-96

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu N.P., HQ Silau-Silau tr., 1550 m, 2.IX. 1988, A. Smetana leg. (MHNG).

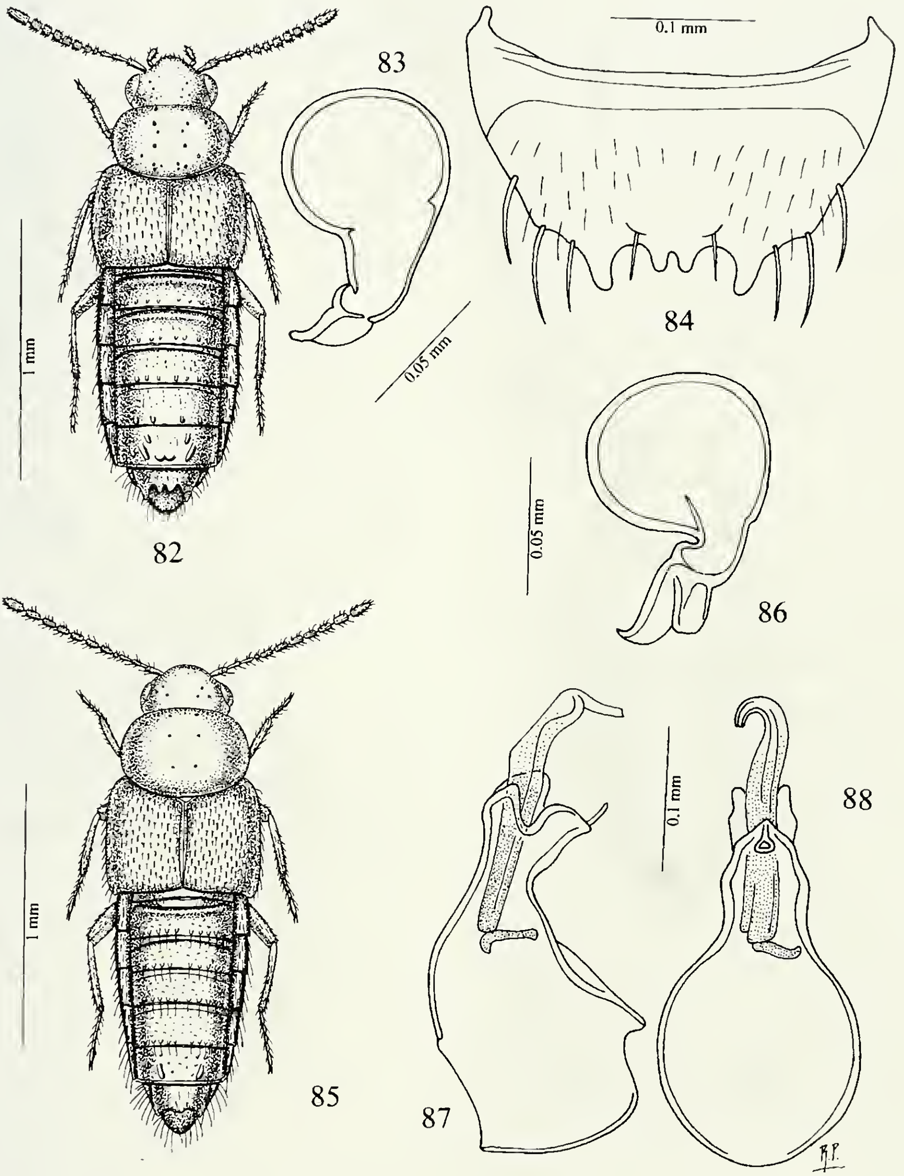
Descrizione. Lungh. 1,9 mm. Corpo lucido e nero; antenne brune con i tre antennomeri basali gialli, i due seguenti giallo-rossicci e il sesto e il settimo rossicci; zampe giallo-rossicce. Non è presente reticolazione sulla superficie corporea dorsale. Le elitre sono coperte di granulosità fine e saliente. Edeago figg. 94-95, sesto urotergo libero del ♂ fig. 96.

Etimologia. Il corpo nero e lucido ha suggerito il nome della nuova specie.

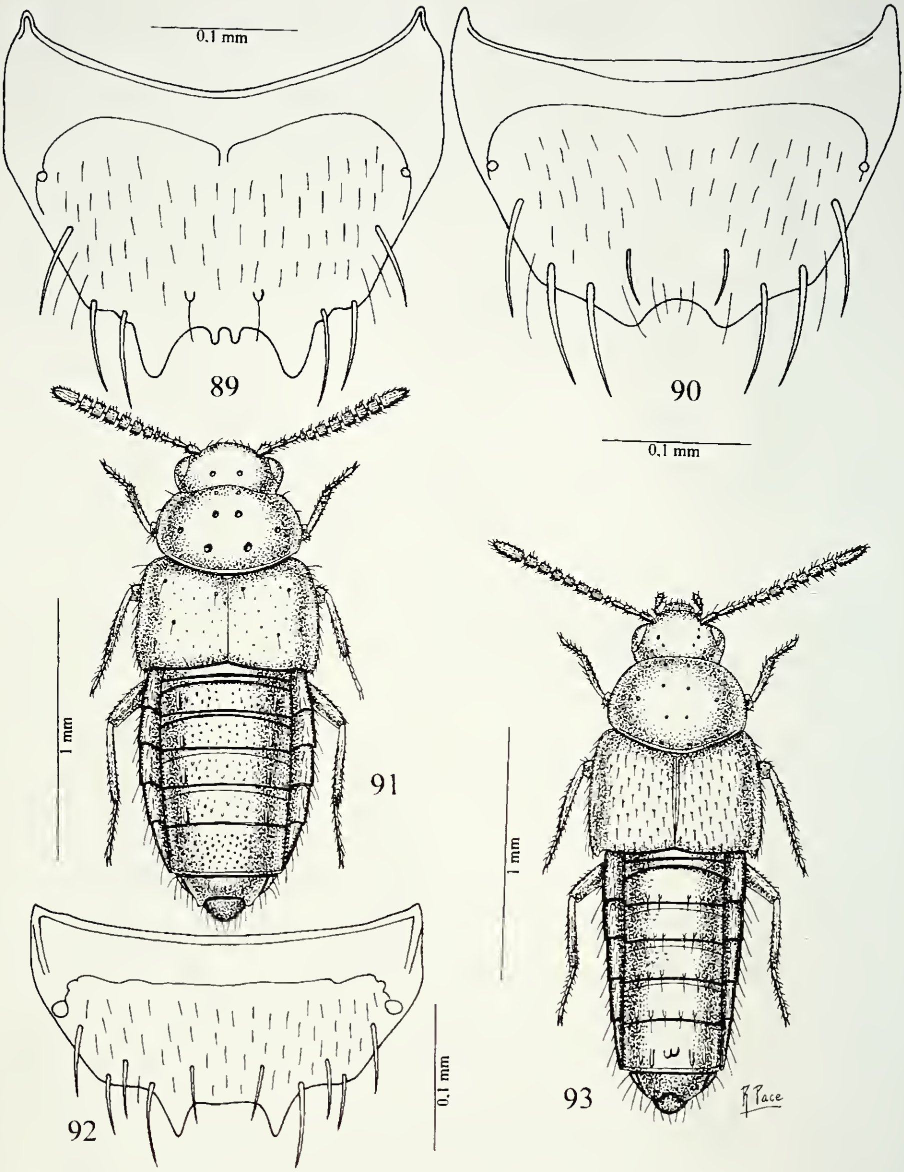
Gyrophaena (Gyrophaena) fontium sp. n. Figg. 97-100

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, 500 m, 11.V.1987, Burckhardt & Löbl leg. (MHNG).

Descrizione. Lungh. 1,5 mm. Corpo lucido e bruno, con pronoto rossiccio; antenne rossicce; zampe gialle. La reticolazione della superficie del capo, delle elitre e dell'addome è molto superficiale, quella del pronoto è assente. Le elitre sono coperte di punteggiatura fine e poco distinta.

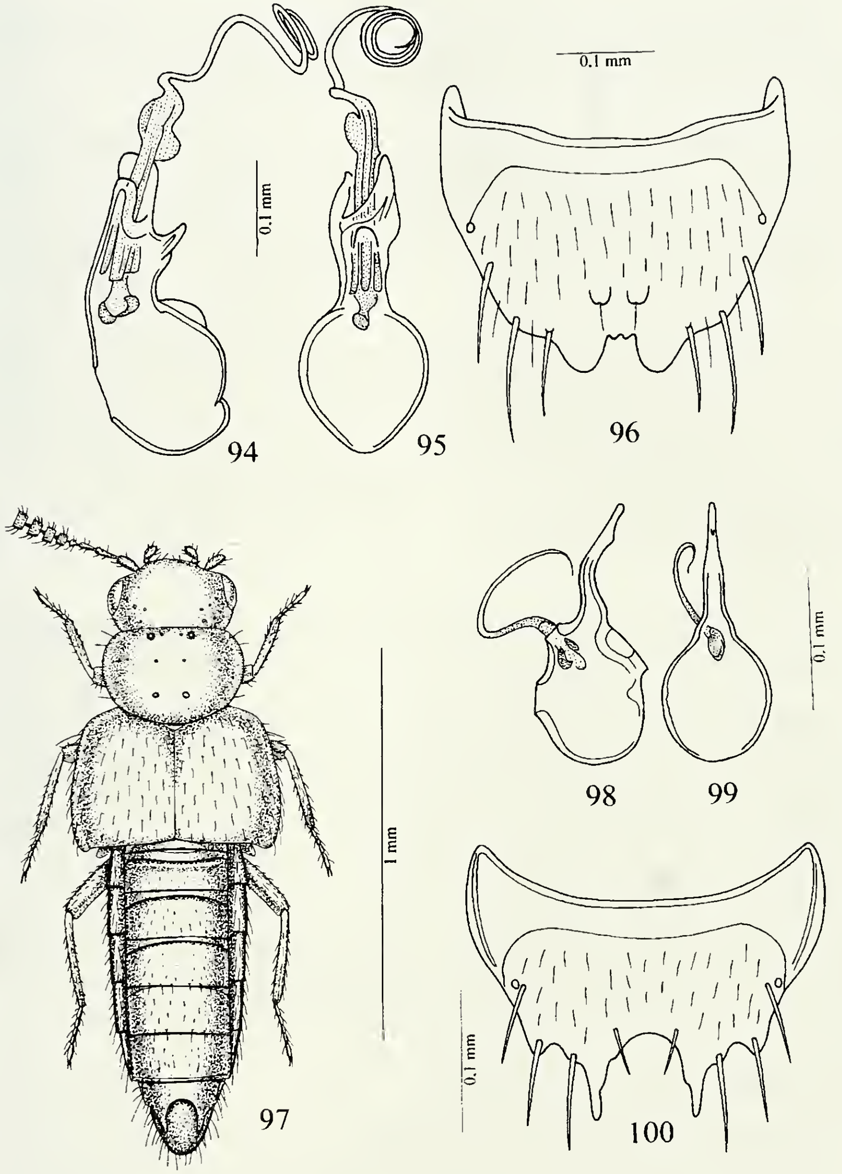


FIGG. 82-88
Habitus, spermateca, sesto urotergo libero del ♂ ed edeago in visione laterale e ventrale. 82-84: *Gyrophaena (Gyrophaena) uncus* sp. n.; 85-88: *Gyrophaena (Gyrophaena) robusta* sp. n.



FIGG. 89-93

Sesto urotergo libero del ♂ (89) e della ♀ (90 e 92) e habitus. 89-90: *Gyrophaena (Gyrophaena) robusta* sp. n.; 91-92: *Gyrophaena (Gyrophaena) validicornis* sp. n.; 93: *Gyrophaena (Gyrophaena) nigrolucida* sp. n.



FIGG. 94-100

Edeago in visione laterale e ventrale, habitus e sesto urotergo libero del ♂. 94-96: *Gyrophaena (Gyrophaena) nigrolucida* sp. n.; 97-100: *Gyrophaena (Gyrophaena) fontium* sp. n.

Edeago figg. 98-99, sesto urotergo libero del ♂ fig. 100.

Etimologia. Dato che la nuova specie è stata raccolta nella località "Hot Springs", cioè "Sorgenti Calde", prende nome "delle sorgenti".

Gyrophaena (Gyrophaena) burckhardti sp. n. Figg. 101-106

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, Langanan Falls, 900-950 m, 12.V.1987, Burckhardt & Löbl leg. (MHNG).

Paratypi: 10 es., Borneo, Sabah, Mt. Kinabalu N.P., Kibongol V., 7 Km N Tambunan, 700 m, 20.V.1987, Burckhardt & Löbl leg.; 1 ♀, Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, 510 m, 12.V.1987, A. Smetana leg.

Descrizione. Lungh. 1,2 mm. Corpo lucido e giallo sporco con capo bruno-rossiccio ed elitre giallo-brune; antenne giallo sporco con i tre antennomeri basali gialli; zampe gialle. Il capo, il pronoto e l'addome sono coperti di reticolazione superficiale, le elitre presentano reticolazione ondulata trasversa distinta. Le elitre presentano punteggiatura fine e poco distinta. Edeago figg. 102-103, spermateca fig. 101, sesto urotergo libero del ♂ fig. 105, sesto urotergo libero della ♀ fig. 106.

Etimologia. Specie dedicata a uno dei suoi raccoglitori, il Dr. D. Burckhardt del Museo di Storia Naturale di Ginevra.

Gyrophaena (Gyrophaena) pseudoburckhardti sp. n. Figg. 107-110

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, 550-600 m, 9.V.1987, Burckhardt & Löbl leg. (MHNG).

Descrizione. Lungh. 1,2 mm. Corpo lucido e bruno con addome giallo-rossiccio sporco avente una fascia bruna agli uriti quarto e alla base del quinto; antenne brune con i tre antennomeri basali gialli; zampe gialle. L'avancorpo è coperto di reticolazione superficiale, l'addome è distintamente reticolato. Le elitre presentano una punteggiatura poco distinta. Edeago figg. 108-109, sesto urotergo libero del ♂ fig. 110.

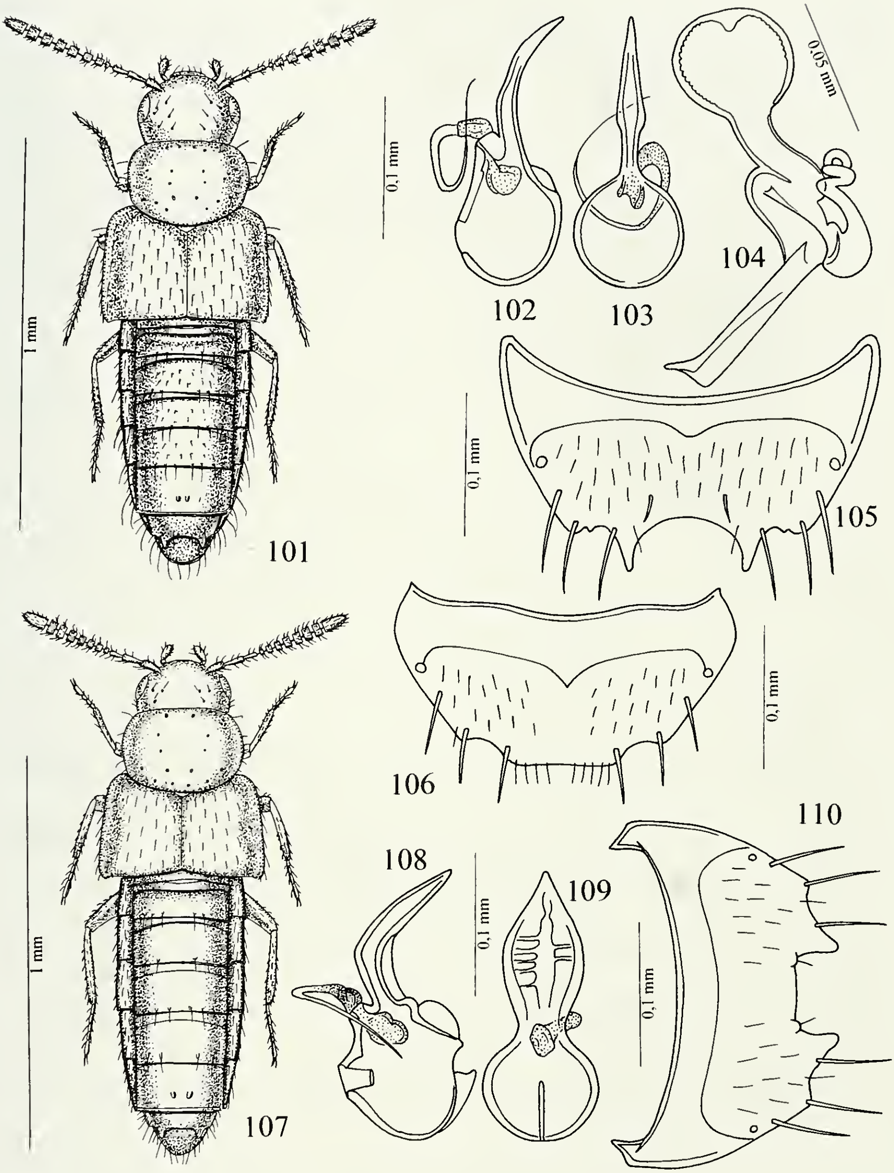
Etimologia. In un primo tempo avevo determinato l'esemplare di questa specie come *G. burckhardti.* Ma l'esame della lama sternale dell'edeago in visione ventrale, così evidentemente molto larga, mi ha permesso di comprendere che si trattava di specie differente. Per questo fatto è chiamata "falsa *burckhardti*".

Gyrophaena (Gyrophaena) confundens sp. n. Figg. 111-116

Holotypus ♂ Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, Langanan Falls, 900-950 m, 12.V.1987, Burckhardt & Löbl leg. (MHNG).

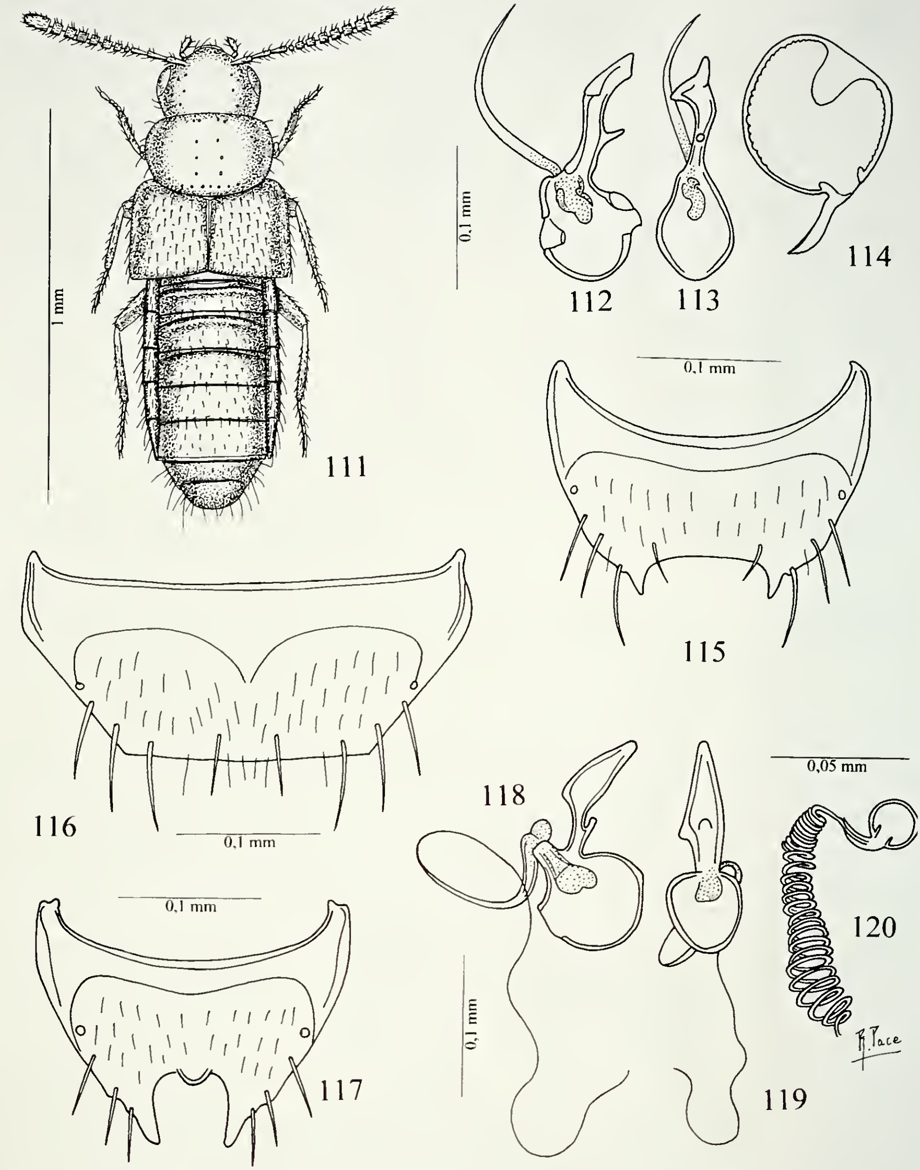
Paratypi: 1 ♂ e 2 ♀♀, Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, 550-600 m, 9.V.1987, Burckhardt & Löbl leg.; 1 ♂, Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, Bat Cave, 600 m, 10.V.1987, Burckhardt & Löbl leg.

Descrizione. Lungh. 1,15 mm. Corpo lucido e bruno, con addome giallo-rossiccio sporco; antenne brune con i tre antennomeri basali gialli; zampe di un giallo sporco. L'intero corpo è privo di reticolazione. La punteggiatura delle elitre è fine e distinta. Edeago figg. 112-113, spermateca fig. 114, sesto urotergo libero del ♂ fig. 115, sesto urotergo libero della ♀ fig. 116.



FIGG. 101-110

Habitus, edeago in visione laterale e ventrale, spermateca, sesto urotergo libero del ♂ (105 e 110) e della ♀. 101-106: *Gyrophaena (Gyrophaena) burckhardti* sp. n.; 107-110: *Gyrophaena (Gyrophaena) pseudoburckhardti* sp. n.



FIGG. 111-120

Habitus, edeago in visione laterale e ventrale, spermateca, sesto urotergo libero del ♂ (115 e 117) e della ♀. 111-116: *Gyrophaena (Gyrophaena) confundens* sp. n.; 117-120: *Gyrophaena (Gyrophaena) torquifera* sp. n.

ETIMOLOGIA. Poiché la nuova specie è simile a *G. burckhardti* sp. n., sopra descritta, è "confondibile" con essa.

Gyrophaena (Gyrophaena) torquifera sp. n. Figg. 117-122

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu N.P., 29.X.1990, G. de Rougemont leg. (MRSN).

Paratypi: 1 ♀, stessa provenienza; 25 es., Borneo, Sabah, Mt. Kinabalu N.P., HQ Liwagu River, 1500 m, 16.V.1987, A. Smetana leg.; 75 es., Borneo, Sabah, Mt. Kinabalu N.P., HQ Liwagu River, 1520 m, 11.VIII.1988, A. Smetana leg.; 4 ♀♀, Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, area Kipungit CZK, , 1530 m, 26.VIII.1988, A. Smetana leg.; 52 es., Borneo, Sabah, Mt. Kinabalu N.P., HQ Silau-Silau tr., 1550 m, 2.IX.1988, A. Smetana leg.; 9 es., Borneo, Sabah, 1550-1650 m, 24.IV.1987, Burckhardt & Löbl leg.; 2 ♀♀, Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, Langanan Falls, 900-950 m, 12.V. 1987, Burckhardt & Löbl leg.; 1 ♀, Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, 550-600 m, 9.V.1987, Burckhardt & Löbl leg.

DESCRIZIONE. Lungh. 1,5 mm. Corpo lucido. Capo e pronoto bruno-rossicci; elitre brune con omeri bruno-rossicci; addome giallo con uriti liberi terzo, quarto e quinto rossicci; antenne giallo-brune con i tre antennomeri basali giallo paglierino; zampe gialle. La reticolazione della superficie del corpo è da superficiale a estremamente superficiale. La punteggiatura delle elitre è distinta sulla metà basale e fine e poco distinta sulla metà posteriore. Edeago figg. 118-119, spermateca fig. 120, sesto urotergo libero del ♂ fig. 117, sesto urotergo libero della ♀ fig. 122.

ETIMOLOGIA. Il nome della nuova specie significa "colei che porta un avvolgimento a spira", riferimento al fine tubulo a spirale annesso alla spermateca.

Gyrophaena (Gyrophaena) antefuscicollis sp. n. Figg. 123-127

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu N.P., above Pondor Lowii, 2300 m, 8.VIII.1988, A. Smetana leg. (MHNG).

Paratypi: 126 es., stessa provenienza; 1 ♂ e 1 ♀, Borneo, Sabah, Mt. Kinabalu N.P., HQ Mempening trail, 1600 m, 17.V.1987, A. Smetana leg.; 19 es., Borneo, Sabah, Mt. Kinabalu N.P., 1750 m, 27.IV.1987, Burckhardt & Löbl leg.; 1 ♀, Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, Bat Cave, 600 m, 10.V.1987, Burckhardt & Löbl leg.

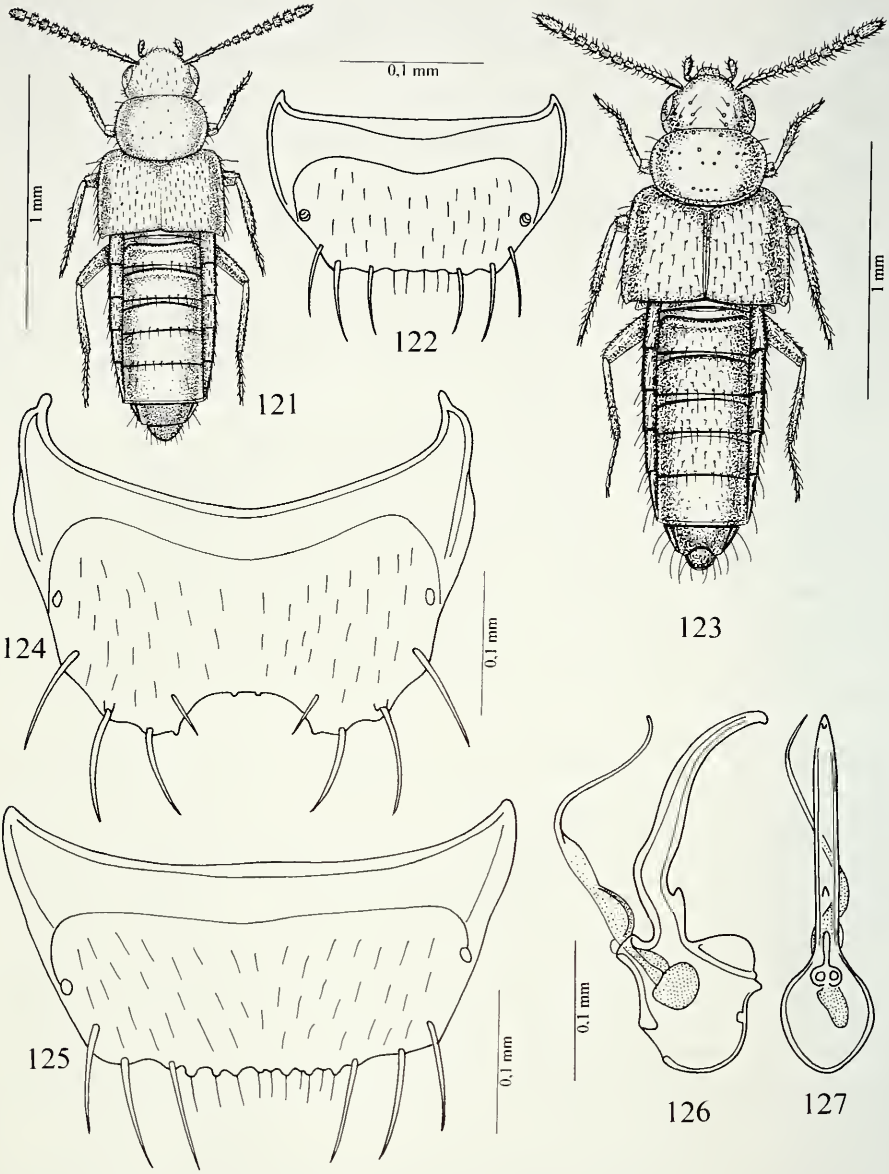
DESCRIZIONE. Lungh. 1,9 mm. Corpo lucido e giallo-rossiccio con capo rossiccio, elitre brune aventi omeri gialli e con macchia bruna addominale sul quarto urotergo libero; antenne giallo-rossicce; zampe dello stesso colore. La reticolazione del capo e del pronoto è superficiale, quella delle elitre e dell'addome è distinta, sulle elitre a maglie trasverse. Edeago figg. 126-127, spermateca non sclerificata perciò non visibile, sesto urotergo libero del ♂ fig. 124, sesto urotergo libero della ♀ fig. 125.

ETIMOLOGIA. La parte anteriore del pronoto giallo, infoscato di bruno, è l'origine del nome della nuova specie.

Gyrophaena (Gyrophaena) microprofuga sp. n. Figg. 128-131

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu N.P., Kibongol V., 7 Km N Tambunan, 700 m, 20.V.1987, Burckhardt & Löbl leg. (MHNG).

DESCRIZIONE. Lungh. 1,4 mm. Corpo lucido e nero-bruno, con pronoto, base dell'addome e pigidio bruno-rossicci; antenne bruno-rossicce con i tre antennomeri



FIGG. 121-127
Habitus, sesto urotergo libero della ♀ (122 e 125) e del ♂ ed edeago in visione laterale e ventrale. 121-122: *Gyrophaena (Gyrophaena) torquifera* sp. n.; 123-127: *Gyrophaena (Gyrophaena) antefuscicollis* sp. n.

gialli; zampe gialle. La reticolazione della superficie del capo è assente, quella del pronoto e dell'addome è distinta e quella delle elitre è superficiale. La punteggiatura delle elitre è finissima. Edeago figg. 129-130, sesto urotergo libero del ♂ fig. 131.

Etimologia. Il nome della nuova specie significa "Piccolissima *profuga*". *G. profuga* è nuova specie descritta più avanti.

Gyrophaena (Gyrophaena) bruneicola sp. n. Figg. 132-135

Holotypus ♂, Borneo, Brunei, Temburomg, Kuala Belalong (east), 21.III.1995, Borcherding leg. (MRSN).

Paratypi: 3 ♀♀, stessa provenienza.

Descrizione. Lungh. 2,8 mm. Corpo lucido. Capo e pronoto bruno-rossicci, elitre nero-brune con base rossiccia, addome giallo-rossiccio con quarto urite libero rossiccio; antenne brune con i tre antennomeri basali e apice dell'undicesimo giallo-rossicci; zampe gialle. L'intero corpo è privo di reticolazione. La punteggiatura delle elitre è netta presso la sutura. Edeago fig. 133, spermateca fig. 134, sesto urotergo libero del ♂ fig. 135.

Etimologia. La nuova specie prende nome dal Brunei.

Gyrophaena (Gyrophaena) promissumfilum sp. n. Figg. 136-141

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu N.P., HQ Silau-Silau tr., 1550 m, 2.IX.1988, A. Smetana leg. (MHNG).

Paratypi: 7 es., stessa provenienza; 1 ♀, Borneo, Sabah, Mt. Kinabalu N.P., HQ Liwagu River, 1505 m, 9.VIII.1988, A. Smetana leg.

Descrizione. Lungh. 1,9 mm. Corpo lucido e bruno-rossiccio; antenne giallo-rossicce con i tre antennomeri basali gialli; zampe giallo-rossicce. La reticolazione del capo e del pronoto è estremamente superficiale, quella delle elitre è netta, composta di maglie trasverse e ondulate, quella dell'addome è distinta. La punteggiatura delle elitre è distinta. Edeago figg. 137-138, spermateca fig. 139, sesto urotergo libero del ♂ fig. 140, sesto urotergo libero della ♀ fig. 141.

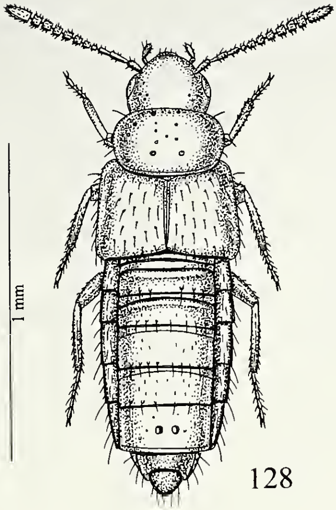
Etimologia. La nuova specie prende nome dal lunghissimo filo sporgente dall'apice dell'armatura interna dell'edeago. Il suo nome significa "filo lungo".

Gyrophaena (Gyrophaena) profuga sp. n. Figg. 142-147

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu N.P., HQ 1560 m, 30.IV.1987, A. Smetana leg. (MHNG).

Paratypi: 1 ♀, Borneo, Sabah, Mt. Kinabalu N.P., HQ Silau-Silau tr., 1560 m, 23.V. 1987, A. Smetana leg.; 1 ♀, Borneo, Sabah, Mt. Kinabalu N.P., HQ Liwagu River, 1500 m, 21.V.1987, A. Smetana leg.; 27 es., Borneo, Sabah, Mt. Kinabalu N.P., 1550-1650 m, 24.IV.1987, Burckhardt & Löbl leg.

Descrizione. Lungh. 2,2 mm. Corpo lucido e bruno-rossiccio, con elitre brune; addome giallo-rossiccio con uriti liberi terzo e quarto bruno-rossicci; antenne bruno-rossicce con i tre antennomeri basali giallo-rossicci; zampe gialle. Solo sui due uroterghi basali è visibile una reticolazione, che è molto superficiale. La punteggiatura delle elitre è distinta. Edeago figg. 143-144, spermateca fig. 145, sesto urotergo libero del ♂ fig. 147, sesto urotergo libero della ♀ fig. 146.



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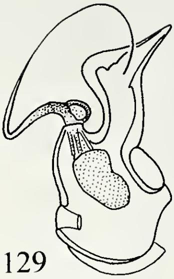

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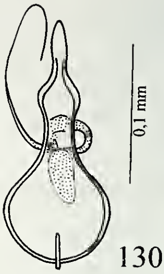

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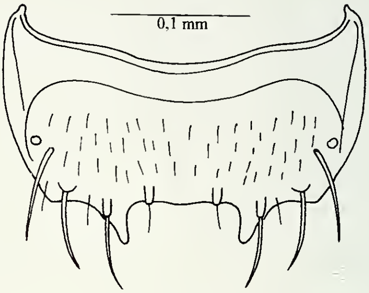

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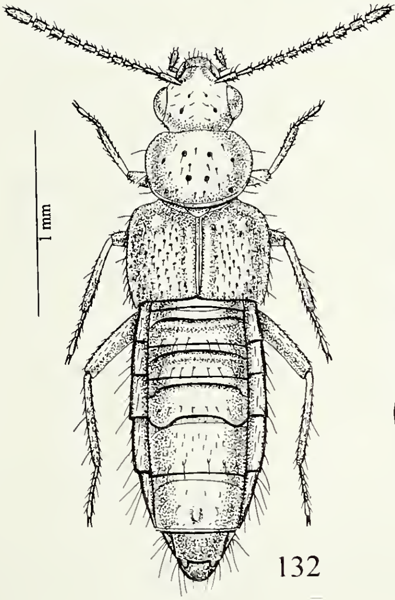

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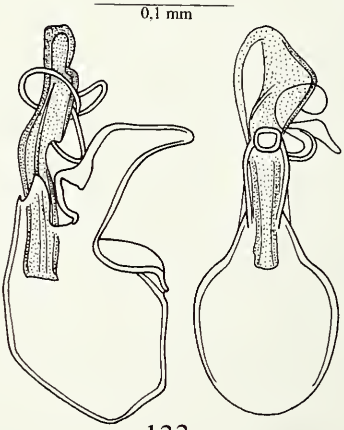

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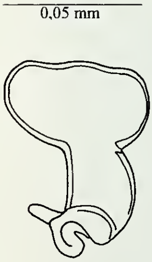

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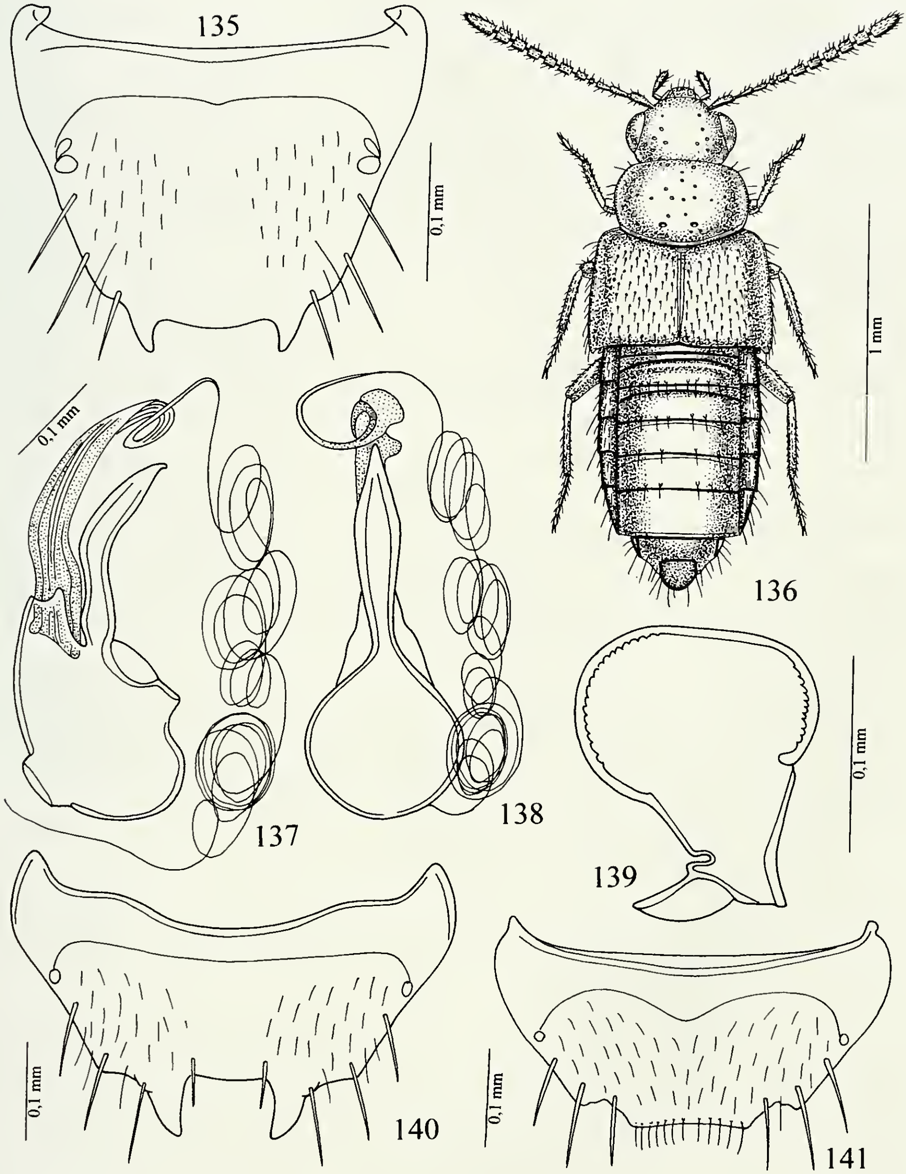
FIGG. 128-134

Habitus, edeago in visione laterale e ventrale, sesto urotergo libero del ♂ e spermateca. 128-131: *Gyrophaena (Gyrophaena) microprofuga* sp. n.; 132-134: *Gyrophaena (Gyrophaena) bruneicola* sp. n.



Figg. 135-141

Sesto urotergo libero del ♂ (135 e 140) e della ♀, habitus, edeago in visione laterale e ventrale e, spermateca. 135: *Gyrophaena (Gyrophaena) bruneicola* sp. n.; 136-141: *Gyrophaena (Gyrophaena) promissumfilum* sp. n.

Etimologia. La nuova specie, essendo stata rinvenuta in varie località del M. Kinabalu, ha preso il nome attribuitole.

Gyrophaena (Gyrophaena) brendelli sp. n. Figg. 148-151

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, Langanan Falls, 900-950 m, 12.V.1987, Burckhardt & Löbl leg. (MHNG).

Descrizione. Lungh. 1,7 mm. Corpo lucido e giallo-bruno, con addome giallo-rossiccio; antenne brune con i tre antennomeri basali gialli; zampe gialle. Su tutta la superficie del corpo si osserva una reticolazione da superficiale a estremamente superficiale. La punteggiatura delle elitre è svanita. Edeago figg. 148-149, sesto urotergo libero del ♂ fig. 151.

Etimologia. Specie dedicata al Dr. M. G. Brendell del Museo di Storia Naturale di Londra per l'invio di materiale tipico e l'aiuto nella ricerca bibliografica.

Gyrophaena (Agaricophaena) benevola sp. n. Figg. 152-157

Holotypus ♂, Borneo, Sabah, [Mt. Kinabalu N.P.], HQ at Liwagu Rv. tr., 1520 m, 11.VIII.1988, A. Smetana leg. (MHNG).

Paratypi: 2 ♂♂, stessa provenienza; 12 es., Borneo, Sabah, Mt. Kinabalu N.P., HQ Silau-Silau tr., 1550 m, 2.IX.1988, A. Smetana leg.; 4 es., Borneo, Sabah, Mt. Kinabalu N.P., Crocker Ra. 1200 m, Km 63 rte. Kota Kinabalu-Tambunan, 19.V.1987, Burckhardt & Löbl leg.; 1 ♀, Borneo, Sabah, Mt. Kinabalu N.P., Crocker Ra. 1600 m, Km 51 rte. Kota Kinabalu-Tambunan, 18.V.1987, Burckhardt & Löbl leg.

Descrizione. Lungh. 1,2 mm. Corpo lucido e bruno; antenne giallo-rossicce con i tre antennomeri basali gialli; zampe gialle. La reticolazione del capo e del pronoto è assente, quella delle elitre è distinta e quella dell'addome è netta. La punteggiatura delle elitre è netta. Edeago figg. 153-154, spermateca fig. 155, sesto urotergo libero del ♂ fig. 156, sesto urotergo libero della ♀ fig. 157.

Etimologia. Nome della specie di fantasia.

Gyrophaena (Agaricophaena) malevola sp. n. Figg. 158-163

Holotypus ♂, Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, Langanan Falls, 900-950 m, 12.V.1987, Burckhardt & Löbl leg. (MHNG).

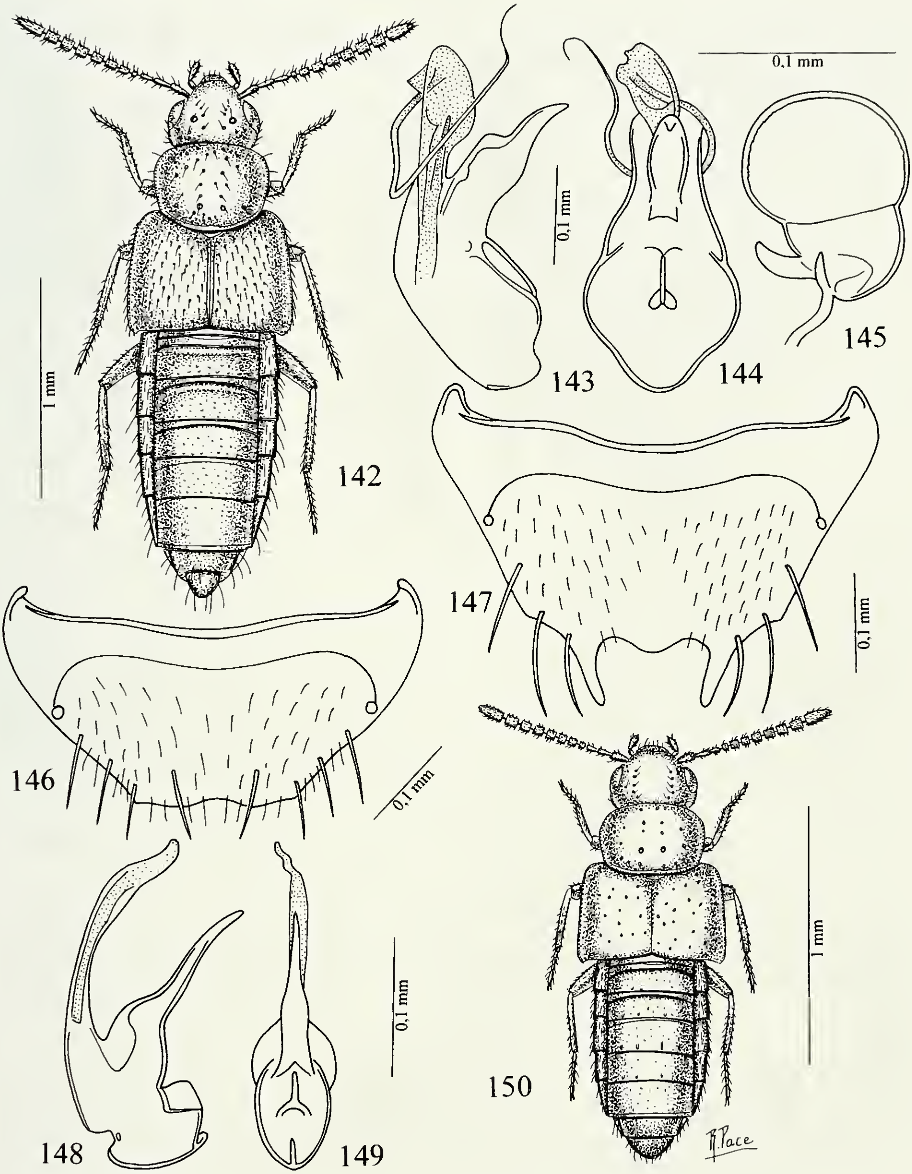
Paratypus: 1 ♀, stessa provenienza.

Descrizione. Lungh. 1,4 mm. Corpo lucido e giallo-bruno con elitre brune con omeri rossicci; antenne di un giallo sporco, con i tre antennomeri basali gialli; zampe gialle. La reticolazione del capo è assente, quella del pronoto è molto superficiale e quella delle elitre e dell'addome è distinta. La punteggiatura delle elitre è distinta, rada sull'area perisuturale e moderatamente fitta sul resto della superficie. Spermateca fig. 158, edeago figg. 159-160, sesto urotergo libero del ♂ fig. 162,

Etimologia. Il nome della specie è di fantasia, in contrapposizione a quello di *G. benevola* sp. n. sopra descritta.

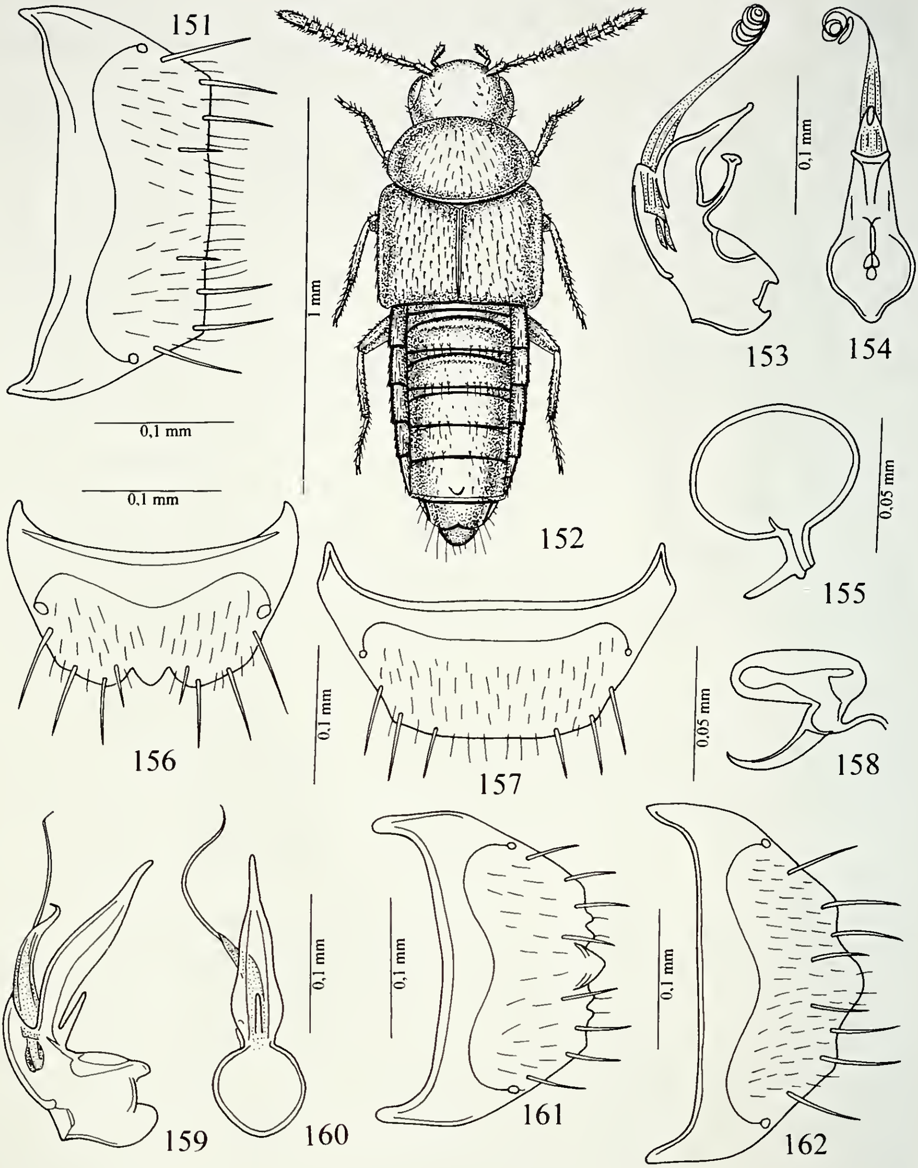
Gyrophaena (Agaricophaena) kinabaluicola sp. n. Figg. 164-170

Holotypus ♂, Borneo, Sabah, M.t Kinabalu N.P., 29.X.1990, G. de Rougemont leg. (MRSN).



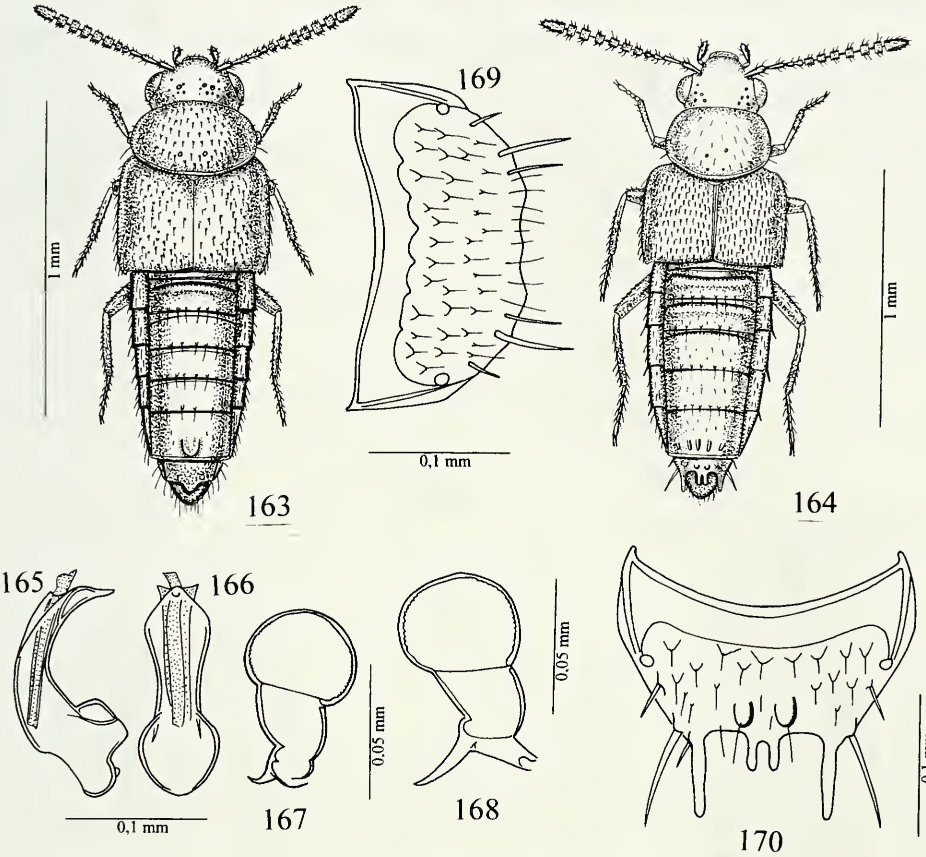
FIGG. 142-150

Habitus, edeago in visione laterale e ventrale, spermateca, sesto urotergo libero del ♂ (147) e della ♀. 142-147: *Gyrophaena (Gyrophaena) profuga* sp. n.; 148-150: *Gyrophaena (Gyrophaena) brendelli* sp. n.



FIGG. 151-162

Sesto urotergo libero della ♀ (151, 157 e 162) e del ♂ (156) , habitus, edeago in visione laterale e ventrale e spermateca. 151: *Gyrophaena (Gyrophaena) brendelli* sp. n.; 152-157: *Gyrophaena (Phaenogyra) benevola* sp. n.; 158-162: *Gyrophaena (Phaenogyra)) malevola* sp. n.



FIGG. 163-170

Habitus, sesto urotergo libero della ♀ (169) e del ♂ (170), edeago in visione laterale e ventrale e spermateca. 163: *Gyrophaena (Phaenogyra) malevola* sp. n.; 164-170: *Gyrophaena (Phaenogyra) kinabaluicola* sp. n.

Paratypi: 19 es., Borneo, Sabah, Mt. Kinabalu N.P., HQ Silau-Silau tr., 1550 m, 2.IX.1988, A. Smetana leg.; 1 ♂ e 1 ♀, Borneo, Sabah, Mt. Kinabalu N.P., Crocker Ra. 1350-1650 m, 16-17.V.1987, Burckhardt & Löbl leg.; 2 es., Borneo, Sabah, Mt. Kinabalu N.P., Poring Hot Springs, Langanan Falls, 900-950 m, 12.V.1987, Burckhardt & Löbl leg.; 2 es., Borneo, Sabah, Mt. Kinabalu N.P., 1430 m, 22.V.1987, Burckhardt & Löbl leg.

DESCRIZIONE. Lungh. 1,8 mm. Corpo lucido. Capo e pronoto giallo-rossicci, elitre bruno-rossicce, addome rossiccio; antenne gialle con i tre antennomeri basali di un giallo paglierino; zampe gialle. La reticolazione è assente sul capo, quella del pronoto è estremamente superficiale e quella delle elitre e dell'addome è distinta. Le elitre sono coperte di granulosità superficiale. Edeago figg. 165-166, spermateca fig. 167, sesto urotergo libero del ♂ fig. 170, sesto urotergo libero della ♀ fig. 169.

ETIMOLOGIA. La nuova specie prende nome dal M. Kinabalu.

Gyrophaena (Agaricophaena) anquisita sp. n. Figg. 171-173

Holotypus ♀, Borneo, Sabah, Mt. Kinabalu N.P., HQ Liwagu Riv. trail, 1500-1550 m, 27.IV.1987, A. Smetana leg. (MHNG).

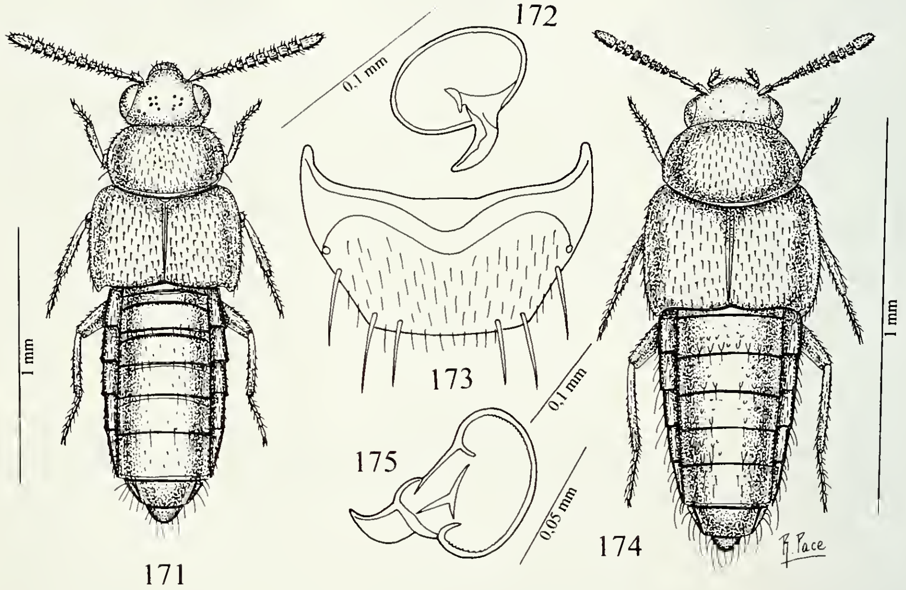
Paratypus: 1 ♀, stessa provenienza.

DESCRIZIONE. Lungh. 1,8 mm. Corpo lucido e rossiccio con elitre brune; antenne rossicce con i tre antennomeri basali gialli; zampe gialle. La reticolazione del capo e delle elitre è estremamente superficiale, quella del pronoto è assente e quella dell'addome è netta. La punteggiatura delle elitre è distinta. Spermateca fig. 172, sesto urotergo libero della ♀ fig. 173.

ETIMOLOGIA. Il nome della nuova specie significa "investigata".

Gyrophaena (Agaricophaena) oligotinoides sp. n. Figg. 174-175

Holotypus ♀, Borneo, Sabah, Mt. Kinabalu N.P., Crocker Ra. 1200 m, Km 63 rte. Kota Kinabalu-Tambunan, 19.V.1987, Burckhardt & Löbl leg. (MHNG).



FIGG. 171-175

Habitus, spermateca e sesto urotergo libero della ♀. 171-173: *Gyrophaena (Phaenogyra) anquisita* sp. n.; 174-175: *Gyrophaena (Phaenogyra) oligotinoides* sp. n.

DESCRIZIONE. Lungh. 1,2 mm. Corpo lucido e rossiccio, con metà posteriore delle elitre bruna; antenne bruno-rossicce con i tre antennomeri basali giallo-rossicci; zampe gialle. Non è presente reticolazione sulla superficie del corpo. Le elitre sono coperte di granulosità superficiale. Spermateca fig. 175.

ETIMOLOGIA. Il nome della nuova specie deriva dal fatto che il corpo ha forma simile a quello di gran parte delle specie del genere di Aleocharinae *Oligota*.

CHIAVE DELLE SPECIE BORNEANE DEL GENERE *GYROPHAENA* MANNERHEIM

Nella presente chiave si segue la tradizionale suddivisione sottogenerica, pur riscontrando in molti casi, in base alla forma dell'edeago, che componenti di gruppi di specie sono disseminati in sottogeneri differenti. Sono comprese tutte le specie del Borneo, tranne due, non disponibili per l'esame da parte del Museo di Storia Naturale di Londra (*G. bryanti* Cameron e *G. metallescens* Cameron).

1 Occhi enormemente sviluppati, fortemente sporgenti; parte mediana e prossimale della spermateca avvolta in spire grossolane. Sottogenere *Phanerota* Casey, 1906. Lungh. 1,9 mm. Sandakan . . . . . *borneensis* Cameron

\- Occhi non enormemente sviluppati, da poco a non sporgenti; parte mediana della spermateca senza spire 2

2 Pronoto coperto da punteggiatura regolarmente distribuita e da pubescenza più o meno fitta. Sottogenere *Agaricophaena* Reitter, 1909 36

\- Pronoto coperto da punteggiatura irregolare, normalmente con punti allineati in file longitudinali sulla fascia mediana. Sottogenere *Gyrophaena* Mannerheim, 1831 3

3 Antenne molto lunghe, con antennomeri 5° a 10° nettamente più lunghi che larghi 4

\- Antenne corte, talvolta solo gli antennomeri 5°, 6° e 7° più lunghi che larghi, con antennomeri 4° a 10° trasversi o lunghi quanto larghi 13

4 Corpo uniformemente nero o bruno, al massimo gli uroterghi sono orlati di rossiccio 5

\- Corpo bicolore o tricolore, bruno, giallo-rossiccio o rossiccio 8

5 Apice dell'undicesimo antennomero giallo; presenza di un ampio lobo al margine posteriore del sesto urotergo libero sia del ♂ che della ♀. Lungh. 1,9 mm. M. Kinabalu . . . . *G. magnilobata* sp. n.

\- Apice dell'undicesimo antennomero uniformemente bruno 6

6 Zampe brune, con tarsi rossicci. Lungh. 1,8 mm. M. Kinabalu. *G. robusta* sp. n.

\- Zampe giallo-rossicce o gialle 7

7 Corpo uniformemente nero; antenne brune dal 4° antennomero; pronoto con due file mediane di punti ben allineati. Lungh. 1,9 mm. M. Kinabalu . . . . *G. nigrolucida* sp. n.

\- Corpo uniformemente bruno; antennomeri 4° e 5° rossicci, 6° e seguenti bruni; pronoto con file mediane di punti confusi tra punti minori. Lungh. 2,4 mm. M. Kinabalu . . . . *G. insulsitatis* sp. n.

8 Antenne giallo-rossicce, con i tre antennomeri basali gialli; addome uniformemente bruno-rossiccio. Lungh. 1,9 mm. M. Kinabalu . . . . *G. involuta* sp. n.

\- Antenne brune, con uno o due antennomeri basali gialli; addome bicolore . . . 9

9 Addome bruno, con base gialla; pronoto poco trasverso 10

\- Addome giallo-rossiccio, con fascia rossiccia o rossiccio con fascia bruna; pronoto fortemente trasverso 11

10 Decimo antennomero appena più lungo che largo: disco del capo senza reticolazione. Lungh. 2,4 mm. Pangi . . . . *G. basalis* Pace, 1986

- Decimo antennomero nettamente più lungo che largo: disco del capo con reticolazione estremamente superficiale. Lungh. 2,1 mm. M. Kinabalu . . . . *G. subinsulsitatis* sp. n.

11 Addome rossiccio, con una fascia bruna. Lungh. 1,8 mm. M. Kinabalu . . . . *G. asymmetrica* sp. n.

- Addome giallo-rossiccio, con fascia rossiccia 12

12 Undicesimo antennomero bruno, con apice giallo-rossiccio; pronoto meno trasverso, con quattro punti robusti in quadrato sul disco; elitre nero-brune, con base rossiccia. Lungh. 2.8 mm. Brunei . . . *G. bruneicola* sp.n.

- Pronoto più trasverso, con quattro punti in rettangolo sul disco; elitre uniformemente brune. Lungh. 1,7 mm. M. Kinabalu . . . . *G. incredibilis* sp. n.

13 Decimo antennomero lungo quanto largo o appena trasverso 14

- Decimo antennomero nettamente trasverso 22

14 Corpo uniformemente nero. Lungh. 1,9 mm. M. Kinabalu . . . . *G. borneocicatricosa* sp. n.

- Corpo bruno, bicolore o tricolore, giallo-rossiccio, bruno-rossiccio 15

15 Corpo uniformemente bruno o bruno-rossiccio 16

- Corpo bicolore o tricolore 17

16 Antenne giallo-rossicce dal 4° antennomero; occhi assai sporgenti. Lungh. 1,9 mm M. Kinabalu . . . . *G. promissumfilum* sp. n.

- Antenne brune dal 4° antennomero; occhi non sporgenti. Lungh. 1,7 mm. M. Kinabalu . . . . *G. tactilis* sp. n.

17 Antenne giallo-rossicce. Lungh. 1,9 mm. M. Kinabalu *G. antefuscicollis* sp. n.

- Antenne brune dal 4° antennomero 18

18 Addome uniformemente giallo-rossiccio. Lungh. 1,7 mm. M. Kinabalu . . . . *G. brendelli* sp. n.

- Addome rossiccio o giallo-rossiccio fasciato di bruno-rossiccio 19

19 Addome bicolore 20

- Addome uniformemente rossiccio 21

20 Capo con due profondi punti: punteggiatura del pronoto robusta: addome giallo-rossiccio con fascia bruno-rossiccia. Lungh. 2,2 mm. M. Kinabalu . . . . *G. profuga* sp. n.

- Capo con punteggiatura irregolarmente distribuita; punteggiatura del pronoto quasi indistinta; addome bruno con i tre uriti basali gialli. Lungh. 1,8 mm. Pangi . . . . *G. misella* Pace, 1986

21 Corpo esile; presenza di un solco obliquo a ciascun lato del 5° urotergo libero. Lungh. 1,7 mm M. Kinabalu . . . . *G. piceicornis* sp. n.

- Corpo tozzo; 5° urotergo libero senza solco a ciascun lato. Lungh. 1,7 mm. M. Kinabalu . . . . *G. uncus* sp. n.

22 Corpo nero o nero-bruno 23

- Corpo bruno, bicolore, rossiccio o bruno-rossiccio 26

23 Capo largo quanto il pronoto. Lungh. 1,7 mm. M. Kinabalu . . . . *G. microdentata* sp. n.

\- Capo nettamente più stretto del pronoto 24

24 Corpo molto robusto; zampe bruno rossicce; corpo nero con pronoto nero-bruno. Lungh 1,9 mm M. Kinabalu .... *G. validicornis* sp. n.

\- Corpo meno robusto e uniformemente nero o nero-bruno; zampe giallo-brune o giallo sporco 25

25 Corpo nero; occhi più sviluppati; pronoto non reticolato; margine posteriore del 6° urotergo libero del ♂ crenellato. Lungh. 1,4 mm. M. Kinabalu .... *G. microcicatricosa* sp. n.

\- Corpo nero-bruno; occhi ridotti; pronoto reticolato; margine posteriore del 6° urotergo libero del ♂ trilobato. Lungh. 1,7 mm. M. Kinabalu .... *G. biplicatella* sp. n.

26 Corpo uniformemente bruno-rossiccio. Lungh. 1,9 mm. M. Kinabalu .... *G. botulitheca* sp. n.

\- Corpo bicolore o tricolore 27

27 Addome uniformemente colorato 28

\- Addome bicolore 33

28 Avancorpo uniformemente bruno 29

\- Avancorpo bicolore 30

29 Taglia corporea minore: 1,15 mm. M. Kinabalu .... *G. confundens* sp. n.

\- Taglia corporea maggiore: 1,7 mm. M. Kinabalu .... *G. aculeus* sp. n.

30 Taglia corporea minore: 1,2-1,5 mm 31

\- Taglia corporea maggiore: 1,6-1,7 mm 32

31 Addome bruno. Lungh. 1,5 mm. M. Kinabalu .... *G. fontium* sp. n.

\- Addome giallo. Lungh. 1,2 mm. M. Kinabalu .... *G. burckhardti* sp. n.

32 Capo appena più stretto del pronoto; 5° antennomero nettamente trasverso. Lungh. 1,7 mm. M. Kinabalu .... *G. apiciflagellum* sp. n.

\- Capo nettamente più stretto del pronoto; 5° antennomero lungo quanto largo. Lungh. 1,6 mm. M. Kinabalu .... *G. longiqua* sp. n.

33 Avancorpo uniformemente colorato 34

\- Avancorpo bicolore 35

34 Reticolazione del capo e del pronoto assente, quella delle elitre è netta. Lungh. 1,1 mm. M. Kinabalu .... *G. seraphim* sp. n.

\- Reticolazione del capo, del pronoto e delle elitre superficiale. Lungh. 1,2 mm M. Kinabalu .... *G. pseudoburckhardti* sp. n.

35 Pronoto molto trasverso; elitre uniformemente nero-brune; base dell'addome e pigidio bruno-rossicci. Lungh. 1,4 mm. M. Kinabalu .... *G. microprofuga* sp. n.

\- Pronoto meno trasverso; elitre brune, con omeri bruno-rossicci; base dell'addome gialla. Lungh. 1,5 mm. M. Kinabalu .... *G. torquifera* sp. n.

36 Antenne quasi interamente gialle o giallo-rossicce 37

\- Antenne nere, rossicce o bruno-rossicce 39

37 Corpo uniformemente bruno 38

\- Corpo bicolore o tricolore 40

38 Antenne giallo-rossicce, con i tre antennomeri basali gialli; antennomeri 5° e 6° nettamente trasversi; occhi ben sviluppati, reticolazione dell'addome netta. Lungh. 1,2 mm. M. Kinabalu . . . . *G. benevola* sp. n.

- Antenne gialle, con antennomeri 10° e 11° infoscati di bruno; antennomeri 5° e 6° più lunghi che larghi; occhi ridotti; reticolazione dell' addome assai superficiale. Lungh. 1,7 mm. Pangi . . . *G. perparva* Pace, 1986

39 Quinto antennomero lungo quanto largo; pronoto poco trasverso; elitre uniformemente brune. Lungh. 1,8 mm. M. Kinabalu . . . *G. kinabaluicola* sp. n.

- Quinto antennomero trasverso; pronoto fortemente trasverso; elitre brune, con omeri rossicci. Lungh. 1,4 mm. M. Kinabalu . . . *G. malevola* sp. n.

40 Antenne nere, con base gialla; capo con due forti punti isolati; pronoto appena trasverso. Lungh. 1,7 mm. Pangi . . . . *G. perpusilla* Pace, 1986

- Antenne rossicce o bruno-rossicce, con base gialla; capo con molti punti; pronoto molto trasverso 41

41 Punteggiatura del capo superficiale; elitre brune, con base rossiccia; uroterghi con scultura vagamente squamiforme. Lungh. 1,2 mm. M. Kinabalu . . . . *G. oligotinula* sp. n.

- Punteggiatura del capo netta; elitre uniformemente brune; uroterghi senza scultura vagamente squamiforme 42

42 Avancorpo bruno; antenne rossicce, con il 10° antennomero bruno; occhi ridotti. Lungh. 1,2 mm. Pangi . . . . *G. borneorum* (Pace, 1986), **comb. n.**
(*olim Brachida borneorum* Pace, 1986)

- Capo e pronoto rossicci, elitre brune; antenne rossicce con i tre antennomeri basali gialli; occhi molto sviluppati. Lungh. 1,8 mm. *G. anquisita* sp. n.

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Survey of the family Corynidae (Cnidaria, Hydrozoa)

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Survey of the family Corynidae (Cnidaria, Hydrozoa). - All genera and species of the family Corynidae are reviewed and the validity of some species discussed. Descriptions and figures for most valid species are given. The classification based on cladistic principles established by Petersen (1990) is discussed and modified. The family Corynidae encompasses the genera *Coryne*, *Sarsia*, *Dipurena*, *Nannocoryne*, *Cladosarsia*, *Bicorona*, and *Dicyclocoryne*. The family Dicyclocorynidae is not recognised and its members returned to the Corynidae. The genus *Bicorona* is redefined to accommodate *Coryne tricycla* Schuchert, 1996 as *Bicorona tricycla* comb. nov. The genus *Dicodonium* is excluded from the Corynidae because its type species is most probably an *Ectopleura* species and thus belongs to the Tubulariidae.

Key-words: Marine invertebrates - Cnidaria - Hydrozoa - Anthoathecata - Corynidae - worldwide survey - revision - descriptions - taxonomy.

CONTENTS

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1. INTRODUCTION

Corynid hydroids and medusae are a regular component of many shallow water faunas of the world. This, and their relatively easy cultivation, has made them the preferred subject of a number of life-cycle studies and biological investigations. Numerous species have been described, but most information resides scattered in publications spanning more than 200 years of history. Identifications, especially at the species level, can often be very difficult. Therefore, the main incentive of this study was to provide a complete catalogue of the species, to discuss their status, to outline their distinguishing characters, and to summarise aspects of their biology. It was not intended to give a complete literature record for every species as Bedot (1901-1925) did. It is evident that many authors have misidentified their material or based their identification on a too small set of characters (e. g. non-reproductive polyps, juvenile medusae, damaged material). Simple records of species are therefore often unreliable if not supplemented by additional information. Simply listing all citations for a species might lead to the wrong implication that all identification were correct. Therefore, I mostly worked only with studies providing descriptions and figures. Wherever possible, material of the species concerned was examined and described.

The first corynids to be described were *Coryne muscoides* by Linnaeus in 1761 (as *Tubularia muscoides*) and shortly after *C. pusilla* by Gaertner (1774). Subsequently, new species were described regularly, although many older descriptions based on preserved material made distinction of species sometimes difficult. It was only after Rees, Edwards, and Brinckmann-Voss started to work with living specimens that the quality of information became more reliable. One important outcome of these studies was that in most cases knowledge of the complete life cycle is necessary to identify a species. It became evident that some species have nearly indistinguishable medusae, while their polyp stages were strikingly different, and likewise that some similar polyps produced medusae that sometimes even belonged to different families. New species of corynids continue to be described and it is evident that only a more careful search is needed to discover new species (see also below, discussion on distribution).

The limits of the family Corynidae have always been unclear and remain so even today. Some authors (e. g. Hincks, 1868; Naumov, 1969) also included members of the Zancleidae in this family (e. g. the genera *Zanclea* and *Halocoryne*). However, this group with medusae having partitioned gonads and macrobasic euryteles is only quite distantly related to the Corynidae (Petersen, 1990). Unexperienced students nevertheless may find it rather difficult to discriminate infertile hydranths of *Zanclea* and *Coryne*. *Zanclea* species, however, generally have many more tentacles and these are more scattered. More importantly, *Zanclea* species usually have a rather shallow hypostome and quite often it is completely flat. The resemblance of their polyps is probably a plesiomorphy. The most likely sister group of the Corynidae is the clade Eleutheriidae (the latter includes also the Cladonematidae, see Schuchert, 1996). Both groups are united by the presence of thin, filiform tentacles lacking nematocysts. Although this character has been lost in some species of both groups, it still remains a valid argument for a close affinity of both groups. Upon close examination, some Corynidae (e. g. *Sarsia lovenii*) without filiform tentacles have at the place of them a ring of epidermal sensory cells with long, stiff cilia. Similar cells are otherwise found on the filiform tentacles. However, as there is no good synapomorphy available for the Corynidae, the Eleutheriidae could as well be an ingroup of the Corynidae (see below).

The Solanderiidae are another group with a close affinity to the Corynidae. The former family has recently been revised by Bouillon *et al.* (1992) and the number of species was considerably reduced.

The position of the genera *Bicorona* and *Dicyclocoryne* are likewise problematic. Petersen (1979, 1990) united them in the family Dicyclocorynidae and synonymised *Bicorona* with *Dicyclocoryne*. Both genera are here retained in the family Corynidae, mainly because *Dicyclocoryne* has tentacle bulbs with high gastrodermal chambers and because *Bicorona tricycla* is intermediate between *Dicyclocoryne* and *Coryne*. For more details see the discussion on phylogeny and under genus *Bicorona*.

The difficulties in delimiting the family as a monophyletic taxon are due to the very limited number of characters that can be used for phylogenetic reconstructions. The macrotaxonomy of the aforementioned families appears thus only resolvable by using molecular techniques.

Like the limits of the family, the generic division of the family Corynidae is a longstanding controversy that is still not resolved satisfactorily (comp. Petersen, 1990). The main problem resides in the fact that many Corynidae have lost their medusa stage and the polyp phase does not offer enough characters to discriminate genera that are congruent with the system based on the medusae. Traditionally (e. g. Rees, 1957; Brinckmann-Voss, 1970; Bouillon, 1985a), the Corynidae were primarily subdivided based on the presence or absence of a medusa stage: *Coryne* had sessile gonophores, while *Sarsia* and *Dipurena* liberated free medusae. The distinction of *Sarsia* and *Dipurena* was based on the number of gonads. Several authors proposed an even finer subdivision and numerous synonyms are thus available. Mostly they are not worth being discussed further, perhaps with the exception of *Staurocoryne* and *Stauridiosarsia*, taxa occasionally still used by some non-taxonomists. *Staurocoryne* and *Stauridiosarsia* refer simply to *Coryne* or *Sarsia* species that have polyps with filiform tentacles. Numerous investigations have shown that the presence of these filiform tentacles is dependent on environmental conditions and they have likely been reduced several times during evolution. Furthermore, their presence is most probably a plesiomorphy and today's consensus is that they should not be used to delimit genera, but they are an important diagnostic trait to discriminate certain species.

The subdivision of the Corynidae into the three genera *Coryne, Sarsia*, and *Dipurena* has gained wide acceptance, although this classification is based on two characters only (loss of medusa stage, number of gonads). Both characters are apomorphies, but it is widely known from other hydrozoan families that the loss of the medusa stage has presumably occurred several times independently (e. g. Cunningham & Buss, 1993). Some corynids additionally present interpretational difficulties. *Sarsia occulta* forms liberable medusae, which however – depending on clone and environmental conditions – are retained on the polyp. To make the case even more perfid, the retained medusae also lose the long manubrium, another characteristic of most *Sarsia* medusae. *Sarsia occulta* thus clearly shows the shortcomings of this system (although, admittedly, it is very informative and practical!).

The only attempt to classify the Corynidae based on their phylogeny, meaning using cladistic methodology, was made by Petersen (1990). His findings will be discussed in detail below.

A cursory overview on the distribution of the Corynidae, in particular the species diversity, reveals that the best investigated sites like Great Britain, the Vancouver Island Region, and the Mediterranean also have the highest number of reported species. The investigations of Edwards (1978, 1983) and Brinckmann-Voss (1985; 1988; 2000) clearly show that life-cycle studies can reveal the existence of sibling species. Species diversity thus largely depends on search effort and many more species could likely be found. In particular the tropics are insufficiently examined.

The studies of Bouillon and co-workers at one restricted site in Papua New Guinea and using appropriate collecting methods (not general plankton samples) demonstrated the existence of an immense variety of small medusae and hydroids (Bouillon, 1978b-1985, Bouillon *et al.*, 1988-1991, Boero *et al.*, 2000).

It can therefore be expected that closer examinations of other localities will reveal the existence of considerably more species than known so far.

2. PHYLOGENY OF THE CORYNIDAE

Based on cladistic methodology, Petersen (1990) made a detailed analysis of the phylogeny of the Capitata and within them also the family Corynidae. Petersen used his findings to create a new classification. His classification has been accepted for some taxa (e. g. in Schuchert, 1996), but that of the Corynidae has attracted criticism (Kubota & Takashima, 1992; Pagès *et al.,* 1992; Schuchert, 1996; Brinckmann-Voss, 2000). The phylogeny of the Corynidae as interpreted by Petersen (1990) is shown in Figure 1.

Although Petersen's phylogenetic hypothesis must be regarded as an essential step towards a natural classification and his work is mostly well founded, there are indeed several points that need reconsideration. In the following, the transformation steps given by Petersen (in italic, see also Fig. 1) will be discussed in detail. Cladistic terms and methodology used here follow the general usage (e. g. as in Ax, 1984).

a) *tentacles homologous to aboral whorl in the Tubularoidea thin or completely reduced.*
Petersen postulates that the ancestor of the Corynidae and Eleutheriidae had a polyp with only one whorl of oral tentacles and one whorl of filiform tentacles, basically resembling the polyps of *Dipurena reesi* or *Cladonema radiatum.* The capitate tentacles below the oral whorl – here named lower capitate tentacles – were thus absent in the ground state of the Corynidae and Eleutheriidae. Outgroup comparisons (e. g., to the Solanderiidae, Pennariidae, Acaulidae, Zancleidae etc.), however, suggest that it is more parsimonious to assume the presence of these lower tentacles in the ground plan. It is more plausible that these lower tentacles were reduced in a few events (Eleutheriidae, Tubularoidea, some Corynidae) than to assume the independent appearance of these lower tentacles in several taxa. Prévot (1959) even mentions an unidentified *Cladonema* species from the Red Sea that had two whorls of capitate tentacles. The stem species of the Corynidae most probably had lower capitate tentacles reaching to or beyond the middle of the body, thus overlapping with the site of gonophore development. According to this view, species conforming with the ground plan of the Corynidae are *Coryne producta* or *C. japonica.*

b) *aboral tentacles thin and transformed into sense organs.*
This is a good synapomorphy uniting Corynidae and Eleutheriidae (sensu Petersen, 1990). The filiform tentacles, however, have been lost is some groups again. Some vestiges of them may remain as a ring of sensory cells (e. g. as in *Sarsia lovenii*).

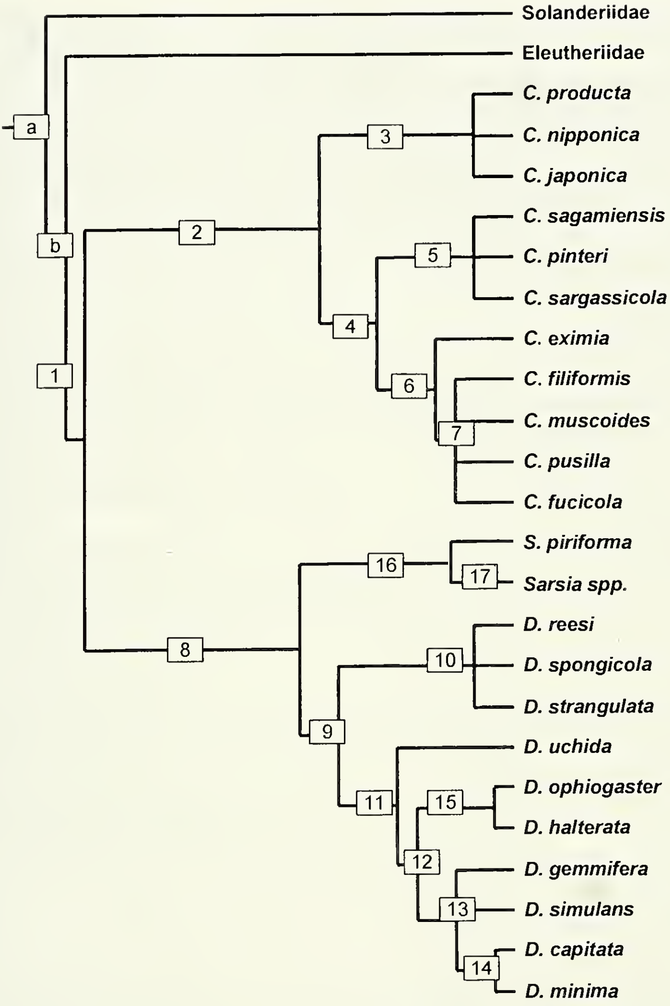

FIG. 1

Phylogeny of the Corynidae according to Petersen (1990). For the numbers and letters indicating character changes see text.

1) *marginal bulbs in medusa with bulbous gastrodermal chamber and nearly closed ring of thickened epidermis with nematocysts.*
This is perhaps a synapomorphy of the Corynidae, but some Eleutheriidae (e. g. *Cladonema radiata*) have comparable bulbs.

2) *gastrodermal chamber ovoid, laterally flattened, with tentacles issuing obliquely.*
This is invalid for several reasons. The shape of the gastrodermal chamber depends on the filling of the gastrodermal system and it is also otherwise highly variable. I was unable to find ovoid and laterally flattened chambers in the species

Coryne sensu Petersen. Furthermore, the shape is dependent on the state of contraction, and even in relaxed medusae it shows intra-specific variation.

Outgroup comparisons clearly show that the oblique direction of the tentacles is prevalent in out-groups like Eleutheriidae and Zancleidae and it is probably a plesiomorphic character. The vertically issuing tentacles occur also in *Coryne inabai* and most *Sarsia* and *Dipurena* species clearly issue their tentacles obliquely (see e. g. the photographs in Miller, 1982: fig. 3). Moreover, the direction is often variable and dependent on the state of contraction.

3) *medusae buds developed at location and instead of lowest whorl of lower capitate tentacles.*

This is a problematic character. The gonophores do not replace tentacles, but tentacles are reduced due to reproductive exhaustion (see e. g. Edwards, 1978: 309). This tentacle reduction starts with the lowest tentacles first. The location of the gonophores at the level of the lowest tentacles, meaning in the middle of the hydranth of the species concerned (*C. producta*, *C. japonica*, *C. nipponica*) is probably a plesiomorphic trait. Only the spreading of the gonophores towards the more distal tentacles is apomorphic.

In *Coryne japonica,* the gonophores are either independent from the tentacles or in their axils (Schuchert, 1996). Thus this character comes in mixed states in some species and furthermore they do not necessarily replace the lowest whorl of tentacles as asserted by Petersen (1990).

4) *medusae buds developed in the upper axils of the capitate tentacles.*

This is a clear and important apomorphy for a clade within the genus *Coryne.*

5) *perisarc transparent, wrinkled.*

A very problematic character which is most probably dependent on environmental conditions. Culture experiments (e. g. Brinckmann-Voss, 1970) have clearly shown that the morphology of the perisarc may depend on external factors.

6) *stems upright, regularly branched*

A weak apomorphy, very likely to show extensive homoplasia.

7) *medusae reduced to fixed sporosacs.*

A synapomorphy at this level only. Petersen strongly argues against using the reduction of the medusa phase as a synapomorphy for defining genera within the Corynidae. However, compared to the low complexity of the other characters recognised here as valid synapomorphies, the classification based on medusa reduction appears equally credible.

8) *manubrium of medusa with thin proximal part and swollen distal stomach.*

A good synapomorphy, although the transition between thin and swollen part can be rather gradual in some species (see also Pagès *et al.,* 1992).

9) *gonad developed around distal stomach; endodermal chamber of marginal bulbs regularly ovoid with radial canal and tentacle openings at top and bottom centre; button-shaped hypostomal gland field.*

The gonads covering the stomach region is certainly a plesiomorphic condition as it is also present in *Coryne* sensu Petersen. It is thus not useful to detect a monophyletic group.

The morphology of the gastrodermal chamber is too variable and was found to be of little significance for recognising clades.

The epidermal field of high gland cells around the mouth of the polyp is a problematic character, perhaps it is a plesiomorphy. Some infertile polyps collected by myself at Sandgerdi (Iceland) had all the characteristics of *S. tubulosa* and they also had a calotte of high epidermal cells. Likewise, *S. lovenii* has them too. Preserved material of *S. occulta* also quite clearly showed a calotte of high epidermal cells. According to Bouillon (1995), also *Coryne japonica*, *C. producta*, and *C. filiformis* have these cells. Furthermore, the same morphology is also found in *Zanclea* and *Asyncoryne*, genera only quite distantly related to Corynidae. In some Eleutheriidae these cells are also present, but they are so numerous that they form a pre-oral chamber. These facts taken into account, one can as well assume that the absence of such cells constitutes an apomorphy.

10) *gonad on stomach not reaching serpentine part of manubrium.*
This is not correct for the species concerned, they do have additional gonad cylinders on the thin part.

11) *"oral tentacles" in hydroid spread over hydranth, independent of medusae buds.*
Probably invalid, see remark under point a).

12) *gonad on distal stomach reaching serpentine manubrium section.*
Invalidated under point 10.

13) *gonad forms one ring.*
Is a plesiomorphic condition, thus not suitable for recognising a clade.

14) *medusae tentacles with stalked capitations.*
A good synapomorphy. However, life-cycle information is still missing for the two species of *Cladosarsia.*

15) *gonad divided into separate cylinders.*
A good synapomorphy uniting most members of the genus *Dipurena.*

16) *gonad developed on serpentine part of manubrium and not on stomach; gastrodermal chamber of bulbs saddle-shaped.*
The gonad-free stomach is a good synapomorphy for the genus *Sarsia* sensu Petersen, while the shape of the gastrodermal bulb chamber is not generally applicable.

17) *oral tentacles in hydroid spread over distal part of hydranth above medusae budding zone.*
Probably invalid as discussed under a) and 11).

We are thus left with the following more or less reliable synapomorphies summarised below and in Figure 2:

a) *most proximal tentacles very thin, without nematocysts, transformed into sense organs.*

b) *medusa with branched tentacles and sucker pads, more than four radial canals, polyp with preoral chamber.*

1) *marginal bulbs in medusa with large gastrodermal chamber and nearly closed ring of thickened epidermis with nematocysts.*

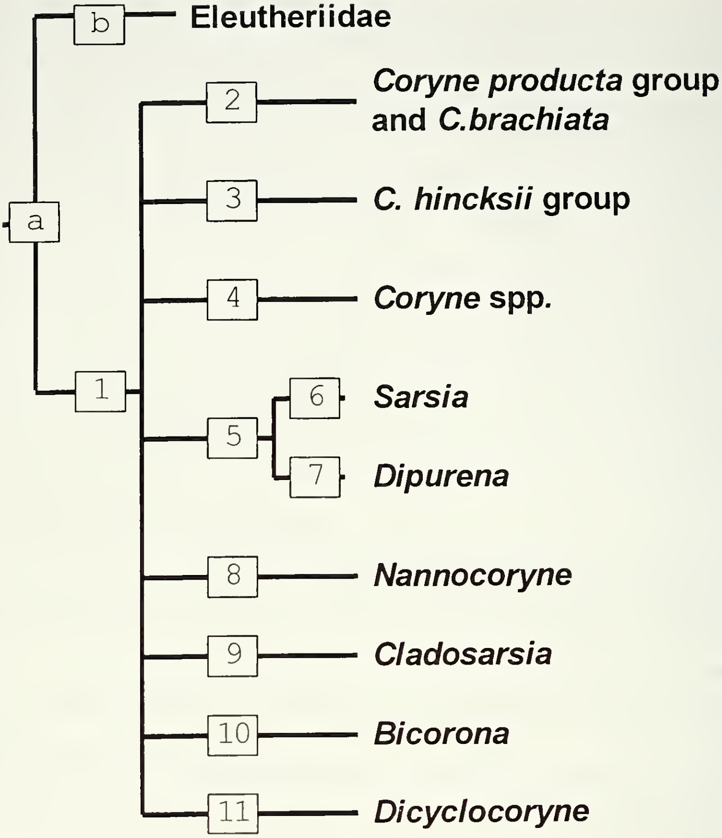

FIG. 2

Revised phylogeny of the Corynidae. For the numbers and letters indicating character changes see text.

The ground plan of the Corynidae comprises a polyp with an oral whorl of capitate tentacles, lower capitate tentacles reaching to the middle of the hydranth, gonophores developing in middle of hydranth among lowest capitate tentacles, one whorl of filiform tentacles. The medusa is small and has a short manubrium completely covered by one gonad. The ground plan of the Corynidae is thus best represented by species like *Coryne producta* and *C. japonica*.

2) no character available.

3) *medusa phase reduced to eumedusoids (sporosacs with radial canals), loss of filiform tentacles.*

4) *medusae buds develop in the upper axils of the capitate tentacles.*

5) *manubrium of medusa longer than bell, with thin proximal part and swollen distal stomach, cnidome comprises oblong isorhiza nematocysts* (lost in some species again).

6) *gonad only on thin part of manubrium, leaving swollen stomach region uncovered, lower capitate tentacles confined to zone above gonophore production.*
7) *gonad covers stomach nearly to distal end, gonad on serpentine part nearly always divided into several rings* (except *D. gemmifera*)*; lower capitate tentacles of polyp confined to zone above gonophore production for the majority of species.*
8) *gonophores completely reduced, gametes retained in gastrodermis.*
9) *medusa with branched tentacles* (perhaps shared with Eleutheriidae?).
10) *number of tentacles in lowest whorl twice or more the number found in oral whorl, gonophores reduced to sporosacs, sporosacs produced distal to aboral whorl of capitate tentacles; colonies large and branching, perisarc annulated throughout.*
11) *two whorls of tentacles, lower one with slightly more tentacles than upper one, medusae developing below tentacles, medusae released without ocelli.*

A useful character not mentioned by Petersen (1990) is the presence of oblong isorhiza capsules in the polyp or medusa. The cnidome is not known far all species of the Corynidae, but these oblong isorhizas are only present in members of the genera *Sarsia* and *Dipurena* (sensu lato, synapomorphy number 5).

Nevertheless, it is plainly evident that we do not have enough characters to resolve the phylogeny of the Corynidae and their relatives. In particular, there is no apparent synapomorphy for all members of the genus *Coryne* sensu Petersen. The genus *Coryne* as used here may thus be paraphyletic, but there is also no evidence that some of these *Coryne* groups are more closely related to the clade having long manubria (clade 5). The synapomorphies 4, 5, 6, and 7, however, must be used for a classification based on monophyletic groups and genus definition based on the cladogram given in figure 2 are used in this study. This system is largely congruent with the one of Petersen (1990), and it differs only in the generic placement of *C. uchidai* (see under this species for a discussion), and the provisional retention of the genera *Bicorona, Dicyclocoryne, Cladosarsia* and *Nannocoryne*. Contrary to Petersen (1990), both described species of *Cladosarsia* are here regarded as valid. Applying the synapomorphies outlined above, *Cladosarsia minima* would fall within the genus *Coryne*, *Cladosarsia capitata* to the genus *Dipurena*. I think it is advisable to keep both in the genus *Cladosarsia* until more data on their life cycle becomes available. Perhaps they are even a sister group of the Eleutheriidae, with which they share the branched tentacles. Likewise problematic is *Nannocoryne mammylia*, as its gonophores are totally reduced. Only molecular sequence analysis can give reliable data on its affinity.

Despite all this, the classification as used here is quite unambiguous and only the position of *Sarsia lovenii* is somewhat controversial. *Sarsia lovenii* is the only member of the clade *Sarsia* that has a medusa that is never released. Although *Sarsia occulta* medusae can remain fixed at the polyp stage, the liberated medusae are unequivocally related to otherwise typical *Sarsia* species.

Contrary to Petersen (1990), no clade Dicyclocorynidae is accepted and the group is here returned into the Corynidae. The medusa of *Dicyclocoryne* has tentacle bulbs with the characteristic, high gastrodermal chamber. This chamber is regarded as a weak synapomorphy for the Corynidae. Also Petersen used this synapomorphy to demonstrate the monophyly of the Corynidae. For further discussions see remarks under genus *Bicorona*.

Unclear remains also the position of the Solanderiidae with its sole genus *Solanderia* (Schuchert, 1996). *Solanderia* polyps resemble closely corynid polyps and its cnidome is identical to the one found in most *Coryne* species. Only their gonophore production on the branches and not hydranths sets them apart from most Capitata. The lack of comparable characters precludes any further discussions on their affinity.

These facts underline once more how important new approaches, like DNA sequencing, are for giving us a more accurate picture of corynid phylogeny. Additionally, further life-cycle observations, notably knowledge of the polyp stages of *D. gemmifera* and *Cladosarsia* spp., can help us to test the validity of the system proposed above.

3. MATERIAL AND METHODS

Corynid medusae and polyps are best studied alive. General collection methods for medusae and hydroids have been described by Russell (1953), Naumov (1969), Brinckmann-Voss (1970), and Bouillon & Barnett (1999). These authors also give a good introduction to the general morphology and terminology of these animals. The term "shoot" is here often used and it refers to a single, erect, polyp bearing stem arising from the stolons. All shoots and the stolons form the colony. Sometimes also the expression cormoid is used for this element (see Schuchert, 1996).

Ideally, medusae are caught by dipping a glass beaker. However, the densities are usually very low and the medusae hardly visible. Normally medusae are caught with a nylon plankton net. A mesh width of 0.25 mm is needed to collect also smaller forms and also to avoid damage by shearing. To further minimise damage the net should be dragged very slowly (up to 2 km/h). Due to the low abundance of these animals, large volumes of water must be filtered. Collection from long jetties and rowing boats give the best results, although even with slow filtration medusae will get damaged. Damaged medusae can sometimes be kept isolated in jars and they will regenerate. Many corynid medusae are seasonal, so samples must be taken at different dates. To account for diurnal migrations, samples must be taken at different depths or times of the day.

Polyps are best collected by examining pieces of rocks, shells, algae, sea-grass, sponges, etc. with the help of a stereomicroscope. The pieces can be obtained by diving or by dredging. Some polyps on rocks will become visible only after days or weeks in running sea-water. Feeding with planktonic crustaceans or *Artemia* nauplii hatched from dried egg may help to promote the growth of such colonies.

Examination of nematocysts is preferably done in living material. The size of nematocysts can also be measured in preserved material if it is immersed in 50 % lactic acid. Preserved nematocysts show about 10 % shrinkage, which is not much in view of the often considerable size variation of the capsules. Values given in this publication were usually obtained from preserved material.

4. ABBREVIATIONS

BCPM	Royal British Columbia Museum, Victoria, Canada
IRSNB	Institut Royal des Sciences Naturelles de Belgique, Bruxelles, Belgium
MHNG	Muséum d'Histoire Naturelle Genève, Switzerland
MNHN	Muséum National d'Histoire Naturelle, Paris, France
NMSZ	National Museums of Scotland, Zoology, Edinburgh, United Kingdom
NSMT	National Science Museum, Tokyo, Japan
ROMIZ	Royal Ontario Museum, Toronto, Canada
USNM	Unites States National Museum (Smithsonian Institution), Washington, USA
ZMA	Zoological Museum, University of Amsterdam, The Netherlands
ZMUC	Zoological Museum Copenhagen, Denmark
ZSM	Zoologische Staatssammlung München, Munich, Germany.

5. FAMILY CORYNIDAE, SYSTEMATIC PART

Diagnosis – Hydroids with colonial, monomorphic polyps having club-shaped to cylindrical or slightly vasiform bodies. With one whorl of capitate tentacles around mouth, with or without further capitate tentacles below them, with or without one whorl of filiform tentacles. Colonies upright, stolonal or branching, monosiphonic, stem and branches covered by perisarc. Stolons tubular. Nematocysts: stenoteles, with or without isorhizas or mastigophores, desmonemes absent. Gonophores in most species arising on hydranths, either liberated as free medusae or retained as medusoids or sessile sporosacs. Exceptionally gonophores completely reduced and gametes stored in hydranth wall. Free medusa if present with four radial canals, four tentacle bulbs, and four tentacles. Tentacle bulbs with a distinct gastrodermal chamber, epidermal part contains many nematocyst and forms a complete or nearly complete ring around tentacle base. Each bulb normally with one abaxial ocellus only. Manubrium cylindrical, without lips, gonads encircle manubrium without perradial interruptions. Exumbrella without nematocyst pouches. Nematocysts as in polyp stage, but additionally with desmonemes, macrobasic euryteles absent. Newly released immature medusae with manubrium always shorter than bell cavity.

5.1. Genus *Coryne*

Synonyms – (in part or fully) *Fistularia* Mueller, 1776; *Fistulana* Mueller, 1776; *Capsularia* Cuvier, 1798; *Stipula* M. Sars, 1829; *Syncoryna* Ehrenberg, 1834; *Hermia* Johnston, 1838; *Halybotrys* de Filippi, 1866; *Actinogonium* Allman, 1871 [not *Actinogonium* Schomburgk, 1847]; *Staurocoryne* Rotch, 1872; *Eucoryne* Broch, 1909 [not *Eucoryne* Leidy, 1855]; *Actigia* Stechow, 1921; *Perinema* Stechow, 1921.

Type species – *Coryne pusilla* Gaertner, 1774.

Diagnosis – Hydroids colonial with creeping stolons, stems branched or unbranched. Hydranths with capitate tentacles either scattered, or in at least three whorls, whorls below oral one usually with four (rarely five or six in some hydranths) tentacles only; with or without filiform tentacles. Gonophores develop either in the upper axil of the lower capitate tentacles or among the lowest whorl of capitate tentacles. These proximal tentacles can be reduced with ongoing gonophore maturation. Isorhiza nematocysts absent from polyp stage. Gonophores remain fixed or are released as free medusae. Tentacles of medusa unbranched. Manubrium of free adult medusa not longer than bell, without thin proximal part. Gonads cover manubrium for most of its length.

Remarks – The outline of this taxon has been discussed above in chapter 2 and corresponds closely to the concept of Petersen (1990).

Coryne tricycla Schuchert, 1996 is here excluded from the genus *Coryne* and placed in the genus *Bicorona* Millard, 1966. To account for this, only Corynidae with roughly equal numbers of tentacles per whorl (normally four, exceptionally up to six) are here accepted in the genus *Coryne*.

With one exception (*Sarsia lovenii*), the genus *Coryne* as conceived here comprises all the Corynidae with fixed gonophores as well as those producing free medusae with a short manubrium. The genus *Sarsia* as seen here, and in agreement with Petersen (1990), comprises only Corynidae with a long manubrium.

The development of gonophores in the upper axil of the capitate tentacles is a good synapomorphy that unites several *Coryne* species to a clade of their own. A future revision based on the discovery of new characters might exclude the remaining *Coryne* species which produce gonophores independent from the tentacles. Some of them show a mixed character state, e. g. *Coryne japonica* and *C. cliffordi* develop medusae buds in the axil of tentacles as well as independent of them (Schuchert, 1996). Some species are only provisionally allocated to *Coryne* as they are not adequately known and new data may necessitate removing them from here. *Coryne* thus serves also as default genus for hydroids with incomplete life-cycle information. The order of the species given in the following is approximately as sketched in figure 2. The groupings made within the genera do not necessarily correspond to clades and are only made to allow easier comparisons. The groups are formed by grouping similar species around a well known or easily identifiable species. The groups are as follows: *Coryne producta* group, *Coryne hincksii* group, *Coryne brachiata* group, *Coryne pintneri* group, and *Coryne eximia* group.

5.1.1. *Coryne* species with non-axillary gonophores

This is a paraphyletic or polyphyletic grouping.

5.1.1.1. *Coryne producta* group

This group comprises the species *Coryne producta, C. cliffordi, C. japonica,* and *C. nipponica.* Important differences between these similar species them are tabulated in table 1.

TABLE 1. Differences of the species resembling *Coryne producta*

character	*C. producta*	*C. cliffordi*	*C. japonica*	*C. nipponica*
size of adult medusa, mm	6-10	5.5	3-6	1.2 - 2.4
tentacles of medusa	long	long	long	short
nematocyst clusters on tentacles of medusa	>50	>50	>50	<13
egg size in µm	11-46	about 200	105±14	127±10
radial canals very fine	no	yes	no	no
exumbrellar nematocysts in young medusa	scattered	variable	8 adradial rows	scattered
polyp size in mm	0.8-1.5	1.4-1.7	1.3-2.7	1.3-1.9
filiform tentacles of polyp	always present	absent	frequently present	ephemeral
polyp capitate tentacles	12 (8-16 range)	16-20	18 (12-24 range)	16-18
lower capitate tentacles	2 whorls	scattered	3 whorls	scattered
number of medusa buds	1-5	3-20	up to 14	2 (max. 4)
buds clustered	never	possible	possible	no
stems branched	no	occasionally	no	no

Coryne producta (Wright, 1858) Fig. 3A-C

Coryne cerberus Gosse, 1853: 222, pl. 14 figs 4-6; Rees, 1938: 37.
? *Oceania thelostyla* Gegenbaur, 1856: 224, pl. 8 fig. 9.
Stauridia producta Wright, 1858: 283, pl. 7, figs 6-8; Hartlaub, 1895: 142, pl. 7 figs 1-19, pl. 8 figs 1-8, pl. 9 figs 1-2, 6.
not *Coryne producta* Hargitt, 1902: 551 [=*Sarsia hargitti* Mayer, 1910]
Sarsia producta – Kramp, 1959: 80, fig. 19; Brinckmann-Voss, 1970: 67, figs 77-78; West, 1974: 5, figs 1-2; Brinckmann-Voss, 1989: 688, tables 2-3, fig. 7; Altuna Prados, 1993: 30; Orlov, 1996: 329, figs 8.
Stauridium productum – Hincks, 1868: 68, pl. 12 fig. 1; Allman, 1871: 371, pl. 17 figs 11-12; Hartlaub, 1907: 53, figs 48 50; Rees, 1938: 37, fig. 11.
Stauridiosarsia producta – Russell, 1953: 64, figs 26A-C, 27A-B; Kramp, 1961: 33; Kramp, 1968: 8, fig. 10.
Coryne producta – Petersen, 1990: 211; Schuchert, 2001: 49, Fig. 35.
? *Sarsia* sp. – Altuna Prados, 1993 : 35, fig. 4a-d.
not *Coryne producta* – Migotto, 1996: 21, fig. 5d-g, [=*Coryne nipponica*].
TYPE LOCALITY – Firth of Forth, Scotland.
MATERIAL EXAMINED – ZMUC, north of Frederikshavn harbour, Denmark, 0.2 m depth, on *Halichondria* (Porifera), 11. 08.1972, polyps and young medusae – Sandgerdi, Iceland, 0.5 m, May 2000, infertile polyps, cultivated for 10 months, no gonophores formed, described also in Schuchert (2001).

DESCRIPTION – (combined from various sources) Hydroid stolonal, cauli short, perisarc smooth or slightly wrinkled, thin. Hydranths clavate, height 0.8-1.5 mm when relaxed, diameter 0.15-0.23 mm, hypostome dome shaped, short. One whorl of 4-6 oral tentacles, 1-3 additional whorls of lower capitate tentacles, whorls distinct, normally 4 tentacles per whorl but 3-6 possible in some hydranths, tentacle positions alternate in adjacent whorls. Total number of capitate tentacles 12-16. At lower third of hydranth a single whorl of 3-6 filiform tentacles. The filiform tentacles are a constant feature of this species. They are produced during development just after the oral whorl of tentacles, thus before the lower tentacles. Gonophores develop among or below the lowest whorl of capitate tentacles and are set free as medusae, 1-5 buds per hydranth. Colour: reddish gastrodermis. Nematocysts: stenoteles, (23-27) x (20-21) μm and (15-16) x (11-12) μm.

Newly released medusa 0.8-1.1 mm high, slightly less in diameter, with scattered nematocysts on exumbrella, apical canal present.

Adult medusa 6-10 mm in height, diameter 5-8 mm, umbrella bell shaped to spherical, top rounded, jelly thick, jelly at apex about 1/4 of total height. Velum spans 1/2 of its radius. Manubrium 2/3 to 1/1 as long as bell cavity, tubular, with long apical canal spanning at least 1/2 of the mesogloea, base of apical canal may be enlarged to a conical apical knob. Gonad encircles manubrium for nearly its entire length, leaving short free parts near base and mouth. Radial canals and circular canal of similar thickness. Radial canals well visible, entering gastrodermal chamber of bulbs in middle. Gastrodermal chamber of bulbs high. One black or deep-brown ocellus on abaxial side of epidermal ring of tentacle bulb. Tentacles long (<1.5 bell height), covered with many crescent shaped nematocyst clusters, terminal cluster spherical, not or only slightly enlarged. Colours: apical canal and bulbs reddish or brown. Nematocysts: stenoteles as in polyp; desmonemes (6-7) x (9-10) μm.

DISTRIBUTION – European Atlantic coast from Bay of Biscay to White Sea and Iceland; North American coast along New England region. The presence in the Mediterranean is uncertain (Brinckmann-Voss, 1970).

BIOLOGY – The polyp was found growing on *Tubularia indivisa* (Rees, 1938), on *Spartina* spec. (Salt Marsh Grass: West, 1974), shells (Orlov, 1996), and probably on many other solid objects, just below the low water line. The medusa has only rarely been collected from nature (e. g. by West, 1974). Orlov (1996) describes prey capture and preference. The most common prey items were copepod nauplii, protists, and larvae of gastropods and polychaetes. Aspects of its ecology and feeding behaviour were also studied by Orlov (1996).

REMARKS – The adult medusa of *Coryne producta* resembles *C. eximia*, but living specimens should be distinguishable. *Coryne producta* is considerably larger (5-10 mm versus 3-4 mm) and has a distinct apical canal or chamber. Their polyp phases are very different.

Coryne producta in both polyp and medusa phase differs only little from *Coryne japonica*. Differences between the two are discussed under the latter species and in table 1 (see also Kubota & Takashima, 1992).

The medusae of *C. producta* and *C. cliffordi* are likewise similar, although their polyp phases differ. The medusae – they are apparently not sympatric – can be distinguished by the much thinner radial canals in *C. cliffordi*.

West (1974) tabulates an egg size of 11-46 μm for this species. This seems unusually small and needs reconfirmation.

Naumov (1969) reported this species also from the Sea of Okhotsk. He had only a juvenile medusa and therefore his identification must be considered uncertain. Moreover, *Coryne japonica* is not readily distinguishable from this species.

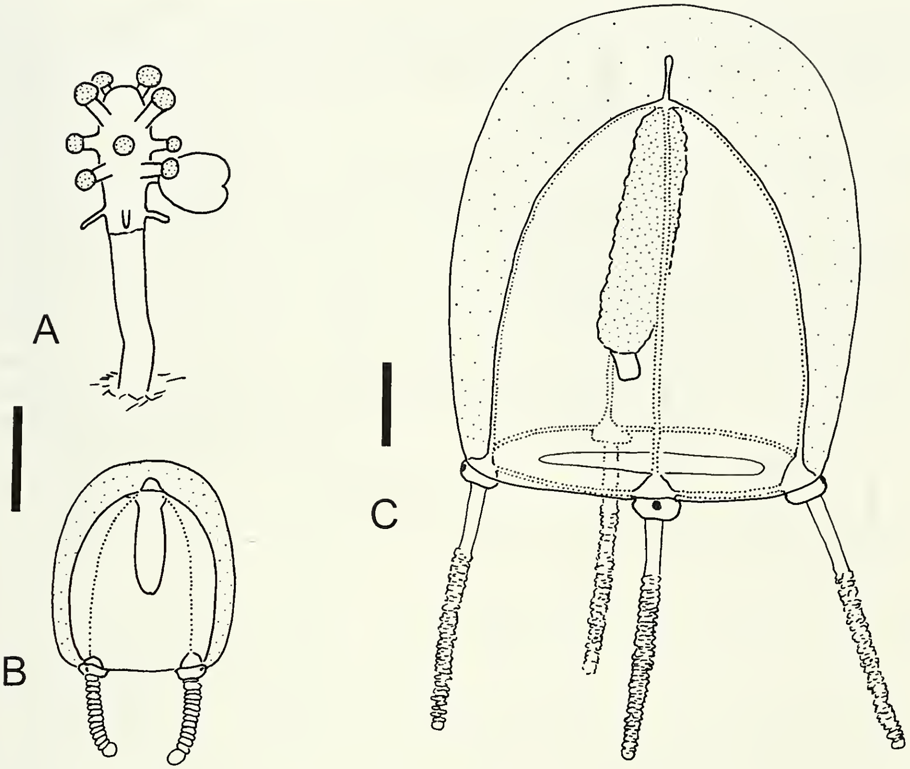

FIG. 3

Coryne producta (Wright, 1858). A-B, after preserved material from Denmark, C, modified after Russell (1953). A) Somewhat contracted polyp with medusa bud, scale bar 0.5 mm. B) Newly released medusa, same scale as A. C) Mature medusa, scale bar 1 mm.

The ultrastructure of receptors in the filiform tentacles was investigated by Golz & Thurm (1994). Vannucci (1949) and Migotto (1996) identified a corynid polyp from Brazil as *C. producta.* They were able to rear the medusa. The polyp had more than the usual two whorls of lower tentacles and the mature medusa reached only 3 mm in height, had no apical canal, and short tentacles covered by only a dozen nematocyst clusters. These are all characteristics of *Coryne nipponica* and the Brazilian records are here referred to this species (in a personal communication Dr. A. Migotto agreed with this view).

Coryne cliffordi (Brinckmann-Voss, 1989) Fig. 4

Sarsia sp. I Arai, 1987: 187, pl. 4.
Sarsia cliffordi Brinckmann-Voss, 1989: 685, figs 1-4.
TYPE LOCALITY – Sooke Harbour, British Columbia, depth 0.2 m (hydroid).
MATERIAL EXAMINED – ROMIZ B934, paratypes, 2 female medusae raised from holotype colony by A. Brinckmann-Voss, August 1984 – MHNG INVE 29807, Canada, Quadra Island near Vancouver Island, hydroid colony with medusae buds growing on other hydroid, from floating dock, 0.2-0.5 m, coll. 10.06.1999 by A. Brinckmann-Voss.

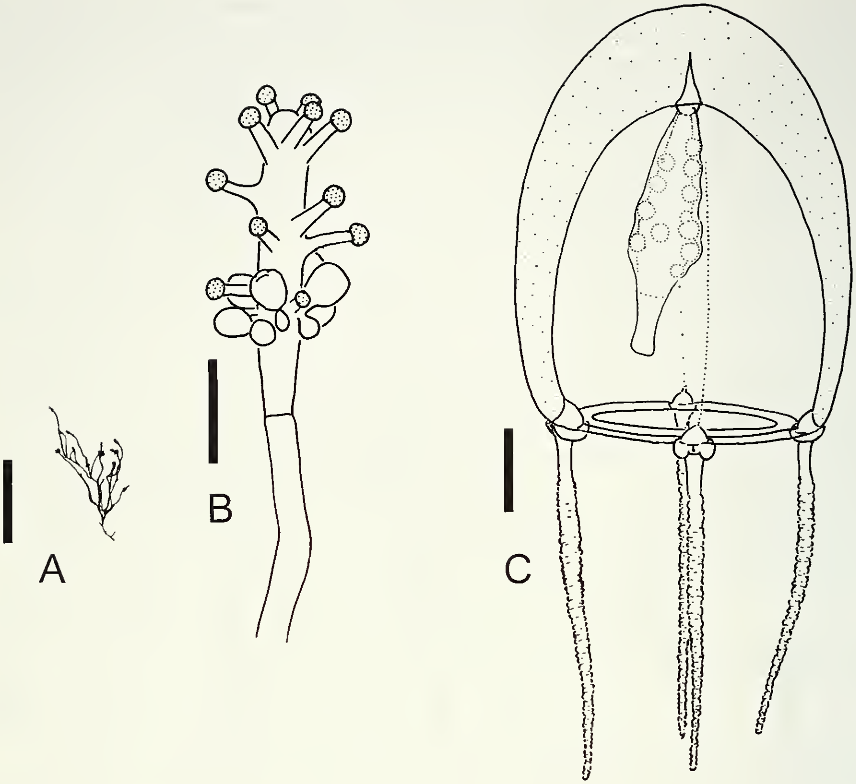

FIG. 4

Coryne cliffordi (Brinckmann-Voss, 1989). A) Hydroid colony, scale bar 1 cm. B) Hydranth with medusae buds, scale bar 0.5 mm. C) Female medusa, scale bar 0.5 mm.

DESCRIPTION – (partly after Brinckmann-Voss, 1989) Hydroid forms bushy colonies up to 2 cm high, stolons tangled but not anastomosed, transition between stolons and caulus indistinct, larger stems usually branched a few times. Stems and stolons enclosed in clear, transparent perisarc. Perisarc often wrinkled and undulated, rarely annulated. Hydranths fusiform, 1.4-1.7 mm in height, with an oral whorl of 4-5 capitate tentacles, oral tentacles 0.2-0.3 mm long, slightly shorter than lower tentacles, stalks not much tapering. Lower capitate tentacles present in 2-4 whorls, each with 4-5 tentacles, whorls sometimes indistinct and tentacles thus scattered. Filiform tentacles absent. Lowest fourth of hydranth free of tentacles. Gonophores develop in clusters of 1-3 among, above, or slightly below the lowest tentacles, 3-20 per hydranth. Gonophores develop mostly independent from tentacles, perhaps by mere coincidence they are sometimes in their upper axils. Colours: hypostome and capitulae white, gastrodermis of body pink, gonophores brown, yellow, or pink. Nematocysts: stenoteles, (18-19) x (12-13) µm and (11-12) x (7-8) µm.

Gonophores are released as free medusae. Newly released medusa 1 mm in height and diameter, exumbrellar nematocysts scattered or in rows, tentacles with about 10 nematocyst clusters, terminal one not enlarged. Nematocysts: stenoteles (10-11.5) x (7-8) µm; desmonemes (8-9) x (4) µm; round heteronemes on the exumbrella, (11-12) x (9-11) µm.

Mature medusa up to 5.5 mm high, diameter 2.5 mm, bell thus higher than wide, bullet-shaped, jelly thick, thicker at apex. Manubrium shorter than height of subumbrella, with large conical apical chamber spanning up to $^1/_2$ of apical mesogloea. Gonad covers nearly the whole manubrium but leaves distal 1/5 free, females with few (10-20) eggs. Radial canals very fine, much thinner than ring canal, barely visible in preserved material. Bulbs with ocellus, epidermal nettle ring thick, not completely encircling bulb. Tentacles issued obliquely or vertically, when extended longer than 1.5 times the bell height, covered by clasping nematocyst clusters, terminal cluster spherical and not enlarged. Colours: manubrium yellow to orange. Nematocysts: stenoteles (12) x (9) µm.

DISTRIBUTION – Pacific coast of Canada.

BIOLOGY – The polyp occurs on mussels, barnacles, and logs. It can tolerate reduced salinity. The life span of medusa is about 5 weeks and it can spawn several times.

REMARKS – *C. cliffordi* medusae resemble *C. eximia*, *C. producta* and *C. japonica*. The very thin radial canals are a characteristic of this species. For further discussions see under these species and table 1.

The reported occurrence of macrobasic euryteles in the newly released medusae (Brinckmann-Voss, 1989) is erroneous (A. Brinckmann-Voss, pers. com.). My own examinations revealed the occurrence of a spherical heteroneme on the exumbrella of the young medusa.

Coryne japonica (Nagao, 1962) Fig. 5A-C

Stauridiosarsia japonica Nagao, 1962: 176, figs 1-5; Kubota, 1976: 231. fig 1.9-12, nematocysts.
[not *Sarsia japonica* Maas, 1909 = *Euphysa japonica*]
Sarsia japonica – Arai & Brinckmann-Voss, 1980: 21, fig. 10; Brinckmann-Voss, 1989: table 2 & 3; Kubota & Takashima, 1992: 371, figs 1-14; Schuchert, 1996: 128, fig. 79a-g.
TYPE LOCALITY – Akkeshi, Hokkaido, Japan.
MATERIAL EXAMINED – see Schuchert (1996), New Zealand material, in part also deposited at MHNG as INVE 27293 (slide).

DESCRIPTION – (after Nagao, 1962; Kubota, 1976; Kubota & Takashima, 1992) Hydroids mostly stolonal, occasionally branched once or twice, height 5-10 mm. Perisarc thin, transparent, entirely smooth. Hydranths 1.3-2.7 mm, diameter 0.3-0.44 mm, cylindrical to slightly clavate, with short dome-shaped hypostome; one oral whorl of 4-5 (max. 6) capitate tentacles, below them 3 whorls of lower tentacles, 4-5 per whorl, total number of capitate tentacles 12-24 (average 18), all tentacles of roughly equal length, stalks only slightly tapering. All capitate tentacles confined to distal half of hydranth. At lower third one whorl of 2-5 filiform tentacles. Gonophores develop among lowest whorls of capitate tentacles or below them, they are inde-

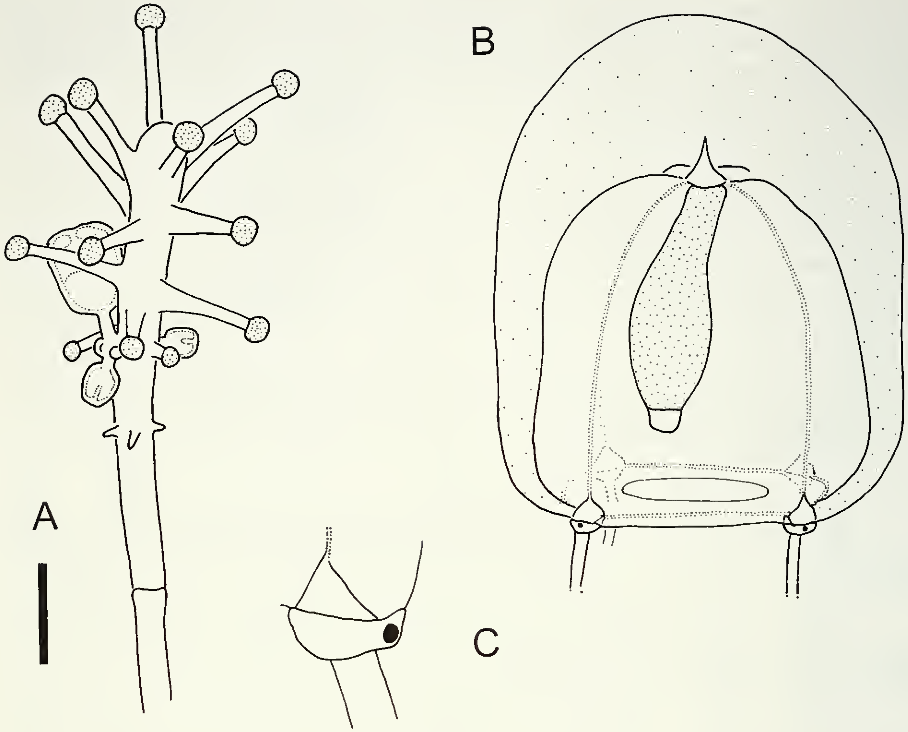

FIG. 5

Coryne japonica (Nagao, 1962), modified after Kubota (1992). A) Cultivated polyp with clusters of medusae buds, scale bar 0.5 mm. B) Mature medusa, (after 48 days), tentacles truncated, bell height 5.2 mm. C) Tentacle bulb, about three times larger than in B.

pendent of the tentacles, on relative long stalks, in clusters of usually up to 4, maximal observed number of gonophores per hydranth 14. Gonophores are released as free medusae. Colour: pink. Nematocysts: stenoteles of two size classes (for measurements see Kubota & Takashima, 1992).

Newly released medusa 1.1-1.4 mm, with exumbrellar nematocysts in eight adradial rows, radial canal wider than ring canal, with apical canal. Maturity in culture is reached after 2-3 weeks.

Mature medusa 3- 6 mm, bell nearly as wide as high, jelly thick, much thicker at apex where jelly is about as thick or thicker than 1/4 of bell height. Umbrella bell-shaped, top rounded. Velum spanning about 1/2 of its radius. Manubrium cylindrical, length about 2/3 to 1/1 of bell cavity, with or without shallow conical apical knob, shape of knob variable. Gonad covers manubrium nearly along its entire length. The radial canals are broader than the ring canal, entering the gastrodermal chamber of the bulb in the adaxial half. Gastrodermal chamber of bulbs triangular in side view. Epidermal nettle ring of bulb complete, abaxial ocellus black or red, tentacles issue bulbs obliquely. Tentacles very long, covered by clasps of nematocyst clusters, terminal cluster globular but not particularly enlarged. Egg size: 105±14 µm, more than 100 eggs per medusa. Nematocysts: two size classes of stenoteles; desmonemes; aberrant stenoteles on exumbrella of young medusa, resembling mastigophores (for measurements see Kubota & Takashima, 1992).

DISTRIBUTION – Coasts of Japan, British Columbia (Canada), New Zealand (Schuchert, 1996).

BIOLOGY – The polyps grow on shells, rock; from the intertidal to depths of 5 m.

REMARKS – *Coryne japonica* and *C. producta* resemble each other very closely. The differences, here considered significant, are listed in table 1. *Coryne nipponica* also resembles these species and the differences are discussed under *C. nipponica.*

Coryne japonica has so far been recorded from Japan (Nagao, 1962; Hirohito, 1988; Kubota & Takashima, 1992), British Columbia (Arai & Brinckmann-Voss, 1980) and New Zealand (Schuchert, 1996). A record from California was regarded as doubtful by Brinckmann-Voss (1989). The only records of the medusa were made by Arai & Brinckmann-Voss (1980) who found the medusa on the coast of British Columbia.

The population from New Zealand identified by myself (Schuchert, 1996) differed in some details from the Japanese one. The polyps had smaller nematocysts, their tentacles were occasionally scattered, gonophores developed also among the second lowest whorl of capitate tentacles. The medusae were slightly smaller, reached maturity in less time, lacked an apical knob, had a less thick jelly, and the nematocyst clusters of the tentacles were arranged like beads. The New Zealand medusae additionally had characteristic tufts of stiff cilia which were so far not observed in Japanese animals. As previous workers might have overlooked these cilia, not too much emphasis can be placed on this difference. If, however, these cilia are absent in medusae from the type locality, the population of New Zealand is probably a separate species.

Coryne nipponica (Uchida, 1927) Fig. 6

Sarsia nipponica Uchida, 1927: 183, pl. 10 fig. 1; Uchida, 1940: 222, fig. 4; Chow & Huang, 1958: 174, pl. 1 fig. 1; Kramp, 1961: 29; Kramp, 1968: 7, fig. 7; Kubota, 1991: 17, figs 1-9; ? Gravier Bonnet & Mioche, 1996: 173, fig. 2E.
Syncoryne nipponica – Nakamura, 1940: 255, figs 1-12; Nakamura, 1941: 185, fig. 1.
? *Sarsia producta* – Vannucci, 1949: 223, pl. 1 figs 1-2.
? *Coryne producta* – Migotto, 1996: 21, fig. 5d-g [not *Sarsia producta* (Wright, 1858)].
TYPE LOCALITY – Seto Marine Biological Laboratory, Misaki Tanabe Bay, Kishu, Japan.
MATERIAL EXAMINED – NSMT-Hy R2690, Japan, Sagami Bay, colony described by Hirohito (1988).

DESCRIPTION – (mainly after Kubota, 1991) Hydroid stolonal, cauli 0.4-1.6 mm, covered by thin periderm without annulations. Hydranths cylindrical to slightly clavate, 1.3-1.9 mm in height, with one oral whorl of 4-5 capitate tentacles, additionally 14-18 lower capitate tentacles scattered over distal 2/3 of hydranth. At lower third there may be a transient whorl of 4 filiform tentacles, these mostly absent in colonies from nature. Gonophores are formed among but independent of the lowest capitate tentacles, mostly two per hydranth, but a few more possible. Gonophores are

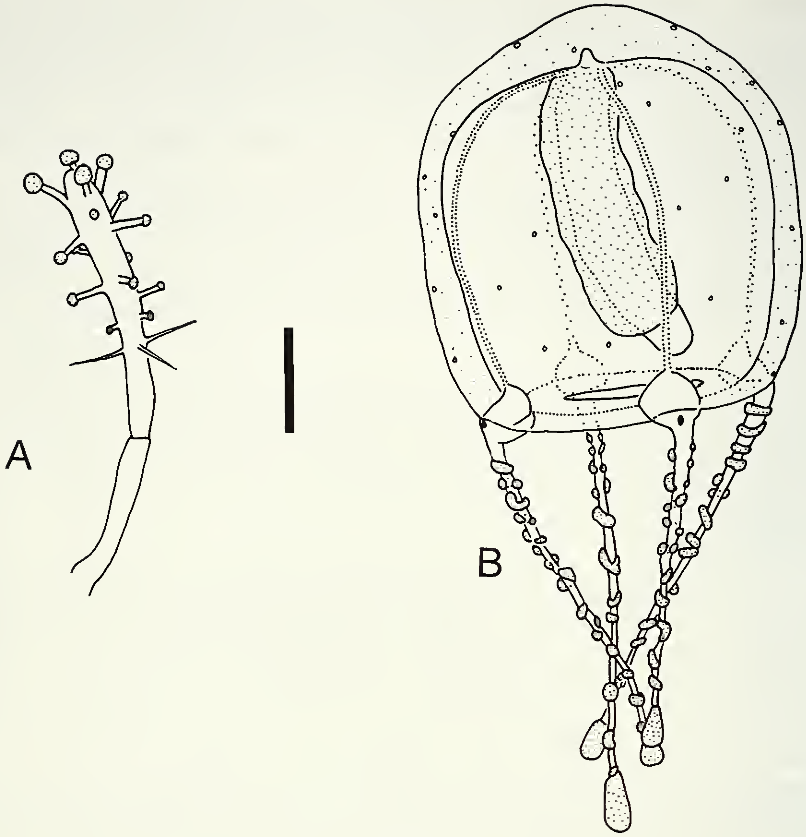

FIG. 6

Coryne nipponica (Uchida, 1927), modified after Kubota (1991), scale bar for both sections equals 0.5 mm. A) Hydranth from culture. B) Mature, cultivated medusa (after 8 days), note short tentacles and low number of nematocyst clasps.

released as free medusae. Colour: pink, reddish brown below hypostome. Nematocysts of polyp: stenoteles, (15-17) x (21-22) µm and (7-8) x (10-11) µm.

Newly released medusa 0.6 mm high, with scattered nematocysts on exumbrella, four short tentacles with only four nematocyst clusters, with or without brown ocelli. Medusa matures within 6 days.

Adult medusa 1.2 mm (nature) to 2.4 mm (culture), only slightly higher than wide, umbrella bell shaped, jelly of moderate thickness, thickness nearly even, only at top slightly thicker. Velum spans 1/2 of its radius. Manubrium nearly as long as height of bell cavity, tubular, with or without a small apical knob, no apical canal. The gonads encircle nearly the whole manubrium, leaving free only a small part near the mouth. Radial canals enter the gastrodermal chamber of the bulbs in the adaxial half. Gastrodermal chamber triangular in side view, abaxial side concave. Each bulb with a brownish-crimson ocellus and a short tentacle, tentacle fully extended only 0.5 to 1.1

times as long as bell size. Tentacles are stout, covered by maximally 13 clasping nematocyst clusters, terminal cluster slightly enlarged and elongated. Egg size: 127 ±10 µm. Nematocysts (see Kubota, 1991 for measurements): stenoteles of various sizes, desmonemes, aberrant stenoteles resembling mastigophores on exumbrella.

DISTRIBUTION – Coasts of Japan, Chefoo (China), ? Brazil, La Réunion.

BIOLOGY – The polyp is known to occur in the intertidal to subtidal region on submerged bamboo, *Mytilus*, floats of a net, and red algae.

REMARKS – *Coryne nipponica* was first described by Uchida (1927) based on mature medusae found in the plankton. Later, Uchida (1940) described its polyp, although he did not observe the full life cycle. The full life cycle was elucidated by Kubota (1991).

Nakamura (1940; 1941) carried out regeneration experiments with hydranths of *S. nipponica*. As a most surprising result he found that regeneration of cut hydranths is strictly dependent on light. No regeneration was observed in the dark. Nakamura's regeneration experiments also showed that *S. nipponica* transiently forms filiform tentacles. The ephemeral character of these filiform tentacles was later confirmed by Kubota (1991).

Sarsia nipponca closely resembles *S. producta* and *S. japonica*. The best character to separate it from the other two species are the short tentacles of the medusa (Fig. 6B). The tentacles are also covered by few nematocyst clusters only. For further differences see table 1.

The material of Sagami Bay examined here lacked filiform tentacles, which, however, is not surprising due to their ephemeral character. This material was also described by Hirohito (1988) and he noted that the newly released medusae had no ocelli. The same observations were made by Uchida (1940). This is in contrast with the observations made by Kubota (1991), who obtained slightly larger medusae with ocelli present even at the earliest stages. Perhaps these are only clone-specific differences or differences due to culture conditions.

Vannucci (1949) and Migotto (1996) identified a corynid polyp from Brazil as *S. producta*. They were able to rear the medusa to maturity. The polyp had more than the usual two whorls of lower capitate tentacles and the mature medusa reached only 3 mm in height, had no apical canal, and had short tentacles covered by only a dozen nematocyst clusters. These are all characteristics of *Sarsia nipponica* and the Brazilian records are here referred to this species (see also under *C. producta*).

Recently, Gravier Bonnet & Mioche (1996) recorded *Sarsia nipponica* from La Réunion (Indian Ocean).

5.1.1.2. ***Coryne hincksii*** group

This group comprises the species *C. hincksii*, *Coryne sagamiensis*, and *C. crassa*. Although perhaps not a clade, they all have gonophores with a ring canal. Distinguishing characters are given in table 2.

TABLE 2. Distinguishing characters of the *Coryne hincksii* group

character	*C. hincksii*	*C. crassa*	*C. sagamiensis*
colony	branched	branched	stolonal
gonophore oblong	yes	no	variable
gonophore with velum	no	yes	yes

Coryne hincksii Bonnevie, 1898 Fig. 7A-C

Coryne hincksii Bonnevie, 1898a: 492, pl. 27, fig. 48-49; Rees, 1956: 109; Calder, 1972: 222, pl. 1 fig. 6; Schuchert 2001: 46, fig. 32A-C.

? *Dipurena uchidai* – Petersen, 1990: 212

TYPE LOCALITY – Hammerfest, Norway 183 m.

MATERIAL EXAMINED – ZMUC, Greenland, Hellefiskebanke, 21.08.1976 – ZMUC, Greenland, 59.99°N 43.93°W, 30-40 m, 19.08.1970 – ZMUC, Greenland, 59.88°N 43.53°W, 225 m, 20.08.1970 – ZMUC, labeled *Coryne uchidai*, Russia, Vladivostok, 42.27°N 130.73°E, 130-225 m, on cable, mentioned in Petersen (1990) – ROMIZ B562, Canada, Frozen Strait, 66°13'N 85°09'W, 85-92 m, 29.08.1961, material described by Calder (1972) as *C. pusilla*, branched colony, with annulated perisarc, but some sporosacs seem to have radial canals and the sporosacs appear not to be in the axils of the tentacles, thus this material is perhaps also *C. hincksii*, however, contraction of the material does not allow a detailed investigation.

DESCRIPTION – Hydroid up to 2 cm, stems branching 1-3 times, 0.25-0.3 mm in diameter, perisarc thick, mostly smooth, occasionally corrugated, rarely annulated. Hydranths 1.5-2.2 mm in height, 0.4 mm in diameter, spindle-shaped, 16-22 scattered capitate tentacles, oral tentacles 4-6, without filiform tentacles. Gonophores are sessile sporosacs, 4-12 developing among but independently of the tentacles in lower half of hydranth, sometimes up to three sporosacs clustered, stalk of sporosacs longer than in other species. Sporosacs oblong, up to 1 mm length and 0.7-0.75 mm wide when fully developed, at distal end a clearly visible ring canal of narrow diameter, radial canals only occasionally visible, spadix distinct, without bulbs or tentacle rudiments. Nematocysts: stenoteles of two size classes, (16-18) x (11-12) µm and (28-29) x (18-20) µm.

REMARKS – *Coryne hincksii* differs from *Coryne pusilla* in developing its gonophores independently from the tentacles. *Coryne pusilla* carries them in the upper axils of the tentacles. Furthermore, *Coryne hincksii* has sporosacs with a distinct circular canal and the sporosacs are longer and more elongated. Additionally, the perisarc of *Coryne pusilla* is usually annulated. However, this is not a diagnostic trait.

The radial canals of *C. hincksii* could only be seen in a minority of the sporosacs. There were not always four canals present in these cases. It appears that the radial canals in this species are only occasionally formed. More likely, they are so narrow that they often cannot be seen properly using a stereomicroscope or unsectioned material. Bonnevie (1898a) described this species as having radial canals. Rees (1956) re-examined her type material and was unable to find the radial canals. Calder (1970) examining Canadian material found radial canals only occasionally, just like my own observations on material from Greenland. This variability certainly explains the discrepancy of Bonnevie's and Rees' observations.

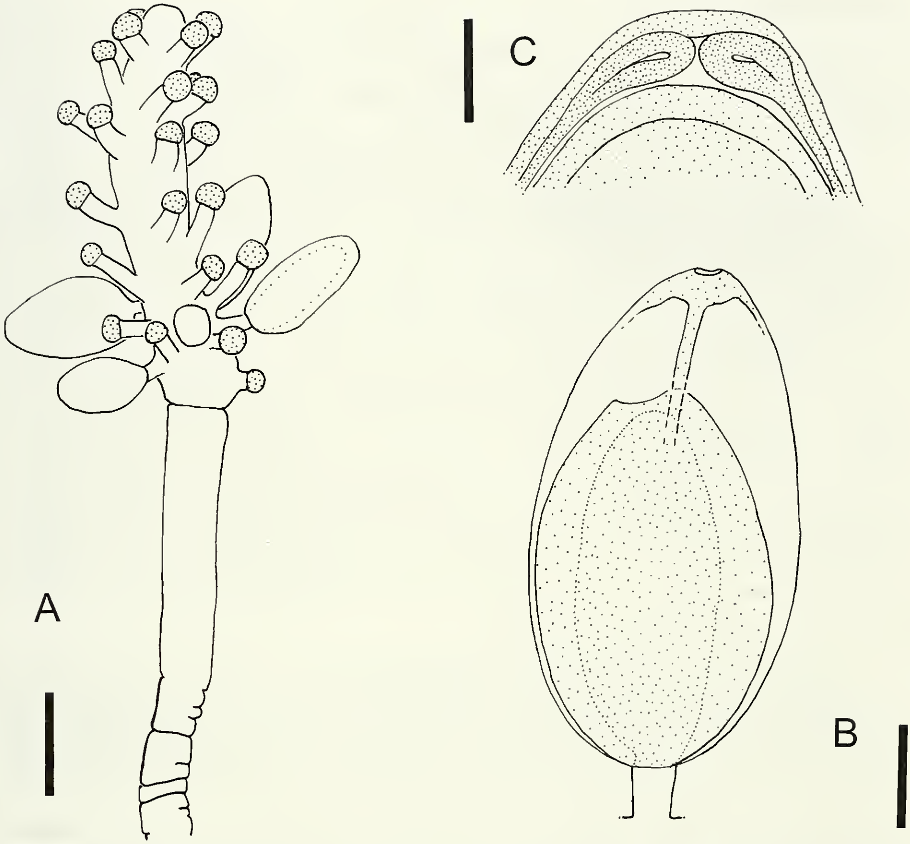

FIG. 7

Coryne hincksii Bonnevie, 1898 from Cape Farewell, Greenland. A) Hydranth with sporosacs, scale bar 0.5 mm. B) Male sporosac, note presence of radial canals, scale bar 0.2 mm. C) Optical section of a young sporosac showing circular canal, scale bar 0.1 mm.

In the examined material it was not possible to see a button of high gland cells around the mouth. However, for a reliable investigation histological sections must be made.

Material from Vladivostok identified as *C. uchidai* by Petersen (1990) was reexmined by me and I think it belongs to *C. hincksii*, although radial canals could not be seen reliably and it forms larger and more robust colonies than *C. hincksii* from the Atlantic.

DISTRIBUTION – An Arctic species known from the coasts of Norway, Canada, Greenland, perhaps also off Vladivostok, Russia.

Coryne crassa **Fraser, 1914** Fig. 8A-B

Coryne crassa Fraser, 1914: 113, pl. 2 fig. 3; Fraser, 1937: 27, fig. 10; Brinckmann-Voss, 1996: 96.

[not *Syncoryne crassa* Pictet, 1893 = *Pteroclava crassa* (Pictet, 1893)]

TYPE LOCALITY – Friday Harbour, Washington, USA.

MATERIAL EXAMINED – original material of Fraser from Friday Harbour, possibly type material (see Arai, 1976), BCPM 976-129-2, slide, with gonophores.

DESCRIPTION – (in part after Fraser, 1914) Hydroid slightly and irregularly branched, reaching a height of 15 mm. Branches originate at wide angle, stem and branches of same diameter, perisarc corrugated or with occasional annulations. Perisarc ends at base of hydranths without dilation. Hydranths 1.5-2 mm, fusiform, with an oral whorl of 4 tentacles and below them additional 10-15 tentacles scattered over nearly the whole length of the hydranth. Hypostome comparatively long, mouth without button of high gland cells. Several gonophores develop in clusters below or above the proximal tentacles, often on one side of the hydranth only. Gonophores 0.7 mm to 1 mm (uninflated), seated on relatively long stalks. Gonophores remain presumably fixed as sporosacs, but at maturity perhaps with umbrella. Almost mature gonophores have a truncated distal end with a velum-like structure as well as a broad ring canal. Tentacles are absent (Fig. 8B). The manubrium with the gonad fills nearly the whole subumbrellar cavity. Colours: stem and branches horn colour, hydranths and sporosacs pink, spadix red to pink.

DISTRIBUTION – Known from type locality only.

REMARKS – Some medusa-like gonophores in the type slide suggest that the mesogloea of mature gonophores swells like that of a free medusa before it is released. The presence of a circular canal as well as a velum-like structure (Fig. 8B) are quite evident. Radial canals or rudimentary bulbs could not be seen, but their presence in fully mature gonophores is possible. Radial canals can be invisible in slide preparations. Also in slides of *C. lovenii* and *C. sagamiensis*, which definitely have these canals, they are often invisible. Further observations on living material or histological cross-sections are needed to reveal more details on the gonophore morphology *C. crassa*.

Coryne crassa resembles closely *C. hincksii*, however, a velum is absent in the latter species. Differences to *C. sagamiensis* are also minimal and consist in the branched stems and occasional perisarc annulation of *C. crassa*.

Coryne sagamiensis **Hirohito, 1988** Fig. 9A-D

Coryne sagamiensis Hirohito, 1988: 33, fig. 10d-f.

TYPE LOCALITY – Amadaiba, Sagami Bay, Japan, 90 m.

MATERIAL EXAMINED – Type material, NSMT-Hy numbers 648 to 652, Sagami Bay (see Hirohito, 1988), slides and alcohol material.

DESCRIPTION – Hydroid stolonal, cauli 1-1.5 mm high, perisarc cover doubles diameter towards distal, smooth or slightly and irregularly undulated, never annulated, transparent, some with very fine longitudinal striations. Hydranth about 1.5 mm in height, spindle-shaped, tentacles confined to distal 2/3, just below them an annular thickening of the epidermis. Tentacle number about 16-21, one oral whorl of 4-5

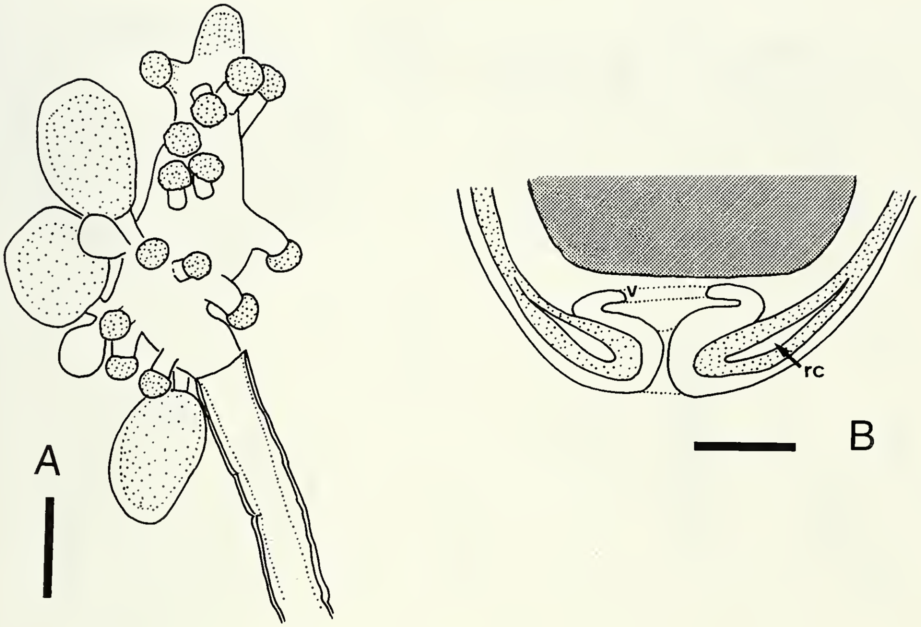

FIG. 8

Coryne crassa Fraser, 1914, syntype material. A) hydranth with gonophores, *camera lucida* drawing, this might be the same hydranth as depicted by Fraser (1914), scale bar 0.5 mm. B) distal end of advanced gonophore in optical section, scale bar 0.1 mm, gastrodermal tissue lightly stippled, manubrium and gonads dark, v velum, rc ring canal.

tentacles, 10-16 lower capitate tentacles scattered or in indistinct whorls, length of tentacles rather uniform except for the oral ones which are shorter than the lower tentacles. Hypostome rounded, without button of high gland cells.

Gonophores develop around middle of hydranth body, about 1-3 per hydranth, in upper axil or independent of tentacles. Gonophores remain fixed as medusoids, umbrella spherical to oblong, 1.1 mm, jelly thin and even, distal opening narrow, with four distinct radial canals, circular canal, four marginal bulbs with nematocysts, no ocelli and no tentacles. Manubrium bulbous, size about 2/3 of bell cavity. Gonads completely cover manubrium and nearly fill bell cavity. Eggs numerous (>100), in one layer, high, polygonal. Distal half of exumbrella studded with nematocysts.

Nematocysts: stenoteles of two sizes, (19-21) x (12-17) μm and (11-13) x (6-7) μm.

DISTRIBUTION – Known from type locality only.

BIOLOGY – The polyps grows on other hydroids in depths of 60-100 m.

REMARKS – Although the formal differences from other species of this group appear minimal, *Coryne sagamienesis* is likely a distinct species. It is characterised by the purely stolonal colonies, the smooth and dilated perisarc of the caulus, the relatively long basal part of the hydranth that is free of tentacles, and the annular epidermal thickening. Its gonophores are more rounded than the ones of *C. hincksii*.

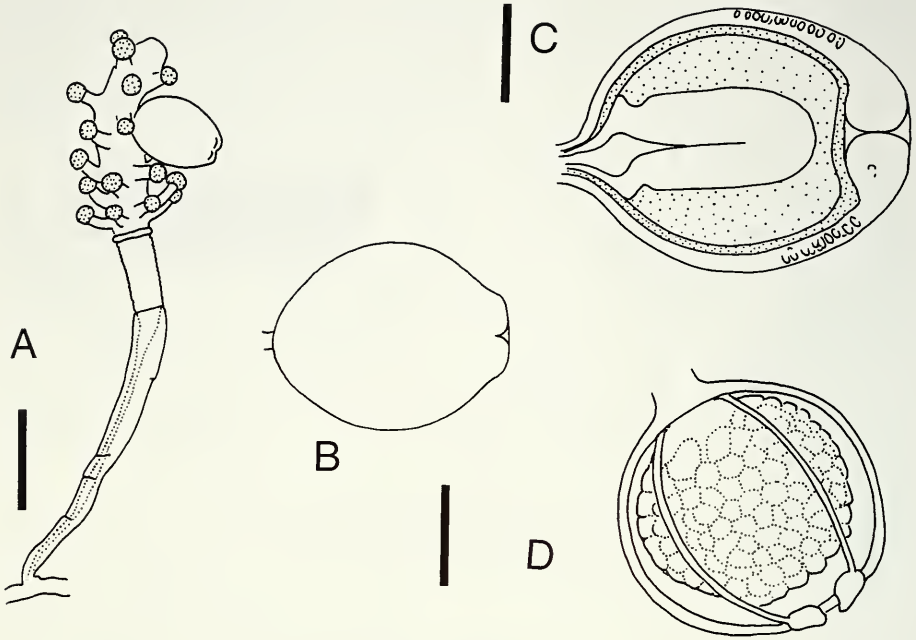

FIG. 9

Coryne sagamiensis Hirohito, 1988. A) Single stem with gonophore-bearing hydranth, scale bar 0.5 mm. B) Outline of medusoid from ethanol material, scale bar 0.2 mm. C) Optical cross-section of a immature male medusoid, scale bar 0.1 mm. D) Schematic drawing of a mature female medusoid, drawn from slide preparation, shape may be distorted, same scale as B.

Contrary to the view of Petersen (1990), perhaps inspired by the figures of Hirohito (1988), the gonophores of *C. sagamiensis* do not exclusively develop in association with tentacles, although some may be found in their proximity by mere coincidence.

5.1.1.3. ***Coryne brachiata*** group

This group comprises at present only one species. The peculiar brachioles (nematophores?) distinguish this species from all the other members of the Corynidae.

Coryne brachiata Nutting, 1901 Fig. 10A-B

Coryne brachiata Nutting, 1901: 159, 165, pl. 14 figs 1-2; Fraser, 1937: 26, pl. 2 fig. 8.
TYPE LOCALITY – Yakutat, Alaska, USA.
MATERIAL EXAMINED – syntype material, USNM no. 71384 and no. 70508, Yakutat, Alaska.

DESCRIPTION – Hydroid branched, 1 cm, straggling, branches originate at very acute angles, shoots thus slender, branching up to fourth degree. Perisarc annulated throughout. Hydranths typical for genus, with 20-35 scattered capitate tentacles, without filiform tentacles. Gonophores develop between the capitate tentacles. Gonophores sessile sporosacs, spherical, without radial canals, females with 12-20 eggs.

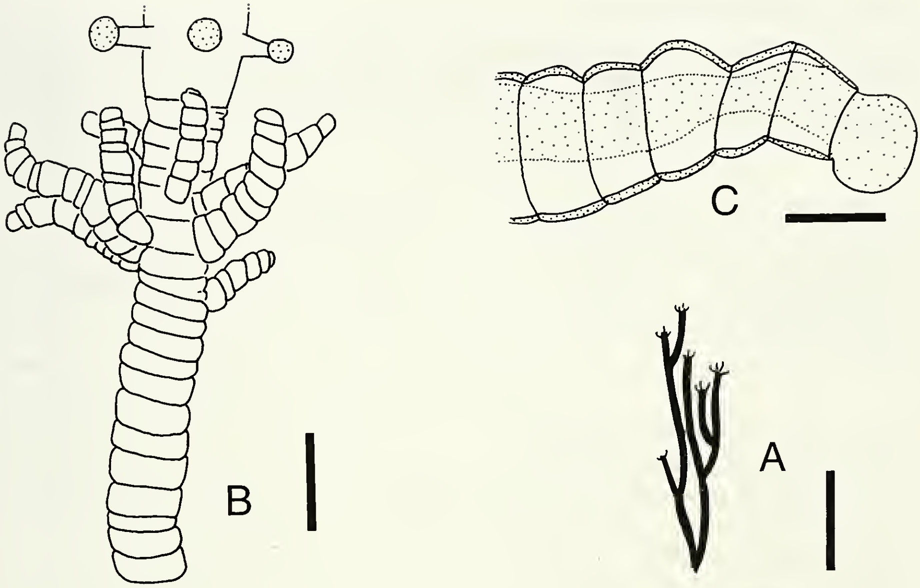

FIG. 10

Coryne brachiata Nutting, 1901, after type material. A) Colony form, scale bar 5 mm. B) Distal part of caulus with brachioles (perisarc covered tentacles), scale bar 0.5 mm. Brachiole in higher magnification, note that coenosarc protrudes at tip, scale bar 0.1 mm.

With numerous arms at distal end of caulus in perisarc covered zone, scattered in a small band. These arms mostly unbranched, but some branched once, diameter at origin about 1/3 to 1/2 of caulus diameter, tapering towards distal, covered by perisarc which is annulated throughout, distal end with opening where a small spherule of coenosarc protrudes.

DISTRIBUTION – Known from type locality only.

REMARKS – *Coryne brachiata* is unique among the Capitata in having tentacle-like appendages (brachioles) covered by perisarc (comp. Fig. 10B). Although it was not possible to see nematocysts in the capitae of these arms in the available material, they might normally be present. The function of these arms remains enigmatic, but possibly they are defensive and correspond to nematophores. The origin of the gonophores could not be seen reliably in the available material. Thus it is uncertain whether they are associated with tentacles or not.

5.1.2. ***Coryne*** species with axillary gonophores

As mentioned in the introduction, this clade is revealed by the synapomorphic trait of gonophores that develop solely in the upper axil of the lower capitate tentacles.

5.1.2.1. *Coryne pintneri* group

This group comprises *Coryne pintneri*, *C. filiformis*, and *C. uchida*. They form stolonal or sparingly branched colonies, have sessile sporosacs in the axil of the tentacles, and possess filiform tentacles. Distinguishing characters are given in table 3.

TABLE 3. Distinguishing characters of the *Coryne pintneri* group

character	*C. pintneri*	*C. filiformis*	*C. uchidai*
tentacle numbers	15-26	28-36	25-30
filiform tentacles	present	present	transiently present
eggs in one whorl	no	no	yes
viviparous	no	no ?	yes

Coryne pintneri Schneider, 1898 Fig. 11A

Coryne pintneri Schneider, 1898: 476; Brinckmann-Voss, 1970: 53, text-figs 59-64, pl. 3 fig. 3; Edwards & Harvey, 1983: 37, fig. 1.
Staurocoryne pintneri – Rees, 1936: 140.
Staurocoryne spec. – Swedmark, 1975, figure in obituary, Cah. biol. Mar., vol 16.
TYPE LOCALITY – Rovigni, Adriatic Sea.
MATERIAL EXAMINED – BMNH 1974.11.21.15, Naples, from *Posidonia*, cultivated for 6 months, preserved November 1962, material described in Brinckmann-Voss (1970), infertile, not well preserved – BMNH 1956.10.24.10, as *Staurocoryne filiformis*, identified by W. J. Rees, collected 12.9.1956 at Roscoff (Brittany), single hydranth with filiform tentacles, without gonophores, growing on white unidentified substrate, is better referred to *C. pintneri* but may also be *C. producta*. – IRSNB 27.838 as *C. filiformis*, Roscoff, coll. J. Bouillon Sept. 1965 and 1966, infertile, growing on *Bugula* together with *Zanclea* spec. – Villefranche-sur-Mer, Ligurian Sea, Mai 2001, several small, infertile colonies growing on rock in a depth of about 1 m, cultivated, sporosacs and filiform tentacles formed in secondary hydranths.

DESCRIPTION – (in part after Brinckmann-Voss, 1970) Hydroid mostly stolonal, occasionally sparingly branched with two hydranths, rarely up to five side branches, maximally 1-2 cm in height. Perisarc mostly smooth, not thick, yellowish, annulated for occasional stretches at origin of side branches and cauli or at other places. Cauli perisarc-covered, up to 3 mm high. Hydranths cylindrical, 1.2-1.6 mm from filiform tentacles to mouth. With 15-21 tentacles, either scattered or in whorls each with 3-4 tentacles. Oral capitate tentacles with 14-17 gastrodermal cells. Below capitate tentacles one whorl of 2-6 filiform tentacles, often absent, especially in colonies from agitated waters. Gonophores develop in two whorls in upper axils of tentacles in middle of hydranth body, often two gonophores of different developmental stage per tentacle. Gonophores remain fixed as sporosacs. Sporosacs spherical, about 0.3 mm, without radial or circular canals. Females with numerous eggs. Sexual products are shed into the water, development takes place in the free water. Nematocysts: stenoteles of two size classes.

After Edwards & Harvey (1993) there is often also an annular thickening at the base of the hydranth, possibly associated with caulus elongation.

DISTRIBUTION – Mediterranean, coasts of Brittany (France) and Scotland.

Biology – The polyp grows on *Posidonia oceanica* (sea grass), on *Peysonnellia* (red algae), and also on rock in depths of 1-30 m. Sporosacs are formed from March to end of May (Brinckmann-Voss, 1970). Tardent & Stössel (1971) and Tardent & Schmid (1972) described the morphology of mechano-receptors in the filiform tentacles. The reactions to mechanical stimulation is described in Stössel & Tardent (1971).

Remarks – The filiform tentacles are often missing, especially in colonies from agitated waters (see Brinckmann-Voss, 1970; Edwards & Harvey, 1983). Such colonies are indistinguishable from juvenile *Coryne pusilla* and a culture is necessary for a correct identification. In culture, the filiform tentacles are always formed by *C. pintneri* and mature *C. pusilla* form branched colonies with several hydranths. It is likely that many earlier authors misidentified *C. pintneri* lacking these filiform tentacles as *C. pusilla* (Brinckmann-Voss, 1970).

Edwards & Harvey (1983) found *C. pintneri* also in Scotland, thus the distribution of *C. pintneri* and *C. filiformis* overlap. Both species resemble each other extraordinarily and can only be distinguished by their tentacle numbers and the hydranth size. *Coryne pintneri* has 15-26 capitate tentacles and the hydranth is about 1.5 mm high, while *C. filiformis* has 28-36 capitate tentacles and the hydranth reaches a size of 3.5 mm. *Coryne pintneri* seems also to prefer more warmer temperatures than *C. filiformis* (Edwards and Harvey, 1983). Tentacle number is otherwise not considered to be a criterion of much use in distinguishing *Coryne* species. Further studies are clearly needed to prove that *C. filiformis* is separate from *C. pintneri*.

It is well possible that the higher tentacle number of *C. filiformis* as described by Rees (1936) was just a population-specific trait. Rees (1938) later described a finding of a colony from near Plymouth, the only description of *C. filiformis* hydranths from nature. These hydranths were smaller than his previous cultivated ones and his figure shows 22 tentacles (but some might be hidden). These polyps seem indistinguishable from *C. pintneri* as depicted in Edwards & Harvey (1983: fig. 1). Rees also deposited a corynid in the British Museum which he collected at Roscoff (see material examined). This single, infertile polyp was only 1.2 mm high and had only about 18 tentacles. It thus conforms better with *C. pintneri*. This can be interpreted that Rees perhaps did not consider the tentacle number as decisive for separating his *C. filiformis* from *C. pintneri*. However, at the time of Rees' publication, he could not know the gonophores of *C. pintneri* as they were only described in 1970 by Brinckmann-Voss. Material from Roscoff collected by J. Bouillon in 1965 and 1966, now held by the IRSNB, was likewise identified as *C. filiformis*, despite being infertile. The tentacle numbers of these specimens varied between 16 and 24 (7 hydranths examined) and the hydranths measured about 1.5 mm in height, the tentacle whorls were distinct only in the lower half. Both Rees' and Bouillon's material from Roscoff is here assigned to *C. filiformis*. Identical material was also found by myself at Roscoff in June 2000. The infertile polyps were growing on a holdfast of a laminarian alga and they grew reasonably well in culture, although they did not produce gonophores (after 3 months). The colony was surprisingly sensitive to low temperatures (12 °C). It immediately reduced all hydranths at this temperature and did not form them again. However, the colony grew at 20-25 °C, although few new hydranths were formed. The filiform tentacles appeared after 2 whorls of capitate tentacles had developed. This thus makes it less probable that it might have been *C. producta.*

Coryne filiformis (Rees, 1936) Fig. 11B

Staurocoryne filiformis Rees, 1936: 135, figs 1-11; Rees, 1938: 38.
Coryne filiformis – Edwards & Harvey, 1983: 41; Petersen, 1990: 211.
TYPE LOCALITY – Stoke Point, Plymouth, England.

DESCRIPTION – (after Rees, 1936 and Rees, 1938) Hydroid stolonal or slightly branched, several mm high. Perisarc mostly smooth, annulated at origin of branches and cauli. Hydranths on caulus, fully grown hydranths 3.0 to 3.5 mm in height, with 28-36 tentacles, these either scattered or in 7-9 whorls with four tentacles arranged cross-like and tentacles of adjacent whorls often in alternate positions. Below capitate tentacles 4-5 filiform tentacles that are often vestigial or reduced in older hydranths. Filiform tentacles of secondary polyps develop only after several whorls of capitate tentacles are present. Filiform tentacles may have few nematocysts. Gonophores develop in axils of tentacles in middle of hydranth, mostly one, sometimes two or three, in one whorl. Gonophores remain fixed as sporosacs. Female sporosacs lack circular and radial canals, spherical, size 0.35 mm. Initially they contain a large number of eggs that are later reduced to about 10-20. Male gonophores unknown.

DISTRIBUTION – Coasts of Great Britain.

BIOLOGY – Reported to grow on dead *Eunicella verrucosa* (Pallas) and on *Pecten* shells.

REMARKS – For the distinction of the closely resembling *Coryne pintneri* see under this species.

Coryne uchidai Stechow, 1931 Fig. 12A-E

Coryne uchidai Stechow, 1931: 178; Stechow & Uchidai, 1931: 546, fig'd; Kakinuma, 1960: 137-140, figs. 1-2.
not *Dipurena uchidai* – Petersen, 1990: 212
TYPE LOCALITY – Tsuchia, Asamushi, Mutsu Bai, Japan.
MATERIAL EXAMINED – material identified and processed to slide by Stechow, putative holotype, ZSM, as *Coryne uchidai*, Japan, Mutsu Bay, one slide with two hydranths; the red framing of the label also indicates this being the holotype.

DESCRIPTION – (in part after Kakinuma, 1960) Hydroid stolonal or sparingly branched. Perisarc corrugated or wrinkled, but not annulated. Hydranths clavate, 1.6 mm high, 0.36-0.48 mm diameter, with 25 to 30 scattered capitate tentacles. Tentacles quite long, length of tentacles and size of capitulum decreasing towards proximal. Oral tentacles with 12-15 gastrodermal cells. Young hydranths have four aboral filiform tentacles, which are later reduced to a ring-shaped vestige or are completely lost. Numerous gonophores develop in the upper axils of the lower tentacles, either singly or two to three gonophores of different developmental stages closely grouped together. Gonophores are fixed sporosacs, without canal system. Mature male gonophores about 0.4 mm, with a short stalk, broadest near base, then conical with pointed

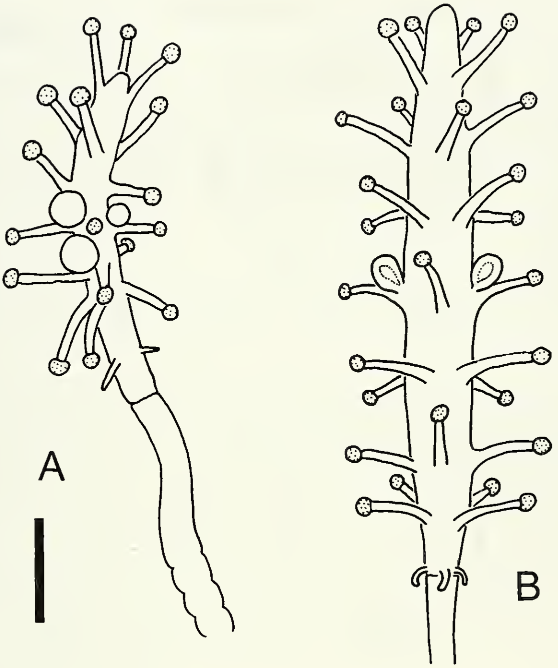

FIG. 11
A) *Coryne pintneri* Schneider, 1898, combined from various sources, scale bar 0.5 mm. B) *Coryne filiformis* (Rees, 1936), modified after Rees (1936), scale approximately like in A.

distal end (drop-shaped). Spermatozoa are ejected through hole at the pointed end. Mature female gonophores about the same size as male ones, spherical, with short stalk, with 4-5 eggs (up to 9 possible), arranged in one ring around spadix, egg size 0.1-0.15 mm. Eggs are fertilised while still within the sporosac and the planulae develop within the sporosac or remain attached to the spadix after rupture of the sporosac casing.

BIOLOGY – Colonies grow on rocks and seaweeds and show periods of dormancy in summer, with gonophores present from March to April. The polyps feed on copepods, amphipods and annelids (Kakinuma, 1960). Kakinuma (1961) and Hirai & Kakinuma (1960) described more morphological details of this species.

DISTRIBUTION – Mutsu Bay, Japan.

REMARKS – Stechow (1931) based his initial description on two hydranths only. Stechow & Uchida (1931) provided a figure of this very material, which is still kept in the ZSM. The figure of the colony fragment in Stechow & Uchida (1931, fig. 1B), corresponds exactly to the fragment present on the slide. This material must therefore be the material on which the first description was based, hence the holotype. Later, Kakinuma (1960) described the male gonophores and life cycle using material

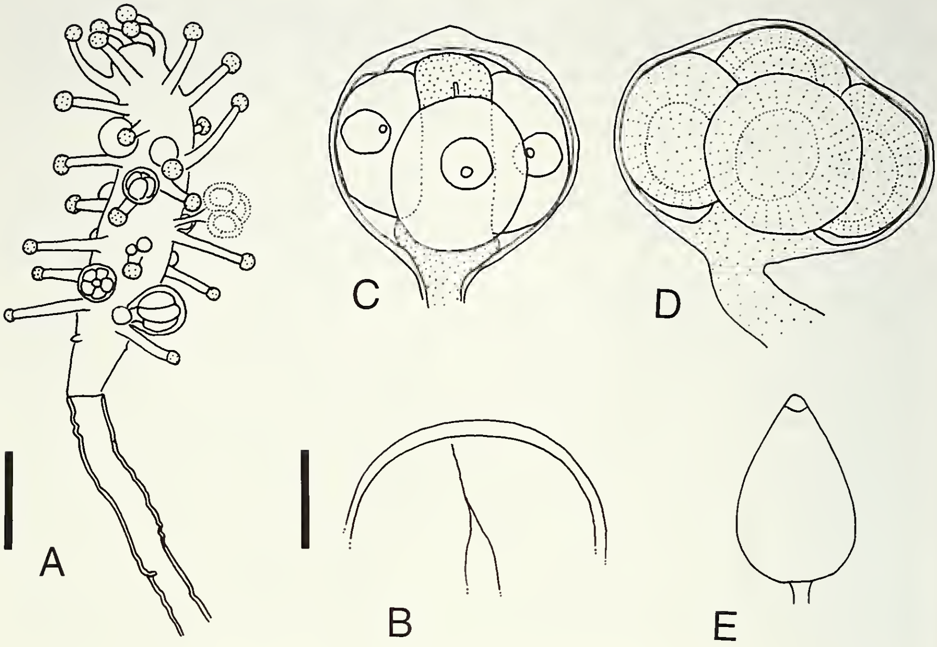

FIG. 12

Coryne uchidai Stechow, 1931. A-D, after possible type material. A) hydranth with gonophores, scale bar 0.5 mm. B) Optical longitudinal section through mouth region, scale bar 0.1 mm. C) Mature female gonophores, note large pronuclei, same scale as B. D) Female sporosacs with planulae, same scale as B. E) Shape of male gonophores, redrawn from Kakinuma (1960).

from the same region. Kakinuma (1960) described the female gonophores as having a transient discoidal structure at their distal end. Such a structure was not found in the present material, but the distal half of the mature female gonophores had a thickened epidermis (Fig. 12) with an even thicker margin. This structure certainly corresponds to the one observed by Kakinuma. Perhaps this thickening forms a discoidal end in living material only (see figures in Kakinuma, 1960). Kakinuma (1960) noted that the gonophores develop in the upper axils of the capitate tentacles. This was also observed in the present material. *Coryne uchidai* appears not to have high gland cells around the mouth opening. Petersen (1990) placed this species in the genus *Dipurena* owing to the gonophores that are independent from the tentacles. Petersen's material (ZMUC, as *Dipurena uchidai*, Vladivostok, 130-225 m, coll. 9.03.1895) was reexamined for this study. The colonies are large and branched. The sporosacs develop indeed independently from the tentacles. They are oblong and arise in clusters of up to 3 sporosacs. I am convinced that this colony is not *C. uchidai* and it is better referred to *C. hincksii*.

Coryne uchidai resembles *C. pusilla*, but clearly differs by its filiform tentacles (often absent), by vivipary, by the low number of eggs arranged in one ring around the spadix, by the thickened epidermis of the female gonophore, and by the pointed male gonophore.

5.1.2.2. *Coryne eximia* group

This group contains only *C. eximia*, but *C. gracilis* most probably belongs also to this group, if it is not altogether conspecific with *C. eximia*. Differences are discussed below.

Coryne eximia Allman, 1859 Figs 13A-D & 18B-C

Coryne eximia Allman, 1859: 141; Petersen, 1990: 211, fig. 43A-C.
Syncoryne eximia – Allman, 1871: 262, fig; Haeckel, 1879: 17, pl. 1 fig. 5; Fraser, 1944: 41, pl. 4 fig. 14.
Coryne tenella Farquhar, 1895: 208, pl. 13 fig. 5.
Sarsia bretonica Hartlaub, 1904: 99, *nomen nudum*; Hartlaub, 1907: 10, fig. 2a-b.
Syncoryne tenella – Bale, 1924: 228; Ralph, 1953: fig. 15, Schuchert, 1996: 125.
Sarsia eximia – Browne, 1905: 756; Mayer, 1910: 57, fig. 20; Hartlaub, 1907: 8, figs 1-2; Vanhöffen, 1913b: 4, fig. 1, pl. 1 fig. 1, pl. 2 fig. 1; Russell, 1938: 150, figs 8-12; in part Berrill, 1953: 281, figs 4-5 (not others); Russell, 1953: 50, text fig. 17A, 18A-B, plate 2 fig. 3; Kramp, 1959: 79, fig. 15; Kramp, 1961: 27; Kramp, 1966: 2; Bodo & Bouillon, 1968: 83, fig. 4; Brinckmann-Voss, 1970: 68; Russell, 1970: 232; Millard, 1975: 52, fig. 20A-D; Brinckmann-Voss, 1989: 688, figs 5-6; Altuna Prados, 1993: 28, fig. 1; Schuchert, 1996: 125, figs 77a-h, 78; Watson, 1997: 506, fig. 2A.
? *Sarsia eximia* – Goy, Lakkis & Zeidane, 1991: 101, fig. 3.
? *Sarsia tubulosa* – Goy, Lakkis & Zeidane, 1991: 102, fig. 5.
TYPE LOCALITY – British Isles.
MATERIAL EXAMINED:
France – MHNG INVE 25126, Roscoff, France, tonne du pot de fer, 15.4.1919, preserved, large polyp colony on *Mytilus edulis*, with medusae buds, height up to 25 mm – Roscoff, several living colonies collected by author underneath pier of Île de Batz ferry, 31.5.2000, young medusae reared until incipient gonads visible (3 days), one colony preserved as NHMG INVE 29982 – Roscoff, 5.6.2000, living, adult medusae from plankton of 10-20 m depth.
Great Britain – ZMUC, Plymouth, 4.10.1906, det. E. Browne, polyps, 3 cm colony, with medusae buds, some hydranths with thin perisarc cup at base.
New Zealand – Wellington and Goat Island, see Schuchert (1996).
Chile – ZMUC, 31°51.5'S 71°35'W, 25.02.1960, coll. E. Fagetti, det Kramp, 2-3 mm high medusae, bell cylindrical, terminal tentacle cluster small.

DESCRIPTION – (after examined European material) Hydroid erect, 1-5 cm, branching. Shoots irregular, no main stem, often forming tufts, up to 20 hydranths per shoot. Perisarc of branches smooth with some annulated stretches. Hydranths 1.5-1.8 mm high, diameter 0.3 mm, spindle-shaped or cylindrical, on pedicels of 1-2 mm length or at end of branches, occasionally perisarc funnel shaped at base of hydranths (collar, sheath). Hydranth with up to 20 capitate tentacles, 4-5 oral tentacles, remaining lower tentacles scattered over nearly entire hydranth leaving only at base about 1/6 of height free, hypostome large, rounded. Oral tentacles attached obliquely, length 1-1.5 times the diameter of the hydranth body, most proximal tentacles shorter. Tentacles not much tapering, diameter of capitulum about two times diameter of tentacle stalk. Gonophores develop in upper axils of lower tentacles, up to 3 per tentacle, released as free, immature medusae. Colours: hydranths orange-red, some greenish. Nematocysts: stenoteles, (18-20) x (11-15) µm and (11-13) x (6.5-7) µm.

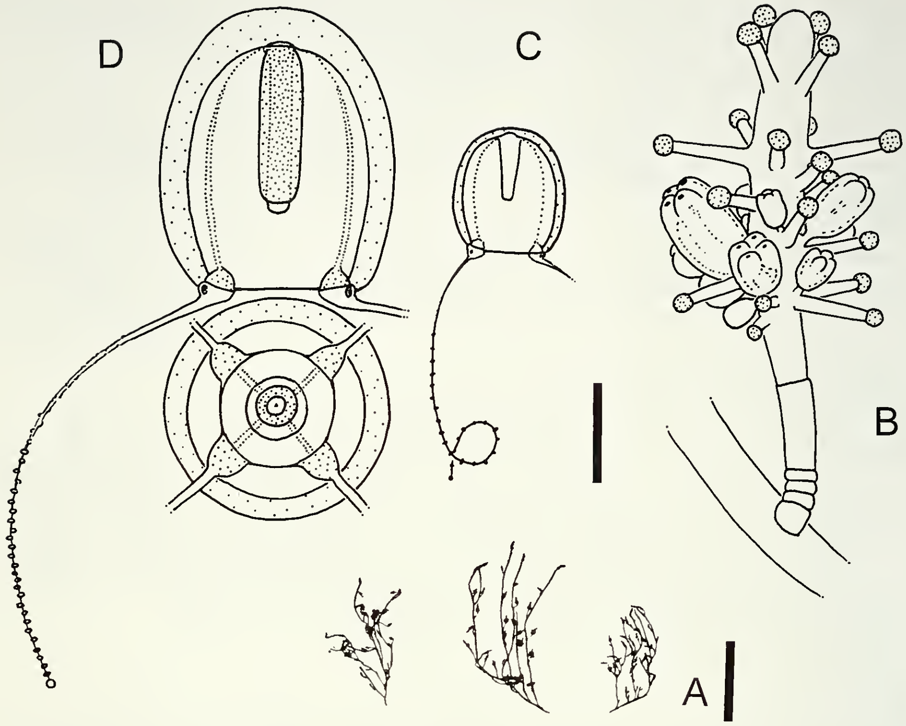

FIG. 13

Coryne eximia Allman, 1859; after living material from Roscoff, France. A) Three different shoots, scale bar 1 cm. B) Hydranth with medusae buds, scale bar 0.5 mm. C) Newly released medusa, only one tentacle shown, scale bar 1 mm. D) Mature male in side view (top) and seen from below (bottom), same scale as C.

Newly released medusa 1.2 mm high, exumbrella with scattered stenoteles, ocelli dark brown-red, no gonads visible, tentacles with approx. 30 nematocyst clusters, cnidocils short and fine, no tufts of cilia on tentacles.

Adult medusa 2-3 mm (reportedly up to 10 mm), normally bell-shaped, diameter slightly less than height, jelly evenly thick or slightly thicker at apex. Four radial canals, broader than ring canal, ending in four large marginal bulbs. Bulbs with rounded red gastrodermal chamber, entry of radial canal at top, epidermal pad studded with nematocysts on adaxial side and on abaxial side a large dark-brown ocellus. Relaxed tentacles issued obliquely, 2-3 times as long as bell height, tapering, proximal part smooth, otherwise studded with about 30 clasping nematocyst clusters, terminal cluster spherical, diameter about 1.5 times as large as other clusters. Manubrium spans 2/3 of subumbrella, cylindrical, without apical chamber, greenish. Gonads encircle manubrium for almost its complete length, leaving free only a small part near mouth. Egg size 0.18-0.20 mm. Nematocysts: stenoteles, (12-14) x (8.5-10) μm and (10-10.5) x (6-7) μm; desmonemes (8-10) x (4-5) μm.

ADDITIONAL DATA – Russell (1938) reported slightly larger stenoteles for the hydroid: (21.5-26) x (15-18) µm and (12-13) x (7.5-9) µm. Schuchert (1996) recorded for hydroids from New Zealand (20-24) x (13.5-15) µm and (11-13) x (6.5-7) µm.

DISTRIBUTION – All European coasts from Norway to Galicia; east coast of Canada and USA; coasts of South Africa; Alaska to California (but some records may refer to *C. cliffordi*), Chile; New Zealand; Western Australia. The medusa has also been reported from the Mediterranean, as well the coasts of Brazil and Papua New Guinea. However, these records need reconfirmation.

BIOLOGY – The hydroids occur in shallow waters (max. 25 m, Fey, 1965) up to the low water mark, growing on rocks, mussels, seaweed, floating objects like buoys and rafts. Perhaps due to the small size of the medusa, it's seasonality is not clearly established. At Roscoff (Brittany), colonies with medusae buds appear in May, but fertile medusae can already be found in April. According to Russell (1953) and Fey (1970), medusae are produced from April to September. Around Wellington (New Zealand), Schuchert (1996) found mature medusae and colonies with medusae buds all year round. Young medusae are positively phototactic. Although corynid hydroids might be eaten by numerous nudibranchs, one of them seems to feed exclusively on *C. eximia*: *Doto sarsiae* (see Morrow, Thorpe & Picton, 1992). The gastropods seem to feed by puncturing the stem of hydroids and sucking out the sap - just like aphids (B. Picton, pers. comm.). The early development has been described by Bodo & Bouillon (1968).

REMARKS – *Coryne eximia* is a well known and common species. Despite this, our knowledge of its ecology is very limited.

The diameter of spawned eggs observed in material from Brittany was 0.18 to 0.2 mm. This compares favourably with values from New Zealand (0.19 mm; Schuchert, 1996). Brinckmann-Voss (1989) tabulated only 0.11 mm for material from western Canada, however, the eggs shown in her figure 6 have a diameter of about 0.2 mm.

Schuchert (1996) observed some large variants of the medusa (up to 7 mm) that had a more cylindrical umbrella. This variant was connected to the normal form by a continuous row of intermediates. Crosses of both forms resulted in viable planulae. Similarly large forms were also mentioned by Hartlaub (1894) to occur in the North Sea.

Some hydranths of *C. eximia* may bear a thin cup of dilated perisarc at their base, similar to *C. muscoides*. This was observed in colonies from New Zealand (Schuchert, 1996) as well as in material from Great Britain (this study).

Sarsia bretonica Hartlaub, 1904 was only mentioned as a name without description nor figure. Later, Hartlaub (1907) mentioned this species again and even figured it, but he acknowledges it to be *Sarsia eximia*. Considering his figures, which are indistinguishable from *C. eximia* and the frequent occurrence of this species at Roscoff, it is obvious that *Sarsia bretonica* must in fact be *C. eximia*.

Coryne gracilis Browne, 1902 closely resembles *C. eximia* and both could be conspecific. For further details see under *C. gracilis*.

Coryne cliffordi Brinckmann-Voss, 1989 from British Columbia may be mistaken for *C. eximia*. But contrary to *C. eximia*, in *C. clifffordi* stolons and branches or cauli are not clearly distinguishable, the branches lack any annulation, and the perisarc is thin and transparent. More importantly, the medusae buds of *C. cliffordi* are never in the upper axils of the tentacles as in *C. eximia.*

I think that Berrill (1953) misidentified a colony of *S. lovenii* from Guernsey as *S. eximia.* The position of the medusoid below the tentacles as well as the shape and maturity of the medusoid clearly agree with *S. lovenii.* Berrill's two colonies from the Gulf of Maine are also not referable to *C. eximia.* One is perhaps also *S. lovenii* (figure 10 in Berrill, 1953), while the colony depicted in his figure 9 has gonophores independent of the tentacles and could belong to several species of Corynidae.

The distribution of *C. eximia* is not entirely clear. *Coryne eximia* medusae have been reported for the Mediterranean by Kramp (1957), Goy (1970), and Goy *et al.* (1991). None of these authors, however, had mature animals or provided evidence of medusae with developed gonads. Furthermore, the extensive survey of Brinckmann-Voss (1970) did not find this species. The Mediterranean occurrence of *C. eximia* thus needs re-confirmation. The medusa of *C. eximia* have also been recorded from warm or tropical waters like the Gulf of Mexico, Florida, Brazil and Papua New Guinea (Deevey, 1950; Vannucci, 1957; Bouillon, 1978). Deevey's (1950) hydroid from Texas had no medusae buds and thus was not reliably identifiable. Berrill (1953: 281, fig. 3) probably depicted material of this population as *Syncoryne* spec. (see under *C. angulata* and 5.9 for further discussions). The record for *C. eximia* from Brazil was regarded as rather uncertain by Vannucci herself. As the polyp phase is only known from temperate waters, both records must be regarded cautiously and they need confirmation by life-cycle observations. Likewise, the records from Greenland and Iceland need reconfirmation, as they were based on non-reproductive polyp material (see Schuchert 2001).

5.1.2.3. *Coryne pusilla* group

This group comprises *C. pusilla* and *C. muscoides*. Differences between them are discussed under *C. pusilla.*

Coryne pusilla Gaertner, 1774 Fig. 14A-B

Coryne pusilla Gaertner, 1774: 40, pl. 4 fig. 8; Johnston, 1847: 39, pl. 2; Hincks, 1868: 39, pl. 7 fig. 1; Allman, 1871: 266, fig. 60, pl. 4 figs 1-7; Vanhöffen, 1910: 275; Stechow, 1919: 5, fig. A; Da Cunha, 1944: 11; van de Vyver, 1967 : 500 ; ? in part Calder, 1972: 223, pl. 1 fig. 7; Brinckmann-Voss, 1970: 51, fig. 57; ? Millard, 1975: 51, figs 19F-G; Boero, 1981: 187, fig. 1C-D; Hirohito, 1988: 33, fig. 10a-e; Schuchert, 1996: 119, fig. 72a-d.

Hydra ramosa Fabricius, 1780: 348 (synonym after Bedot, 1901).

Stipula ramosa – Sars, 1829: 4, pl. 1 fig. 1; Allman, 1871: 269; Bonnevie, 1898b: 492.

Coryne glandulosa Dujardin, 1845: 1276; Bedot, 1905: 119.

Coryne fruticosa Hincks, 1861: 158, pl. 6 figs 5-6; Hincks, 1868: 44, pl. 7 fig. 2; Allman, 1871: 269; Koch, 1873: 467, pl. 23 figs 6-7.

Coryne vermicularis Hincks, 1866: 296; Hincks, 1868: 42, pl. 8 fig. 2; Allman, 1871: 267; Jäderholm, 1909: 39, pl. 1 fig. 4; Broch, 1916: 16; Fraser, 1944: 39, pl. 3 fig. 9.

TYPE LOCALITY – possibly Cornwall (after Allman, 1871).

MATERIAL EXAMINED:

French Atlantic coast – MHNG INVE 29386, Roscoff, coll. 31.5.2000 below pier of Île de Batz ferry, low water level, examined alive – MHNG INVE 29385, Roscoff, coll. 1.6.2000

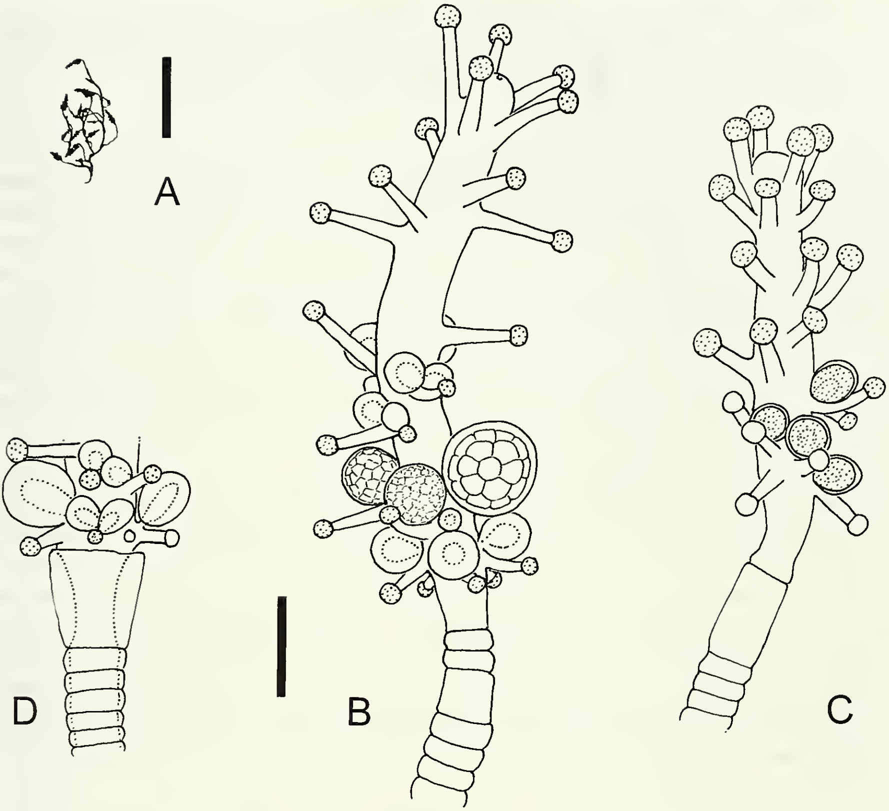

FIG. 14

Coryna pusilla Gaertner, 1774; all from Roscoff, France. A) Typical form of single shoots, scale bar 1 cm. B) Extended hydranth with female sporosacs, after life, note that it represents a hydranth of maximal size, much smaller hydranths with less tentacles are also possible, scale bar 0.5 mm. C) More contracted hydranth with male sporosacs, preserved material, same scale as B. D) Base of hydranth with perisarcal collar formation, MHNG INVE 29387, same scale as B.

on *Ascophyllum nodosum*, well above low water level, examined alive, some hydranths with perisarc collars – MHNG INVE 29387, Roscoff, coll. 4.6.2000 by author on *Ascophyllum nodosum*, well above low water level, examined alive – IRSNB, Wimereux, coll. J. Bouillon 1965 – IRSNB, Roscoff, coll. J. Bouillon June 1966.

Norway – ZMUC, loc. Bergen, det. Kramp.

Denmark – ZMUC, Frederikshavn, July 1899, leg. Th. Mortensen, 3 cm high fertile colonies – ZMUC, Frederikshavn, 27.07.1981, 2 cm colony, typical flabellate form of shoots, with female sporosacs, hydranths with perisarc funnels.

Iceland – ZMUC, Reykjavik, leg. Saemundson, id. Broch, 2 cm colony.

United Kingdom – NMSZ 1993-065-161, Kentra Bay Narrows, Millport, 5.5.1989 – NMSZ 1993-065-166, Loch Sunart, mid- to eulittoral, on *Ascophyllum nodosum* – NMSZ 1993-065-163, Loch Ewe, littoral, 9.6.1990 – NMSZ unregistered, Plymouth Marine Biological Station, on fucoid alga, no date, det. Rees & Thursfield – NMSZ 1993-065-162, Loch Ewe, 9.6.1990 – NMSZ 1976.64.64, South of Fintray Bay, Great Cumbrae, under rock overhang LWM, 24.5.1976 – NMSZ 1997-130-143, south of Pincushion

Rock, Seaham, 10.6.1993 – NMSZ 1993-065-165, Loch Tarbert, mid- to low shore, 21.8.1990 – NMSZ 1997-130-142, as *C. muscoides*, south side of Newbiggia Point, NE England, 6.6.1992 – NMSZ 1974-72-10, as *C. muscoides*, Shetland, 25.7.1974 – NMSZ 1974-72-3, as *C. muscoides*, Bay of Okraquoy, Shetland, 26.7.1974.

New Zealand – see Schuchert (1996).

DESCRIPTION – (after Atlantic material) Hydroid erect, branching several times, shoots 1-3 cm in height, 5-15 hydranths per shoot, colony shape typically rather broad and bushy, occasionally more elongated, branches and stems often curved irregularly, sometimes also straight. Perisarc of stems and cauli either annulated throughout or with annulated stretches interrupted by smooth regions, annulation can be quite irregular and indistinct, diameter of stem and branches variable. Perisarc of distal end of some cauli may rarely end in funnel-like dilation (perisarc collar). Hydranths 1.5-2.5 mm long, cylindrical in relaxed animals, more spindle-shaped in contracted animals, with 18-28 tentacles. All tentacles capitate, oral whorl of 4-5 tentacles inserted obliquely, stalk only slightly tapering, stalk less than 2 times as long as hydranth body diameter, lower tentacles scattered, held at right angle to hydranth body, lowest tentacles somewhat shorter; capitae spherical, diameter about two times the diameter of the stalk. Gonophores arise in upper axil of the tentacles along lower 1/2 to 2/3 of hydranth, 1-3 per tentacle. Gonophores remain fixed as sporosacs, without canal system, spadix present, sporosac spherical to egg-shaped, size max. 0.45 mm, size of mature sporosacs variable. Mature female sporosacs with 15-25 eggs, younger ones with many more eggs, number reduced during maturation. Sporosac casing of males sometimes thickened at distal end. Nematocysts: stenoteles, (18-23) x (11-15) µm and (12-16) x (6.5-10) µm. Colours: observed living hydranths were white, brownish or greenish, mature male and female sporosacs white. Red hydranths are also known.

FURTHER DATA – Stenotele sizes in Japanese populations: (21.7-26.5) x (13.0-16.2) µm and (13.4-16.1) x (6.8-10) µm (Kubota, 1976). Stenotele sizes in New Zealand populations: (21-23) x (13-15) µm and (10-12) x (5.5-6.5) µm.

DISTRIBUTION – All European coasts, Mediterranean, coasts of South Africa, Kerguelen, Seychelles, Korea, Japan, New Zealand, eastern Canada.

BIOLOGY – Grows on a variety of substrates, also on man-made floating objects (Schuchert, 1996). The population from the English Channel tolerates exposure to air. These colonies often grow on *Ascophyllum nodosum* which remains above the water line for several hours during low water. The hydroid is mostly protected from drying out by the wet sea-weeds covering it. Colonies mature in May and June in the English Channel. Colonies from Brittany apparently harbour endosymbiotic zooxanthellae (visible in living hydranths only).

REMARKS – Many authors (e. g. Allman, 1871; Brinckmann-Voss, 1970) thought that Gaertner's original description was insufficient to recognise the species correctly. While this is certainly the case, it is nevertheless very likely that Gaertner's material, probably originating from the English Channel coast, coincides with our present concept of the species. *Coryne pusilla* is frequently found on seaweeds exposed to air at low tide and it is the most abundant corynid of the English Channel. It is thus highly probable that Gaertner's material belonged to what we know today as

C. pusilla. Roscoff lies close to this putative type region and the living material described here can therefore be seen as representative for the species.

Coryne pusilla and *C. muscoides* were usually separated by the occurrence of a perisarc collar (basal beaker, sheath) in the latter species. However, some otherwise typical colonies of *C. pusilla* from Brittany and Denmark also had occasional hydranths with a perisarc collar. This collar formation can also be observed in other branching corynids, e. g. *Coryne eximia* (see above and Schuchert, 1996). The presence of such a collar alone is thus not diagnostic for *C. muscoides*. *Coryne pusilla* and *C. muscoides* occur sympatrically and both species are normally easily separable in the north-eastern Atlantic. The differences found in material from Roscoff are as follows: *Coryne pusilla* differs from *C. muscoides* by its smaller colonies (3 cm versus 5-12 cm); the more straggling, bushy habit versus the elongate form; the general absence of a long main stem; differences in hydranth colour (brown-green versus red); the more irregular and broader annulation; the perisarc collar which is only occasionally present; the longer hydranths and higher tentacle numbers (18-28 versus 16-22); the smaller size of the large stenoteles (18-23 μm versus 25-32 μm). Comparing mature female colonies (Figs 15A and 16 A), I also found that the maximal number of mature eggs per sporosac of *C. pusilla* is only half to one third of the one of *C. muscoides* (table 4). However, this trait needs careful use as a taxonomic character. On one hand, immature female sporosacs of *C. pusilla* contain many more eggs than mature ones and their number is reduced during maturation (see Weisman, 1884; Rees, 1936; van de Vyver, 1967). On the other hand, the numbers of apparently mature eggs in sporosacs of *C. muscoides* was found to be very variable, even in sporosacs of the same hydranth (20-70) and the number also decreases during maturation.

Contrary to the Atlantic, the Mediterranean populations resembling *C. muscoides* or *C. pusilla* pose considerable difficulties by showing all possible intermediate forms between the forms found in the Atlantic (see below). No Mediterranean material unequivocally attributable to *C. pusilla* could be examined.

Coryne pintneri often lacks its characteristic filiform tentacles and such colonies are hardly distinguishable from smaller colonies of *C. pusilla*. Because *C. pintneri* is quite frequent in the Mediterranean, some earlier authors may have mistaken *C. pintneri* for *C. pusilla* (Brinckmann-Voss, 1970).

Coryne fruticosa is here seen as conspecific with *C. pusilla*. Hincks (1868) distinguished it from *C. pusilla* on account of its dense growth and larger sporosacs. Notably Allman (1871) commented “it is plainly very nearly allied to *Coryne pusilla*...I feel much tempted to regards it as a mere variation of that species...” The figures of Hincks (1861) leave no doubt that *Coryne fruticosa* belongs to *C. pusilla* as it is seen today.

Coryne vermicularis Hincks, 1866 was also regarded as a possible synonym of *C. pusilla* by Allman (1871). Broch (1916) regarded both species as conspecific, a view also adopted here. *Coryne vermicularis* was probably based on a completely extended hydranth as shown in Fig. 15A.

Bonnevie (1898b) examined the type material of *Stipula ramosa* Sars, 1829 and found that it must belong to *C. pusilla*.

TABLE 4. Differences of examined independent colonies of *C. muscoides* and *C. pusilla*

species	material (see material examined)	perisarc collar	colony size in cm	length of large stenotele in µm	st. dev	number of measurements	eggs per sporosac
Atlantic material							
C. muscoides	Roscoff, coll. 1998	present	5	28.3	2.3	3	nd
C. muscoides	Roscoff, MHNG INVE 29383	present	6	32.0	0.6	5	20-70
C. muscoides	Roscoff, MHNG INVE 29384	present	10	27.1	0.0	6	male
C. muscoides	Isle of Man, NMSZ1910.174.5	absent, ? lost	7	24.9	0.3	7	50
Mediterranean material							
C. muscoides	Naples, MHNG INVE 25125	present	3	28.8	1.7	12	20-25
C. muscoides	Naples, MHNG INVE 27202	absent	4.5	20.8	0.8	8	nd
C. muscoides	Villefranche, MHNG INVE 31743	present	3.5	24.6	1.5	6	male
C. muscoides	Cala Murada, MHNG INVE 27129	present	2	18.5	0.6	5	15-20
C. muscoides	Cala Murada, MHNG INVE 27129	present	2	20.3	0.8	8	nd
C. muscoides	Cala Murada, MHNG INVE 27129	present	2	19.8	0.5	5	nd
C. muscoides	Cala Murada, MHNG INVE 27129	present	2	20.5	0.6	8	nd
C. muscoides	Cala Murada, coll. 2000	mostly absent	2	21.3	0.6	8	25-30
C. muscoides	Otranto, MHNG INVE 31742	absent	1-2	22.7	0.3	8	nd
C. muscoides	Otranto, coll. 2000	absent	1	23.9	1.8	6	nd
C. muscoides	Lecce, coll. 1997	absent	1-2	21.0	-	2	15-20
Atlantic and Pacific material							
C. pusilla	Frederikshavn, coll. 1899	absent	3	18.4	1.8	6	male
C. pusilla	Frederikshavn, coll. 1981	few present	2	18.4	0.8	7	10-20
C. pusilla	Roscoff, coll. 1966	absent	3	18.4	0.3	13	male
C. pusilla	Roscoff, MHNG INVE 29386	absent	2	18.9	0.6	7	15-25
C. pusilla	Roscoff, MHNG INVE 29385	absent	2	21.4	0.8	13	male
C. pusilla	Roscoff, MHNG INVE 29387	some present	2	19.3	0.9	8	male
C. pusilla	Wimereux, coll. 1965	absent	3	17	-	2	nd
C. pusilla	Shetland, NMSZ 1974-72-3	absent	1	17.8	1	6	male
C. pusilla	Kentra Bay, NMSZ 1993-065-161	absent	1-2	19.0	0.6	6	nd
C. pusilla	Loch Sunart, NMSZ 1993-065-166	absent	2	18.3	1.5	6	nd
C. pusilla	Loch Ewe, NMSZ 1993-065-163	absent	1-2	18.5	0.6	6	male
C. pusilla	Seaham, NMSZ 1997-130-143	absent	1-2	19.1	0.5	6	nd
C. pusilla	Loch Tarbert, NMSZ 1993-065-165	some indistinct	1	17.8	1.2	6	nd
C. pusilla	NMSZ 1997-130-142	absent	1-2	18.5	1.0	6	male
C. pusilla	Auckland, coll. 1994	absent	2	22.0	0.5	10	20-25

Coryne pusilla is most probably restricted to temperate waters. Results of a re-examination of Canadian material identified by Calder (1972) as *C. pusilla* suggest that it could also belong to *C. hincksii* (see there).

Coryne muscoides (Linnaeus, 1761) Figs 15A-B & 16A-F

Tubularia muscoides Linnaeus, 1761: 539.

Coryne ramosa – Johnston, 1847: 42, pl. 6 figs 4-7 (plate as *Coryne pusilla* var. *muscoides*).

Coryne muscoides – Bedot, 1910: 275; ? not Mammen, 1963: 45, figs 12-13; van de Vyver, 1967: 501, figs 14-18, development; Brinckmann-Voss, 1970: 49, figs 54-56; Boero, 1981: 187, fig. 1A-B.

Coryne vaginata Hincks, 1861: 295; Hincks, 1868: 41, pl. 3 fig. 1; Allman, 1871: 268, pl. 4 figs 8-9; Da Cunha, 1944: 11, fig. 12.

Coryne pusilla – Weisman, 1883: 49.

? *Coryne pusilla* var. *Napolitana* Weisman, 1883: 49, pl. 13, fig. 3, 5-8, 12, 15, 17-18.

TYPE LOCALITY – Linnaeus (1761) states: "*Habitat in Oceano Bahusiam alluente*", which translates to coast of Bohuslan (west coasts of Sweden).

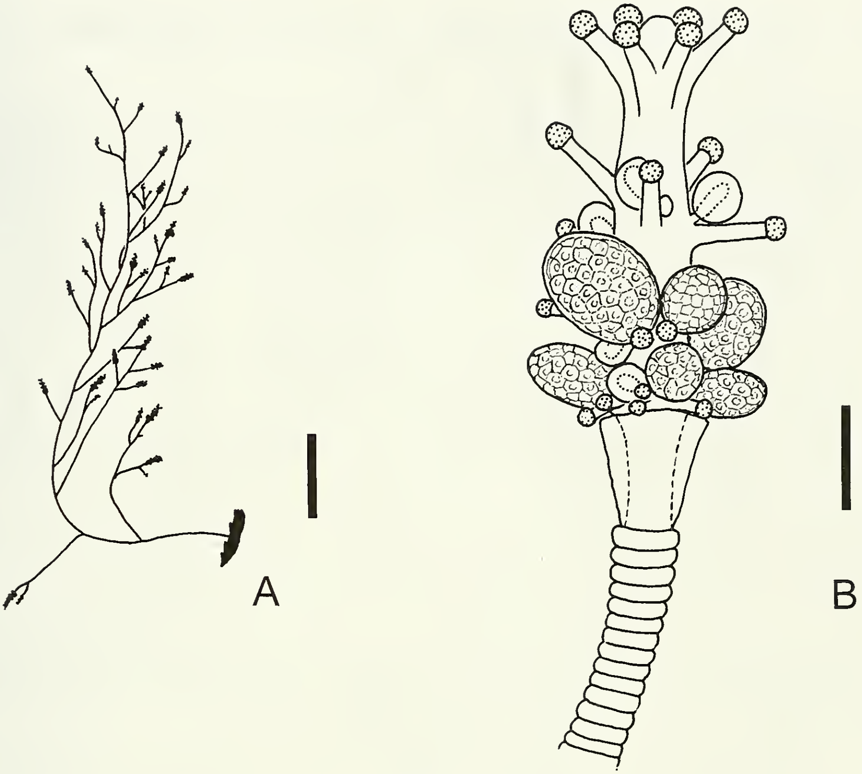

FIG. 15

Coryne muscoides (Linnaeus, 1761), after living material from Brittany. A) One typical shoot, scale bar 1 cm. B) Hydranth with female sporosacs of different developmental stages, scale 0.5 mm.

MATERIAL EXAMINED:

Atlantic – Roscoff, France, living colonies coll. 31.3.1998 by myself on fucoid algae, 0 m, several stems, up to 3 cm, young gonophores present – Roscoff, 4 colonies collected 1-4.06.2000 by myself on diverse algae, all at low water mark but immersed, males and females, examined alive, some preserved as MHNG INVE 29383 and MHNG INVE 29384 – NMSZ1910.174.5, as *C. pusilla*, coll. J. Ritchie, Isle of Man, 5.8.1910, det. Rees & Thursfield 1964, apparently dried out at some stage (reconstituted 1992), typical 7 cm colony but no perisarc collars visible, perhaps collapsed.

Mediterranean – MHNG INVE 25125, Naples, coll. 10.4.1911, on brown algae, 3 cm, elongated colony, with perisarc collars – MHNG INVE 27202, Naples, Italy, coll. 20.2.1892, infertile, 4.5 cm colonies, without perisarc funnels – MHNG INVE 27129, Mallorca, Cala Murada, coll. 22.08.1999 by author, numerous male and female colonies growing on *Corallina* spec. at 0.2 to 0.5 m depth on vertical rock coast, up to 2 cm, with perisarc collars – MHNG INVE 29759, labelled *C. pusilla*, Mallorca, Cala Murada, coll. 21.08.2000, same locality and substrate as MHNG INVE 27129, with and without perisarc collars – MHNG INVE 31743, Villefranche-sur-Mer, Ligurian Sea, 0-0.5 m, coll. by author 8.5.2001, fertile male, 3.5 cm high, very elongate, with collars – MHNG INVE 31742, Italy, Otranto, Torre del Serpe, coll. S. Piraino 13.3.2001, 1-2 m on algae, mass occurrence, infertile, several shoot per colony, without perisarc collars or with fine membrane only, elongate colony form – Italy, Otranto, coll. A. Frese 10.3.2000, infertile, appears identical to previous material – near Lecce, Italy, coll. A. Faucci 1997 on *Cystoseira*, infertile.

Description – (after Atlantic material) Hydroid large, 5-15 cm, shape of shoots usually very elongate, with long, straight main stem and shorter side branches (Fig. 15A), diameter of stem and branches similar, about 0.3 mm, branches and stems regularly straight; stem and branches regularly and sharply annulated throughout, rings narrow, height of rings less than half of diameter. Perisarc usually ends at base of hydranth in a funnel-shaped perisarc collar (Fig. 15B), distal diameter of collar about twice the caulus diameter, collar regularly present in examined undamaged material, but can be missing in some hydranths, can also be collapsed in preserved material. The collar has thin, filmy walls and is a dilation of the perisarc, sometimes with indistinct annulation, it is not a gelatinous addition. Hydranths about 2 mm in height, spindle shaped, with 16-22 tentacles. Tentacles all capitate, arranged in an oral whorl of 4-6 tentacles and lower tentacles scattered or in 3 indistinct whorls. Oral tentacles attached very obliquely to hydranth, up to 40 gastrodermal cells in stalk. Tentacle stalks not much tapering, capitae spherical, relatively small, most proximal tentacles short and their capitae small. Gonophores develop in upper axils of lower tentacles, 2-3 per tentacle, 10-16 in total, all of variable developmental stages. Gonophores are sessile sporosacs without any canal system, with spadix, shape oblong, max. 0.6 mm long, size of mature sporosacs variable, female sporosacs with 20-70 eggs, depending also on stage of maturity. Nematocysts: stenotele (25-33) x (14-22) μm and (17-21) x (8-12) μm. Colours: hydranths orange, capitae of tentacles red, stems yellow-orange, mature male and female sporosacs white.

Additional data – Van de Vyver (1967) examined the early development and gives an egg size of about 0.1 mm.

Distribution – Coast of Sweden, south-western Britain, France, Portugal, Mediterranean.

Biology – The Atlantic forms occurs on brown algae in depths of 0-2 m, mature animals can be found from March to June, perhaps also later.

Remarks – For notes on the taxonomic history see Bedot (1910).

Colonies of *C. muscoides* from the Atlantic are normally easily distinguishable from *C. pusilla*. The differences are given above under *C. pusilla*. As mentioned, the presence of a few perisarc collars alone is not diagnostic of *C. muscoides*. Some hydranths of *C. muscoides* can lack it and *C. pusilla* and other corynids like *S. eximia* can have hydranths with such collars. In the examined Atlantic material, however, nearly all hydranths of *C. muscoides* had this collar (one dried out specimen excepted), while the collar is only present in some hydranths of *C. pusilla*, if at all.

Contrary to the Atlantic populations, the Mediterranean forms here allocated to *C. muscoides* are difficult to evaluate and they could belong to a separate species or subspecies. The Mediterranean forms are very variable and are in many respects intermediate between the Atlantic forms of *C. muscoides* and *C. pusilla*. This perhaps lead Picard (1960) to synonymise *C. pusilla* with *C. muscoides*. His opinion was not shared by Brinckmann-Voss and I also regard both species as valid. The Medi-

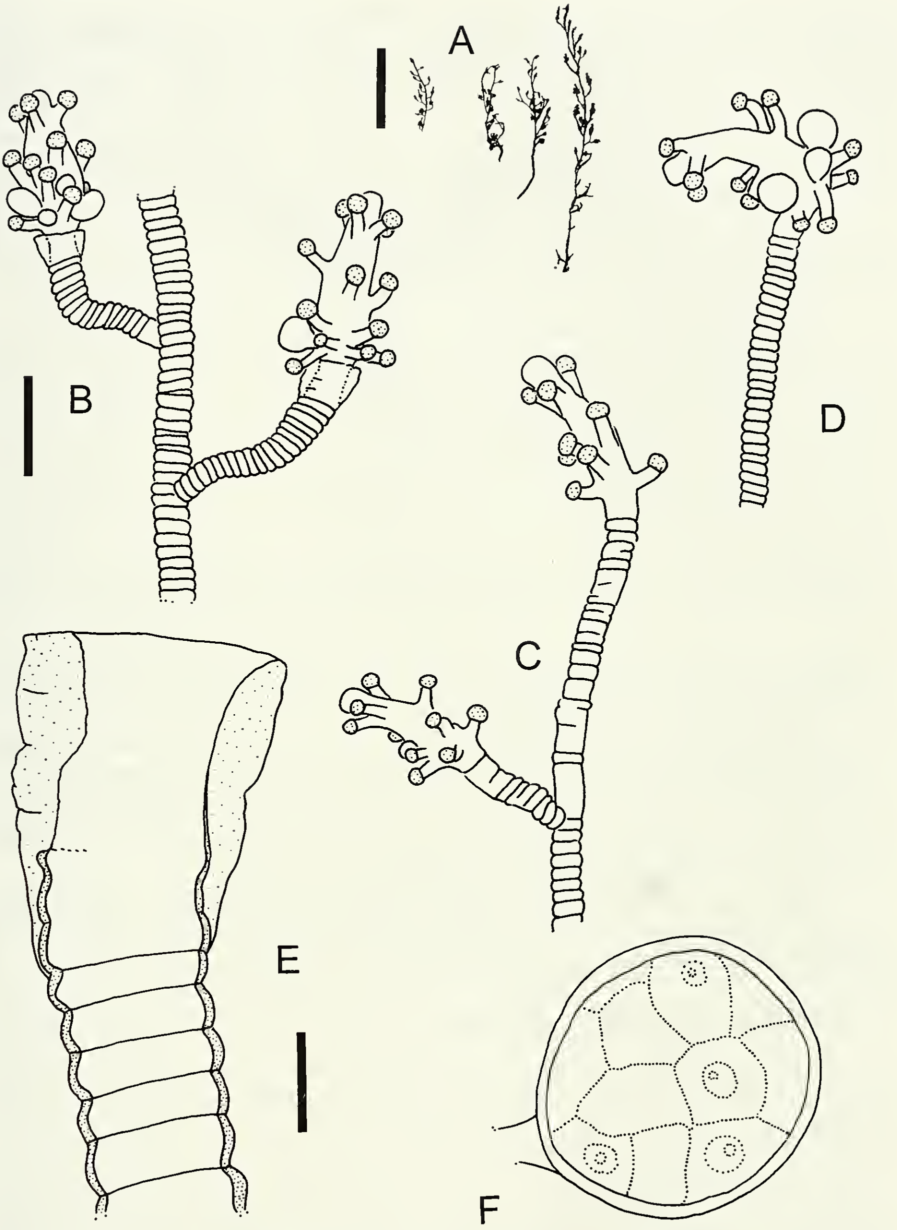

FIG. 16

Coryne muscoides (Linnaeus, 1761), Mediterranean form, all after preserved samples associated with *Corallina* spec. A) Silhouettes of typical colonies, scale bar 1 cm. B) MHNG INVE 27129, part of shoot with two hydranths, note presence of perisarc collars, scale bar 0.5 mm. C-D) Parts of one colony (MHNG INVE 29759), note absence of perisarc collars, same scale as B. E) Distal end of caulus with perisarc collar, scale bar 0.1 mm. F) Female sporosac, same scale as E.

terranean form resembling *C. muscoides* is well documented by Brinckmann-Voss (1970). I found abundant identical material on Mallorca and at Villefranche-sur-Mer (Fig. 16A-F). The colonies are frequently found immediately below the water surface growing in association with a species of the calcareous red algae *Corallina*. They form mostly solitary, elongate shoots with a main stem like typical *C. muscoides*. A perisarc collar is frequently present in these colonies, but some lack it. Especially in colonies from deeper waters (1-3 m), these collars can be entirely absent or they are only formed as a adhering perisarc film. Some of the perisarc collars found in the Mediterranean material were like a gelatinous additional layer on the outside of the annulated periderm (Fig. 16E), something not observed in the Atlantic material.

The Mediterranean material here examined was reluctantly allocated to *C. muscoides* and not *C. pusilla* following Brinckmann-Voss (1970). This decision was based on the elongated colony shape, the frequent occurrence of a perisarc collar, the tentacle numbers, and the often regular and complete annulation. Admittedly, these are all characters often acknowledged as prone to variation due to environmental factors, but sometimes the overall similarity of specimens from both populations was quite striking. The Mediterranean material usually differs from the Atlantic *C. muscoides* in forming smaller colonies measuring 1-4.5 cm in height; the female sporosacs have fewer eggs (10-30); and the length of the large stenotele is usually smaller. These characteristics match better *C. pusilla*. The length of the larger stenotele was found to be very variable, but without forming two separate groups (see table 4). Boero (1981) used nematocyst size to separate Mediterranean *C. muscoides* and *C. pusilla*. With the material observed here, this was not evident.

Nevertheless, I am inclined to regard the Mediterranean *Coryne* growing in association with *Corallina* as a species separate from both *C. pusilla* and *C. muscoides*. The differences from the Atlantic *C. muscoides* and *C. pusilla* have been listed above, but are considered insufficiently reliable to be of diagnostic value. New investigations using genetic methods must address the problem.

Mostly for biogeographic reasons I doubt that Mammen's (1963) material from the tropical Indian Ocean identified as *C. muscoides* belongs to this species. Mammen's colonies were only 5 mm high, but they had perisarc collars.

5.1.3. Incompletely known *Coryne* species

This set comprises all species of which we have only incomplete information. Some of them are nevertheless distinct and well recognisable species. They are listed in alphabetical order.

Coryne epizoica Stechow, 1921 Fig. 17

Coryne spec. P – Graeffe, 1884: 352
Coryne epizoica Stechow, 1921: 248; Stechow, 1923b: 41, fig. C; ? not Riedl, 1959: 603; Brinckmann-Voss, 1970: 48, figs 52-53.
TYPE LOCALITY – Naples, Italy, Mediterranean.
MATERIAL EXAMINED – Naples, coll. J. Bouillon June 1962, IRSNB IG27.838, three hydranths.

DESCRIPTION – Hydroid stolonal, 2-3 mm high, stolons creeping on shells of *Rissoa* spec. (Gastropoda), hydranths with perisarc-covered caulus (1-3 mm),

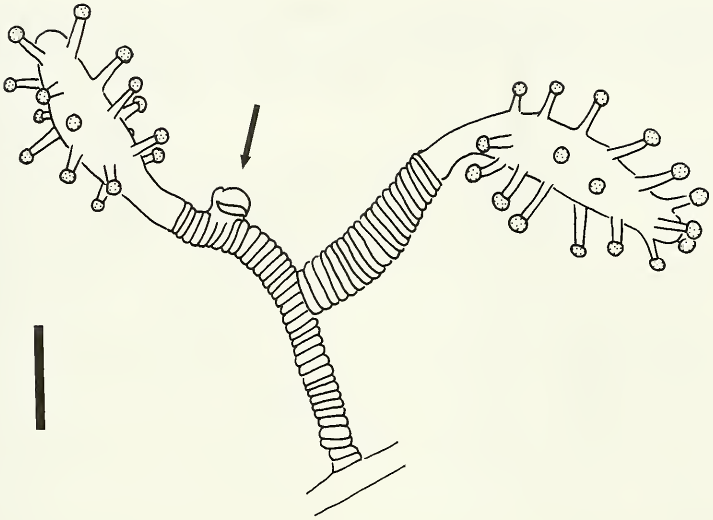

FIG. 17

Coryne epizoica Stechow, 1921, after preserved material from Naples, arrow points at residue of a gonophore-like outgrowth, scale bar 0.5 mm.

hydranth body 1-2 mm. Perisarc of caulus always narrowly annulated throughout. Hydranth body cylindrical, with about 15-20 tentacles, 4-6 oral tentacles in one whorl, others scattered or in indistinct whorls. Gonophore-like outgrowths develop on caulus in perisarc covered zone. Mature gonophores unknown. Colours: hydranth reddish brown, perisarc light to dark brown.

DISTRIBUTION – Naples, Villefranche, Trieste (Mediterranean).

BIOLOGY – This species grows exclusively on shells of *Rissoa* spec. living in *Posidonia* beds in 20-40 m depth (Brinckmann-Voss, 1970).

REMARKS – The outgrowths from the perisarc-covered region of the caulus were interpreted by Brinckmann-Voss (1970) as incipient gonophores, although she never found spermatids or oocytes. It is thus probable that these outgrowths are a structure of unknown function. New life-cycle studies on this species are needed.

Coryne gracilis (Browne, 1902) Fig. 18A

Sarsia gracilis Browne, 1902: 275; Browne & Kramp, 1939: 271, pl. 14 figs 1-2, pl. 15 fig. 1; Kramp, 1957: 4; Kramp, 1959: 79, fig. 16; Kramp, 1961: 28; Schuchert, 1996: 128.

? *Syncoryne sarsi* – Hartlaub, 1905: 525, fig. F.

TYPE LOCALITY – Falkland Islands.

MATERIAL EXAMINED – ZMUC, Falkland Islands, Stanley Harbour, several medusae collected at various dates in 1901 and 1902 by Vallentin, id. Kramp, mature specimens 1.5-2 mm – IRSNB IG27.838, South Africa, Cape Town, Table Bay, coll. J. Bouillon 1969, 1 medusa 1.4 mm with few eggs on manubrium.

DESCRIPTION – (after Browne & Kramp, 1939; Kramp, 1959) Medusa 5 mm high, 3 mm wide, cylindrical bell, wall moderately thick, margin quadrangular; manu-

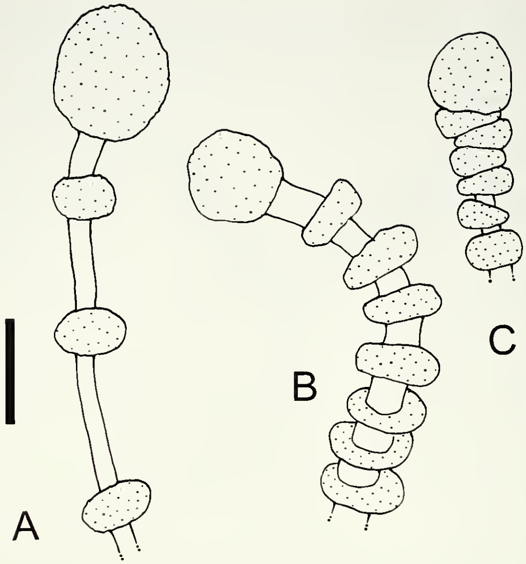

Fig. 18

A) *Coryne gracilis* from South Africa, terminal tentacle tip of medusa, scale bar 0.1 mm. B) *Coryne eximia* from Brittany, same scale as A, but more contracted. C) *Coryne eximia* tentacle tip from New Zealand, same scale as A, but more contracted.

brium two-thirds as long as bell cavity, nearly whole length surrounded by gonad; tentacles with large oval terminal knob. Juvenile medusae with bell wall much thickened in interradial position.

Distribution – Falkland Islands, ? South Africa.

Remarks – Medusae from the type locality (ZMUC, Stanley Harbour) examined here seem to be identical to the form of *C. eximia* with cylindrical bell described by Schuchert (1996). However, they are smaller and do not reach the size given by Browne & Kramp (1939). The medusae look like *C. eximia* with a thicker apex and the terminal nematocyst clusters of the tentacles are somewhat larger. The South African medusa was also quite small (1.4 mm), but already had a few eggs (diameter 0.2 mm), its terminal cluster was also somewhat larger than in *C. eximia* and resembled the ones from the Falkland Islands. Browne & Kramp (1939) described juvenile stages of this species with the interradial portion of the subumbrella bulging towards the axis. This seems at first to be the only considerable difference to *C. eximia*; however, such a bulging of the subumbrellar ectoderm is often seen in small medusae due to mechanical stress (e. g. caused by the collecting procedure with a plankton net). I have seen it too in *C. eximia* from the English Channel. Thus, it might well be that the interradial bulges described for the young *C. gracilis* are an artifact only.

The cylindric shape of *C. gracilis* is also not unique to this species, as some *C. eximia* have it too (Schuchert, 1996). The only consistent difference to *C. eximia* remains thus the larger terminal tentacular cluster (Fig. 18A-C). I suspect that *C. gracilis* belongs to *C. eximia*, but life-cycle observations at the type locality must be made before a closer comparison is possible.

Coryne inabai Uchida, 1933 Fig. 19

Sarsia inabai Uchida, 1933: 126, fig. 2, Bouillon, 1978a: 131, fig. 3; Bouillon, 1985b: 248, fig. 1.
Plotocnide borealis – Kramp, 1968: 91.
Type locality – South West of Kamchatka, 51°33'N 156°20'E, 0-30 m.
Material examined – Laing Island, Papua New Guinea, IRSNB IG 27.828, coll. J. Bouillon 1978 and 1981, two lots with two medusae, some mature.

Description – Medusa bell height 3 mm (reportedly up to 8.5 mm), higher than wide, jelly very thick, especially at top where about 2/5 of total height, maximal diameter of bell in middle of height or above. Manubrium short, about 3/5 of bell cavity, with or without very shallow apical knob, gonads encircle manubrium for nearly its whole length, leaving manubrium visible only at the top and near the mouth. Velum narrow. Ring canal broader than radial canals, these narrow, ending in large tentacular bulbs. Gastrodermal chamber of marginal bulbs high, epidermal ring complete, with distinct ocellus. Each bulb with one short tentacle, for most part with few nematocysts, distal part swollen and studded with nematocysts (2 sizes of stenoteles, desmonemes). Shape of distal tentacular swelling spherical or oblong. Polyp phase unknown.

Distribution – Kamchatka, Mozambique, Papua New Guinea.

Remarks – *Coryne inabai* is a very rare species. Kramp (1942) doubted its validity and referred it to *Plotocnide borealis*, a morphologically similar species but one which lacks ocelli. Bouillon (1978a) thought he had found the species again at the Seychelles (1 medusa). However, his medusa – although mature – measured only 1.3 mm as opposed to 3-8.5 mm given by Uchida (1933) and it had a slight peduncle. Perhaps this is a different species. Later, Bouillon (1985b) recorded this medusa also from Papua New Guinea. These specimens – re-examined for this study – fit Uchida's description rather well, except for the more oblong tentacular swellings (Fig. 19A). Some smaller, juvenile specimens from Papua New Guinea had distinctly spherical capitae (Fig. 19D) and it seems that the tentacle tips undergo some changes during development.

Although not unusual for hydrozoans, the occurrence in the cold northern Pacific as well as in the tropical Pacific and Indian Ocean is somewhat surprising. New investigations have to prove that all medusae assigned to *S. inabai* in fact belong to one species.

Coryne prolifera (Forbes, 1848) Fig. 20A-D

Sarsia prolifera Forbes, 1848: 59, pl. 7 fig. 3; Hartlaub, 1907: 15, figs 7-8; Russell, 1953: 52, pl. 2 fig. 1, text-figs 17B, 19, 20, 25D; Kramp, 1959: 79 fig. 14; Kramp, 1961: 30; Brinckmann-Voss, 1970: 66; Bouillon, 1974: pl. 6.
? *Codonium codonoforum* Haeckel, 1879: 14, pl. 1 fig. 3; Mayer, 1910: 61.
? *Sarsia prolifera* – Goy, 1972: 971, fig. 2
Coryne prolifera – Petersen, 1990: 211, fig. 43E.
Type locality – Penzance Bay, Cornwall, England.

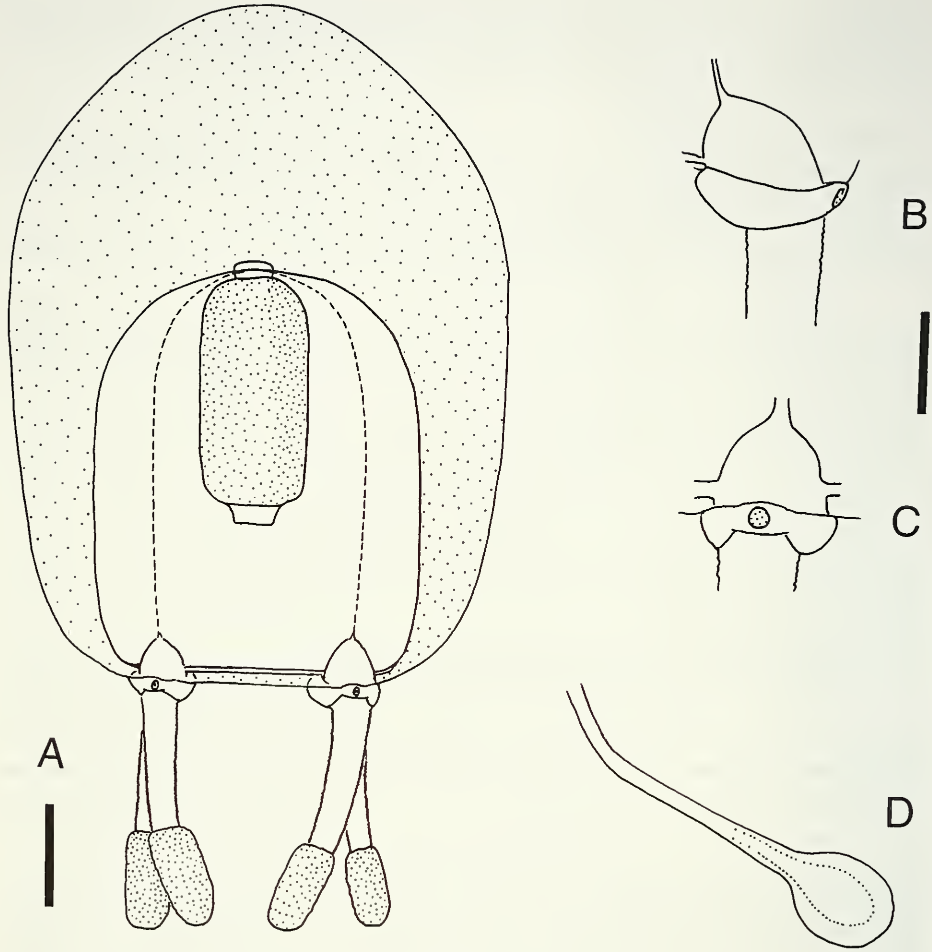

FIG. 19

Coryne inabai Uchida, 1933, material from Papua New Guinea. A) Whole mature, medusa, scale bar 0.5 mm. B) Lateral view of tentacle bulb, scale bar 0.2 mm. C) Frontal view of tentacle bulb, same scale as B. D) Distal end of relaxed tentacle of a smaller specimen, same scale as B.

MATERIAL EXAMINED – IRSNB IG27.838, Roscoff, France, coll. J. Bouillon 1961, 1971, several medusae, young polyps –ZMUC, SW British coasts, leg. E. T. Browne, 3 medusae – ZMUC, Plymouth, 25.11.1907, leg. & det. E. T. Browne, nice medusa of 2 mm.

DESCRIPTION – Medusa up to 3 mm in height, usually smaller than 2 mm, bell diameter as large or slightly larger than height, umbrella broadly bell-shaped, jelly somewhat thickened at apex. Four thin radial canals, tentacular bulbs quite broad, extended tentacles as long or longer than two times bell height, issuing obliquely, covered by numerous clasping nematocyst clusters, terminal cluster not enlarged. Manubrium spans 1/2 of bell cavity, cylindrical, with or without apical chamber,

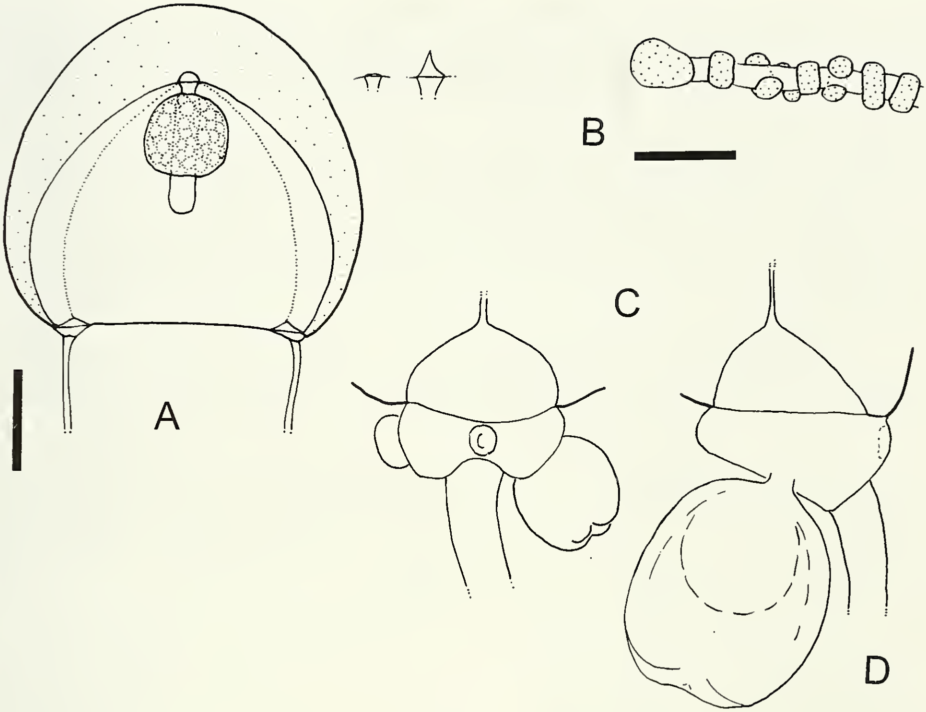

Fig. 20

Coryne prolifera (Forbes, 1848) from Roscoff. A) Side view of mature female with variation of apical chamber (right), scale bar 0.5 mm. B) Tentacle tip of medusa, scale bar 0.1 mm. C) Tentacle bulb with two medusa buds in frontal view, same scale as B. D) Side view of tentacle bulb with one advanced medusa bud, same scale as B.

apical chamber if present rounded or conical. Gonad encircles upper part of manubrium only and leaves distal fourth of stomach free. Nematocysts: stenoteles and desmonemes. Egg size: 45-60 μm. Immature medusae bear characteristic medusae buds on the epidermal part of the tentacle bulbs, up to two buds per bulb.

Biology – The medusa is present along the south-western coast of the British Isles from June to October. Some specimens may also be found as early as March and as late as November (Russell, 1953).

Distribution – British Isles, France, ? Mediterranean.

Remarks – The immature medusae with their medusae buds on the tentacle bulbs are very characteristic and immediately identifiable. Fully mature animals may cease medusae production. Such animals can be difficult to distinguish from *C. eximia* or *C. producta*. The smaller size, the flatter bell, and the shorter gonads are a trait that could help to identify mature, non-budding medusae. Additionally, *C. producta* always has an apical canal or chamber, *C. prolifera* occasionally, and *C. eximia* never.

The polyp stage of *C. prolifera* is so far unknown. However, the IRSNB holds a small polyp collected by Prof. Jean Bouillon that is likely the polyp stage of *C. prolifera*. It is a typical, although small, corynid with scattered capitate tentacles. Filiform tentacles could not been seen. A young stage is probably depicted in Bouillon (1974a, plate 6). Prof. J. Bouillon informed me that he collected this material at Roscoff on sponges. One of the polyps released a medusa with the characteristics of *C. prolifera*, but the medusae buds on the bulbs were only just starting to grow before the animal was lost. Also the polyp colony could not be kept for a longer time. The polyp shown in Bouillon (1974a) clearly has high epidermal cells around the mouth. The polyp stage of *C. prolifera* must nevertheless be considered as insufficiently known and new investigations are required.

Brinckmann-Voss (1970) regarded all Mediterranean records of this species doubtful. Goy (1972) found one specimen in the western Mediterranean, but because the manubrium protruded from the bell she was not sure about her identification.

Haeckel's *Codonium codonoforum* was described from a single medusa from Corfu (Adriatic, Mediterranean) and was much larger (8 mm) compared to Atlantic *S. prolifera* (max. 4 mm, normally 2 mm) and it had an apical canal. It has never been found again, but its size could make it recognisable. Following Mayer (1910), it is here treated as a questionable synonym of *S. prolifera*.

Coryne sargassicola Calder, 1988

Sarsia mirabilis – Fraser, 1912: 347, fig. 3.
[not *Sarsia mirabilis* L. Agassiz, 1849]
Sarsia decipiens – Stechow, 1919: 3.
Coryne sargassicola Calder, 1988: 64, figs 48-49.
TYPE LOCALITY – Natural Arches Beach, Bermuda, on *Sargassum*.
MATERIAL EXAMINED – Slide from ZSM, collection Stechow, labelled *Syncoryna mirabilis*, Gulf of Mexico, Dr. Heitz 1904; colonies grow on algal substrate, most probably material described in Stechow (1919).

DESCRIPTION – (after Fraser, 1912 & Calder, 1988) Stolonal colonies on *Sargassum*, 3 mm high cauli arising from creeping hydrorhiza. Perisarc of moderate thickness, thinning out distally, smooth or with a few wrinkles, not annulated. Hydranth elongate-oval, 1 mm long and 0.3 mm wide, with 2-5 whorls of 4-6 capitate tentacles. Below capitate tentacles one whorl of filiform tentacles that may be reduced. Nematocysts: two types of stenoteles. Gonophores arise from axils of proximal tentacles (Calder, 1988) or below them (Fraser, 1912), developing presumably into sessile sporosacs, perhaps sessile medusoids (Fraser, 1912).

DISTRIBUTION – Bermuda, western Atlantic.

REMARKS – *Coryne sargassicola* is only insufficiently known and especially its mature gonophores are unknown. However, its association with *Sargassum* make it recognisable.

Material that most probably corresponds to material described by Stechow (1919) as *Sarsia decipiens* was examined for this study. Calder (1988) is certainly right in stating that *S. tubulosa* (=*S. decipiens*) does not occur in warm waters and thus Fraser's and Stechow's identifications must be erroneous. Stechow's material

TABLE 5. Distinguishing characters of the *Dipurena* species

characters	*D. gemmifera*	*D. baukalion*	*D. bicircella*	*D. halterata*	*D. ophiogaster*	*D. reesi*	*D. simulans*	*D. strangulata*	*D. spongicola*
number of gonad rings	1	2	2	2-4	3-9	2, occ. 3-4	2-3	2	min. 2
most proximal gonad adjacent to manubrium base	no	yes	no	no	no	no	no	no	no
swellings along radial canal	0	0	0	1-3	0	0	1	0	unknown
apical chamber	present	present	present	present	present	present	small or absent	small	unknown
bell size mm	5	3.8	1.6-2.1	4-8	3-5	2-3	5	2-4	unknown
number of nematocyst clusters	many	many	many	3-6	many	many	1	1	unknown
haploneme in medusa	no?	yes?	no	yes	occasionally	no	yes	no	unknown
polyp associated with sponges only	unknown	unknown	no	yes	no	no	yes	yes	yes
hydranth size in mm	unknown	unknown	0.3 - 0.4	1-1.7	1-2	1-1.5	0.5	0.8-1.0	0.4-0.8
number of capitate tentacles	unknown	unknown	8-10	15-24	10-18	4-5	10-13	4-5	4-5
whorls of capitate tentacles	unknown	unknown	2	3-5 or scattered	4 or scattered	1	2-3	1	1
gastrodermal cells in oral tentacles	unknown	unknown	12?	7-10	unknown	13 -18	6-8	7 - 11	6-8
gonophores below or among capitate tentacles	unknown	unknown	below	among	below	below	below	below	below
filiform tentacles	unknown	unknown	present	absent	present	present	absent	present	present
length of filiform tentacles	unknown	unknown	medium	-	short	long	-	short	short
haploneme in polyp	unknown	unknown	no	yes	no	no	yes	no	present

consists of a few small stolonal stems that might correspond to *Coryne sargassicola* Calder, 1988. It differs from the latter in having an irregularly corrugated perisarc and no filiform tentacles. It bears some immature gonophores, which develop among the tentacles.

5.2. Genus ***Dipurena***

SYNONYM – *Slabberia* Forbes, 1846 (pre-occupied, Mayer, 1910).
TYPE SPECIES – *Dipurena strangulata* McCrady, 1859.

DIAGNOSIS – Colonial hydroids with one or several whorls of capitate tentacles, with or without one whorl of aboral filiform tentacles. Gonophores released as free medusae. When mature the manubrium is distinctly longer than bell height. Gonad in two or more cylinders around manubrium (except *D. gemmifera* which has only one gonad). Gonads also cover distal, swollen stomach region. Tentacles unbranched. Cnidome without or with isorhiza nematocysts.

REMARKS – A summary of the distinguishing characters of the better known species of this genus is given in table 5.

Dipurena baukalion Pagès, Gili & Bouillon, 1992 Fig. 21A-B

Dipurena baukalion Pagès, Gili & Bouillon, 1992: 15, figs 15-16.
TYPE LOCALITY – 34° 51'S 19° 55'E, 0-40 m, Benguela Current, South Atlantic.
MATERIAL EXAMINED – South Africa, INSNB IG27.828, coll. 1978, part of original material used for first description.

DESCRIPTION – (in part after Pagès *et al.*, 1992) Medusa bell-shaped, about twice as high as wide, height up to 3.2 mm, jelly thickened at apex. With rounded apical chamber. Manubrium protruding from bell in adult specimens, with distal swelling. Gonad divided into two cylinders and enveloping the manubrium. Proximal ring short, located just below apical chamber, distal gonad long, covering the distal half of the manubrium except for the mouth region. Four narrow, hardly visible radial canals without dilations. Tentacle bulbs large, oval, with red abaxial ocellus. Four tapering tentacles with a proximal portion free of nematocysts followed by nematocysts clusters, ending in a not significantly enlarged spherical nematocyst cluster. Nematocysts: stenoteles (length 15-22 μm), desmonemes, perhaps also a haploneme. Polyp phase unknown.

DISTRIBUTION – Cape of Good Hope (South Africa).

REMARKS – *Dipurena baukalion* resembles *D. ophiogaster*, but has a different arrangement of the gonads. While *S. ophiogaster* usually has more than two gonad rings of equal size that are at placed far away from the origin of the manubrium, *D. baukalion* has only two unequal ones, the upper beginning just at the origin of the manubrium.

Dipurena bicircella J. T. Rees, 1977 Fig. 22

Dipurena bicircella Rees, 1977: 198, figs 1-2; Pagès *et al., 1*992: 16.
TYPE LOCALITY – Horseshoe Cove, Bodega Bay, California, USA (38°19' N 123°04'W).

DESCRIPTION – (after Rees, 1977) Hydroid stolonal, stems including hydranths up to 5 mm. Hydranths small (0.3-0.4 mm in height), clavate, with one oral whorl of

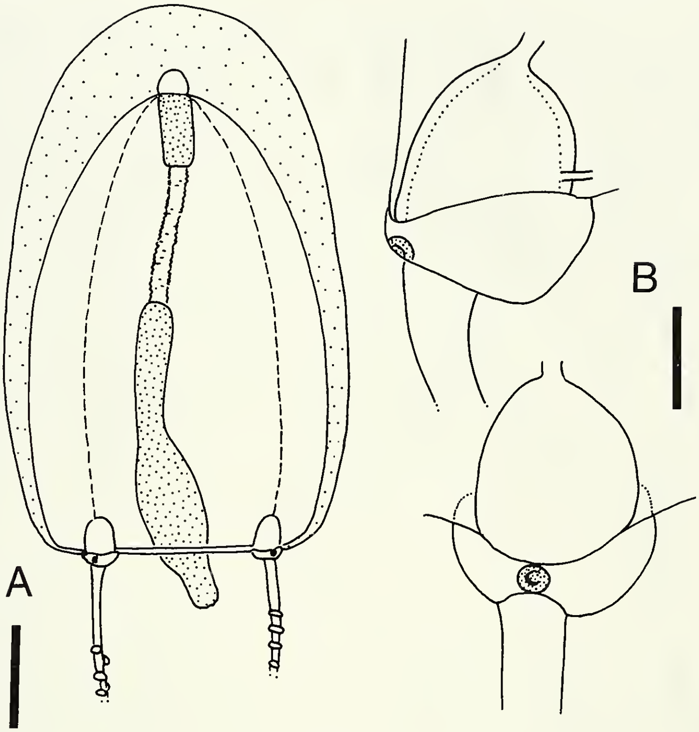

FIG. 21

Dipurena baukalion Pagès, Gili & Bouillon, 1992. A) mature medusa, composite picture after preserved material, scale bar 0.5 mm. B) Tentacle bulbs, scale bar 0.2 mm, top in in frontal view, below in side view.

4-5 capitate tentacles and a single whorl of 4-5 lower capitate tentacles, at lower fourth one whorl of filiform tentacles (present also in colonies from nature). Gonophores develop in middle of hydranth below capitate tentacles and above the filiform tentacles, 1-6 gonophores in one whorl. Gonophores are released as free medusae. Nematocysts: stenoteles, (20-22) x (14-15) µm and (14-16) x (10) µm.

Newly released medusa 0.5 mm high, with red ocelli, with 22 nematocyst clusters on tentacles, exumbrella with scattered nematocysts of microbasic mastigophore type, size (12) x (14-15) µm.

Adult medusa 1.6 to 2.1 mm high, as wide as high, bell-shaped, jelly moderated thick, jelly at apex about 1/4 of bell height. Manubrium with bullet-shaped apical chamber, extended manubrium about two times as long as bell height, with thin serpentine part and distal stomach. Gonads in two rings, distal one on swollen stomach region, more proximal one at lower third of manubrium. Tentacles short, length when extended equals about bell height, with small nematocyst clusters and a slight terminal knob. Ocelli red, gastrodermal system orange-yellow. Nematocysts: stenoteles (12-13) x (9) µm; desmonemes (10-11) x (5) µm.

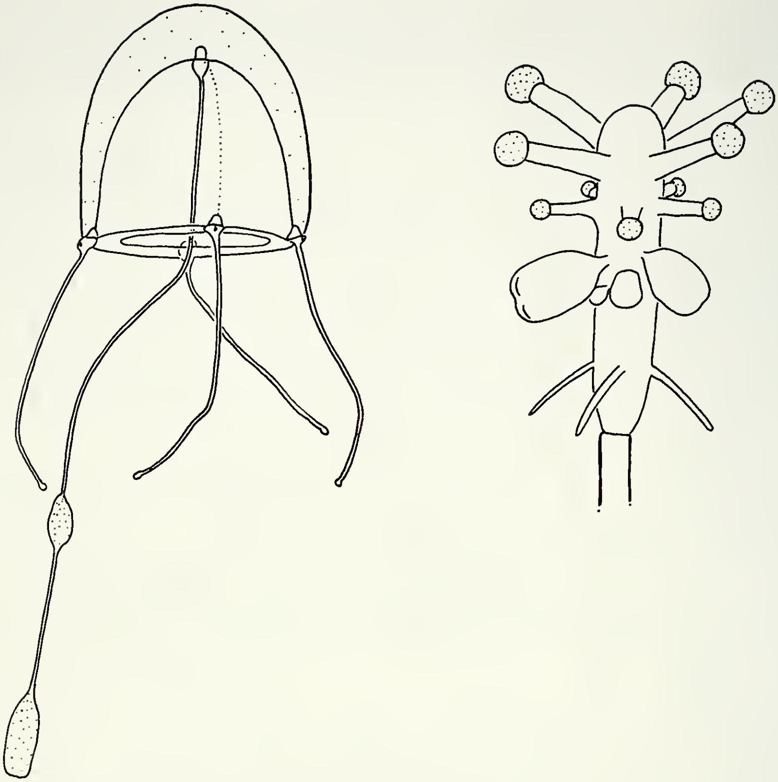

FIG. 22

Dipurena bicircella Rees, 1977, modified after Rees (1977), mature medusa and polyp with medusa buds.

DISTRIBUTION – Only known from type locality in California.

BIOLOGY – The hydroids grow on rock and bivalve shells, depth 3-10 m. The medusa is not known from nature. In the laboratory it matured within two weeks.

REMARKS – *Dipurena bicircella* is so far the only known *Dipurena* species with polyps having constantly two whorls of capitate tentacles only. The relatively short tentacles of the medusa combined with its small size might render this species recognisable also in the medusa stage, although it is very prone to be confounded with *D. ophiogaster*, a medusa known from waters of nearby Mexico. The medusa is also hardly distinguishable from *D. reesi,* a species also known to occur in California (Bullivant, 1970). Perhaps the long cnidocils of *D. reesi* can be used to distinguish them, but the cnidocils of *D. bicircella* remain uninvestigated.

Dipurena gemmifera (Forbes, 1848) Fig. 23A-D

Sarsia gemmifera Forbes, 1848: 57, pl. 7 fig. 2; Sverdrup, 1921: 14, pl1 fig. 3; Kramp, 1927: 35, chart 4; Russell, 1938: 150, figs 13-18; Berrill, 1950: 306, figs 7B-C; Russell, 1953: 61, figs 24 & 25a-c, pl. 1 figs 1 & 4; Kramp, 1959: 79, fig. 12; Kramp, 1961: 27; Brinckmann-Voss, 1970: 64, text-figs 75-76, pl. 3 fig. 1; Goy, Lakkis & Zeidane, 1991: 102, fig. 4.

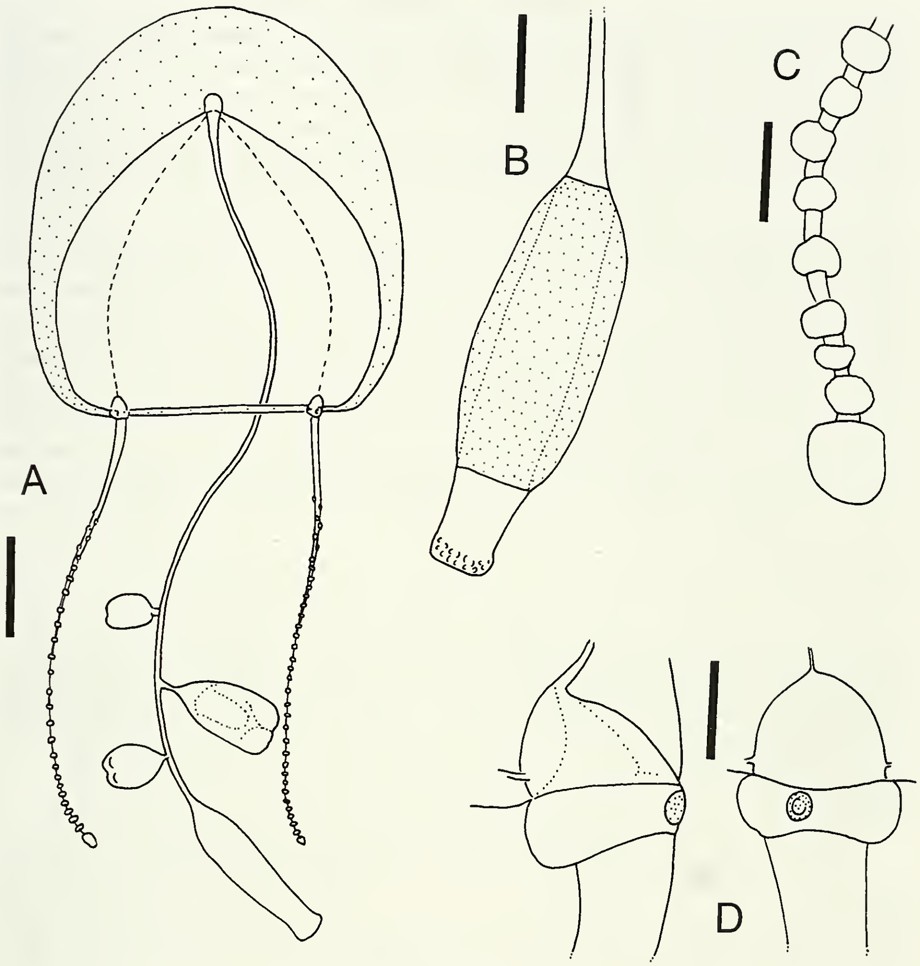

FIG. 23

Dipurena gemmifera (Forbes, 1848), after preserved material. A) Medusa with medusae buds on manubrium, scale bar 0.5 mm. B) Manubrium covered by gonad tissue, scale bar 0.2 mm. C) Tentacle tip, scale bar 0.1 mm. D) Marginal bulbs in side- and frontal view, scale bar 0.1 mm.

Sarsia clavata Keferstein, 1863: 63; Hartlaub, 1907: 51, fig. 46.
Dipurena fertilis Metschnikoff, 1871; synonym after Hartlaub, 1907: 59.
Sarsia siphonophora Haeckel, 1879: 20, pl. 1 fig. 4; Kramp, 1959: 307; Kramp, 1961: 31.
Purena gemmifera – Hartlaub, 1907: 58, figs 54-58, Le Danois, 1913: 305, fig. 2.
Dipurena gemmifera – Petersen, 1990: 212.
TYPE LOCALITY – British Isles.
MATERIAL EXAMINED – IRSNB IG 27.838, Roscoff, France, coll. J. Bouillon 1965 and August 1968, several medusae, one with gonads, several with medusae buds – ZSM, Bergen, Norway, collection Stechow, 1 slide, coll 1905, number E628/15 – ZMUC, 51°43.5N 2°06', 23.08.1906, id. Kramp, badly damaged – ZMUC, British Coasts, leg. & det. E. T. Browne, one medusa – ZMUC, Frederikshavn, Denmark, 27.07.1981, 2 nice medusae – Roscoff, France, 1 juvenile medusa collected by author 5.6.2000, examined alive.

Description – Adult medusa 2-3 mm high, somewhat higher than wide, jelly moderately thick, thicker at apex, exumbrella rounded, subumbrella rounded or pointed. Manubrium with a bullet-shaped apical knob. Extended manubrium at least two times as long as bell height, composed of a long, thin proximal part (serpentine part) and a distal swollen stomach. Along distal part of serpentine manubrium develop spirally arranged medusae buds (normally 1-4, max. 13). The gonad develops only on the distal, swollen stomach. Radial canals very thin, thinner than circular canal, entering gastrodermal chamber of bulb at its top. Gastrodermal chamber of bulbs high, walls bulging, nettle ring of bulb nearly complete, with ocellus. Tentacles issued mostly parallel to main axis of animal, relatively short (1.5 times bell height when relaxed), with 15-30 nematocyst clusters and a slightly enlarged, bullet-shaped terminal cluster. The contracted tentacle has its proximal half free of nematocyst clusters. According to Russell (1953) the tentacles bear cilia confined to the nematocyst clusters. The tentacles make vibrational movements through these cilia. Nematocysts (Russell, 1938): stenoteles (16) x (12) µm and (13) x (9-10) µm; desmonemes (13-14) x (6-7) µm. Colours: stomach, apical chamber, bulbs pale orange-red, ocelli black. Development: daughter medusae released from their host medusa may already have the next generation of medusae buds on their manubrium. Egg size 125 µm, embryo encysts (Brinckmann-Voss, 1970). Polyp stage unknown.

Biology – In the north-western Mediterranean, the medusa is present in the plankton from February to August, with a maximum in April (Goy, 1997), at Naples it is present from April to June (Brinckmann-Voss, 1987). In British and Irish waters it is present from May to September with a maximum in August and September (Russell, 1953).

Distribution – British Isles; European coasts as far north as Bergen, Mediterranean.

Remarks – Due to the gonad that covers the distal stomach, this medusa is here placed in the genus *Dipurena* as proposed by Petersen (1990). It is the only *Dipurena* species with an undivided gonad. The ciliated tentacles are also unique. Such cilia and a similar vibrational tentacle movement have been observed for *Coryne japonica* medusae of New Zealand (Schuchert, 1996).

Sarsia clavata Keferstein was regarded as different from *D. gemmifera* by Hartlaub (1907) on account of its flatter bell and thinner jelly. This, however, is not convincing as Keferstein's medusa might have been in bad condition. Graeffe (1884) gave a description of a polyp which he believed to be the hydroid stage of *D. clavata*. Graeffe's polyps from the Adriatic grew on *Suberites massa* and released medusae with a terminal nematocyst cluster and some incipient nematocyst rings, some already with one such ring. As he gave no figures it is difficult to evaluate his findings, particularly the proportion of the terminal clusters would have been important to know. Graeffe's polyp probably was *Dipurena halterata*.

Also Picard (1960) claims to have identified the polyp stage. However, Picard neither observed medusae buds on the manubrium of the released medusae nor did he cultivate the medusae to maturity. Therefore, his identification is here considered somewhat doubtful and it needs reconfirmation. Picard basically identified his material as belonging to *S. gemmifera* based on the enlarged terminal nematocyst cluster of the newly released medusae. His figure (1G), however, does not show a particularly large cluster. The presumed polyp of *S. gemmifera* formed mostly stolonal colonies, had 3-4 whorls of 4-6 capitate tentacles, developed a whorl of filiform tentacles in culture, and the medusae developed among the capitate tentacles, but not in their axils. The oldest medusa stage obtained had a manubrium that just protruded out of the bell.

Sarsia siphonophora Haeckel, 1879 was described based on a single specimen from the Canary Islands. It was synonymised by Mayer (1910: 62) with *D. gemmifera*, however Hartlaub (1917: 391) and Kramp (1955b; 1961) disagreed without discussing their opinion. Kramp (1959) kept both species separate mainly on account of the tentacles without a terminal nematocyst cluster and possibly also the increased number of medusae buds. The terminal nematocyst clusters are often missing in plankton catches due to mechanical damage. The higher number of medusae buds is here also not seen as sufficient to separate the species. It is thus very likely that *S. siphonophora* is nothing but *S. gemmifera* and I follow Mayer here in uniting it with *D. gemmifera*.

Dipurena halterata (Forbes, 1846) Fig. 24A-E

Slabberia halterata Forbes, 1846: 286; Forbes, 1848: 53, pl. 6 fig. 1; Mayer, 1910: 75; Neppi, 1912: 716, pl. 1 fig. 3, not figs 1-2 = *D. gemmifera*.
Slabberia catenata Forbes & Goodsir, 1851: 311, pl. 10 fig. 3; Haeckel, 1879: 655; Browne, 1900: 704, synonym; Mayer, 1910: 77, pl. 8 figs 8-9; Russell, 1953: 71, synonym.
Dipurena halterata – Browne, 1897: 816, pl. 49 fig. 2, 2a, 2b; Browne, 1900: 704; Rees, 1939: 343, figs 1-3; Russell, 1953: 67, figs 28, 29a-c, pl. 1 fig. 3, pl. 2 fig. 2; Kramp, 1959: 82, fig. 21; Kramp, 1961: 22; Kramp, 1968: 9, fig. 12; Goy, 1972: 970; Bouillon, 1971: 327, fig. 2, pl. 2; ? Christianson, 1972: 284, fig. 2; Petersen, 1990: 212; Goy, Lakkis & Zeidane, 1991: 101, fig. 1; Pagès *et al., 1*992: 14, fig. 14.
Dipurena picta Mayer, 1900b: 29, pl. 18 fig. 45-46; Mayer, 1910: 77, synonym.
? *Syncoryne clavata* – Graeffe, 1884: 352.
Gemmaria implexa – Stechow, 1919: 5.
[not *Zanclea implexa* (Alder, 1857)]
Sarsia pulchella – Stechow, 1923b: 35, fig. A.
[not *S. pulchella* Allman, 1865 = *S. tubulosa*]
? *Syncoryna pulchella* – Rossi, 1950: 197, fig. 2.
Sarsia halterata – Brinckmann-Voss, 1970: 57, fig. 65.
TYPE LOCALITY – Mount's Bay, Cornwall, England.
MATERIAL EXAMINED – Roscoff, France, living non-reproductive polyp colonies on *Haliclona simulans* and living subadult medusae from plankton samples, polyp colonies preserved as MHNG INVE 29388 – IRSNB IG27.838, La Toreau, Roscoff, leg. & det. J. Bouillon 1963, on sponge, with *Cladonema radiatum* and *D. simulans*, one hydranth with gonophores – ZMUC, U. K., Eddystone Fyr, 19.05.1914, id. Kramp, several medusae – ZSM, Naples, Mediterranean, collection Stechow, 5 slides, material described by Stechow (1923b) as *S. pulchella*, polyps on sponge – MHNG INVE 31741, Villefranche-sur-Mer, Mediterranean, Mai 2001, living colony on sponge *Petrosia ficiformis*, cultivated until medusae released.

DESCRIPTION – Hydroid stolonal, stolons deeply embedded in sponge tissue. Stolons and cauli covered by thin, wrinkled or smooth perisarc. Hydranths 1.0-1.7 mm, diameter about 0.15 mm, slightly clavate to cylindrical, with 15-24 capitate tentacles, without filiform tentacles. Capitate tentacles distributed either over entire

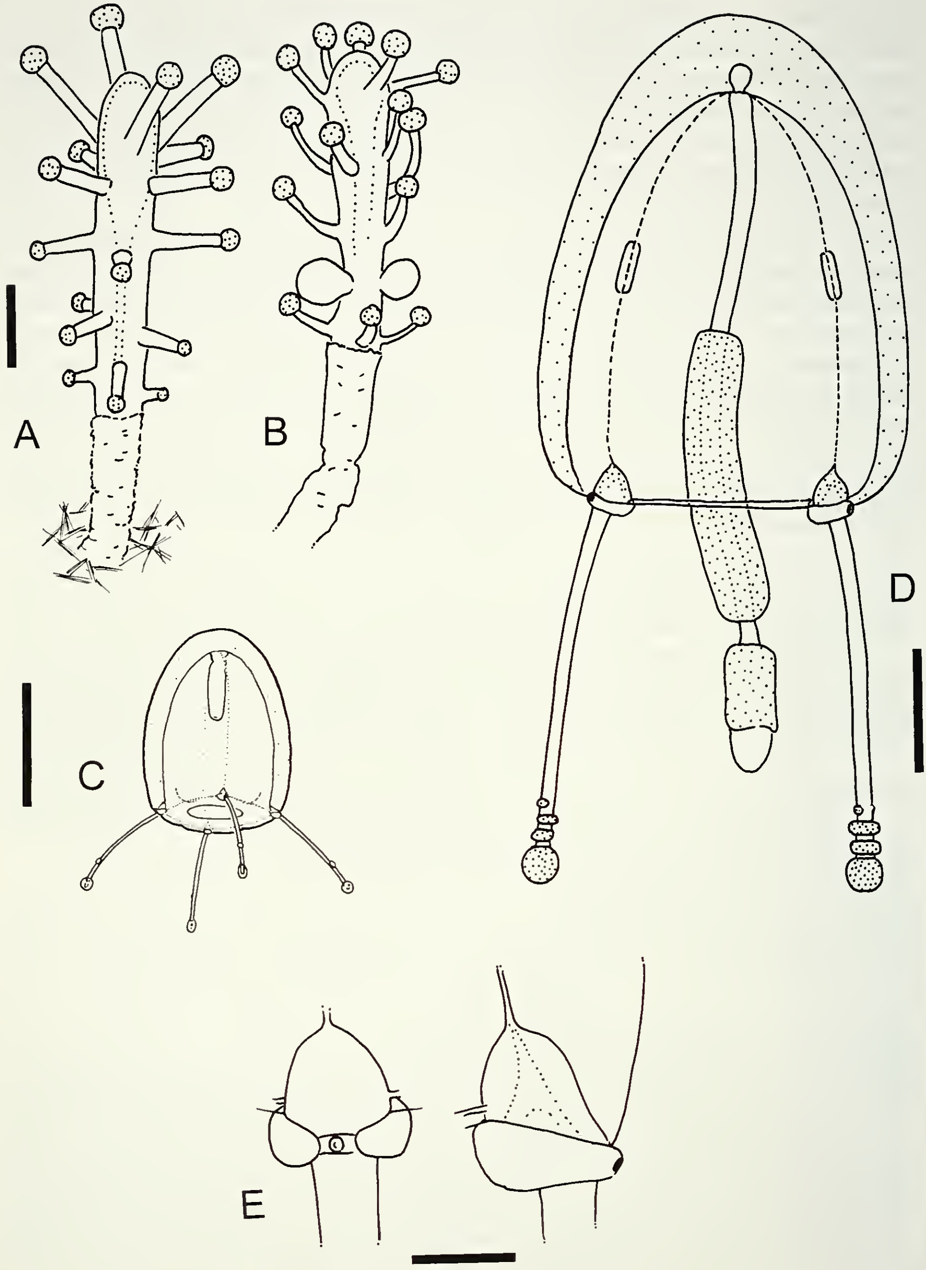

FIG. 24

Dipurena halterata (Forbes, 1846). A) polyp after life material, scale bar 0.2 mm. B) Hydranth with medusae buds, after photograph in Bouillon (1971). C) Newly hatched medusa, after life, scale bar 1 mm. D) Adult medusa, scale bar 1 mm. E) Tentacle bulbs in frontal and side view, scale bar 0.2 mm.

hydranth down to perisarc or covering distal 2/3 of hydranth only, organised in one oral whorl of 4-5 oral tentacles and scattered lower capitate tentacles. Oral tentacles of usual length (1-2 times diameter of hydranth), with 7-10 gastrodermal cells. Stalks of all capitate tentacles slightly tapering, length of stalk and diameter of capitulae decreasing or not towards proximal. Around mouth a button of high epidermal gland cells. Gonophores develop in middle of hydranth, 1-10 per hydranth in one to several whorls, among but independent of tentacles, released as free medusae. Fertile hydranths may reduce their tentacles (reproductive exhaustion). Nematocysts: stenoteles (19-20) x (15.5-16) μm and (10-13) x (6-9) μm; basitrichous isorhizas (17-20) x (8-10) μm.

Newly released medusa 1.5-1.6 mm high and 1.1-1.3 mm wide, exumbrella with interradial furrows, a few scattered exumbrellar nematocysts, radial canals narrow and without swellings, ocelli dark-red, tentacles with a large spherical terminal nematocyst cluster and some smaller clasping clusters on the distal half of the tentacles. Apical knob or canal absent.

Adult medusae 4-8 mm high, higher than wide, umbrella bell-shaped, apex rounded, jelly thick, slightly thickened at apex. Top of manubrium with rounded apical knob. Manubrium 2-3 times as long as bell height, with long thin serpentine part and an swollen stomach at its end. Gonads in 2-4 rings, most distal one may either only cover swollen stomach-region or may be very long and covering stomach as well as end of serpentine part, additional rings along distal half of manubrium may be present. Four radial canals with at least one linear swelling in its middle, sometimes flanked by two smaller swellings. Radial canal enters gastrodermal chamber of bulb at the centre of its top, bulbs large, with dark red ocellus. Tentacles somewhat longer than bell height, smooth for most of their length, at end 2-4 closely set annular nematocyst clusters and one large spherical terminal cluster. Colours: bulbs and terminal tentacular clusters orange to brown, apical knob red to green. Nematocysts: stenoteles; isorhizas; desmonemes.

Distribution – Great Britain, Ireland, France, Mediterranean, western and southern Africa, Florida.

Biology – The polyps grow in and on the sponges *Haliclona cinerea* (Grant) (Rees, 1938, as *Chalina montagui), Haliclona simulans* (Johnston), and *Petrosia ficiformis* (Poiret). Rees (1938) observed medusae buds in May (Rees, 1939). The medusa is only occasionally found in the plankton of the Atlantic from April to September (Russell, 1953). In the Mediterranean, reproductive colonies were found in April to June, colonies occurred in depths of 0.5-5 m (Boero & Fresi, 1985). In the north-western Mediterranean, the medusa is present in May (Goy, 1997).

Remarks – A complete taxonomic history of this species is given by Russell (1953). Forbes (1848) described and depicted *D. halterata* with a single terminal nematocyst cluster per tentacle. Later Forbes & Goodsir (1851) described *S. catenata* which had several additional nematocyst rings. Browne (1900) and Russell (1953) assumed that *Slabberia catenata* was just a more advanced and mature stage of *D. halterata*. However, as the young medusa *D. halterata* sensu Russell has several nematocyst clusters even just after its release, Forbes' *Slabberia halterata* with its single terminal cluster might actually have been the species we call today *D. simulans* Bouillon, 1965. Forbes' medusa was about 3.5 mm high and probably subadult. Perhaps Forbes overlooked the sometimes small additional clusters. The manubria figured by Forbes (1848) apparently had an apical chamber or projection, a feature which is very prominent in *D. halterata* sensu Russell, but rare or small in *D. simulans*. Nevertheless, it remains highly uncertain whether *Dipurena halterata* as we see it today really corresponds to Forbes' *Slabberia halterata*. Because it is unlikely that any of Forbes' medusae are left (pers. com. Susan Chambers, National Museums of Scotland), any taxonomic revision cannot be based on sufficient evidence. As the concept of *D. halterata* sensu Russell is now well established and widely used, and the synonymising of Bouillon's *D. simulans* with *Slabberia halterata* Forbes would certainly generate considerable confusion, I oppose any attempt to do so.

Dipurena picta Mayer, 1900 differs from *D. halterata* by the absence of swellings along the radial canals. These may have been overlooked by Mayer and in his monograph of 1910 he treated it as a synonym of *Slabberia catenata*.

The polyp of *Dipurena halterata* is rather unique for the genus as it develops its gonophores among the tentacles and not below them. For further distinguishing traits see under *D. simulans* and table 5.

Christiansen (1972) identified fertile polyps from Oslofjord as *D. halterata*. His polyps were 6 mm high and had more than 33 tentacles. The unusual size in particular leads me to somewhat doubt this identification.

Material collected by Stechow and identified by him first as *Gemmaria implexa* and then as *Sarsia pulchella* (Stechow, 1919; 1923b) was re-examined for this study. The medusae buds of this material arise among, but independently of the capitate tentacles and thus rule out *S. pulchella*, a putative synonym of *S. tubulosa*. The material was found growing on sponges. Some of the medusae are quite advanced and have tentacles with one large, spherical terminal nematocyst cluster. This is also indicated in Stechow's (1923b) figure, but not clearly enough. The buds also have an elongate nematocyst capsule like an isorhiza. It seems therefore very probable that Stechow's polyps belong to *D. halterata*. Likewise, the material of Rossi (1950) could belong to here, but it is not clearly identifiable. I found *Dipurena halterata* colonies growing on the sponge *Petrosia ficiformis* in shallow waters at Villefranche-sur-Mer (Ligurian Sea). The polyps were absolutely identical to material seen in Brittany. Also the types and sizes of nematocysts were the same. The Mediterranean colony was kept in running seawater and fed regularly with planktonic copepods. The colony proliferated and started to produce many medusae. The medusae budding hydranths often showed reproductive exhaustion and reduced all tentacles. A young medusa is shown in figure 24C.

Dipurena ophiogaster Haeckel, 1879 Fig. 25A-E

Dipurena ophiogaster Haeckel, 1879: 25; Uchida, 1927: 187, fig. 27; Rees, 1941: 131, fig. 2; Russell, 1953: 71, pl. 1 fig. 5, pl. 2 fig. 4; text figs 25e, 30a-b, 31; Kramp, 1959: 82, fig. 22; Kramp, 1961: 23; Kramp, 1966: 2; Kramp, 1968: 8, fig. 11; Bouillon, 1971: 334, table 1; Goy, 1972: 970; Petersen, 1990: 212, fig. 44E; Goy, Lakkis & Zeidane, 1991: 101, fig. 2; Pagès *et al.*, 1992: 16; Schuchert, 1996: 123, fig. 76a-d.

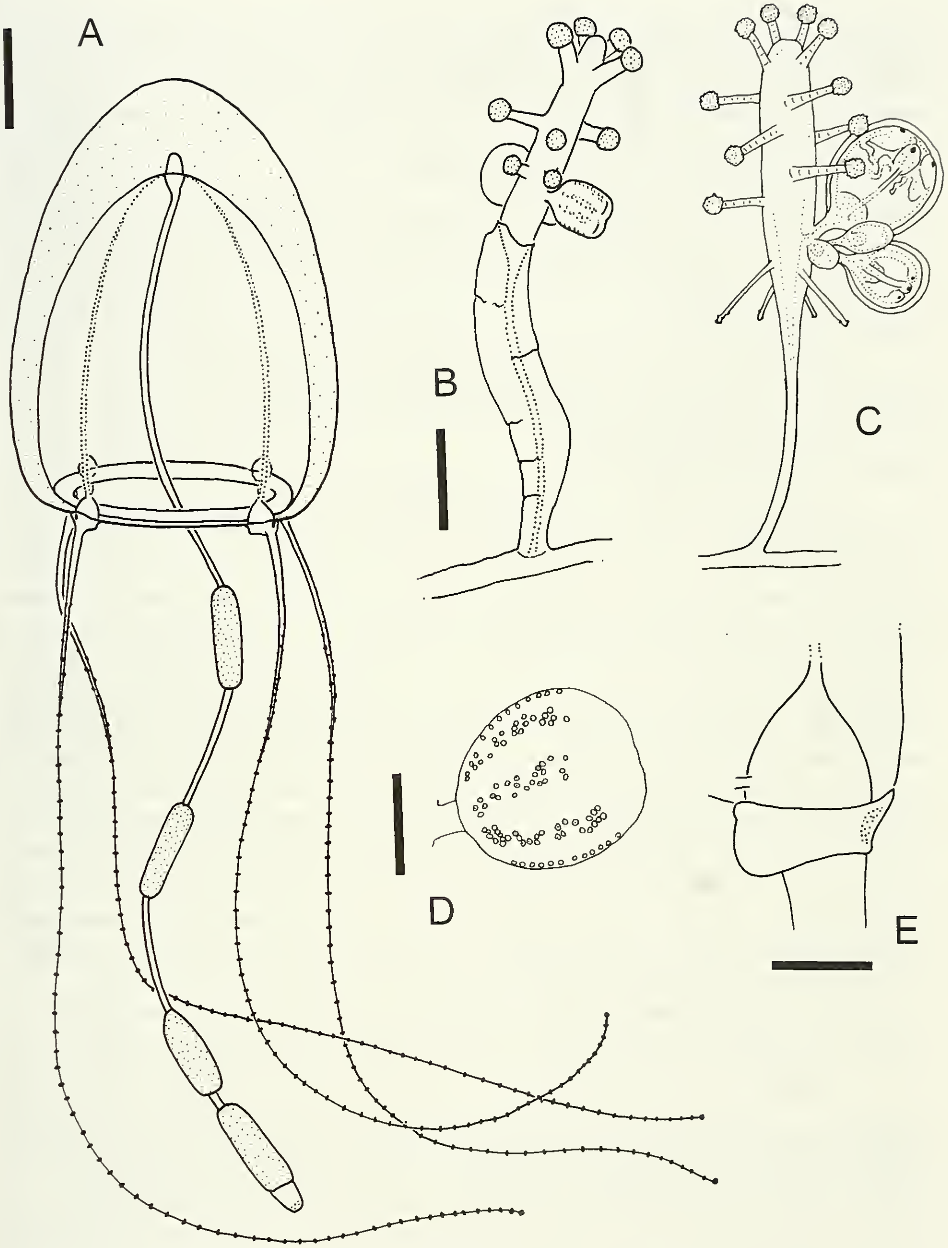

FIG. 25

Dipurena ophiogaster Haeckel, 1879. A) Mature medusa from New Zealand, scale bar 1 mm. B) Polyp stage with medusae buds immediately after collection from the sea (Mediterranean), note absence of filiform tentacles and the characteristic, loose perisarc of the caulus, scale bar 0.5 mm. C) Cultivated polyp with medusae buds, figure modified after Rees (1941). D) Medusa bud with characteristic rows of nematocysts, scale bar 0.1 mm. E) Lateral view of tentacle bulb of mature medusa, scale bar 0.2 mm.

Sarsia strangulata – Allman, 1871: 46, fig. 17.
Dipurena spec. – Browne, 1905: 133, pl. 2 figs 1-2.
Slabberia ophiogaster – Mayer, 1910: 79, figs 36-37.
Sarsia ophiogaster – Brinckmann-Voss, 1970: 59, pl. 3 fig. 4; text figs 66-71.
Purena brownei Bigelow, 1909: 183, pl. 7, fig. 7, pl. 44 figs 8-9; Uchida, 1927:187; Russell, 1953: 71; Kramp, 1959: 82; Kramp, 1961: 22.

TYPE LOCALITIES – Coasts of Great Britain and Ireland.

MATERIAL EXAMINED:

France – INSNB IG 27.838, Roscoff, coll. J. Bouillon 1967, two badly preserved medusae.

Mediterranean – INSNB IG 27.838, Naples, Nisida, coll. J. Bouillon 1962, several polyps, some with medusae buds – MHNG INVE 31740, Torre del Serpe, Otranto, Italy, 0-5 m, on rock, collected 13.3.2001 by S. Piraino, polyps with medusae buds and newly released medusae.

New Zealand – 5 medusae from Auckland and Leigh, collected February 1997 by A. Freudenthal; more material was examined for the study Schuchert (1996).

Chile – ZMUC, Valparaiso Bay, 17.03.1959, leg Fagetti, det. Kramp.

Papua New Guinea – ZMUC, 1 mile E of Port Moresby, Galathea stat. 532, 25.10.1951, det. Kramp, damaged medusa.

Vietnam – ZMUC, Nhatrang, May 1938, several medusae, some mature, tentacles very short, ? det. Kramp; is probably not *Dipurena ophiogaster*.

DESCRIPTION – Hydroid stolonal, cauli only very rarely branched once, height of caulus and hydranth up to 4 mm, stems occasionally with short stolons given away at some distance from the substratum. Perisarc thin, soft, not annulated, some wrinkles present. In colonies from nature the periderm of the stem widens distally and the basal portion of the stem is able to retract into the perisarc (Fig. 25B). Regenerating colonies in culture do not develop this wide perisarc. Hydranth clavate to cylindrical, 1-2 mm in height and 0.25-0.35 mm in diameter. With about 10-18 capitate tentacles and at lower third one whorl of 2-6 filiform tentacles. Capitate tentacles organised in one oral whorl of 4 tentacles and below them scattered lower capitate tentacles. The capitulae may decrease in size towards proximal. The filiform tentacles can be absent in material from nature, sometimes they bear a few nematocysts. Gonophores develop in 2-3 clusters of 2-6 buds below the capitate tentacles and above filiform tentacles. Advanced gonophores have on their outside eight meridional tracks of nematocysts. The gonophores are released as free, immature medusae. Nematocysts of polyp: stenoteles (Bouillon, 1971).

The newly released medusa has eight distinct, broad, adradial rows of spherical nematocysts on its exumbrella, tentacles bear 18 and more nematocyst clusters.

Adult medusa 3-6 mm high, 2-4 mm in diameter, jelly thick, thickened at apex, umbrella bell-shaped, top of bell rounded. At top of manubrium a bullet-shaped apical chamber. Manubrium very long (>2 times bell height), with long, thin serpentine part and cylindric, swollen stomach. Gonads in 2-4 cylinders (max. 9) encircling manubrium, most distal one covering the stomach, the others on distal half of serpentine part. Four radial canals and circular canal present. Gastrodermal chamber high. Epidermal nettle ring of bulbs not complete, in side view with at double curvature at adaxial side (Fig. 25E). Tentacles very long, covered by numerous nematocyst clusters, terminal one spherical and not enlarged. Cnidocils on nematocytes of tentacular clusters normal, about $^1/_2$ as long as stenotele capsule. Ocelli black. Colour of bulbs and apical chamber yellowish brown or reddish yellow. Nematocysts: stenoteles and rarely a few isorhizas along the radial canals (Bouillon, 1971).

Distribution – British Isles to Mediterranean, Skagerak, Sri Lanka, Japan, Palau Islands, Papua New Guinea, Pacific Coast of Mexico, Chile, New Zealand.

Biology – The hydroid is known to occur in shallow depths on algae (Rees, 1941), barnacles and rocks (Brinckmann-Voss, 1970). In British and Irish waters, the medusae are present in the plankton between May and September, with a maximum in July (Russell, 1953). In the north-western Mediterranean, the medusa is present in the plankton from May to July, with a maximum in April (Goy, 1997). Development: the medusa matures within 10 to 15 days (Brinckmann-Voss, 1970).

Remarks – The adult medusa of *Dipurena ophiogaster* is not readily distinguishable from *D. reesi* (see Brinckmann Voss, 1970), and the widespread occurrence of the latter species makes many records for *D. ophiogaster* medusae questionable and some records might in fact relate to *D. reesi*.

Dipurena ophiogaster can be distinguished from *D. reesi* by the higher and more dome shaped bell (versus triangular and as wide as high), the higher number of gonadal rings (3-9, versus 2, occ. 3), and the cnidocils of the tentacles (fine versus stout and long). For further differences see also table 5.

Material from Vietnam identified by Kramp (1962) as *D. ophiogaster* was re-examined for this study and I think it probably does not belong to this species. The medusae were rather small (2 mm), had one to four thick, rounded gonads, and characteristically short tentacles (0.8 mm) with less than 10 nematocysts clusters. The short tentacles make these medusae very distinct and I am convinced that they do not belong to *D. ophiogaster*. The medusae show a strong resemblance to *Euphysa problematica* Schuchert, 1996. The allocation to the genus *Euphysa* of this species has recently been criticised by Bouillon & Barnett (1999), as the ocelli of the preserved material might have had faded. I must admit this possibility and *E. problematica* could as well be a *Dipurena* species. New investigations on living material from new Zealand must be made before further conclusions can be drawn.

Dipurena reesi Vannucci, 1956 Fig. 26A-F

Dipurena reesi Vannucci, 1956: 479, text-figs 1-2, pls 1-2; Kramp, 1959: 82; Brinckmann & Petersen, 1960: 386, figs 1, 3-5, 6b; Kramp, 1961: 24; Bullivant, 1970: 112, figs 2-3; Bouillon, 1971: 333; Moreira et al, 1978: 161; Petersen, 1990: 212; Pagès *et al.*, 1992: 16.

Sarsia reesi – Brinckmann-Voss, 1970: 62, text-figs 72-74, pl. 3 fig. 2; Altuna Prados, 1993: 31, figs 2 - 3.

Type locality – São Paulo, Brazil.

Material examined – hydroids probably coming from Banyuls-sur-Mer, collected 1990 and 1996, cultivated in aquarium of zoological institute of Basel, examined alive, observed young medusa – IRSNB IG 22.838, Naples, coll. J. Bouillon, several medusae released from polyps, some cultivated to maturity – ZMUC, Naples, leg M. Vannucci, 4.06.1959, several young medusae.

Description – Hydroid stolonal, stolons creeping, but may detach in cultured colonies. Stems of variable length. Hydranths 1-1.5 mm, slightly clavate, with only one oral whorl of 4-5 capitate tentacles and at lower third one whorl of 4-5 filiform tentacles. Capitulum of oral tentacles slightly flattened, nematocysts confined to outer half, stalk with 13-15 gastrodermal cells. Gonophores develop singly or in pairs

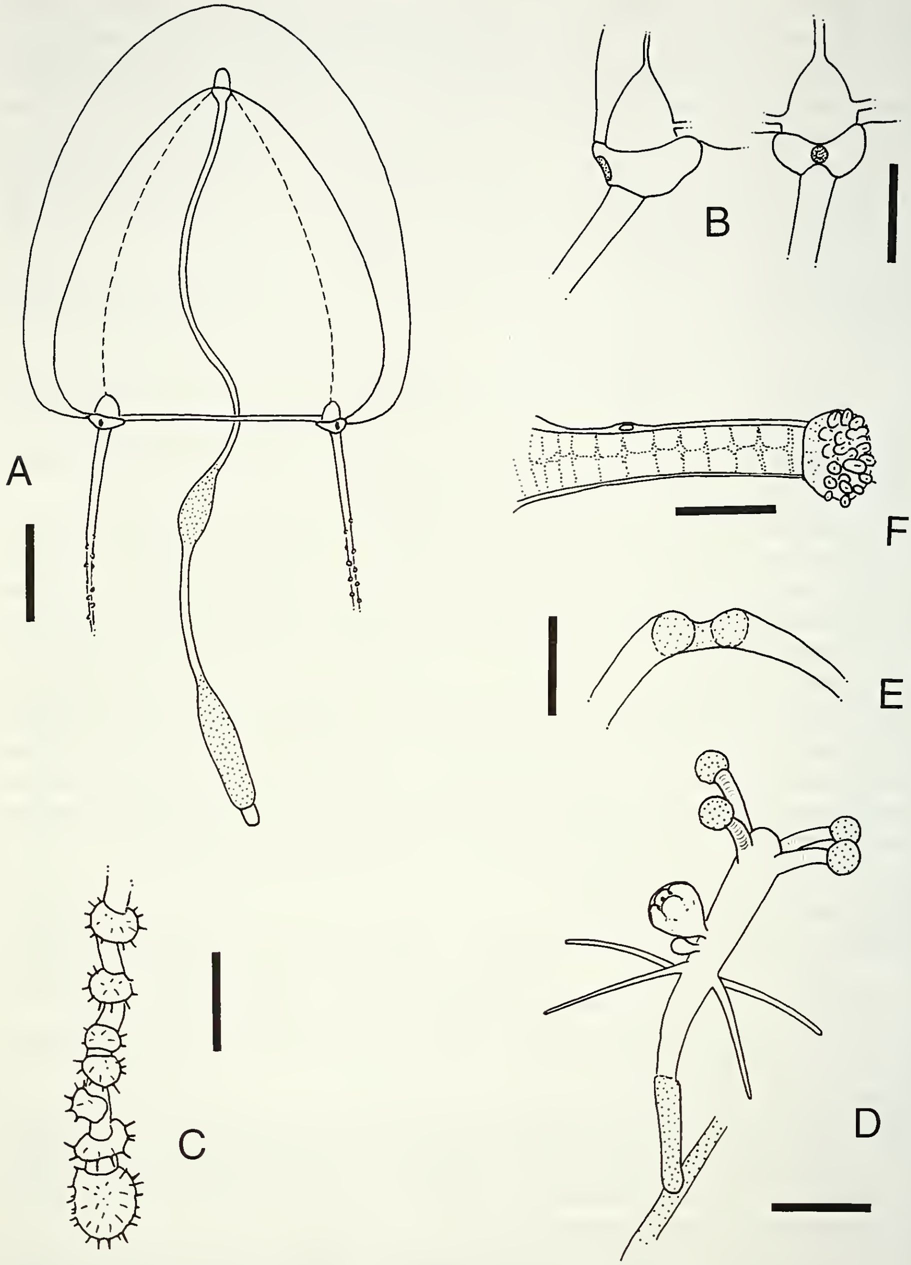

FIG. 26

Dipurena reesi Vannucci, 1956, medusa after preserved material, polyp after living material. A) Mature medusa, scale bar 0.5 mm. B) Lateral and frontal view of tentacle bulbs, scale bar 0.2 mm. C) Tip of medusa tentacle, note long spiny, cnidocils, scale bar 0.1 mm. D) Polyp with medusae buds, scale bar 0.5 mm. E) Optical section through hypostome of polyp, mouth open, note button of high gland cells (shaded), scale bar 50 µm. F) Capitate tentacle, scale bar 0.1 mm.

somewhat above the filiform tentacles and are released as free medusae. Nematocysts of polyp stage: stenoteles of two size classes, (22-29) x (20-21) µm and (16-17) x (10-11) µm, discharged stenoteles with three stilettos.

Newly released medusa 0.8-1 mm, exumbrella with 16 indistinct meridional rows of nematocysts or nematocysts scattered, no apical chamber, tentacles with less than 10 nematocyst clusters. Cnidocils stout and long.

Adult medusa normally 2-3 mm (max. 5 mm), diameter only slightly less, bell somewhat conical but with rounded top, subumbrella rather conical, jelly moderately thick. Manubrium with a bullet-shaped apical chamber. Manubrium at least two times as long as bell height. Divided into a long, thin serpentine part and a thicker cylindrical stomach at its end. Gonads in 2-3 rings, one on stomach region, the others short and on the serpentine part, end of gonad rings taper gently. Radial canals fine, narrower than ring canal, entering gastrodermal chamber of bulbs at centre-top. Epidermal nettle ring of bulb not complete, with ocellus. Tentacles long, issuing either vertically or obliquely (smaller specimen). Tentacles covered by up to 100 nematocyst clusters, terminal cluster not much thicker. Nematocytes bear long, thorn-like cnidocils, much more robust than in other species of the family. Nematocysts: stenoteles and desmonemes.

DISTRIBUTION – Brazil; Mediterranean; Bay of Biscay; California.

BIOLOGY – The hydroid occurs on a variety of solid substrates in shallow water, but is hardly detectable. Brinckmann-Voss (1970) found the polyps on shells at a depth of 20-50 m, Günzl (1964) in 1-2 m depth on rock. Most observations of the polyp were made from aquarium cultures. The polyp is quite invasive and readily establishes colonies in aquaria. The medusa has not yet been identified in material from the sea. Development: gonad maturation in cultivated animals begins 16-18 days after release (Brinckmann-Voss, 1970). Günzl (1964) investigated the factors that induce the formation of medusae buds. He found that a temperature shift from 18 to 24 °C could trigger medusae production provided that the colony had reached a certain size. Günzl (1964) also described the histology of the initial medusa bud formation. Nematocyst development is described in Günzl (1968; 1973). Tardent & Stössel (1971) described the morphology of mechanoreceptors in the filiform tentacles. The reactions to mechanical stimulation are described in Stössel & Tardent (1971).

REMARKS – The polyp of *D. reesi* resembles closely the polyps of *D. strangulata*, *D. spongicola*, *Sarsia marii*, *S. piriforma*, and *Cladonema radiatum* Dujardin, 1843. *D. reesi* differs from all of them by having longer filiform tentacles, which is, however, much dependent on culture conditions. All, except perhaps *S. piriforma,* also have fewer gastrodermal cells in their capitate tentacles (comp. table 5). Further differences to *Cladonema radiatum* have been outlined by Brinckmann & Petersen (1960), although the difference between the armature of the stenoteles is probably incorrect (see Bouillon, 1971: 333).

The medusa of *Dipurena reesi* resembles *D. ophiogaster*. This makes many records of *D. ophiogaster* medusae rather questionable, notably as both species have overlapping distributions (e. g. Bay of Biscay; Altuna Prados, 1993). The medusa of

D. reesi can be distinguished from *D. ophiogaster* by its more pointed form, the fewer gonad rings, and the stouter cnidocils on the tentacles. Brinckmann-Voss (1970) found also differences in the shape of the tentacle bulbs.

Brinckmann & Petersen (1960) found 18 gastrodermal cells in the tentacles of their *D. reesi* polyps. However, in the two colonies examined by me I could find only 13-15 cells. This is still more than in other similar polyps. The exumbrellar nematocysts of the newly released medusa were described by Brinckmann-Voss (1970) as scattered. In my animals they were in 16 radial rows, although some of the rows were indistinct.

In the preserved medusa it was noted that the nematocyst clusters of the tentacles bear long and coarse cnidocils. Their length equalled the length of the stenotele capsule. They were very characteristic and differed markedly from the ones seen in *D. ophiogaster*.

Dipurena simulans Bouillon, 1965 Fig. 27A-D

Dipurena simulans Bouillon, 1965: 323; Bouillon, 1971: 323, figs 1 & 3.1, pl. 1.

Type locality – Roscoff, Britanny, France, Atlantic Ocean.

Material examined – Living polyps on *Haliclona simulans* and subadult medusae from plankton collected near Roscoff (Brittany), June 2000, several polyp colonies with medusae buds, the released medusae were cultivated a few days – INSNB IG 27.838, Roscoff, coll. J. Bouillon 1963 & 1965, polyps embedded in sponge, one young medusa – ZMUC, Roscoff, medusa grown from hydroid stage, leg. & det. J. Bouillon, 2 specimen.

Description – Hydroid stolonal, with stolons deeply embedded in sponge tissue, perisarc very thin and only visible at high magnifications, hydranths protrude at sponge surface and into exhalent canals. Hydranths 0.5-0.6 mm in height, sessile, cylindrical, with prominent dome-shaped hypostome. Near mouth a button of high epidermal gland cells. Polyps on sponge surface with 10-13 capitate tentacles, hydranths in oscula with up to 16 tentacles. Tentacles arranged in one oral whorl of 3-4 tentacles and lower tentacles scattered or in indistinct whorls. No filiform tentacles present. Oral tentacles very long (0.4 mm), with 6-8 gastrodermal cells, capitulum relatively large (70-80 µm), stalk tapering to half of its original diameter. Lower capitate tentacles shorter than oral ones, stalk length and size of capitulae decreases towards proximal. Gonophores develop below tentacles in one whorl of 3-6 buds, released as free medusae. Colour: pale orange. Nematocysts, (7-11) x (4.5-7) µm and (16-17) x (12.5-13) µm; basitrichous isorhizas (17-20) x (8-10) µm.

Newly released medusae 0.7 mm, four radial canals without linear swellings, with slight apical chamber, ocelli dark red, tentacles issue vertically, short, smooth, only with one terminal swelling containing nematocysts, exumbrella with scattered nematocysts.

Adult medusa 3-5 mm high, 3.5-4.5 mm in diameter, umbrella bell-shaped, jelly thick, spanning at apex 1/4 of bell height, subumbrella with flat top, occasionally with shallow apical subumbrellar pockets. Apical chamber absent or shallow. Manubrium up to two times as long as bell height, with long and thin proximal part and a terminal swollen stomach, limits of both parts often indistinct. Gonads usually in one ring (up to 3 rings possible acc. Bouillon, 1971), initial gonad covering swollen

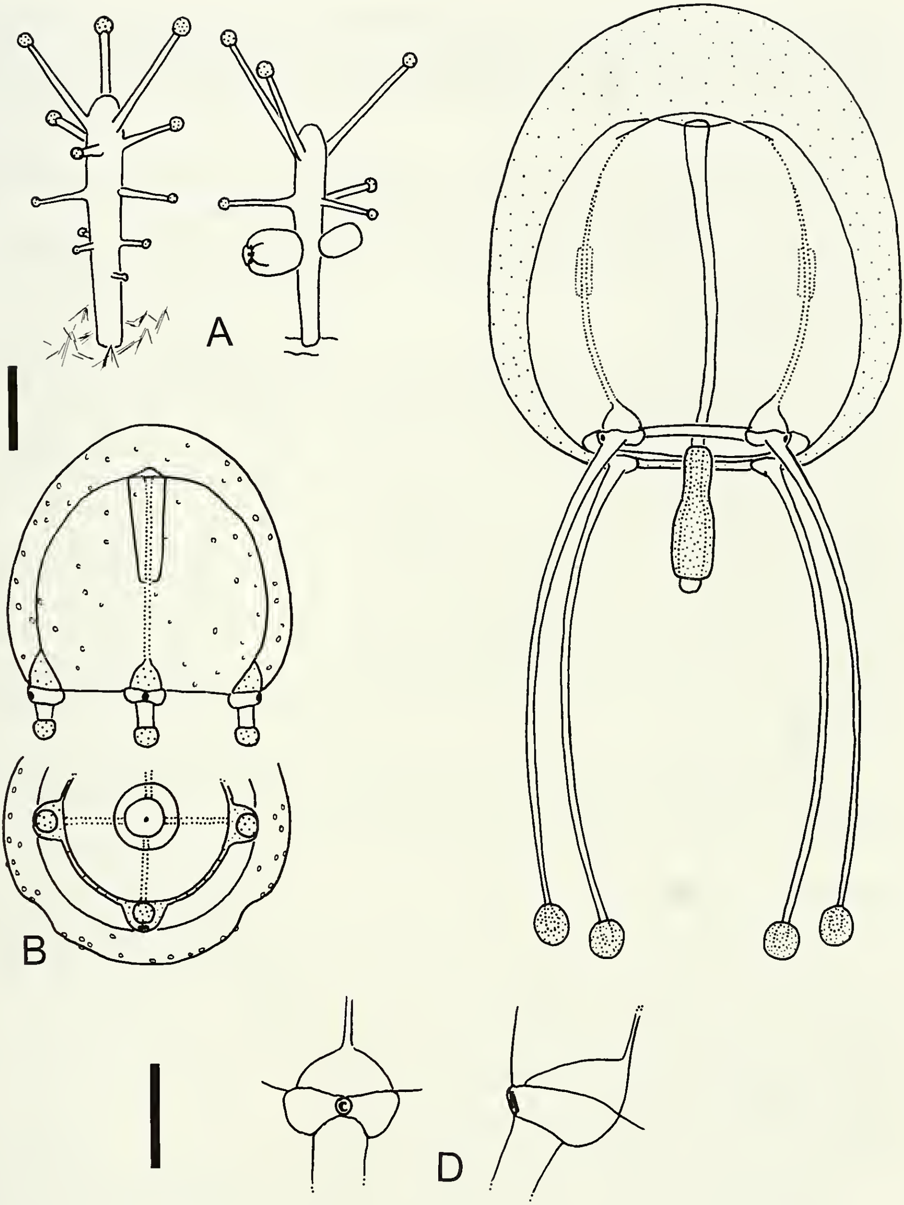

Fig. 27

Dipurena simulans Bouillon, 1965. A) Polyps after living material, right one with medusae buds, scale bar 0.2 mm. B) Newly released medusa in side view (top) and view from below, same scale as A. C) Mature medusa, scale bar 0.5 mm. D) Tentacle bulbs in frontal and side view, scale bar 0.2 mm.

stomach, later ones – if formed – on serpentine part of manubrium. Each radial canal with a single linear swelling in its middle part. Tentacles issue obliquely, somewhat longer than bell height, smooth except for a large, spherical terminal swelling covered by nematocysts. Nematocysts: stenoteles; isorhizas (rare and sometimes absent); desmonemes.

Distribution – The hydroid and the medusae are only known from near the type locality, but they could be more wide-spread (see under *D. halterata*).

Biology – The polyps grows in and on the sponge *Haliclona simulans* (Johnston), medusae are released at Roscoff in May to August, with a maximum in July (Bouillon, 1971).

Remarks – Although the hydroid of *D. simulans* can occur together with *D. halterata* on the same sponge, even non-reproductive hydranths can be distinguished. *Dipurena halterata* polyps are larger, accumulate detritus, and have their base ensheathed in perisarc. They develop their gonophores among the capitate tentacles. Polyps of *D. simulans* also occur on the surface of the sponge, but they are able to retract into the sponge as they have their base not covered by perisarc, they are not smothered with detritus (comp. also figures 24A and 27A). The gonophores of *D. simulans* develop below the capitate tentacles. Gonophore-bearing polyps are preferentially found in the oscular system of the sponge, although dense colonies will also form them on the surface of the sponge. The medusa of *D. simulans* with its single terminal nematocyst cluster and the single linear swelling of the radial canals is quite distinct (see also table 5). For a possible taxonomic problem see discussion under *D. halterata*.

Contrary to the observations of Bouillon (1971), some medusae of *D. simulans* observed by myself had a slight apical chamber (Fig. 27B-C). The newly released medusae also had no visible swelling of the radial canals.

Dipurena strangulata McCrady, 1859 Fig. 28A-D

Dipurena strangulata McCrady, 1859: 135, pl. 9 figs 1-2; Kramp, 1955: 243, fig. 2; Kramp, 1959: 81, fig. 20; Kramp, 1961: 24; Calder, 1970: 109, fig. 1; Pagès *et al.*, 1992: 16, table 2.
Dipurena cervicata McCrady, 1859: 136; Mayer, 1910: 76, synonym.
Dipurena conica L. Agassiz, 1862: 341; Mayer, 1910: 76, synonym.
Slabberia strangulata – Mayer, 1910: 76, pl. 7 figs 1-2, not 3.
Dipurena fragilis Mayer, 1900b: 28, pl. 17 fig. 41.
Slabberia strangulata var. *fragilis* – Mayer, 1910: 77, pl. 7 fig. 4.
Type locality – Charleston Harbor, South Carolina, USA.
Material examined – IRSNB IG 27.838, USA, Virginia, Gloucester Point, coll. D. Calder 28.08.1970, numerous polyps on sponge, some with medusae buds – ZMUC, St. Andrews Bay, Florida, July 1961, medusae det. Kramp – ZMUC, 5°27'N 07'E, 1700 mW, 29.01.1946, Atlantide st. 82, much damaged medusae – ZMUC, Accra, Atlantide station 77, damaged medusae – ZMUC, 4°50'N 1°17W, Atlantide station 76, 23.01.1946, 1 damaged medusa – ZMUC, 8°22'N 14°08'W, Atlantide station 144, 1 mature medusa – USNM 58646, Laurel Reef, Puerto Rico, coll. R. Larson 15.03.1975, 3 mature and 1 juvenile medusa, max. bell size 1.2 mm.

Description – (in part after Calder, 1970) Hydroid stolonal, stolons embedded in sponge tissue, perisarc thin, smooth. Hydranths 0.5-0.8 mm high, clavate to cylin-

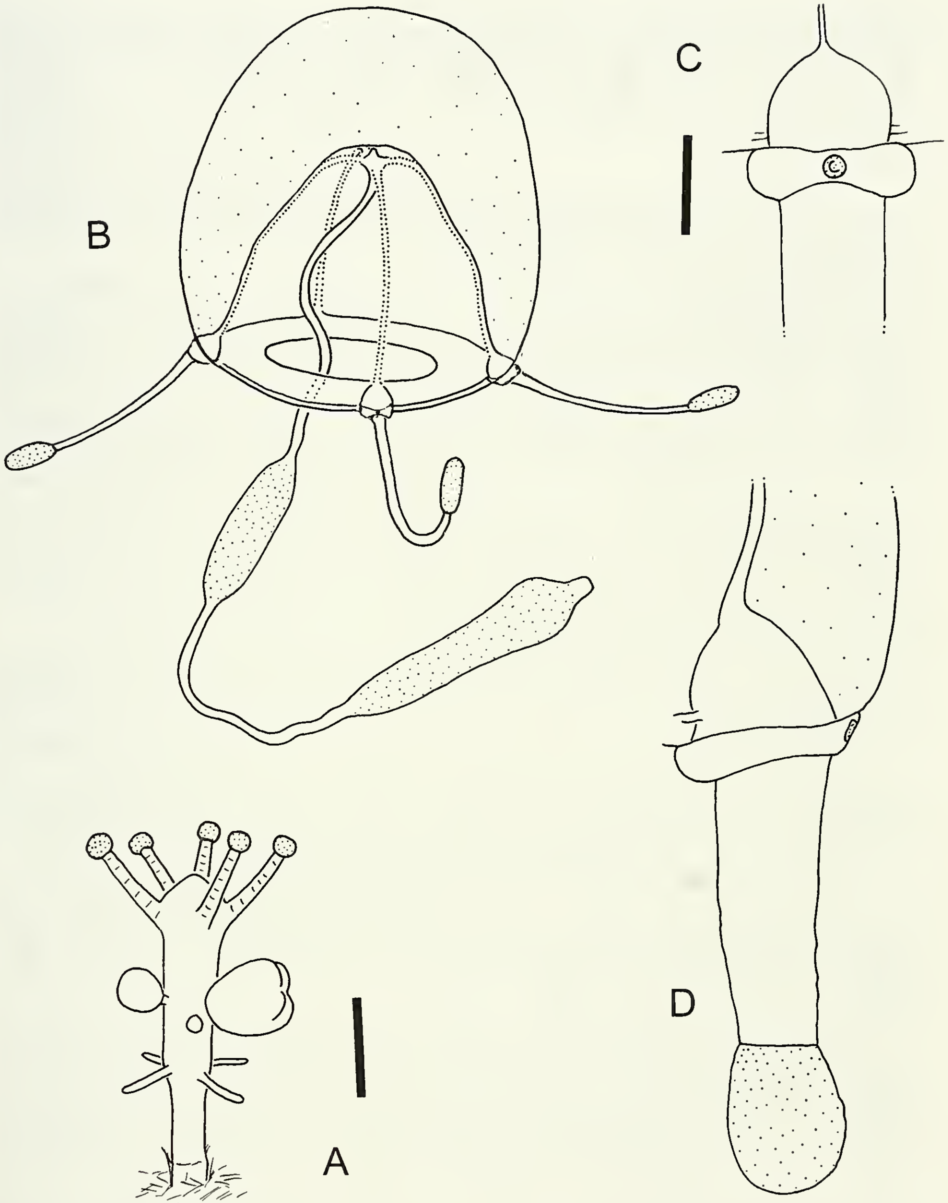

FIG. 28

Dipurena strangulata McCrady, 1859. A) Polyp with medusa buds, drawn after preserved material. B) Adult medusa, modified after Mayer (1910). C) Tentacle bulb in frontal view, scale bar 0.1 mm. D) Contracted tentacle and bulb in lateral view (material from Puerto Rico), same scale as C.

drical, hypostome a flat cone, with one oral whorl of 4-5 capitate tentacles and at lower third one whorl of 4-5 short filiform tentacles. Capitate tentacles short (0.2 mm), with 8-11 gastrodermal cells. A button of high epidermal gland cells is present (Bouillon, 1971: 333). Gonophores develop in middle of hydranth, 1-2 buds per hydranth, released as free medusae. Nematocysts: stenoteles (8-11) x (12-17) µm and (14-18) x (21-25) µm.

Newly released medusa about 0.5 mm in size, with a few scattered exumbrellar nematocysts, ocelli dark red, tentacles short, stout, nematocysts concentrated in a single large spherical cluster at end of tentacle.

Adult medusa 1.5-4 mm high, bell shape variable, often spherical, jelly thick, at apex thicker and jelly reaching 1/4 to 1/3 of total bell height. Manubrium with or without a shallow, conical apical knob. Manubrium about two times as long as bell height, with a long, thin serpentine part an a swollen stomach region at its end. Gonads encircle distal stomach region and there is an additional ring of gonad tissue somewhat more proximal to the former. Radial canals smooth, without linear swellings, entering gastrodermal chambers in middle, gastrodermal chamber high, epidermal nettle ring thick, with one dark red ocellus. Tentacles short, as long or shorter than bell height, stiff, with a single large terminal nematocyst cluster, this one either spherical or elongated. Nematocysts: stenoteles and desmonemes. Colours: gastrodermis is green or yellowish-green (Mayer, 1910).

Distribution – Cape Cod to Florida (USA), Puerto Rico, Gulf of Guinea.

Biology – Can tolerate reduced salinity, the polyp occurs in the sponge *Microciona prolifera*.

Remarks – Mayer (1910) mentions an abaxial spur of the tentacle bulbs on which the ocellus is placed. In the examined material no distinct spur could be seen, only sometimes a very small one (Fig. 28D). Calder (1970) also did not describe such a spur. The bulbs thus do not differ from other species of the genus.

The life cycle of *Diprena strangulata* was described by Calder (1970). Calder also noted that the young stages of *D. strangulata* described by Mayer (1910) were probably misidentified *Sphaerocoryne agassizii*. Young medusae of *D. strangulata* have four tentacles as all other members of the family and not two as depicted by Mayer.

Mayer (1910) examined numerous *Dipurena* medusae from Charleston Harbor and found that *Dipurena cervicata* McCrady, 1859 and *Dipurena conica* Agassiz, 1862 are only slight variants of *Dipurena strangulata*. The forms differ only in bell-shape and length of the manubrium. Both characters are subject to considerable variation even in one population and Mayer's opinion is adopted here too. Mayer himself (1900b) described also another similar species, *Dipurena fragilis*, which he later (Mayer, 1910) considered as a variant only. The variant differs from the normal form by its more slender tentacles and the dull-yellow colour of its gastrodermis. Further details on the synonymy of this species can be found in Calder (1970).

Polyps of *D. strangulata*, *D. reesi*, *Sarsia piriforma*. *Sarsia marii*, and *Cladonema radiatum* are difficult to distinguish. Some of their differences are discussed under *D. reesi*.

Bigelow (1904) described a medusa from the Maldive Islands as "closely allied or identical" to *D. fragilis*, a synoynym of *D. strangulata*. For biogeographic reasons I doubt that Bigelow's medusa belonged to *D. strangulata*.

Dipurena spongicola Anger, 1972

Dipurena spongicola Anger, 1972: 80, figs 1-11.
Type locality – Langeland Island, Germany.
Material examined – holotype material, ZMUC, on *Halichondiria*, leg. K. Anger – Roscoff, 30.3.98, few living polyps in (?) *Suberites domuncula*.

Description – (after Anger, 1972) colonies in sponge tissue, hydranths in cavities of sponge, stolonal, perisarc very thin and loose, short cauli covered with perisarc, hydranth fusiform, 0.4-0.8 mm, diameter 0.12-0.35 mm, one oral whorl of 4-6 short capitate tentacles with 6-8 gastrodermal cells, one aboral whorl of 5-7 filiform tentacles with few nematocysts. Nematocysts: stenoteles and very variable isorhizas. Stenotele with three stylettos. Gonophores unknown, probably a *Dipurena* like medusa with split gonad rings.

Distribution – Germany, Sweden (Baltic Sea).

Biology – The polyp occurs within the canal system of the sponge *Halichondria panicea*, in depths of 9-10 m.

Remarks – This species is not sufficiently described because the medusa stage was not cultivated. The occurrence within sponges, the absence of lower capitate tentacles, and the presence of the haploneme in the polyp stage, however, should render this species recognisable. It resembles *D. reesi* and *D. strangulata*, although both lack haplonemes.

5.3. Genus ***Sarsia***

Synonyms – *Sthenyo* Dujardin, 1845; *Codonium* Haeckel, 1879; *Sarsiella* Hartlaub, 1907; *Stauridiosarsia* Mayer, 1910; *Syndiction* A. Agassiz, 1862.
Type species – *Sarsia tubulosa* (M. Sars, 1835).

Diagnosis – Hydroid with one oral whorl of capitate tentacles and with or without lower capitate tentacles, with or without filiform tentacles. Tentacles usually longer and thinner than in other Corynidae. Gonophores develop below capitate tentacles and over filiform tentacles. Gonophores either released as free medusae or retained at hydranth. Cnidome with or without isorhiza nematocysts. Adult medusa with manubrium extending beyond umbrella margin, thin and serpentine proximally, distally with wide stomach; gonad forming cylinder around thin part of manubrium only, leaving distal stomach free of gonad. Tentacles unbranched.

5.3.1. ***Sarsia tubulosa*** group

Comprises the species: *S. tubulosa, S. densa, S. occulta, S. striata, S. piriforma, S. viridis, S. apicula, S. princeps, S. bella*. Important characters to distinguish the species are given in table 6.

TABLE 6. Distinguishing characters of the *Sarsia tubulosa* group

character	*S. tubulosa*	*S. apicula*	*S. bella*	*S. densa*	*S. occulta*	*S. piriforma*	*S. princeps*	*S. striata*	*S. viridis*
bell pointed	no	sometimes	variable	no	no	yes	yes	no	no
subumbrella pointed	no	yes	no	no	no	no	yes	no	no
apical knob or canal	knob small, present or absent	knob present, size variable	knob short, conical	knob present	knob small, conical	knob rounded to conical	long, thin canal, occ. branched	small knob	conical knob
bell height in mm	6-10	9-12	6-9	6-8	max. 3.4	5-8	15-25	<11	5-8
gonad-free part of manubrium	short	short	more than half	more than half	very short	very short	very short	short	half of manubrium
exumbrellar nematocysts in young medusae	scattered	scattered	concentrated in 16 adradial patches	scattered	scattered	8 adradial groups	8 loose adradial groups	few scattered	unknown
subumbrellar pockets	transient	none	none	none	none	none	none	yes	?none
ridged pockets	no	no	no	no	no	no	no	yes	no
radial canal enters jelly	yes	yes	no	unknown	no	no	no	yes	yes
gastrodermal chamber of bulbs	high	high, abaxial side straight or concave	low	high	high	high, abaxial side concave	very flat	small knob	high, abaxial side straight or concave
colour bulbs	variable	yellow	reddish	red	orange to red	orange to red	intensively orange	red	brilliant green
colour apical knob	variable	red	reddish	red	orange to red	orange to red	orange	red	brilliant green
size of hydranth in mm	0.8-2.6	1.3-2	<1.5	>1.5 mm	1.6	1.0-1.8	0.7-0.8	1.3	unknown
number of capitate tentacles in polyp	12-20	12-15	8	12-20	12-17	4-6	8	8-10	unknown
whorls of capitate tentacles	scattered	3 very closely set	2 very closely set	scattered	3	1	2 closely set	2	unknown
filiform tentacles	absent	present	absent or rudimentary	absent	absent	short	present	present or absent	unknown
colony branched	stolonal or branched	stolonal	stolonal	much branched	stolonal	stolonal or slightly branched	stolonal	stolonal, occasionally branched	unknown
special	-	red tentacles	-	-	medusa sometimes fixed, jelly thin	-	hydranth club shaped, manubrium orange colour	-	green

Sarsia tubulosa (M. Sars, 1835) Fig. 29A-F

Oceania tubulosa M. Sars, 1835: 25, pl. 5 fig. 11.
Syncoryne decipiens Dujardin, 1845: 275, pl. 14-15, medusa named *Stheuyo*; Hartlaub, 1907: 30, figs 21-22b.
Medusa proboscidea Dalyell, 1847-48: 248, pl. 53 fig. 1-2, pl. 52 fig. 3 (after Bedot, 1905).
Sarsia mirabilis L. Agassiz, 1849: 224, pls 4-5; in part Berrill, 1953: 273, fig. 1A-C, (not others, = *S. occulta*).
Coryne mirabilis – in part L. Agassiz, 1862: 189, pl. 17-18.
? *Syndiction reticulatum* L. Agassiz, 1862: 340.
Sarsia tubulosa – Forbes, 1848: 55, pl. 6 fig. 2; Schulze, 1873: 14, pl. 1-3; Browne, 1903: 9; Hartlaub, 1907: 19, figs 10-14; Mayer, 1910: 53, pl. 3 figs 2-5, pl. 4 figs 1-2; in part Kramp, 1926: 8, figs 6-16, pl. 1 figs 5-7; in part Kramp, 1927: 24, chart 3; Russell, 1953: 55, figs 21-23; Kramp, 1959: 78, fig. 10; Kramp, 1961: 32; Kakinuma, 1966: 206, figs 1-5; Kramp, 1968: 6, fig. 2; Brinckmann-Voss, 1970: 66; Russell, 1970: 232; Calder, 1972: 223, pl. 1 fig. 8; Edwards, 1978:301, figs 4-5; Arai & Brinckmann-Voss, 1980: 25, fig. 12; Miller, 1982: 153, figs 3A, 4A, 4C.
Syncoryna Sarsi Lovén, 1836: 276, pl. 8 fig. 7-10.
Syncoryne sarsii – Schulze, 1873: 2, pls 1-3, not Genzano & Zamponi, 1994 [= ? *S. eximia*].
Sarsia macrorhynchia Busch, 1851: 10, pl. 3 fig. 7-10, pl. 4 fig. 1-2.
Sarsia pattersoni Haddon, 1886: 6.
Sarsia barentsi Linko, 1905: 214; Hartlaub, 1907: 14; Mayer, 1910: 53; Kramp, 1959: 207.
Sarsia litorea Hartlaub, 1907: 32, figs 23-24; Mayer, 1910: 53, fig. 13; Kramp, 1926: 15.
Sarsia pulchella – Hartlaub, 1907: 34, fig. 27.
Sarsia reticulata – Hartlaub, 1907: 45, figs 41-43; Kramp, 1961: 31.
Sarsia tubulosa var. *mirabilis* Mayer, 1910: 57, pl. 4 figs 3-4, pl. 5 fig. 6, figs 13-18.
Syncoryne mirabilis -- in part Fraser, 1944: 41, pl. 4.
Coryne tubulosa – Werner, 1963: 468, figs 5-12; Naumov, 1969: 252, figs 36, 122, 123, pl. 29 fig. 6.

TYPE LOCALITY – Florø Island, Norway, summer and fall (Sars, 1835).

MATERIAL EXAMINED – ZMUC, Hirtshals, Denmark, 11.05.1931, several medusae, well preserved – ZMUC, Nyborg Biological Station, Denmark, 17.5.1915, several medusae, 6-8 mm, mature – ZMUC, Dana Station 3047, 17.05.1923, 2 medusae, det. Kramp as blue variant – ZMUC, Dana station 3078, 17.05.1923, several medusae det. Kramp – ZMUC, hydroid labeled as *Coryne sarsii*, Greenland, 67°13N 53°54W, on *Fucus*, intertidal, with gonophores below tentacles – ZMUC, hydroid labeled as *Syncoryne mirabilis*, Woods Hole, Massachusetts, USA, colony 1 cm high, in dense lawn, long stems, fertile– Woods Hole, Massachusetts, USA, living hydroid colony obtained through Annette Frese, cultivated at 16 °C until medusae buds developed – MHNG INVE 29805, Sooke, British Columbia, Canada, three medusae collected 18.4.1999 by A. Brinckmann-Voss – NMSZ 1976.64.66, Marine Station Millport, Scotland, coll. 26.5.1976, 2 mature medusae, manubrium blue-green – NMSZ 1908.151.1, Dunbar, Scotland, coll. 1908, 2 ill preserved medusae – NMSZ 1910.34.7, Heligoland, North Sea, 2 ill preserved medusae, manubrium contracted, gonad free portion very short – ZMA Coel 3969, Helder Harbour, Netherlands, coll. 1928, 3 mature medusae, one with 5 radial canals and bulbs.

DESCRIPTION – (in part after Russell, 1953 and Edwards, 1978) Hydroid stolonal or sparingly branched (up to 2 times), reaching maximal heights of 13 mm. The cauli and stolons are covered by perisarc which may be corrugated but not truly annulated. Hydranths spindle shaped, 0.8-2.6 mm in height. Capitate tentacles confined to the distal half of the hydranth, about 12-20, scattered or in indistinct whorls, length up to 0.9 mm. Filiform tentacles absent. In the lower half of the hydranth an annular thickening of the epidermis, from which a very thin and filmy periderm is secreted that covers the basal part of the hydranth. Gonophores arise in an

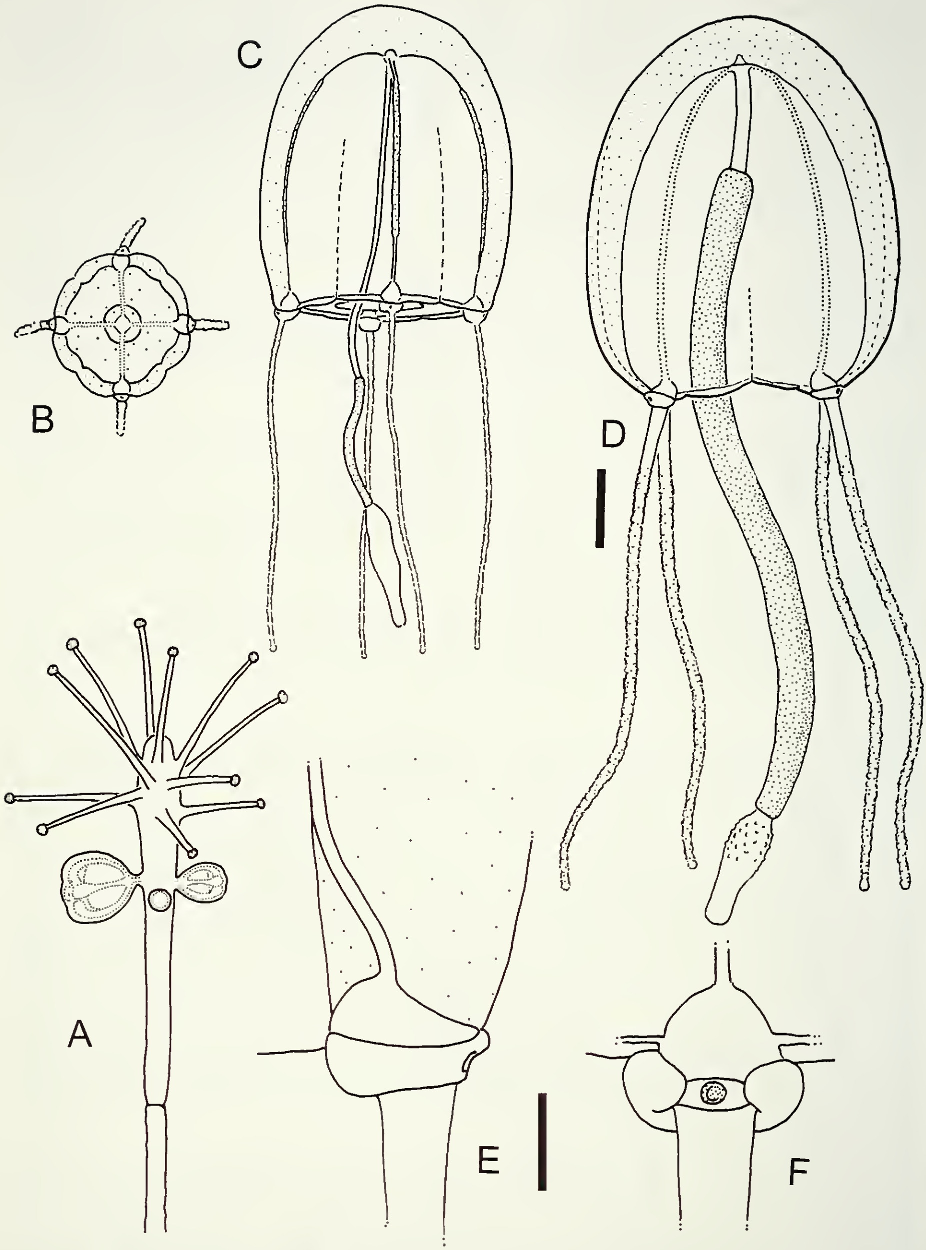

FIG. 29

Sarsia tubulosa (M. Sars, 1835). A-C, modified after Edwards (1978); D-F, after material from Hirtshals, Denmark. A) Hydranth with medusae buds. B) Newly released medusa seen from top, note perradial furrows, diameter 0.8 mm. C) Subadult medusa, height 2.6 mm, note incomplete covering of manubrium by the gonad. D) Mature medusa with relaxed manubrium, note that gonad free portion of manubrium is relatively long in this specimen, scale bar 2 mm. E) Tentacle bulb in side view, note passage of radial canal through mesogloea (stippled), scale bar 0.5 mm. F) Tentacle bulb in frontal view, same scale as E.

irregular whorl in the middle of the hydranth below the lower tentacles, 1-8 per hydranth. Gonophores are released as free, immature medusae. Hydranths producing medusae often reduce their tentacles (reproductive exhaustion). Nematocysts of polyp (Woods Hole material): stenoteles, (18-20) x (12.5-14) µm and (15-16) x (10-11) µm; isorhizas in pedicels, (13-15) x (3) µm.

Newly released medusa 0.8 mm wide and high, with scattered nematocysts on umbrella, with umbilical canal, with deep interradial and shallow perradial furrows in the exumbrella, four radial canals with glandular thickenings along part of their course, black ocelli, tentacles with several rings of nematocyst clusters. Glandular thickenings grow longer during further development, but are absent in mature animals.

Adult medusa 6-10 mm in height (in arctic waters reportedly up to 18 mm), higher than wide, bell-shaped, shape variable, jelly moderately thick, with interradial exumbrellar furrows. Manubrium very long, 2-3 times as long as bell. Apical chamber or apical knob of variable shape usually present, apical canal mostly lacking. Manubrium composed of a long, thin proximal part and a spindle shaped swelling at the distal end (stomach). Stomach at upper end covered by warts with nematocysts. Gonads encircle manubrium along thin part, leaving at top of manubrium a region of the manubrium uncovered (less than 1/4 of bell height in mature animals). Gonad ends distally at beginning of stomach. Four thin radial canals, glandular swellings diminish with adulthood. Radial canals enter gastrodermal chamber of bulbs on abaxial side and pass through mesogloea. Tentacle bulbs large, gastrodermal chamber high, epidermal nematocyst ring incomplete, with on abaxial black or red ocellus. Each bulb with a very long tentacle, leaving bulb vertically to slightly obliquely, covered by nematocyst clusters in patches or spiral rings, terminal cluster spherical but not enlarged. Colours of bulbs and apical knob very variable, blue to green, orange to yellow, ocelli black to crimson. Sars (1835) described the colours of the manubrium and tentacles as a pale brown-grey, red-yellow to faintly greenish. Nematocysts of medusa (Bouillon, 1974): desmonemes, basitrichous isorhizas, stenoteles. The young medusa has also microbasic mastigophores on its exumbrella (Nagao, 1969).

BIOLOGY – The hydroids grow on rocks, stones and weeds, chiefly near low water (Edwards, 1978). The medusa appears in British waters at the beginning of April and commences to disappear by the end of June in the south. In the North it persists into August. Similar observations were given for British Columbia by Arai & Brinckmann Voss (1980). Kramp & Damas (1925) state that off the Norwegian coast *S. tubulosa* comes to the surface on calm days in May, but usually keeps at depths of 20-100 m.

Edwards (1978) cultivated the polyp between 2 and 20 °C and it produced medusae within this temperature range. These findings contrast with results obtained by Werner (1963), who was able to induce medusae buds by lowering the temperature to 2-6 °C. At 14 °C medusae budding stopped, while at 6-8 °C medusae developed irregularly, sometimes the medusae bud were transformed into polyp buds. Perhaps Werner's material was in fact *S. densa*, which could explain the differences.

Sarsia tubulosa is able to tolerate reduced salinity. Christiansen (1972) found the polyp in Oslofjord only during winter and spring. It was rare or absent in summer. Polyps with buds were found in November.

The medusa is known to feed on copepods, mysids, amphipods, nauplii of cirripedia and euphausiids, chaetognaths, fish larvae and occasionally other medusae such as *Aurelia* (Arai & Brinckmann-Voss, 1980). Food intake, growth and ecology of the species have recently been investigated by Daan (1986). The ecological and potentially economic impact on commercially important fish larvae has been investigted by van der Veer (1985) and Purcell (1986).

Sarsia tubulosa has been the subject of numerous morphological, behavioural and physiological studies. References were compiled by Arai & Brinckmann-Voss (1980). Some more recent investigations are Leonard (1980 through 1984), Singla & Weber (1982) and Weber (1982).

Distribution – Boreal Atlantic coasts of Europe and North America, penetrating into arctic regions. Its southern limit in Europe is the English Channel, in the western Atlantic it occurs from Chesapeake Bay to Greenland. In the Pacific it is also present along North America from San Francisco to Alaska. In the Eastern Pacific it occurs in Japan and further north. It is absent from the Mediterranean (Brinckmann-Voss, 1970). Occurrence in arctic waters is known, but some records are doubtful. Apparently it is rarer in cold waters. In view of the existence of several closely resembling species, not all records of *Sarsia tubulosa* may in fact relate to this species.

Remarks – The life cycle of *Sarsia tubulosa* has been examined several times, commencing with Schulze (1873). Edwards (1978) gives a particularly detailed and valuable account.

Sarsia tubulosa is a variable species with a complicated synonymy, discussed extensively among others in Hartlaub (1907), Kramp (1926), Russell (1953), Edwards (1978; 1983), and Arai & Brinckmann-Voss (1980). Particularly confusing was that Agassiz apparently lumped two or three species with differing life cycle into his *S. mirabilis* (see Edwards, 1978). There is no need to repeat all the discussions here, but some ambiguities remain up to now, in particular in relation to the different colour morphs of the medusa stage. New genetic investigations are urgently needed to assess the status of this important species.

Kramp (1926; 1927) found that Danish waters are inhabited by three forms differing in colour:

> The 'blue *Sarsia*' has a manubrium and tentacles in an intensive sky-blue colour without intermixture of any other colours, especially without a tinge of green. It is usually smaller than 10 mm. This form was found widely in the Kattegat and Belt Sea, but it was absent from the North Sea.
>
> The 'brown *Sarsia*' had a manubrium and bulbs ranging from emerald-green to yellowish-brown or brown. Every shade of intermediate colour was present. This form was present in the North Sea and along Norway. Kramp considered this form to correspond to Sars' original morphotype.

> The 'scarlet *Sarsia*' had manubria that were either colourless or with a faint yellowish or greenish hue, but the apical chamber and the bulbs were of a brilliant scarlet. The population was also present along the west coast of Denmark and the distribution overlapped with the brown form. At some places the two forms were found together in the same catch (see Kramp, 1927, chart 3).

Kramp examined these three colour variants for morphological differences and found a few microanatomical differences, but considered them mostly not significant or consistent enough to distinguish separate species. Only the 'scarlet' variant had a nearly filled apical chamber and a relatively long part of the manubrium not covered by gonad tissue, and it thus stood somewhat apart from the other two. Kramp related the 'scarlet' form to *Sarsia densa* Hartlaub, 1897. The 'brown' form he related to the *Sarsia tubulosa* Sars sensu stricto. Colour in hydromedusae can be significant, however, more often it is only due to the type of ingested food (Edward, 1978; Brinckmann-Voss, 1980). The apical canal may be absent or present in individuals from any geographic area without correlation to the size of the medusa. The shape of the apical chamber is also very variable, sometimes it is also missing (see Kramp, 1926: fig. 15). The shape is additionally also correlated with the degree of contraction of the medusa. Some of the medusae for which Kramp recorded the colour (blue, brown, and red) when alive are still kept by the ZMUC and they were examined for this study. It was evident that some of the brown variant had distinct subumbrellar pockets with angular ridges (e. g. Dana station 2999) and I would identify them without hesitation as *Sarsia striata* Edwards, 1983. However, it must clearly be stated that not all brown *S. tubulosa* of Kramp can be attributed to *S. striata*. Kramp's red medusae are too contracted to be of any good use, but it s evident that they are all smaller than usual *S. tubulosa*. Perhaps they are juvenile.

Kramp (1926) concludes that his red medusae and hence *Sarsia densa* might be a distinct species, but that it could also be a mere local variant. Similar conclusions were reached by Russell (1953). Hartlaub (1907) distinguished *Sarsia densa* from *S. tubulosa* mainly by the long gonad free portion of manubrium. This gonad free portion is longer than the bell height and covers about half of the tubular part of the manubrium. Further distinguishing traits are the smaller size and it is reportedly a less active swimmer than *S. tubulosa*. The polyp of *S. densa* is similar to the one of *S. tubulosa*, but the colonies are more dense and the stems more branched. The validity of the long gonad free portion of the manubrium was questioned by Edwards (1983), as he noted that also *S. tubulosa* goes through such a stage during its development (see Fig. 29C). In view of the results obtained by Miller (1982) discussed below, *S. densa* is here kept separate from *S. tubulosa* until other methods help to clearify the situation.

Miller (1982) made a close examination of the "*Sarsia tubulosa*" complex present at Friday Harbour (USA, Washington, Pacific Ocean). He noted consistent differences in egg sizes between individual female medusae. This difference correlated with other minute morphological details that permitted him to distinguish also morphotypes among the male medusae. He was able to distinguish three morphotypes, but one was rare. Miller named the two main types S and L forms (small and large egg-size). The L-form differed from the S-form in having a longer gonad free proximal portion of the manubrium, extending to the bell margin or beyond (shorter than bell in S-form), thus corresponding to *S. densa*. The L-Form also had four adradial nematocyst patches on the exumbrella (completely absent in S-form). Both forms also differ in the timing of their spawning. Miller (1982) then used cross-fertilisation to further investigate whether these morphotypes belong to reproductively isolated populations. Cross-fertilisation between the two forms indeed resulted in only a few viable hybrids and it is now clear that the two forms must belong to two different species. The S-form was initially attributed to *S. tubulosa sensu stricto*, but recently Brinckmann-Voss (2000) referred it to *S. apicula* (Murbach & Shearer, 1902) (although this is difficult to see in Miller's (1982) figures). The L-form was described by Brinckmann-Voss (2000) as a new species, *Sarsia bella*.

Synoryna sarsii Lovén, 1836 was most probably based on a polyp of *S. tubulosa* showing reproductive exhaustion (Edwards, 1978). Although Loven's species is not sufficiently recognisable, most contemporary authors accepted the synonymy of the the two names. Only Genzano & Zamponi (1994) contested this view. Their supposed material of *S. sarsii*, however, was more likely *S. eximia* (they could not cultivate the medusa to maturity). Whatever it was, it obviously does not match Lovén's (1836) description and figures.

S. mirabilis Agassiz, 1849 seems to form dense polyp colonies with considerably branched stems. Mayer (1910: 49) tabulates further differences, although most of them are not appropriate to distinguish *Sarsia* species. Most subsequent authors treated *S. mirabilis* as a synonym of *S. tubulosa*. Even Mayer (1910) gave *S. mirabilis* only a status of a variety of *S. tubulosa*. *Syndyction reticulata* Agassiz, 1862 is seen by most authors as conspecific with *S. mirabilis*. According to Mayer (1910), it differs from *S. mirabilis* in having a smaller medusa (3 mm) with a bell covered by reticulated clusters of nematocysts. The nematocytes seem to have characteristically long cnidocils (Mayer, 1910 : pl. 4 fig. 4, pl. 5 fig. 6). The polyp is smaller and less branched. The colour of the medusa is constantly brick-red in contradistinction of the more variable *S. mirabilis*. *Sarsia reticulata* is here treated as questionable synonym of *S. tubulosa*, while *S. mirabilis* is regarded as subjective synonym of *S. tubulosa*.

Sarsia barentsi Linko, 1905 was described without figures and the observations were based on four specimens only. Linko (1905) considered it a separate species due to the s-shaped manubrium. This may, however, have been an artifact (fixation). No further records of this species are known and it seems very likely that it is referrable to *S. tubulosa*, an opinion already expressed by Mayer (1910, synonym to *S. tubulosa* var. *mirabilis*).

Infertile hydroids of *S. lovenii* have often been misidentified as *S. tubulosa* (see also under *S. lovenii*). The hydranths of the latter species are larger and the stems can be quite branched and tall.

Sarsia apicula (Murbach & Shearer, 1902) Fig. 30A-C

Codonium apiculum Murbach & Shearer, 1902: 72; Murbach & Shearer, 1903: 165, pl. 17 fig. 1, pl. 22 figs 4-5.

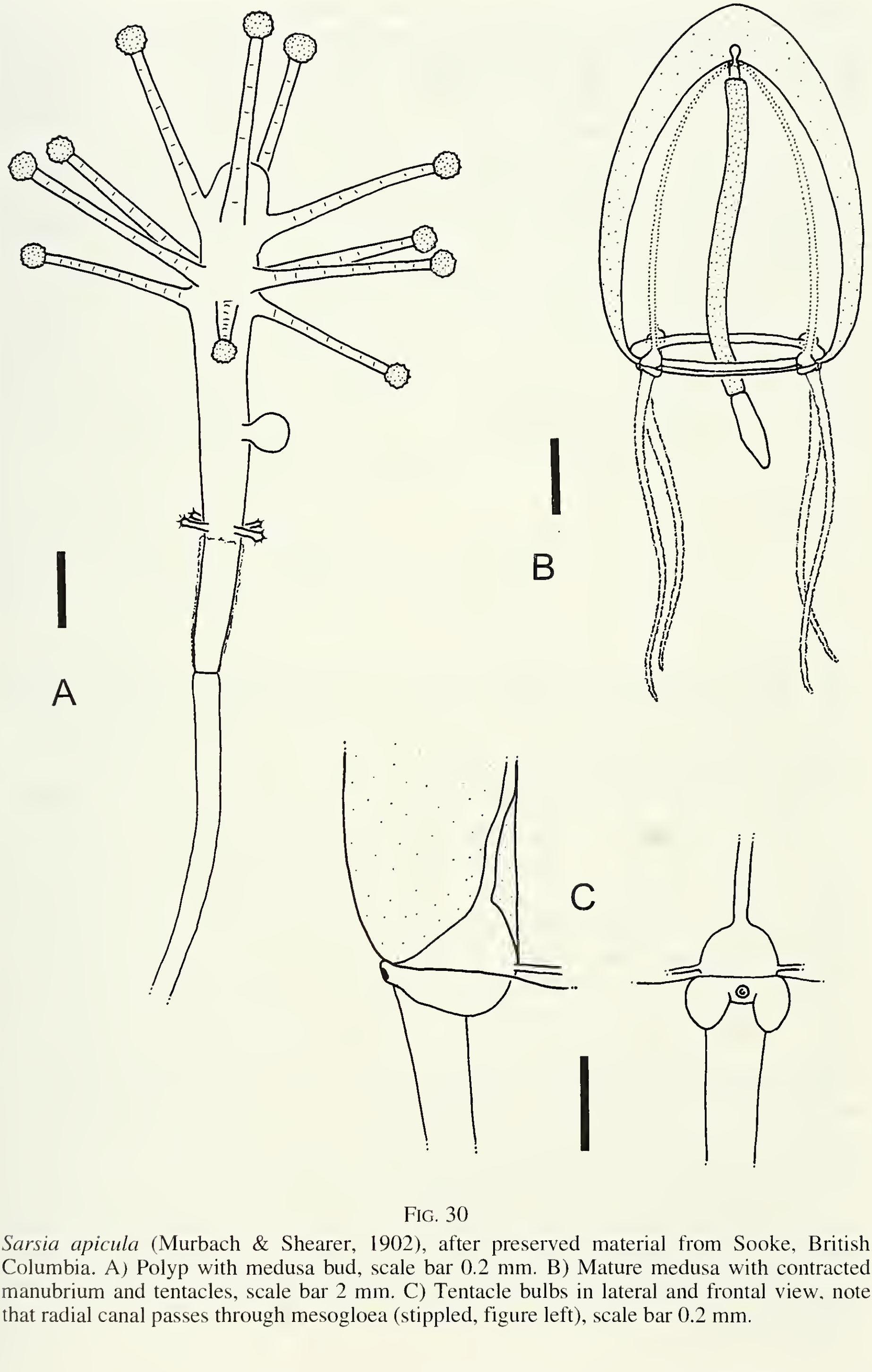

FIG. 30

Sarsia apicula (Murbach & Shearer, 1902), after preserved material from Sooke, British Columbia. A) Polyp with medusa bud, scale bar 0.2 mm. B) Mature medusa with contracted manubrium and tentacles, scale bar 2 mm. C) Tentacle bulbs in lateral and frontal view, note that radial canal passes through mesogloea (stippled, figure left), scale bar 0.2 mm.

Sarsia apicula – Hartlaub, 1907: 17, fig. 9; ? not Sverdrup, 1921: 14, pl. 1 fig. 2; Arai & Brinckmann-Voss, 1980: 18, fig. 8, 9a; Brinckmann-Voss, 1985: 673, figs 1-5.

Type locality – Puget Sound and Victoria, Canada.

Material examined – Sooke, British Columbia, one medusa collected 22.5.1999 by A. Brinckmann-Voss, damaged – MHNG INVE 29806, Sooke, polyps with medusae buds raised from mature medusae by A. Brinckmann-Voss, Nov. 1999.

Description – (in part after Brinckmann-Voss, 1985) Hydroid mostly stolonal, rarely branched once. Stems and stolons covered by thin, flexible, smooth perisarc, no annulations. Hydranths up to 1.3-2 mm high, club-shaped, distal end slightly swollen. Normally with three, rarely two, very closely set whorls of long capitate tentacles. Tentacles confined to distal third of hydranth. Each whorl with four, rarely five tentacles, mostly in alternate position to tentacles of adjacent whorls. Distance between oral whorl and middle whorl larger than distance between the two lower whorls. Lowest whorl of tentacles slightly shorter than other ones. Tentacle stalks tapering somewhat. At lower third of hydranth one whorl of small filiform tentacles, number variable from 0 to 4, with accumulation of sensory bristles at end. Filiform tentacles often absent in material from the sea. Hydranth base from end of perisarc up to level of filiform tentacles covered by very fine, filmy layer (visible in compound microscope only). Gonophores develop in middle of hydranth above filiform tentacles in one or two indistinct whorls. Normally 1-4 gonophores, but up to 10 possible. Colours: gastrodermis pink, hypostome white. Nematocysts: stenoteles (11-17) x (7-11) μm.

Gonophores are released as free medusae. Newly released medusa 1.0-1.1 mm, with scattered exumbrellar nematocysts, tentacles with six to eight nematocyst clusters, terminal one not thickened. Subadult medusa (5-8 mm) is rounded, thick jelly and with subumbrellar pockets that disappear in the adult. Newly released medusa with mastigophores on exumbrella.

Adult medusa 9-12 mm high, diameter 7.5-9 mm, bell top pointed to rounded, jelly thick. Subumbrella quite conical (Fig. 30B). Extended manubrium about two times as long as bell height, with apical knob. Apical knob variable in form from high cone or bulb to a flat cap. Manubrium with long, thin serpentine part and distal swollen stomach. Gonad covers nearly entire serpentine part, thickness near top in extended manubrium tapering evenly. Radial canals enter the gastrodermal chamber at its top, passing a very short distance through the mesogloea. Epidermal part of bulbs with an incomplete nematocyst ring, sometimes a light exumbrellar spur, with black ocellus. Tentacles at least two times as long as bell, covered densely by nematocyst clusters, terminal cluster not thickened. Colours: tentacles in adults characteristically red, epidermal parts of the bulbs yellow, gastrodermal part of bulbs orange to red, apical knob red. Nematocysts: stenoteles, (15-16) x (10-11) μm and (11-12) x (8) μm; desmonemes (9-11) x (4-5) μm. Egg size less than 100 μm.

Distribution – North eastern Pacific, Puget Sound, Sooke and Victoria Harbour, Friday Harbour, San Juan Islands (Brinckmann-Voss, 2000).

Biologyy – The polyp grows on rock scallops [*Hinnites multirugosus* (Gale)], 20-30 m, the medusa was present in the surface plankton from end of March to middle of August.

REMARKS – The medusa of *Sarsia apicula* is characterised by the red tentacles, by its somewhat conical subumbrella, and the tapering of the gonad towards its base (not visible in Fig. 30B). Preserved medusae are hardly distinguishable from *S. tubulosa* and *S. princeps* in the region of sympatry (Vancouver Island region). *Sarsia apicula* is distinguished from *S. tubulosa* through its triangular bell, which is a rather constant feature in living specimens. The pinkish colour of the tentacles and manubrium also distinguishes it from the typical blue *S. tubulosa* of their sympatric range. It is distinguished from *S. princeps* through its shorter apical canal, the relation of height to width of the bell, the shape of the tentacular bulbs and the radial canal that passes through the mesogloea (comp. Figs 30C and 35B).

They are, however, clearly different in their polyp stage. Hydranths of *Sarsia tubulosa* have no filiform tentacles, and those of *S. princeps* have only two whorls of tentacles and they are two times smaller.

Colour in most corynid medusae such as *S. tubulosa* is dependent on their diet (Edwards, 1978), but a colour difference in animals from the same locality is very indicative for that different species are present.

Sarsia bella Brinckmann-Voss, 2000 Fig. 31A-C

Polyorchis penicillatus – Brinckmann-Voss, 1977: 93, figs 1-2.
Sarsia L – Miller, 1982: 157, figs 3B and 4B-D.
Sarsia bella Brinckmann-Voss, 2000: 190, figs 2-6.
TYPE LOCALITY – Becher Bay, off Vancouver Island, Canada.

DESCRIPTION – (after Miller, 1982 and Brinckmann-Voss, 2000) Hydroid stolonal, without clear separation of caulus and stolons, hydranths relatively small (<1.5 mm), with an oral whorl of 4-5 capitate tentacles and an additional whorl of capitate tentacles very close below, lower tentacles only half the length of the oral ones. With about 10 gastrodermal cells in oral tentacles. Filiform tentacles absent or very small. Gonophores develop below capitate tentacles in middle region of hydranth, released as free, immature medusae. Nematocysts: stenoteles (12-18) x (7-12) μm; homotrichous isorhizas (14-15) x (5-7) μm.

Newly released medusa 1 mm high and wide. Exumbrella with 16 distinct adradial nematocyst patches, two patches per adradius, each pair on one meridian, each patch consisting of 6-11 densely packed microbasic mastigophores. During growth, the nematocysts become more scattered and often disappear. Manubrium shorter than bell, without visible gonads.

Mature medusa 6-9 mm high, diameter slightly less, bell rounded to conical. Exumbrella thicker at apex than at side, adradial exumbrellar nematocyst patches faintly visible or absent. Manubrium with short, conical apical chamber. Manubrium about three times as long as bell height, divided into long, thin serpentine part and distal, swollen stomach. Gonads restricted to serpentine part and covering only distal half of it. Four radial canals, stout, clearly visible, not entering mesogloea above gastrodermal chamber of tentacle bulb. Gastrodermal chamber of bulbs shallow, epidermal part prominent, with abaxial ocellus. Tentacles issue obliquely to almost horizontal in living specimen. Tentacles several times as long as bell height, with numerous nematocyst clusters. Nematocysts: stenoteles (9-12) x (7-9) μm; desmo-

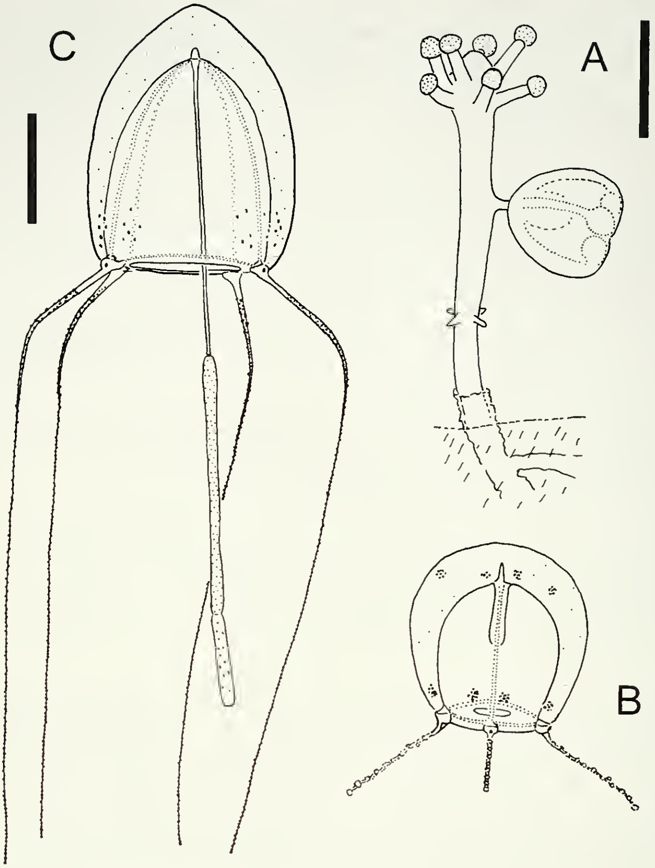

FIG. 31

Sarsia bella Brinckmann-Voss, 2000; combined and modified after Brinckmann-Voss (1977; 2000) and Miller (1982). A) Hydroid with contracted tentacles and medusa bud, embedded in sponge, scale bar 0.2 mm. B) newly released medusa, note characteristic clusters of nematocysts, height about 1 mm. C) Mature medusa, scale bar 4 mm.

nemes (7-9) x (4-5) μm; mastigophores on umbrella (11-12.5) x (8-10) μm. Egg size: 110-130 μm.

BIOLOGY – The polyp was found partially embedded in a sponge growing on the margin of the rock scallop *Hinnites multirugosus* (Gale). Medusae buds were observed in May at sea temperatures of 9 °C.

DISTRIBUTION – Vancouver Island region and Friday Harbor.

REMARKS – Medusae of *Sarsia bella* are best distinguished from other similar medusae by their long gonad free portion of the serpentine part of the manubrium. Only *Sarsia densa* and *Sarsia viridis* have such long portions of the manubrium free of gonads. Another characteristic of *S. bella* are the 16 nematocyst patches on the exumbrella. The patches are in adradial position and form an upper and a lower circle. Mature animals, however, may have lost most of the exubrellar nematocysts. For further differences see table 6. The polyp of this species has previously been misidentified as *Polyorchis penicillatus* (Brinckmann-Voss, 1977; corrected in Brinckmann-Voss, 2000).

Sarsia bella is one of the few hydrozoans that have been investigated for possible mechanisms for reproductive isolation. It is – although perhaps not completely – reproductively isolated from other similar, sympatric species by a difference in the time of spawning and in differences of the sperm attractant (Miller, 1982). However, especially the time difference of spawing might be of minor importance and additional other factors, like species specific sperm binding, are likely to prevent most hybridisations.

Sarsia densa Hartlaub, 1897 Fig. 32

Syncoryne sarsi – Hartlaub, 1895: 165.
Syncoryne densa Hartlaub, 1897: 452, pl. 15b figs 4 & 11, pl. 6c fig. 7; Mayer, 1910: 51, 55, fig. 18; Hartlaub, 1907: 26, figs 17-19; Kramp, 1926: 15; Russell, 1953: 57; Edwards, 1983: 59.
? *Syncoryne pulchella* Allman, 1865: 1; Allman, 1871: 279, pl. 6 figs 1-3.
[not *Sarsia pulchella* Forbes, 1848]
? *Sarsia coacta* Hartlaub, 1918: 386, fig. 333.
TYPE LOCALITY – Heligoland, North Sea.
MATERIAL EXAMINED – ZSM, collection Stechow, several slides originating from Heligoland, identified as *Sarsia decipiens*, collected begin of century, may belong to this species – ZMUC, as *Sarsia tubulosa* red variant, Dana station 3022, north of Bulbjerg, 09.05.1923, id. Kramp, 3 medusae, 2 mm, may belong to here.

DIAGNOSIS – Medusa like *S. tubulosa*, but smaller (6-8 mm, max. 10 mm), gonad free portion of proximal manubrium as long as gonad and longer than bell height, radial canals narrow, colours: bulbs and apical knob dark reddish-brown or scarlet, gonad region yellow-brown or yellow-grey, ocelli red. The polyp phase is similar to *S. tubulosa*, but forms dense colonies and the stems are more branched (shoots with up to 6 hydranths). According to Hartlaub (1897), the perisarc is characteristically yellow.

DISTRIBUTION – North Sea. Due to the difficulties in distinguishing this species from *S. tubulosa*, many records must be seen as doubtful.

BIOLOGY – The medusa is present in Heligoland from February to April.

REMARKS – Hartlaub (1907) distinguishes the medusa of *Sarsia densa* from *S. tubulosa* mainly by the long gonad-free portion of manubrium. This gonad free portion is longer than the bell height and covers about half of the tubular part of the manubrium. The validity of the long gonad free portion of the manubrium was questioned by Edwards (1983), as he noted that also *S. tubulosa* goes through such a stage during its development. Further distinguishing traits are the smaller size and Hartlaub considered it to be a less active swimmer than *S. tubulosa*. The polyp of *S. densa* is similar to the one of *S. tubulosa*, but the colonies are more dense and the stems much more branched (Fig. 32). For more discussions see also under *S. tubulosa*. More work is clearly needed to resolve the status of the various *S. tubulosa*-like

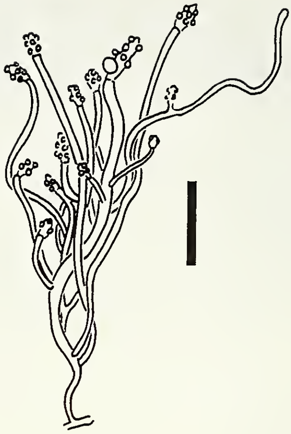

FIG. 32
? *Sarsia densa* Hartlaub, 1897, colony from Heligoland, scale bar 2.5 mm.

species in the North Sea. In view of the results of Miller (1982), *S. densa* is here kept separate from *S. tubulosa* until genetic studies will prove the contrary.

Several hydroid colonies from Heligoland identified by Stechow as *S. decipiens* and now held by the ZSM might perhaps belong to this species. The hydranths and the position of the medusae buds are exactly as described by Edwards (1978) for *S. tubulosa,* but the stems branch much more. One stem has more than 12 hydranths. The diameters of the branches varies considerably (factor 2), the oldest branches increase their diameter towards distal (Fig. 32). Hartlaub (1897) depicts a colony of his *S. densa* with a stem that has 6 terminal hydranths. This is much more than in Scottish material of *S. tubulosa* (Edwards, 1978) or North American colonies (Fraser, 1944, as *S. mirabilis*). The material from Heligoland has a very fine adhering periderm membrane that covers the basal region of the hydranth from the end of the caulus to the origin of the gonophores, however, such a membrane can occur in all *Sarsia* species.

Sarsia frutescens (Allman, 1871) also resembles *Sarsia densa* in forming large colonies and perhaps belongs also to here.

Sarsia coacta Hartlaub, 1917 is only known from its polyp phase. It produces very dense, much branched colonies. The gonophores develop below the tentacles. Kramp (1961) thought that *S. coacta* is conspecific with *S. tubulosa*. The profuse growth of the colonies argues somewhat against this. Material identified by Hartlaub as *S. coacta* is still in the collection of the ZSM (several slides and alcohol material) and was examined for this study. It differed from the above mentioned *S. densa* material in being more gracile. It is here included as a questionable synonym of *S. densa*, although it might also belong to *S. lovenii*.

Sarsia occulta Edwards, 1978 Fig. 33A-B

Coryne mirabilis - in part L. Agassiz, 1862: 189, pls 17-18; Edwards, 1978: 293.
Sarsia occulta Edwards, 1978: 293, figs 1-3; Edwards, 1983: 59.

Syncoryne mirabilis – Berrill, 1953: 277, figs 1E, 2B (not others); Edwards, 1978: 293.
Type locality – Near Dunstaffnage Marine Laboratory, Oban, Scotland.
Material examined – USNM 58288, Keppel, Millport, Scotland, large colony with subadult medusae, collected C. Edwards 8.5.1978, colony was cultivated 1 month.

Description – (in part after Edwards, 1978 & 1983) Hydroid mostly stolonal, rarely branched once. Cauli may reach 9 mm in height, mostly shorter, perisarc smooth, irregularly corrugated, or annulated, annulations present especially in lower part of stem. Hydranths up to 1.6 mm, club- to spindle-shaped, tentacles confined to upper half of polyp, at lower third often an annular thickening. Mouth surrounded by high epidermal gland cells. Tentacles capitate, in three not so distinct whorls, tentacle number up to 17, may be reduced in gonophore producing hydranths, tentacle length up to 0.85 mm. Filiform tentacles absent. Gonophores develop below lower tentacles in middle of hydranth, normally one only, occasionally two per hydranth. Gonophores develop into medusae that are either released or retained at the hydranth, the degree of development at release depends on environmental conditions. Nematocysts: stenoteles, (17-18) x (11-12) µm and (13-14) x (7-8) µm; haplonemes, slightly curved, numerous, (14-15) x (3) µm. Colour of hydranth is pink, perisarc translucent pale horn-coloured.

Young medusa 1.1-1.8 mm in height, manubrium variably developed, exumbrella covered with scattered nematocysts. Maturation of gonads starts already when medusa is still attached to hydroid.

Free, adult medusa up to 3.4 mm, diameter only slightly less, bell-shaped, jelly of even thickness, rather thin, velum breadth about 1/2 of radius. Manubrium with an apical knob and an umbilical canal. Manubrium about two times as long as bell height, with a long thin proximal part and a thicker, spindle shaped stomach at distal end. Mouth region covered by nematocysts. Gonad encircles thin part of manubrium and extends from nearly the base of the manubrium to the begin of the swollen stomach. Radial canals and circular canal narrow, glandular thickenings of radial canals very slight, radial canal enters at top of tentacular bulbs without passing through mesogloea. Tentacular bulbs small, gastrodermal chamber conical, epidermal ring complete, with large deep violet to black ocellus. Each bulb with a tentacle originating in vertical direction, about 1.5 times as long as medusa, with many scattered nematocyst clusters, distal ones ring-shaped, terminal cluster spherical but not enlarged. Nematocysts: stenoteles (11-13) x (7-8) µm; desmonemes (8-9) x (3-4) µm. Colours: gastrodermal system orange, brownish-red or scarlet.

Distribution – Coasts of Scotland, Massachusetts, and Maine.

Biology – Medusae are produced in late winter and in spring within a temperature range of about 7-11 °C (Edwards, 1978). Polyps grow on stones and seaweeds near low water.

Remarks – With the discovery of *Sarsia occulta*, Edwards (1978) resolved a longstanding confusion between *Sarsia tubulosa* and *S. lovenii* going back to Agassiz (1862) and other authors (see Edwards, 1978). With detailed experiments Edwards (1978) was able to show that all three species are distinct, but that gonophore maturity in *Sarsia* may nevertheless be influenced by environmental conditions. Although the medusa of *S. occulta* is often released, Edwards (1978; 1983) found conditions and

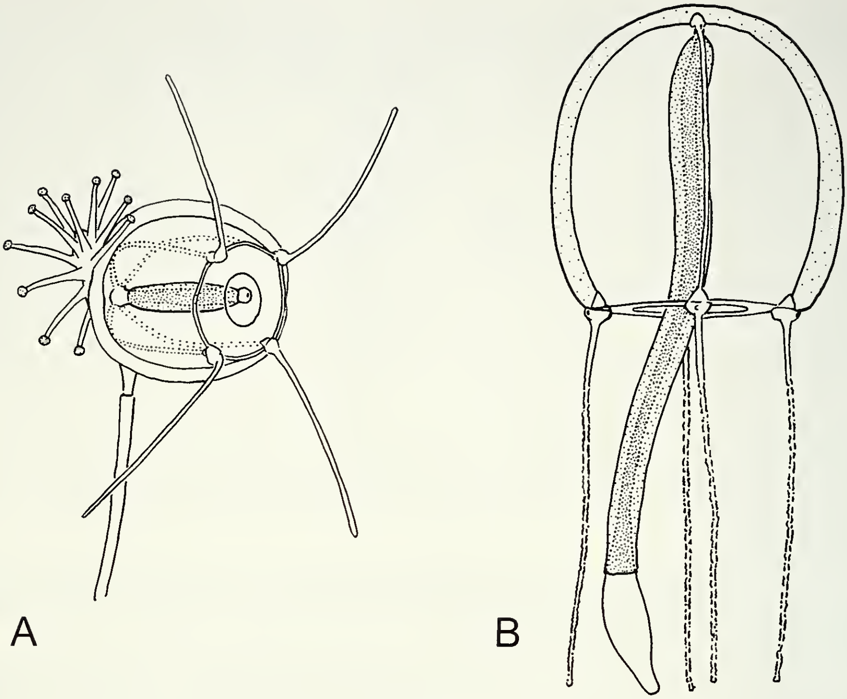

FIG. 33

Sarsia occulta Edwards, 1978, modified after Edwards (1978). A) Polyp with medusa immediately before release, development of gonads is fairly advanced. B) Free, mature medusa; bell height 3.4 mm.

clones that kept the mature medusa fixed at the polyp. Release or retention of the medusa depend on the interplay of environmental factors, particularly food supply and temperature. Development at higher temperatures seemed to favour the retention.

The medusa of *S. occulta* is not known from the sea. It is a very inactive swimmer and may remain near the sea bottom. It closely resembles *S. tubulosa*, but can be distinguished on account of the following details. *Sarsia occulta* differs from *S. tubulosa* by its smaller dimensions (half the size), the advanced stage of the gonads at release, the very short gonad free portion at the base of the manubrium, the retention of the apical canal throughout its life, the indistinct interradial exumbrellar furrows, the indistinct glandular swellings of the radial canals and the radial canal that does not enter the mesogloea before joining the marginal bulb (valid for fully grown animals only).

Sarsia piriforma Edwards, 1983 Fig. 34A-B

Sarsia piriforma Edwards, 1983: 49, figs 1-2.
TYPE LOCALITY – Near Oban, Argyll, Scotland.

DESCRIPTION – (after Edwards, 1983) Hydroid stolonal or stems long and branched 1-3 times. Perisarc of stolons and stems mostly smooth, not annulated,

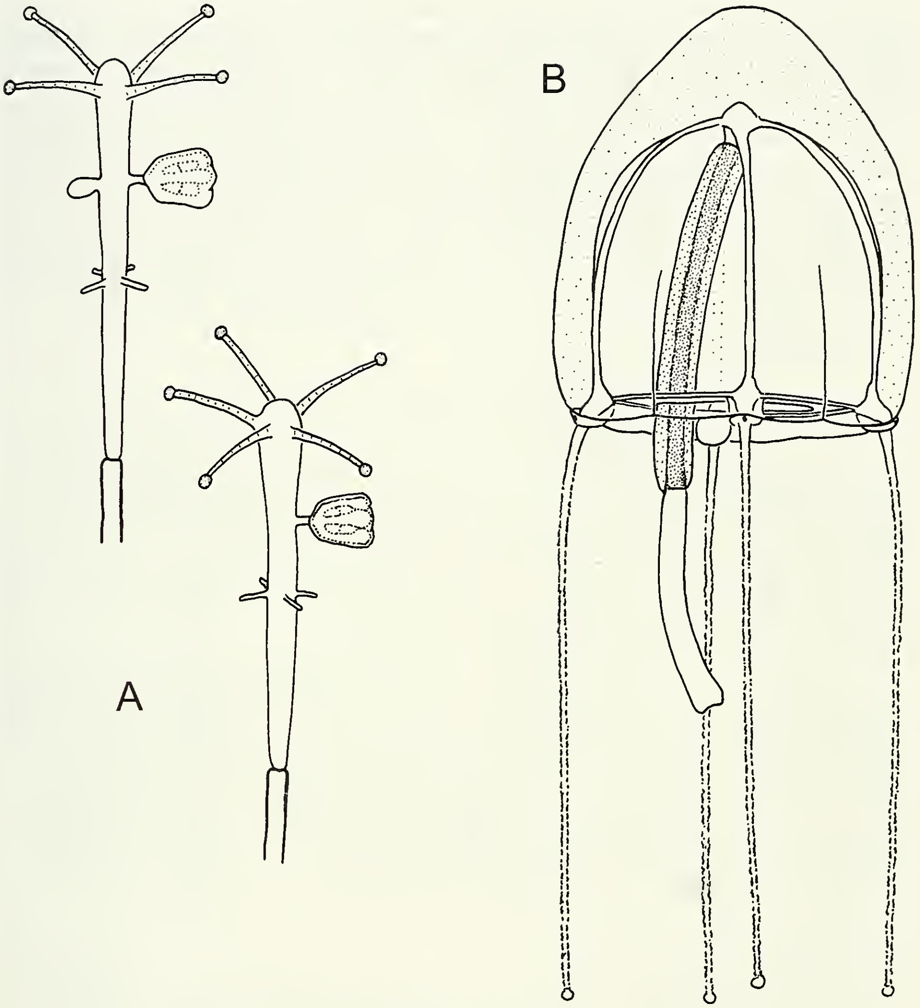

Fig. 34

Sarsia piriforma Edwards, 1983; modified after Edwards (1983). A) Two hydranths with differing tentacle numbers and medusae buds. B) Mature medusa, bell height 7.3 mm.

occasionally somewhat corrugated. Hydranths 1.0-1.8 mm in height, nearly cylindrical, with a single whorl of oral capitate tentacles (4-6) and one whorl of 3-5 short filiform tentacles in the middle of the body. About 10 gastrodermal cells in the oral tentacles. Hypostome short and rounded. Gonophores are formed halfway between filiform and capitate tentacles, one or two per hydranth, released as free medusae. Colours: hypostome white, gastrodermis pink or orange.

Newly released medusae 0.9 mm, with a few rather large exumbrellar nematocysts in eight adradial groups, with umbilical canal, ocelli black, tentacles with spirally arranged nematocyst clusters, terminal cluster not enlarged.

Adult medusa 5-8 mm in height, diameter slightly less than height, jelly moderately thick, much thickened at apex which gives a conical shape to the upper half of the bell, interadial exumbrellar furrows shallow. Manubrium about two times as long as height of bell cavity, with a conical to rounded apical knob. The manubrium has no distinct thin serpentine part, the gonad encircles the manubrium from nearly its origin along the proximal 2/3 of its length. Four radial canals of variable breadth (perhaps not in nature), entering gastrodermal chambers of bulbs at top. Gastrodermal chamber with abaxial side concave. Tentacles about two times as long as height of bell, with spirally arranged nematocyst clusters along nearly its whole length, ending in a slightly enlarged, hollow globular cluster. Colours: apical knob and gastrodermal chambers of bulbs orange or scarlet, ocelli black.

DISTRIBUTION – Type locality only.

BIOLOGY – The polyp was found on clinker in a depth of 15-20 m.

REMARKS – The medusa of *Sarsia piriforma* is not known from the sea. During its cultivation Edwards (1983) noted that it is an inactive swimmer often resting at the bottom of the culture vessel. This suggests that in nature it may also live close to the bottom and does not inhabit the surface layers, which may explain why it has never been found in the plankton. Edwards (1983) further noted that during cultivation, the majority of the medusae died, only 1-3 of hundred and more survived. He suspected that some interaction killed them (nematocyst stings?).

The hydroid of *Sarsia piriforma* is almost indistinguishable from *Dipurena reesi*, but the latter has longer filiform tentacles. The medusa has a characteristic, thick apical jelly which distinguishes it from the similar *S. tubulosa*. In cultivated specimens, the manubrium is also shorter and the gonad-free stomach not much swollen. However, it is not known whether this also holds true for medusae from nature. The medusa of *Sarsia apicula* from the North Pacific is even more similar. *Sarsia apicula* differs from *S. piriforma* by the more pointed subumbrella. The polyps are easily separable (see table 6 and Figs 30 and 34).

Sarsia princeps (Haeckel, 1879) Fig. 35A-E

Codonium princeps Haeckel, 1879: 13, pl. 1 figs 1-2; Grönberg, 1898: 458, pl. 27 figs 1-2.

Sarsia princeps – Browne, 1903: 8, pl. 1 fig. 1, pl. 3 fig. 4; Hartlaub, 1907: 47, fig. 44; Mayer, 1910: 60, fig. 22; Sverdrup, 1921: 14, fig. 1; Kramp, 1926: 2, figs 1-5, pl. 1 figs 1-4; Kramp, 1959: 79, fig. 13; Kramp, 1961: 29; Kramp, 1968: 7, fig. 3; Naumov, 1969: 255, fig. 124, pl. 29 fig. 7; Arai & Brinckmann-Voss, 1980: 23, fig. 11; Brinckmann-Voss, 1985: 676, figs 5-9, tables 1-3.

not *Sarsia princeps* – Uchida, 1933: 126, fig. 1 [? = *S. tubulosa*].

TYPE LOCALITY – Western Greenland.

MATERIAL EXAMINED – Holotype, as *Codonium princeps*, ZMUC, loc. Greenland, leg. Fleischer, 2.10.1865, 22 mm high, Haeckel no. 12 – paratypes, ZMUC, as *Codonium princeps*, loc. Greenland, det. Haeckel, several medusae all > 1 cm – IRSNB IG27.838, 2 medusae, coll. J. Bouillon, loc. arctic, size 22-25 mm – Sooke, British Columbia, collection A. Brinckmann-Voss no. 1740, one 13 mm high male medusa, coll. 10.5.99; hydroid grown from such medusae, without medusae buds as already released, preserved 2.3.2000; 3 young medusae released from mentioned polyp colonies.

DESCRIPTION – (hydroid after Pacific material) Hydroid mostly stolonal, one times branched stems rarely present. Stolons and stems enclosed in thin, soft, wrink-

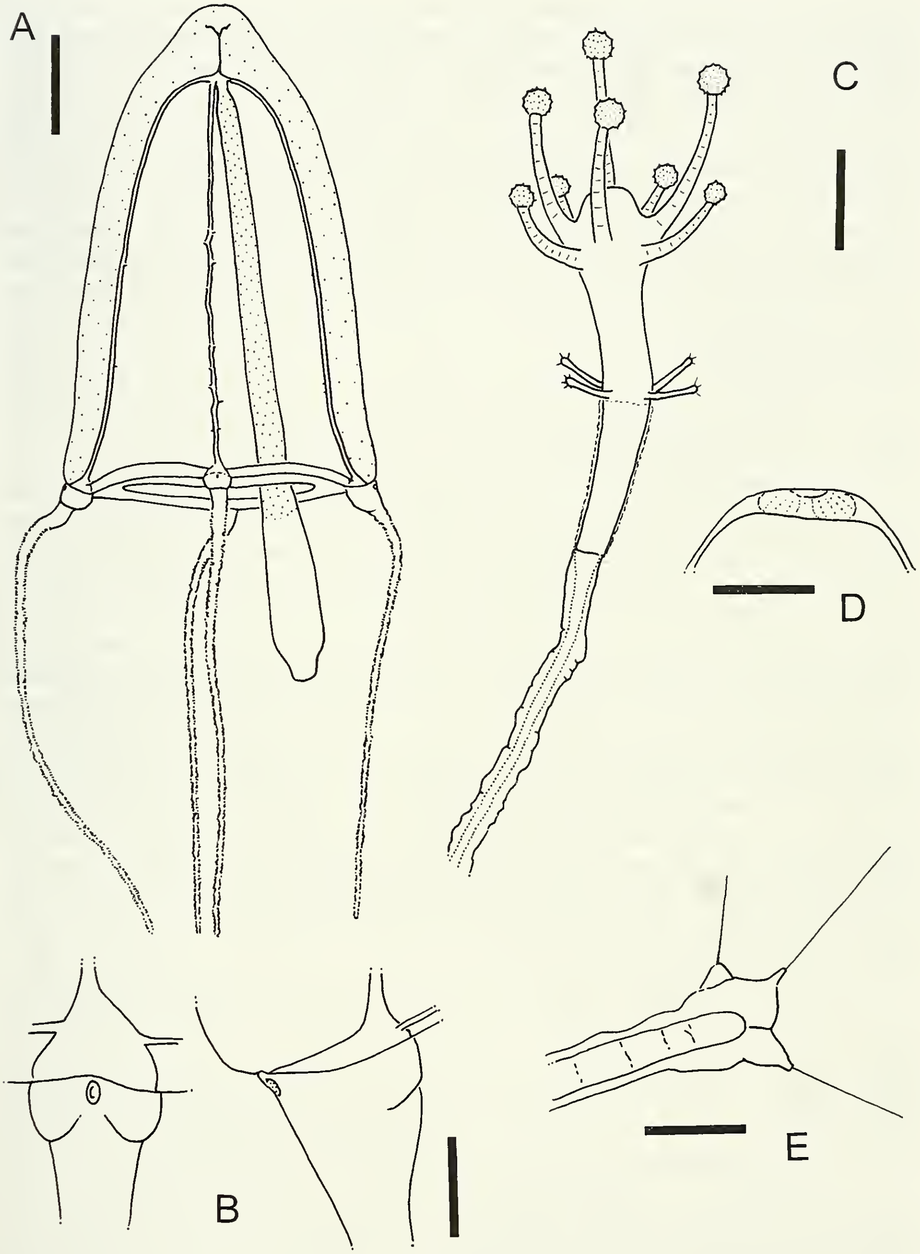

FIG. 35

Sarsia princeps (Haeckel, 1879). A) Fully grown medusa, scale bar 5 mm. B) Tentacle bulbs in frontal and side view, the oblique view makes the gastrodermal chamber in left figure appear higher than it actually is, scale bar 1 mm. C) Polyp stage, material from British Columbia, scale bar 0.2 mm. D) Hypostome of polyp in optical section, high epidermals cells are clearly present, scale bar 50 µm. E) Tip of filiform tentacles with presumed sensory cilia, scale bar 10 µm.

led perisarc, without regular annulations. Base of hydranth up to filiform tentacles enclosed in very fine, filmy perisarc, visible only in compound microscope. Hydranths 0.7-0.8 mm high, slender, club shaped, distal end swollen. With two closely set whorls of long capitate tentacles, 4 per whorl, in alternate positions, lower tentacles shorter than oral ones, all capitate tentacles taper to half the diameter towards distal. Hypostome short, with button of high epidermal cells. Below middle of hydranth one whorl of 4-5 small filiform tentacles of equal length, always present, distal end somewhat swollen and provided with long, stiff sensory cilia. Gonophores develop halfway between capitate and filiform tentacles, 1-5 per hydranth, at different levels but not in whorls. Colours: gastrodermis pink, capitulae white. Nematocysts: stenoteles, (16.5-18) x (11-12) μm and (11.5-13) x (7-9) μm; haplonemes (isorhizas?) (13-16) x (4.5-5) μm.

Gonophores are released as free medusae. Newly released medusa after Brinckmann-Voss (1985) as high as wide, about 1 mm, with eight adradial concentrations of exumbrellar cnidocysts in the lower part of the umbrella.

Adult medusa of Atlantic populations normally 15-25 mm (12-15 mm in southern regions, may reach 40 mm in high arctic waters), bell distinctly conical and about two times as high as wide, jelly quite thick, thickened at apex. Manubrium 1.5 to 2 times as long as height of bell, proximal part thin and tapering, distally swollen to stomach, but limits may be indistinct. Gonads encircle the manubrium from nearly its base to the beginning of the swollen stomach region, the thickness tapers gently towards proximal. At top of manubrium a long, thin, often branched, apical canal. Radial canals broader than circular canal, often jagged and provided with lateral diverticulae. Radial canal enters gastrodermal chamber of bulbs in its adaxial half without entering mesogloea. Tentacular bulbs large, in frontal view quite narrow compared to tentacle width, gastrodermal chamber very shallow, abaxial side straight or more often concave in side view (Fig. 35B, right). Epidermal part high, with large black ocellus. Tentacles long, contracted as long as height of medusa, tightly covered by crescent-shaped to disc shaped (more distal) nematocyst clusters. Colours: manubrium, apical canals, bulbs are light to intensively red-orange. Nematocysts: stenoteles (12-15) x (11-12) μm; desmonemes.

Biology – Brickmann-Voss (1985) found the polyp in depths of 15 to 25 m on shells and she thinks that light plays a role in the triggering of gonophore production. Kramp (1926) found the medusae in arctic waters during the summer months. The medusa ocurrs in the upper strata, often immediately below the surface. Along the Murmansk coast, medusae may also occur during wintertime. Aspects of feeding ecology of the medusa were examined by Matsakis & Conover (1991).

Distribution – A circumpolar arctic species. Southern limits in the Atlantic are the south coast of Newfoundland, Angmagssalik in eastern Greenland, Spitzbergen, Bear Island, and Kola Peninsula; in the Pacific Sea south to Sea of Okhotsk and Hokkaido, in the east Vancouver Island. Kramp (1926) and Arai & Brinckmann-Voss (1980) give more details on the distribution.

Remarks – *Sarsia princeps* is the largest medusa of the Corynidae and fully grown specimens are normally easy to identify. The orange colour, the shallow gastrodermal chamber of the bulbs, the radial canals entering near the adaxial side of the bulbs, the jagged radial canals, the long thin and often branched apical canal, and the characteristic high and pointed bell make this species distinct. The radial canals, however, may not always be jagged, and jagged radial canals may also occur in deteriorating medusae of other species like *S. tubulosa*.

Sarsia princeps is sympatric with *S. apicula* along the coast of British Columbia and it is sometimes difficult to distinguish them, in particular from preserved material. *Sarsia princeps* medusae are normally very large (up to 40 mm), but apparently get smaller (12-15 mm) towards the limits of their distribution. Vancouver Island is close to the southern limit of *S. princeps,* therefore the size of *S. princeps* there comes close to *S. apicula*. The bullet-shaped, more elongated bell, the long apical canal, and the radial canals that enter the bulbs quite adaxially and without entering the mesogloea help to distinguish *S. princeps* from *S. apicula*. Both hydroids are similar, but there are differences in size and in tentacle numbers and whorls. *Sarsia apicula* has maximally 14 capitate tentacles in three whorls, while *S. princeps* has maximally 8 in two whorls. However, it seems unwise to identify polyps from nature down to species level withouth life-cycle information. Newly released medusa of *S. apicula* have scattered nematocysts on their exumbrella, while those of *S. princeps* and *S. piriforma* have eight adradial patches on the lower part of the exumbrella.

Linko (1900) described the microscopic anatomy of the ocelli. Kramp (1926) describes the microscopical anatomy of the manubrium and found an unusual sexual dimorphism of the mesogloea.

In the specimen examined for this study, the manubrium was not clearly divided into a thin serpentine part and a distant large stomach. The thin part rather increased constantly its diameter to reach the diameter of the stomach.

The first stages of the polyp phase were already described by Naumov (see Naumov, 1969), but the complete cycle was revealed by Brinckmann-Voss (1985). Contrary to most other related species, filiform tentacles are always present in *Sarsia princeps* polyps (Brinckmann-Voss, 1985). However, life-cycle investigations on the Atlantic populations should be made to prove that the Atlantic and Pacific populations have identical polyps.

Sarsia striata Edwards, 1983 Fig. 36A-C

Sarsia striata Edwards, 1983: 54, figs 3-4.
TYPE LOCALITY – Near Oban, Argyll, Scotland.
MATERIAL EXAMINED – ZMUC, as *Sarsia tubulosa* brown variant, Dana station 2999, 10 mm high medusa, with distinctly ridged subumbrellar pockets.

DESCRIPTION – (after Edwards, 1983) Hydroid normally stolonal, occasionally branched once or twice, height up to 2-3 mm. The perisarc of stolons and stems is irregularly corrugated and translucent pale horn-coloured. Hydranths are spindle to club-shaped, up to 1.3 mm high, with one oral whorl of 4-5 capitate tentacles and one whorl of 4-5 lower tentacles in alternate positions. Near middle of hydranth one whorl of 4 short filiform tentacles, may be missing or rudimentary. Gonophores develop

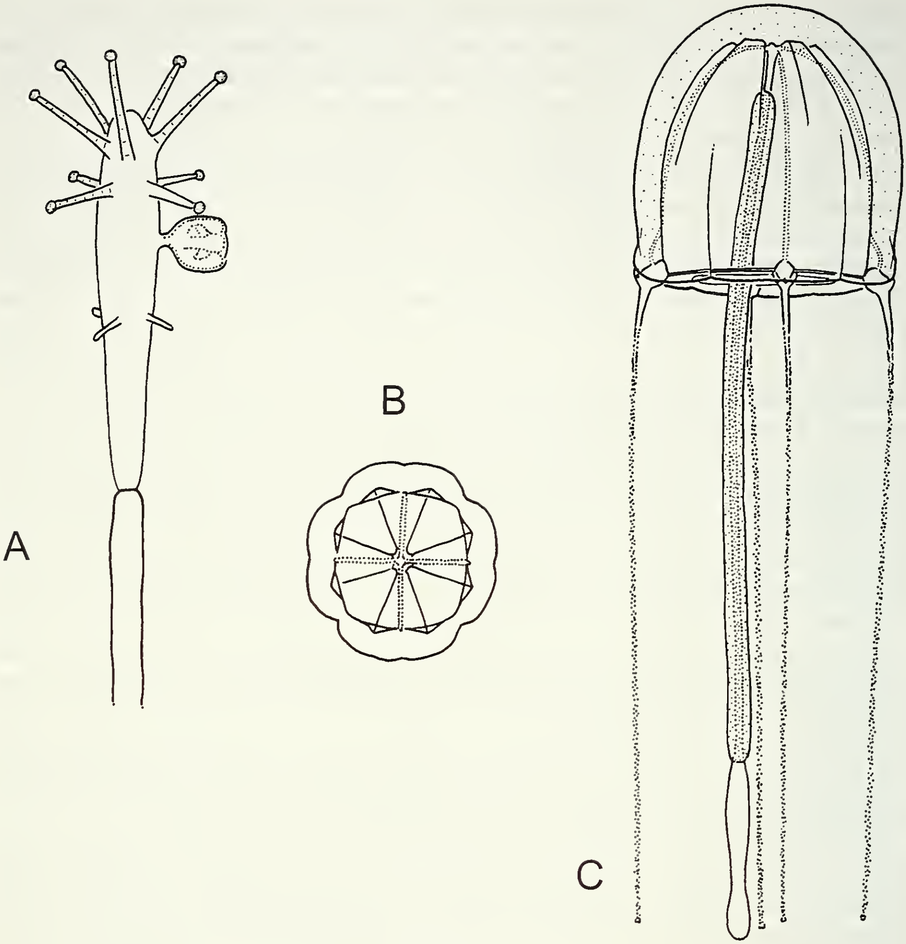

FIG. 36

Sarsia striata Edwards, 1983; modified after Edwards (1983). A) Hydranth with medusa bud. B) Bell of mature medusa seen from above. C) Mature male medusa, note the characteristic ridged subumbrellar pockets, bell height 11 mm.

halfway between capitate and filiform tentacles, 1-2 per hydranth, released as free medusae. Colours: hypostome white, gastrodermis and gonophores pink.

Newly released medusa 1.2 mm, uniformly thick jelly of moderate thickness, umbilical canal present, with few scattered nematocysts on exumbrella, black ocelli, manubrium short and base raised conically.

Adult medusa up to 11 mm in height, bell shaped, as high as broad, jelly relatively thick, more so at apex, top of bell rounded, exumbrella with deep interradial and shallower perradial furrows, subumbrella at top with interradial pockets marked with angular ridges. The velum spans about 1/2 of its radius. The manubrium can attain four times the length of the bell height, with a long and thin serpentine part and a terminal swelling functioning as stomach. The gonad encircles the serpentine part of the manubrium only, leaving uncovered only the stomach and at the base a part of the tubular section (about 1/5 of the height of the bell cavity). Manubrium often with a small apical knob. The radial canals are narrow, without glandular swellings. At maturity (not before), the radial canals pass through the mesogloea to enter the gastrodermal chambers of the bulbs at their abaxial side. Bulbs well formed, gastrodermal chamber large, epidermis with a black ocellus. Tentacles very long and hollow, leaving bulbs obliquely, thickly covered with spirally arranged clusters of nematocysts, ending in a slightly enlarged terminal hollow cluster. Gastrodermal part of bulbs and apical knob are scarlet.

DISTRIBUTION – Firth of Lorn, Scotland.

BIOLOGYY – At the type locality, the polyp was common on clinker in depths of 15-20 m. The medusa was present in the plankton from April to end of May. It is an active swimmer.

REMARKS – While the polyps are quite different – *Sarsia striata* has filiform tentacles and is much smaller – the medusae of *S. striata* closely resembles *S. tubulosa*. It is entirely possible that both have been confounded in earlier publications (e. g. by Kramp (1926; 1927), some of his material of *S. tubulosa* proved to be clearly *S. striata*, see under *S. tubulosa*). *Sarsia striata* can be distinguished from *S. tubulosa* mainly by its characteristic subumbrellar pockets with angular ridges, the thicker jelly, and the longer gonad free portion at the base of the manubrium. The ecology of the two is also slightly different. While the polyps of *S. tubulosa* occur near low water, the polyps of *S. striata* were found in depths of 15-20 m. In Scotland, the medusa of *S. tubulosa* occurred more in sheltered coastal places, while that of *S. striata* was common in more open waters.

Sarsia viridis Brinckmann-Voss, 1980 Fig. 37A-B

Sarsia viridis Brinckmann-Voss, 1980: 2, figs 1-2; Arai & Brinckmann-Voss, 1980: 29, fig. 13.
TYPE LOCALITY – Sooke Harbour, Vancouver Island, Canada, surface water.
MATERIAL EXAMINED – ROMIZ B96, paratype, Ucluelet Inlet, Vancouver Island, 25.05.1977, one medusa.

DESCRIPTION – (in part after Brinckmann-Voss, 1980) Adult medusa 5-8 mm high, maximal diameter slightly less than height, deep bell shaped, umbrella rounded. Manubrium about twice as long as bell, with conical apical chamber, manubrium divided into long and thin serpentine part and a distal swollen stomach part. Stomach part with nematocysts near mouth. Gonad on serpentine part of manubrium only, leaving the upper half of it free of gonad cover. Radial canals enter gastrodermal chamber of bulb at top, passing a short stretch through mesogloea. Gastrodermal chamber of bulb with concave or straight abaxial wall. Epidermal part of bulb relatively shallow, evenly thick, ocellus black in colour. Radial canals rather thick and clearly visible, thicker than ring canal. Tentacles with nematocyst clusters over most of their length, terminal cluster not much larger. Colours: marginal bulbs and apical knob brilliant green, manubrium paler green, umbrella slightly green. Polyp phase unknown.

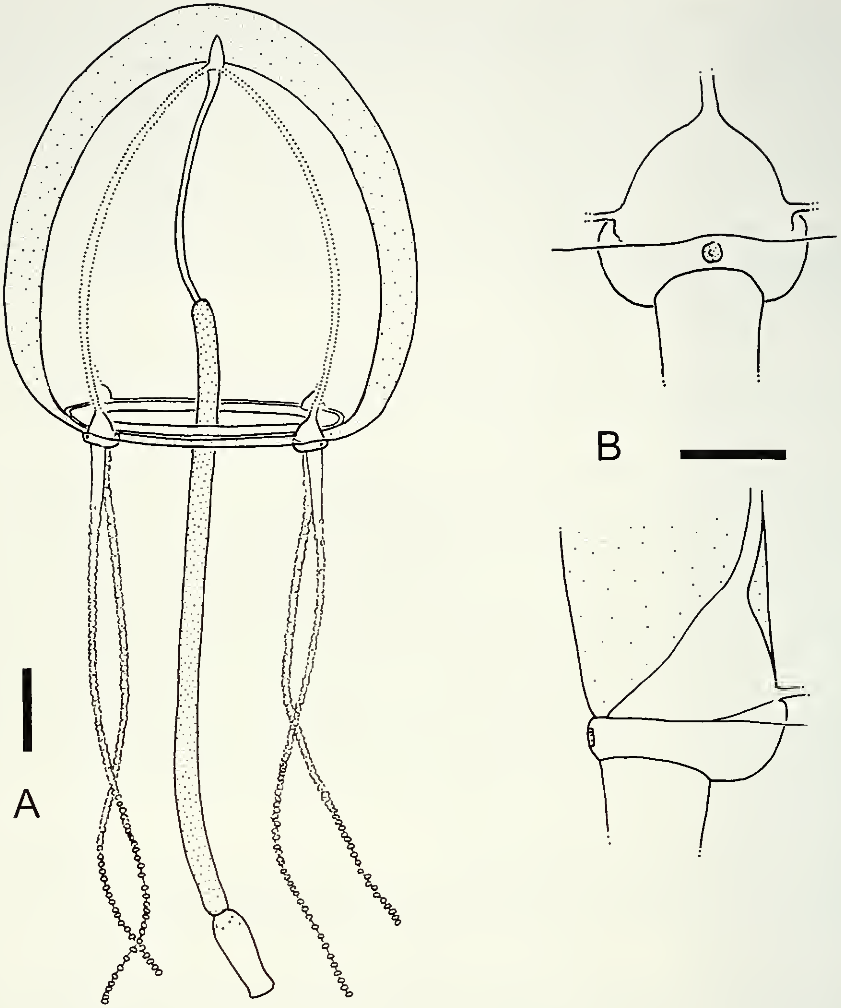

FIG. 37

Sarsia viridis Brinckmann-Voss, 1980. A) Mature medusa, the manubrium is perhaps somewhat contracted, scale bar 1 mm. B) Tentacle bulbs in lateral and frontal view, scale bar 0.2 mm.

DISTRIBUTION – British Columbia and Puget Sound, rare.

REMARKS – *Sarsia viridis* owes its name to the intense green colour of the bulbs and the apical knob. With its long gonad-free portion of the manubrium it resembles *S. bella* and *S. densa* from the North Sea. The characteristic green colour and the smaller size may help to distinguish it. More information on the life cycle of *Sarsia viridis* is needed.

5.3.2. *Sarsia* species with sessile gonophores

This group contains at present only *S. lovenii*, characterised by medusoids that remain attached to the hydroid. The inclusion of this species in the genus *Sarsia* is discussed below.

Sarsia lovenii (M. Sars, 1846) Fig. 38A-D

Syncoryne ramosa – Lovén, 1836: 275, pl. 8 figs 1-6.
Syncoryne lovenii M. Sars, 1846: 2 footnote.
[not *Syncoryne loveni* van Beneden, 1866]
Coryne gravata Wright, 1858: 33, pl. 19 fig. 5.
Syncoryne gravata – Hincks, 1868: 53, pl. 10 figs 1c-f, not e.
Coryne mirabilis – in part L. Agassiz, 1860: pl. 17 figs 10, 11, 13-16.
Syncoryne loveni – Allman, 1871: 276; Jäderholm, 1909: 8, pl. 1 fig. 7; Broch, 1916: 15, fig. A, pl. 1 fig. 2, pl. 2 fig. 13; Hartlaub, 1916: 91, figs 6-10, 12; Russell, 1953: 61, text fig. 23B, pl. 2 fig. 5.
? *Sarsia eximia* – in part Berrill, 1953: 286, figs 6B-D, 7A-C, (not others).
[*Coryne loveni* Allman, 1859]
Coryne lovenii – Naumov, 1969: 257, fig. 12; Schuchert 2001: 47, fig. 33.
Sarsia loveni – Edwards, 1978: 310, fig. 6; Petersen, 1990: 213.
TYPE LOCALITY – coast of Norway.
MATERIAL EXAMINED – IRSNB 27.838, Denmark, Middlefort Harbour, coll. P. Kramp 21.05.1915, dense, 3 x 2.5 cm colony on mussel, with mature male medusoids – ZMUC, Greenland, Godthaab, 26.06.1895, material of Broch (1916), fertile – MHNG INVE 29592, Iceland, Sandgerdi, living colonies collected 7.5.2000 by author, cultivated at 12 °C until medusoids matured (4 weeks).

DESCRIPTION – Hydroid either stolonal or irregularly branched a few times, reaching 3 cm in height. Fertile colonies can form dense mats or consist of few hydranths only. Branches arise at acute angles, mostly growing vertical and giving the stem a slender appearance (Fig. 38A). Length of branches very unequal, but mostly comparatively long. Perisarc annulated over stretches, especially at origin of branches, otherwise smooth or corrugated, not thick, yellowish colour. Perisarc terminates at base of hydranth normally without dilation, very rarely funnel-like dilation present. Hydranth 0.8-1.3 mm in length, spindle-shaped to club-shaped, hypostome large, near lower third a slight annular thickening of the epidermis or a ring of sensory cells with long, stiff cilia. With about 12-18 capitate tentacles arranged in more or less distinct whorls. One oral whorl of 4-6 tentacles, and normally two (occasionally three) additional whorls of lower tentacles, tentacle positions in each whorl alternate with the ones of adjacent whorls, tentacles of most proximal whorl often shorter than more distal ones. Oral tentacles with 8-12 gastrodemal cells, capitae spherical (diameter about 0.14 mm), nematocytes cover entire surface. No filiform tentacles, these replaced by sensory cells. Mouth encircled by button of high epidermal cells.

Gonophores arise just below lowest whorl of tentacles, mostly one per hydranth, but up to three are possible. Some hydranths are reduced with continued growth of gonophore and only a mere blastostyle may remain (reproductive exhaustion). Gonophores remain fixed as medusoids, reaching 0.8-1.0 mm in length. Gonophore much longer than broad in living material, attached by thick peduncle, jelly thin. Gonophores have four distinct radial canals, a ring canal, and four rudi-

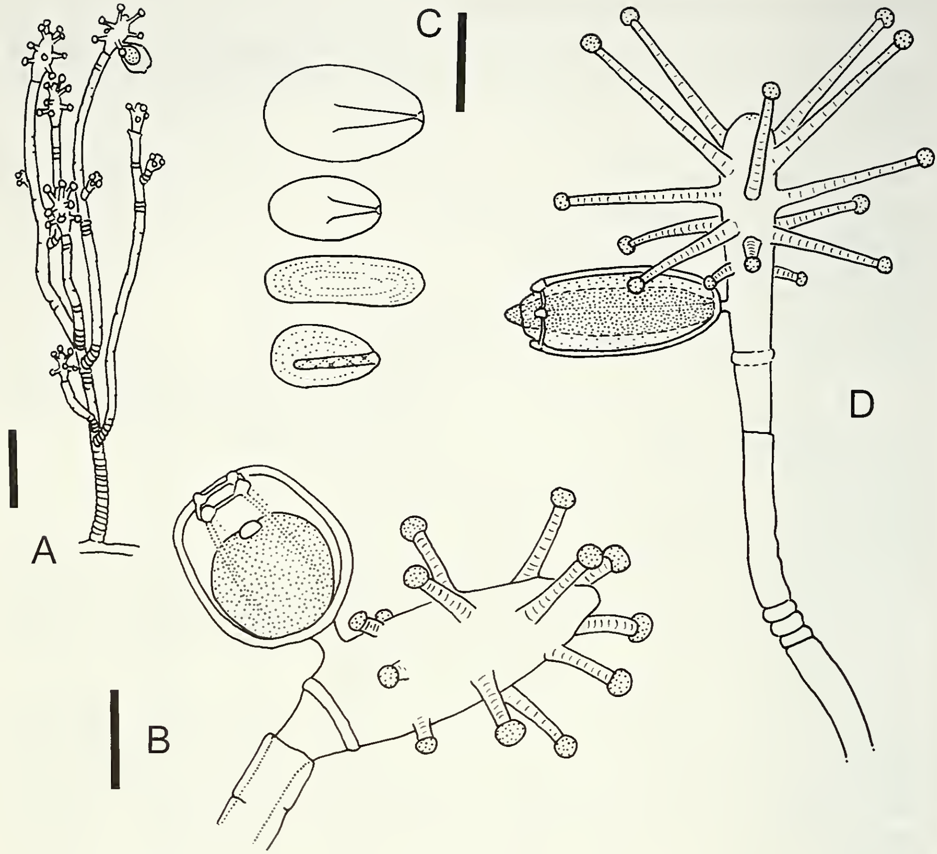

FIG. 38

Sarsia lovenii (M. Sars, 1846); A-C after preserved material from Denmark, D, after living material from Iceland. A) Single stem, scale bar 1 cm. B) Hydranth with mature medusoid, scale bar 0.5 mm. C) Cnidome: stenotele 1, stenotele 2, isorhiza, microbasic mastigophore, scale bar 10 µm. D) Hydranth with mature medusoid, note shape difference to preserved material, same scale as B.

mentary bulbs without ocelli or tentacles. Manubrium present, slightly longer than bell in living animals. Gonads voluminous, encircling manubrium completely and filling nearly bell cavity. Colours hydranth opaque white to pink, canals and manubrium of gonophores red.

Nematocysts: stenoteles, (16-17) x (10) µm and (10-11) x (6-7) µm; isorhizas, at hypostome and in marginal bulbs of gonophores, (14-16) x (5) µm, r ~ 3; microbasic mastigophores, in gonophores only, (10-12) x (6-7) µm, s < 1.

DISTRIBUTION – Cooler waters of the Atlantic (northern boreal to arctic regions). White Sea, Barents Sea, Norwegian Sea, North Sea, Great Britain, western part of Baltic Sea to Kattegat Strait, Davis Strait, Iceland, Atlantic Canada and northern New England (USA).

BIOLOGY – In aquaria with seawater kept at the temperature of circulating sea water, gonophores developed from April to June (Edwards, 1978). *Sarsia lovenii* can tolerate reduced salinity. The polyp grows on stones and other solid object, low water mark to 200 m.

REMARKS – There has been a considerable confusion of this species and others in the older literature, principally going back to Agassiz (1860). The hydroid has often been confounded with *S. tubulosa*. Hartlaub (1916) and Edwards (1978) clarified the status of this species. Edwards (1978) also added new data on behaviour, ecology and occurrence. He noted that the gonophore bell pulsates like a free medusa, although it is never released. The eggs are released into the water and develop into ciliated planulae.

I think that Berrill (1953) misidentified a colony of *S. lovenii* from Guernsey as *S. eximia*. The position of the medusoid below the tentacles as well as the shape and maturity of the medusoid clearly agree with *S. lovenii*. The two colonies from the Gulf of Maine are also not referable to *C. eximia*. One is perhaps also *S. lovenii* (figure 10 in Berrill, 1953), while the colony depicted in his figure 9 has gonophores independent of the tentacles. The identity of this species is unclear and most probably it is a so far unknown species.

The cnidome of *Sarsia lovenii* comprises also an ovoid microbasic mastigophore and an isorhiza. This makes the species quite distinct. The button of high epidermal cells around the mouth opening, the location of the gonophores below the capitate tentacles, the long manubrium, the long and tapering tentacles, and the occurrence of haplonemes associates this species with *Sarsia* or *Dipurena* (see cladogram in figure 2). It is here provisionally placed into the genus *Sarsia*. Molecular investigations must be made to find the correct genus for this species.

5.4. Genus *Nannocoryne*

TYPE SPECIES – *Nannocoryne mammylia* Bouillon & Grohmann, 1994.

DIAGNOSIS – Corynid hydroids with one oral whorl of capitate tentacles and one whorl of filiform tentacles. Gonophores absent, gametes mature in gastrodermis.

REMARKS – *Nannocoryne* has completely suppressed all gonophore development as in *Hydra* species. In Hydrozoa, gamete precursor cells develop in the gastrodermis and are then transferred and stored into the epidermal layer (a synapomorphy for the Hydrozoa, see Schuchert, 1993). In *Nannocoryne mammylia* they remain in the gastrodermis of the hydranth body, which must be interpreted that even the transfer from the epidermal layer has been abolished in this species, an altogether complete reduction of all gonophore development.

Nannocoryne mammylia Bouillon & Grohmann, 1994 Fig. 39

Nannocoryne mammylia Bouillon & Grohmann, 1994: 431, figs 1-2, pl. 1.
TYPE LOCALITY – Rio de Janeiro, Brazil, interstitial.

DESCRIPTION – Hydroid stolonal, stems including hydranths reach 1.1 mm in height, stolons and caulus covered by perisarc. Hydranths fusiform, up to 0.5 mm, with one oral whorl of four (3-5) short capitate tentacles, at lower third 4-7 filiform

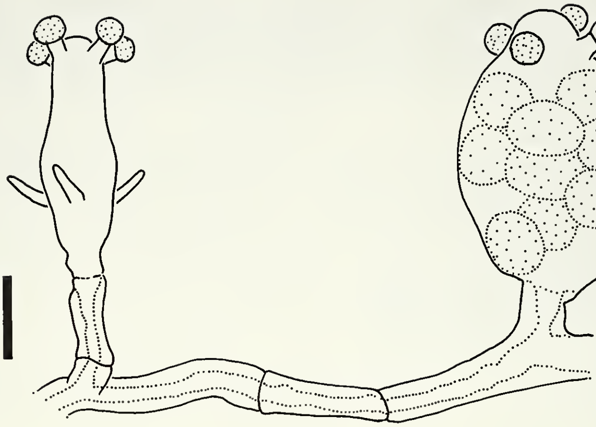

FIG. 39

Nannocoryne mammylia, figure modified after Bouillon & Grohmann (1994), scale bar 0.1 mm.

tentacles, some containing nematocysts. Gametes are formed and stored in the gastrodermis of a hydranth, only females known, with up to 13 eggs. Nematocysts: stenoteles of two sizes; perhaps also rare heteronemes.

DISTRIBUTION – Type locality.

BIOLOGY – Occurs in coarse sand.

REMARKS – The filiform tentacles of *N. mammylia* may contain some nematocysts. This is not unusual for the Corynidae. The hypostome has some slightly enlarged secretory cells, which Bouillon & Grohmann (1994) interpreted as related to the button of high gland cells in the genus *Dipurena*. These gland cells, however, are not characteristic for the genus *Dipurena* only (see phylogeny).

5.5. Genus ***Cladosarsia***

TYPE SPECIES – *Cladosarsia minima* Bouillon, 1978a.

DIAGNOSIS – Corynidae producing medusae with branched capitate tentacles.

REMARKS – Bouillon (1978a) erected the new family Cladosarsiidae to accommodate *Cladosarsia minima*. Later, Bouillon (1978b) added a new species, *C. capitata*, to this family. Both medusae closely resemble other corynid medusae except for the branched tentacles. In his phylogenetic analysis Petersen (1990) included *Cladosarsia* in the Corynidae due to the following synapomorphies: (i) tentacular bulbs with large gastrodermal chamber, (ii) nearly complete ring of thickened epidermis studded with nematocysts. Petersen even went further and synonymised *Cladosarsia* with *Dipurena*. In view of the lack of knowledge on the polyp phase and the few *Cladosarsia* specimens examined so far, this synonymisation with *Dipurena* appears premature. However, Petersen (1990) is followed here in including the genus in the Corynidae. Future life cycle investigations have to confirm this. Perhaps *Zanclea indica* Mammen, 1963 belongs to this genus. *Zanclea indica* is at present not recognisable and might as well belong to the Corynidae. Its medusae with tentacles having a large terminal cluster is certainly more compatible with a member of the Corynidae than with a *Zanclea* species (see also Boero *et al.*, 2000).

Cladosarsia capitata Bouillon, 1978b Fig. 40

Cladosarsia capitata Bouillon, 1978b: 253, figs 2-3.
TYPE LOCALITY – Laing Island, Papua New Guinea.
MATERIAL EXAMINED – holotype, ZMUC, Dec. 1976, leg. & det. J. Bouillon, well preserved – paratypes, IRSNB IG 27.838, Papua New Guinea, Laing Island, coll. J. Bouillon 1976-1983, two jars with 4 medusae in total, not well preserved.

DESCRIPTION – Medusa small, 0.5-1 mm, bell nearly globular, jelly moderately thick, thicker at top. Manubrium in fully grown medusae about 1.5 times as long as bell, cylindrical, with shallow apical knob. Gonads thick, restricted to distal half of manubrium and encircling it completely. Proximal portion of manubrium thin. Mouth simple, circular, hardly visible in fully mature individuals. Gonad maturation apparently starts before the manubrium has developed its full length, thus when still shorter than bell cavity. Four radial canals, ending in large tentacle bulbs. Gastrodermal chamber of bulbs high and large, epidermal ring complete and with a distinct ocellus. Each bulb with one slender tentacle, length extended about 1.5 times the size of the bell, distal end with up to 5 short branches in one row, each ending in a spherical nematocyst cluster like at end of main tentacle. Side branches becoming shorter towards proximal so that most proximal clusters are nearly sessile. Juvenile medusae have only nearly sessile capitae. Tentacles except for the capitations with few nematocysts. Colours: ocelli red or brown. Nematocysts: stenoteles and desmonemes.

DISTRIBUTION – Type locality only.

REMARKS – A small but distinctive medusa. For the distinction from *Cladosarsia minima* see below.

Cladosarsia minima Bouillon, 1978a Fig. 41

Cladosarsia minima Bouillon, 1978a: 135, fig. 4.
TYPE LOCALITY – Seychelles, Indian Ocean.

DESCRIPTION – (after Bouillon, 1978a) Medusa small (0.4 mm high, 0.5 mm diameter, tentacles 0.3 mm), bell nearly globular, with small apical process. Velum very broad. Manubrium cylindric, length about half the height of the bell cavity, mouth simple, circular. Gonads encircle the whole manubrium without interruptions. Four radial canals ending in four large tentacle bulbs. Gastrodermal chamber of bulbs higher than wide, epidermal ring complete, adaxial side thickened and studded with nematocysts, at abaxial side a red ocellus. Four tentacles, conical, distal end branched once and each end with a spherical nematocyst cluster, proximal to the branching point there is a further, sessile spherical cluster and the proximal half of the tentacle is covered by nematocysts.

DISTRIBUTION – Type locality only.

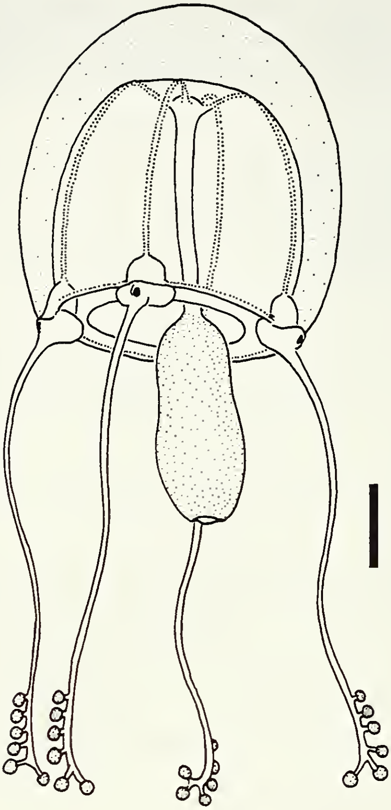

FIG. 40

Cladosarsia capitata Bouillon, 1978b, adult medusa, modified after Bouillon (1978b), scale bar 0.25 mm.

REMARKS – *Cladosarsia minima* is known from one specimen only. Petersen (1990) hypothesized that *C. minima* is nothing but a younger *C. capitata*. While subadult *C. capitata* indeed have a short manubrium like *C. minima*, the latter differs from *C. capitata* in having a differently shaped bell and in having the proximal part of the tentacles covered by nematocysts. However, more material and information is clearly needed.

5.6. Genus *Bicorona*

TYPE SPECIES – *Bicorona elegans* Millard, 1966.

DIAGNOSIS – Corynidae forming large, branching colonies. Hydranth body vasiform, all tentacles capitate, with one oral whorl of four tentacles and one basal whorl of seven or more tentacles. With or without one whorl of four tentacles between distal and proximal whorl. Gonophores fixed sporosacs developing above aboral whorl of tentacles. Nematocysts: stenoteles only.

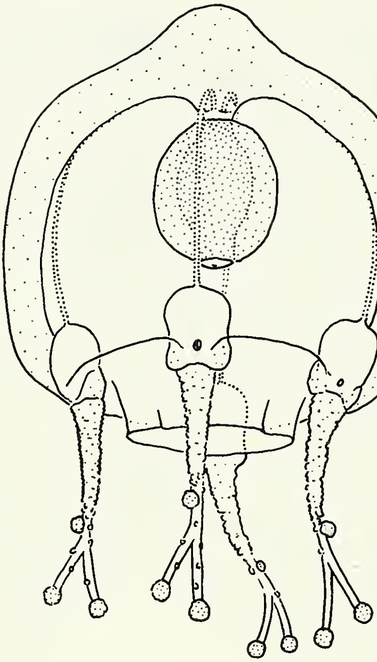

FIG. 41
Cladosarsia minima Bouillon, 1978a, medusa, modified after Bouillon (1978a), bell diameter about 0.5 mm.

REMARKS – The genus is here redefined to accommodate *Coryne tricycla* Schuchert, 1996. Millard (1966) proposed the new genus *Bicorona* for her species *Bicorona elegans*. She thought this necessary as the hydranths of *B. elegans* differ somewhat from all other Corynidae: the body is somewhat vase-shaped and the tentacles are in two clearly separate sets. The hydranth thus attains some resemblance to the ones of the genus *Pennaria*. However, the simple cnidome composed only of stenoteles precludes any affinity with *Pennaria*. The gap between *Bicorona* and *Coryne* was somewhat filled by the discovery of *Coryne tricycla*. *Coryne tricycla* resembles *C. elegans* in having a vasiform hydranth body and an aboral whorl of capitate tentacle having more than the usual four tentacles. Both species also form large colonies, have a completely annulated perisarc, both have the base of their hydranths covered by a gelatinous funnel of perisarc, and both occur in the intertidal region of the southern hemisphere. Also their overall appearance (*habitus*) is quite similar. In contradistinction to *B. elegans*, *B. tricycla* has an additional whorl of tentacles, which is, however, formed quite late in development, even after the onset of gonophore development. Another important difference is found in the site of gonophore production: while it is in the upper axils of the tentacles in *B. elegans*, the sporosacs of *B. tricycla* develop independently from the tentacles. I regard the development of the sporosacs in the upper axils in *B. elegans* and in some *Coryne* species as a homoplasy.

Although the combination *Bicorona tricycla* is somewhat of an oxymoron, the undeniable shared apomorphies of vasiform hydranth and increased number of tentacles in the most proximal whorl prompted me to unite *Bicorona elegans* and *Coryne tricycla* in a common genus.

Petersen (1990) synonymised *Bicorona* Millard, 1966 with *Dicyclocoryne* Annandale, 1915 based on the argument that the degree of gonophore reduction cannot be used to distinguish genera. In view of the scant knowledge of the type species of the genus *Dicyclocoryne* and the notable differences of the polyp stages both species are here kept separate. *Bicorona elegans* forms large, much branched colonies and develops its sporosacs above the aboral whorls, while *Dicyclocoryne* is mostly stolonal, liberates medusae which originate below the most proximal tentacles of the polyp. Any speculations concerning on the phylogenetic relationship of *Bicorona* and *Dicyclocoryne* are better postponed until more details of *D. filamentata* – especially the cnidome – become known. Petersen (1979) also placed *Dicyclocoryne* including *Bicorona* in a separate family. The discovery of *Bicorona tricycla*, however, made it difficult to draw a clear separation line between the Corynidae and the Dicyclocorynidae. The high gastrodermal chamber of the tentacle bulbs of *Dicyclocoryne* strongly suggests that this is also a member of the Corynidae. Until additional evidence to the contrary is forthcoming, I continue to regard *Bicorona* and *Dicyclocoryne* as members of the Corynidae.

Bicorona elegans Millard, 1966 Fig. 42

Bicorona elegans Millard, 1966: 441, fig. 3; Millard, 1975: 49, frontispiece, fig. 19A-E.
Dicyclocoryne elegans – Petersen, 1990: 204.
Type locality – Saldanha Bay, South Africa.

Description – (after Millard, 1975) Hydroid reaching 58 mm in height, stem monosiphonic, monopodial, one main stem with long side branches that can be branched again, all endings bearing hydranths. Perisarc closely annulated throughout except for a smooth area at the base of each branch. Perisarc terminates as a gelatinous, compact funnel covering base of hydranth. Hydranths 1-2 mm in length, vasiform, with one oral whorl of 4-7 capitate tentacles and one aboral whorl of 10-21 capitate tentacles in middle of hydranth. Aboral tentacles longer than oral ones, held alternately elevated and depressed in life, usually shorter and longer ones alternating. Oral tentacles held erect. Aboral set of tentacles of young hydranths in up to three alternating whorls. Gonophores on seven short blastostyles in the upper axils of the aboral tentacles. Each blastostyle unites 2-4 gonophores. Gonophores develop into fixed sporosacs. Sporosacs oval to oblong. without radial or circular canals, females 0.4 mm in diameter and containing 29-84 small eggs, males 0.6 mm. Nematocysts: stenoteles, (13.5) x (7) μmn and (26) x (17) μm. Egg size 0.05-0.10 mm. Colours: dark red ("plum-colour" after Millard).

Distribution – Endemic to South Africa.

Biology – Grows at lower intertidal level, stems embedded in sponges.

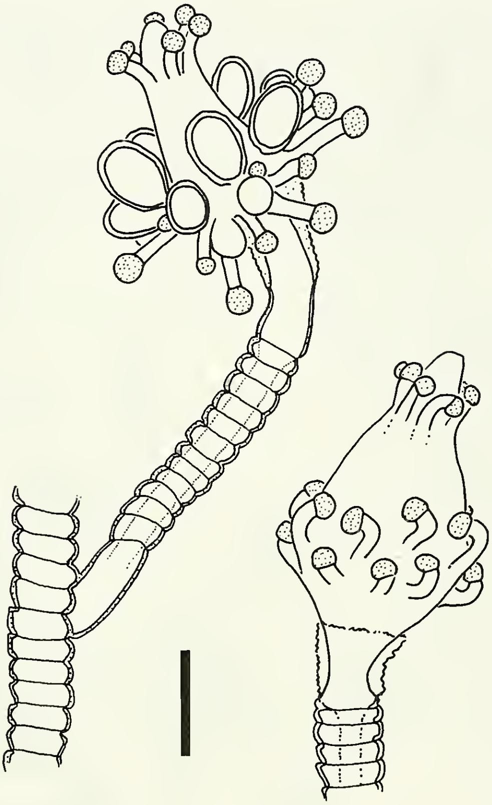

FIG. 42

Bicorona elegans (Millard, 1966), part of colony with hydranth bearing sporosacs, and infertile hydranth with two aboral tentacle whorls, scale bar 0.5 mm, modified after Millard (1966).

Bicorona tricycla (Schuchert, 1996) **comb. nov.** Fig. 43A-D

Coryne vaginata – Ralph, 1953: 66, fig. 13; misidentification.
Coryne tricycla Schuchert, 1996: 120, fig. 73a-d.
TYPE LOCALITY – North-east of Te Raekaihau, Lyall Bay, Wellington, New Zealand, intertidal.

DESCRIPTION – Colonies arising from creeping, ramified stolons. Stems up to 45 mm high and with up to 30 hydranths. With monopodial growth and branching in all planes. Perisarc soft and elastic, sharply annulated throughout. At base of hydranths the perisarc dilates to a thick, gelatinous funnel into which hydranth is unable to retract. Hydranths up to 2 mm long (free part), cylindrical to slightly pear shaped; with one oral whorl of 4 short, adnate capitate tentacles, one median whorl of four capitate tentacles in alternate positions to oral tentacles, and one aboral (proximal) whorl of eight capitate tentacles. These 8 tentacles all originate at the same level from a slightly thickened region of the hydranth body. They are all held in the same plane. The median whorl is either exactly in the middle of the body or closer too

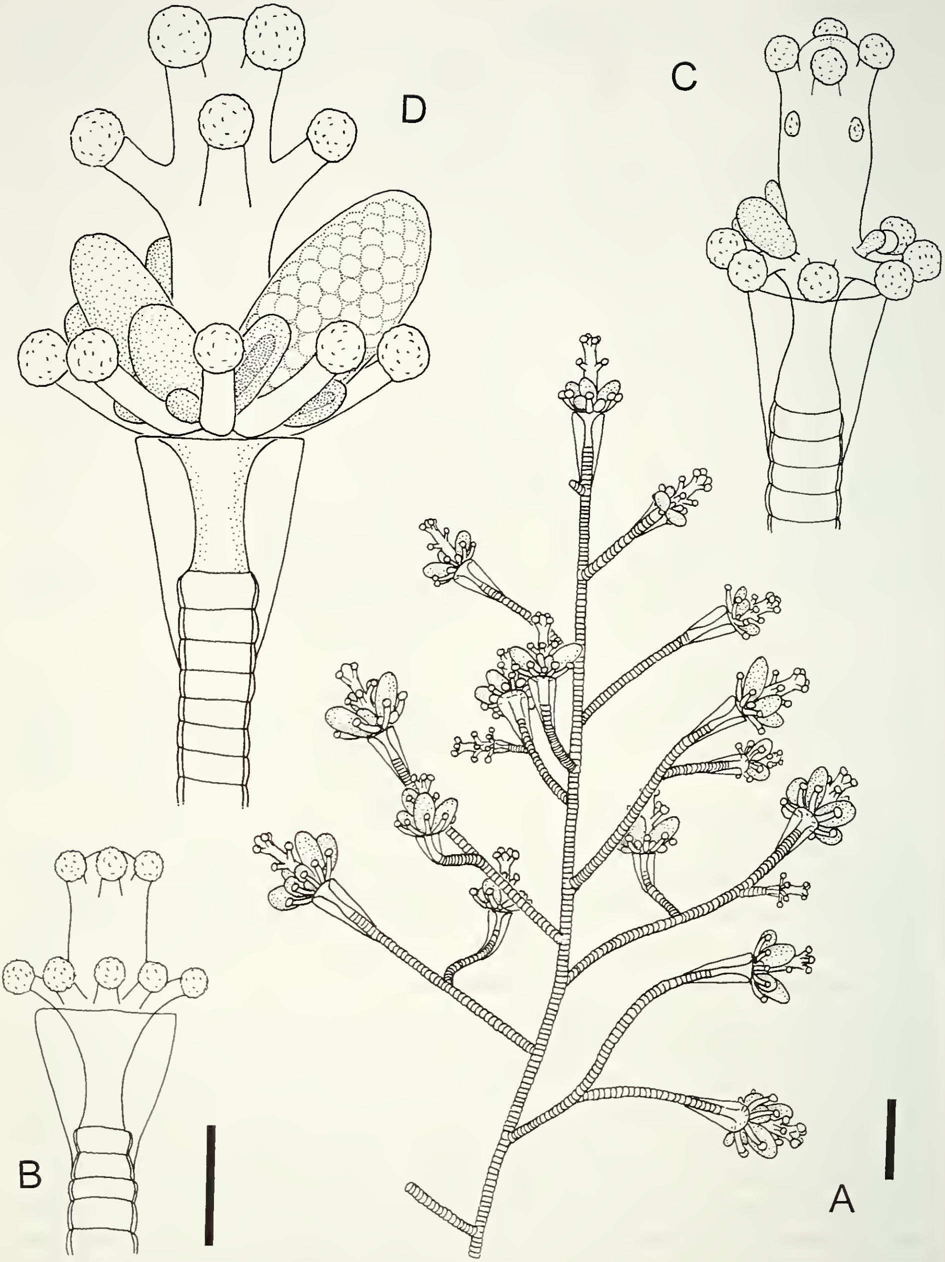

FIG. 43

Bicorona tricycla (Schuchert, 1996); drawn after living holotype. A) Colony, scale bar 2 mm. B) Young hydranth with two whorls of tentacles, scale bar 0.5 mm. C) Hydranth with beginning gonophore development, same scale as B. D) Fully mature hydranth with ripe sporosacs, same scale as B.

the oral whorl of tentacles. Median whorl of tentacles develop last, even after onset of gonophore development. Gonophores arise just above the aboral whorl of tentacles and alternate in position with these. There are up to 3 gonophores per position, all in various stages of development. The mature female gonophores are oblong and remain fixed as sporosacs with up to 100 eggs; a spadix is present but radial or circular canals are absent. Male gonophores unknown. Nematocysts: Only stenoteles of very variable size, (19-36) x (9-22)mm. Colour: brown, especially gonophores. Stem diameter 0.20-0.23 mm, gonophores up to 1 mm long, size of spawned eggs 114 µm (s. dev. = 6 µm, n=6).

Biology – Occurs on rock and macroalgae at low waterline.

Distribution – Wellington and Makara Beach, New Zealand.

5.7. Genus *Dicyclocoryne*

Type species – *Dicyclocoryne filamentata* (Annandale, 1907).

Diagnosis – Hydroid colonial, hydranth with one oral whorl of four capitate tentacles and one aboral whorl of six capitate tentacles. Gonophores borne below aboral tentacles. Gonophores released as medusae. Medusae known only as newly liberated. Umbrella evenly rounded, manubrium stout, shorter than subumbrellar cavity, simple circular mouth, four tentacle bulbs with epidermal ring and ovoid gastrodermal chamber. Four short tentacles. Ocelli not present.

Remarks – Complete life-cycle information of *Dicyclocoryne filamentata* and knowledge of its cnidome is needed before the affinities of this genus can be discussed any further. See also the remarks under genus *Bicorona*.

Dicyclocoryne filamentata (Annandale, 1907) Fig. 44A-C

Syncoryne filamentata Annandale, 1907: 139, figs 1-2.
Dicyclocoryne filamentata – Annandale, 1915: 110, pl. 9 fig. 4a-c.
Type locality – Port Canning, Lower Bengal, in brackish water.

Description – (after Annandale, 1907 and 1915) Hydroid stolonal or occasionally branching. Hydrorhiza branching sparingly, not anastomosing, often not adhering and drawn into long filamentous processes with clubbed terminal endings. Pedicels of hydranths smooth or slightly corrugated. Hydranths about 1.5-2.5 mm high, spindle-shaped, with one oral whorl of 4 capitate tentacles and one whorl of up to 6 capitate in the middle of the hydranth. The gonophores develop at the bases or distinctly below the aboral whorl of tentacles, 6 or more per hydranth. Gonophores are released as free, immature medusae. Colour: white. Nematocysts unknown.

Newly released medusa bell-shaped, slightly deeper than broad, diameter 0.4 mm, exumbrella covered by minute tubercules (nematocysts ?). Manubrium shorter than bell cavity, cylindrical. Four radial canals and ring canal present. Radial canals end in prominent tentacle bulbs. Gastrodermal chamber ovoid, entrance of radial canal at top. Epidermal ring of bulb complete, studded with nematocysts, below this ring another ring with nematocysts. Four tentacles, short, shorter than bell height. With a large, globular, terminal nematocyst cluster.

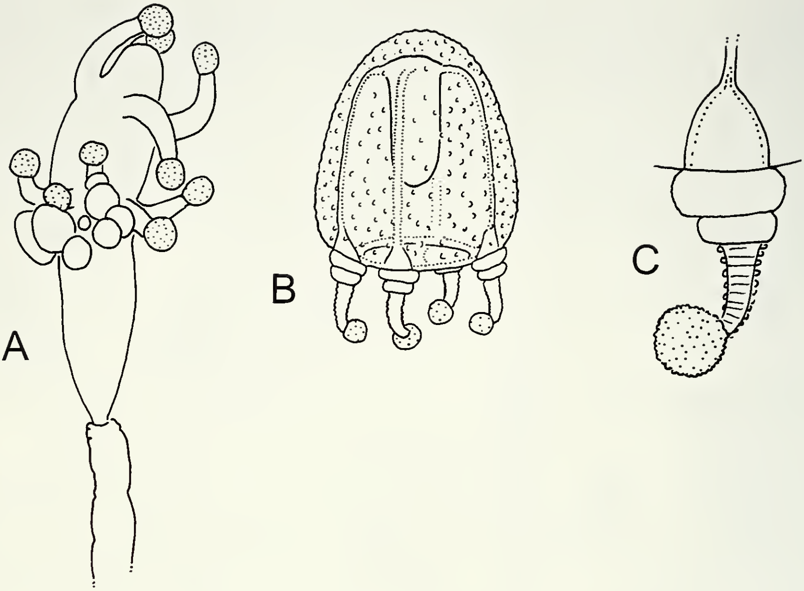

FIG. 44
Dicyclocoryne filamenata (Annandale, 1907), modified after Annandale (1915). A) Hydroid with medusae buds. B) Newly released medusa. C) Tentacle and bulb.

DISTRIBUTION – *Dicyclocoryne filamentata* has only been found in brackish waters of the Ganges delta.

REMARKS – Although the hydroid is distinctive and recognisable, *Dicyclocoryne filamentata* is insufficiently known as only the newly released medusa is known. Furthermore, we do not have any information on the cnidome of this species. The spherical terminal nematocyst clusters of the medusa tentacles suggest some relation to certain *Dipurena* or *Cladosarsia s*pecies. The absence of ocelli in the newly released medusae does not mean that they are also absent in the adult. Other Corynidae, e. g. *Coryne nipponica*, are sometimes also released with underdeveloped ocelli.

5.8. **Problematic or indeterminable species**

REMARKS – This section lists Corynidae, or species once associated with this family, that are either unrecognisable or so imperfectly known that their systematic position remains disputable.

The following species could not be traced to the original source, but were already considered indeterminable or invalid by Allman (1871): *Coryne ramosa* Chamisso & Eysenhardt, 1821 (=*Syncoryne chamissonisi* Ehrenberg, 1832), *Coryne prolificata* (Bosc, 1797), *Coryne amphorata* (Bosc, 1797), *Coryne filifera* (Bosc, 1797).

Coryne angulata (Mayer, 1900)

Syndictyon angulatum Mayer, 1900a: 5, fig. 6-8, pl. 3.
Sarsia angulata – Mayer, 1910: 60, pl. 5 fig. 1, pl. 6 fig. 3; Kramp, 1959: 80, fig. 17; Kramp, 1961: 25.
Type locality – Bahamas.
Material examined – USNM 57718, USNM7712, USNM 57713, USNM 57965, all Carrie Bow Cay, Belize, collected R. J. Larson, March-April 1978, many mature medusae.

Diagnosis – Medusa 3 mm high, half-egg-shaped, moderately thick walls. Manubrium spindle-shaped, without apical chamber, 2/3 as long as bell cavity, gonads from base almost to the mouth. Slender tentacles with fairly thick, spindle-shaped ends (Kramp, 1961). Polyp unknown.

Distribution – Bahamas; Florida.

Remarks –According to Kramp (1959a), the diagnostic traits of this medusa are the thickened distal ends of the tentacles. In the figure given, however, this thickening looks just like normal contracted tentacles and nothing distinguishes this medusa from *C. eximia*. Because life-cycle studies might nevertheless prove the existence of a distinct polyp phase at the type locality, the name is here retained. Additionally, its tropical occurrence argues in favour of it being different from *C. eximia,* which is clearly a species of temperate waters. Perhaps the hydroid depicted by Berrill (1953: 281, fig 3) is the polyp phase of this species. Berrill (1953) noted that it is common along the coast of Florida and perhaps also Deevey's (1950) *S. eximia* could belong to here.

Medusae allocated to this species originating from Belize and held by the USNM could be examined for this study. The material is in no way distinguishable from *C. eximia.*

Coryne brachygaster (Grönberg, 1898)

Sarsia brachygaster Grönberg, 1898: 459, pl. 27, figs 3-4, (not material from Greenland); Hartlaub, 1907: 11, fig. 3; Kramp, 1926: 20; Kramp, 1959: 207, fig. 18; Kramp, 1961: 26.
Type locality – Danes Gat, Spitzbergen, North Atlantic.

Description – Medusa bell 15-18 mm high, 8-10 mm wide. Manubrium 2/3 as long as bell cavity, cylindrical, without apical chamber, completely encircled by gonad. Tentacle bulbs of medium size, ocelli very small. Polyp unknown.

Distribution – Spitzbergen, West Greenland.

Remarks – Kramp (1926) re-examined Grönberg's material from Greenland and found it was *Euphysea flammea.* The figures of *Sarsia brachygaster* as given by Grönberg (1898) resemble closely *Coryne eximia*, except for their size. Although Kramp regarded the species as doubtful, its size might well make it recognisable. The species should be re-described from new material collected at the type locality.

Coryne brevicornis Bonnevie, 1898

Coryne brevicornis Bonnevie, 1898b: 3-4, pl. 1 figs 2 & 2a; Rees, 1956: 111.
Type locality – Hammerfest, Norway, 100-200 m.

Description – (after Bonnevie, 1898b) Colonies reaching 10 mm in height, branched, perisarc without distinct annulation. Tentacles scattered, gonophores arise among tentacles, with very long pedicels, without radial canals.

Remarks – Rees (1956) re-examined type material of this species and thought it to be conspecific with *C. hincksii*. Because he might have been wrong concerning the radial canals of the latter species (see above) this synonymy must be doubted. *Coryne brevicornis* is an inadequately known species, the only special character being the long pedicels of the gonophores. It has close affinities with *C. pusilla*.

Coryne brevis Stechow, 1923

Corynidae species A Hickson & Gravely, 1907: 15.
Clavatella juv. Ritchie, 1913: 13, fig. 1.
Coryne brevis Stechow, 1923a: 1; Stechow, 1923b: 42.
Type locality – McMurdo Bay, Antarctica, 36 m.

Remarks – The single corynid hydranth of Hickson & Gravely (1907) was clearly insufficient to be identified and they wisely enough did not name it. However, Stechow (1923a) did so and included also another corynid described by Ritchie (1913) in it. Ritchie considered his single, juvenile hydranth so ill defined that he also refrained from naming it.

Coryne caespes Allman, 1871

Coryne caespes Allman, 1871: 270; Brinckmann-Voss, 1970: 47.
Type locality – La Spezia, Italy, Mediterranean.

Description – (after Allman, 1871) Colonies mostly stolonal or occasionally sparingly branched, reaching a height of 6 mm. Stolons a creeping, entangled mass of tortuous tubes. Cauli and stems densely aggregated. Perisarc irregularly annulated. Hydranth elongated and with about 25 tentacles. Gonophores globular, scattered on the lower portion of the hydranth body, where they spring by short peduncles from the axils of the tentacles. Gonophores develop in March.

Distribution – Type locality only.

Biology – Grows on rocks among *Cystoseira*, 0.6 m.

Remarks – Allman (1871) regarded this species as distinct on account of its dense, crowded, moss-like growth. He states that the colonies "spread like a turf for many square miles (sic!) over the submerged rocks". This seems quite unrealistic to me and may be a typographic error. *Coryne caespes* has never been found again and could belong to *Coryne pintneri* or *C. muscoides*.

Coryne coccometra (Bigelow, 1909)

Sarsia coccometra Bigelow, 1909: 179, pl. 7 fig. 8, pl. 40 fig. 1, pl. 43 fig. 8-9; Mayer, 1910: 488; Kramp, 1968: 7, fig. 5; Kramp, 1961: 26.
Type locality – Pacific Ocean, near Coiba Island, Panama.
Material examined – USNM 59195, 00°17.5'S 081°53'W, 202 m, 8.02.1967; one damaged, contracted, mature medusa – USNM 59216, 03°52'N 085°57W, 180 m, 19.03.1967, one very damaged medusa without manubrium.

Description – Medusa 5 mm high, 4 mm wide; thin walls, with apical projection of variable size; with apical canal. Manubrium as long as bell cavity, (?) entirely encircled by gonad, gonad fills subumbrella, eggs very large. Tentacles ringed with prominent nematocyst rings, distal end swollen, knob-like; bulbs large, with ocelli (Kramp, 1961).

Remarks – This is certainly a valid species, but with its apical projection *Sarsia coccometra* is unlike any other *Sarsia* species. Bigelow (1909: pl. 40 fig. 9) depicts the manubrium with deep perradial clefts, although he insists that the gonads are not interrupted perradially which he confirmed by horizontal sections. He interpreted the clefts as folds due to contractions. Despite this, it is very likely that *S. coccometra* is actually referable to the family *Sphaerocorynidae*, as postulated by Petersen (1990: 213). However, until this assertion can be proved by life observations or life-cycle information, it is here kept provisionally in the Corynidae.

The material available for this study clearly agreed with the given description and figures of this species. However, its state of preservation did not allow an examination to determine whether the gonads are partitioned, which would be clear sign that they belong to the Sphaerocorynidae. The nematocysts found were stenoteles and desmonemes.

Distribution – Pacific Coast of Central America (Bigelow, 1909), Ecuador (this study).

Coryne conferta Allman, 1876

Coryne conferta Allman, 1876: 115; Allman, 1879: 285, pl. 18 fig. 1-3; Vanhöffen, 1910: 274, fig. 1; Millard, 1971: 401.
Type locality – Observatory Bay, Kerguelen Island, at lower intertidal level.

Distribution – Kerguelen Island, Marion Island, Tierra del Fuego.

Biology – Occurs on mussels and stones.

Remarks – No gonophores have ever been described for this species. It is therefore not sufficiently well described and is at present not distinguishable from *Coryne pusilla* or *Coryne eximia*. Vanhöffen (1910) described infertile *Coryne conferta* colonies from close to the type locality and also fertile colonies of *Coryne pusilla* on floating *Fucus*. However, his concept of both species was based on characters today seen as unreliable (annulation, colony size). Only new investigations at the type locality can bring us more clarity.

Coryne conica (Haeckel, 1880)

Codonium conicum Haeckel, 1880: 634.
Sarsia conica – Kramp, 1961: 27.
Type locality – Indian Ocean.

Remarks – This species was described by Haeckel (1880) from its medusa phase only and no pictures are available. It might be difficult to recognize this species. The mature medusa is 12 mm high, 4 mm wide, manubrium half as long as bell cavity, with long apical canal.

Coryne corrugata Fraser, 1925

Coryne corrugata Fraser, 1925: 167, fig. 1; Fraser, 1937: 27, pl. 2 fig. 9.
Coryne corrigata – Berrill, 1953: 297, fig. 12 [misspelling].
TYPE LOCALITY – near jetty, San Diego, California, USA.

DESCRIPTION – (after Fraser, 1937) 3.5 cm high colonies, much branched, branches coming off with a definite knee-joint at a very acute angle with stem, secondary branches arise in the same manner from the primary branches; many of these secondary branches, while terminating in a hydranth, give off numerous branchlets that have no hydranths; perisarc thick, with deep annulations or corrugations throughout the whole stem and branches; hydranths capable of great extension and usually appearing long and slender, 20-30 scattered tentacles.

DISTRIBUTION – Type locality only.

REMARKS – The gonophores of *Coryne corrugata* are unknown and the species is therefore not recognisable. The branchlets mentioned by Fraser (1937) recall the brachioles of *C. brachiata*. The syntype material in the Royal British Columbia Museum (Victoria, Canada) has dried out (M. Arai, pers. com.).

Berrill (1953) in a paper describing growth and form of corynid hydroids mentions two *Coryne* species. At least one of them (Berrill, 1953, fig. 12) was from the Pacific coast and he identified it with *C. corrugata* Fraser. The outgrowths on the upper end of the hydranth pedicels clearly match Fraser's (1937) description and Berrill's identification appears correct. Berrill also shows fertile *Coryne* hydranths (figure 13) which are in no way distinguishable from *C. pusilla*. Because Berrill (1953) speaks of two *Coryne* species and because he repeatedly lumped species in this paper, it is highly probable that the fertile hydranths shown in his figure 12 are not identical with the material shown in his figure 13.

Coryne cylindrica (Kirkpatrick, 1890)

Coryne vel *Syncoryne Cylindrica* Kirkpatrick, 1890: 605, pl. 14 fig. 1
TYPE LOCALITY – Albany Pass, Sommerset, North Queensland, 15 m.

DESCRIPTION – (after Kirkpatrick, 1890) Stolons and hydranths partially embedded in bryozoan host, hydranths in the angles between bryozoan zooids, hydranths sessile, about 4 mm in height, about 15 tentacles, clustered in the upper half of the hydranth, sub-sessile.

DISTRIBUTION – Type locality only.

BIOLOGY – Occurs on *Celleporaria granulosa* (Haswell) (Bryozoa).

REMARKS – The gonophores of this species are unknown. The intimate association of this hydroid with its bryozoan host suggests that it is actually a member of the family Zancleidae. There are numerous species of this family tightly associated with bryozoans, while this so far unknown for the Corynidae (see Boero, Bouillon, and Gravili, 2000).

Coryne dubia Ritchie, 1907

Coryne (?) *dubium* Ritchie, 1907: 491, pl. 23, fig. 1-2.
TYPE LOCALITY – on seaweed taken from piles of pier, Porto Praya, Santiago, Cape Verde Islands.

Description – (after Ritchie, 1907) Small irregularly ramified colonies, 7 mm, ramification to fourth order, transparent brown perisarc, branches arise at narrow angles, nearly parallel to sister branches. Perisarc wrinkled or annulated throughout, no funnel-shaped dilation at end of branch. Hydranth 0.5 mm, 12-15 scattered tentacles.

Distribution – Type locality only.

Substrates – Red algae.

Remarks – As the gonophores are unknown for this species it remains unrecognisable. It could well belong to *Coryne pusilla* or *Coryne eximia*, as both species can be expected to occur at the Cape Verde Islands.

Coryne ferox Wright, 1867

Coryne ferox – Hincks, 1868: 319; Allman, 1871: 283.
Type locality – Firth of Forth.

Biology – Occurs on shells inhabited by hermit crabs and under stones (Hincks, 1868).

Remarks – *Coryne ferox* is insufficiently described and not recognisable. Perhaps it belongs to *Sarsia tubulosa*.

Coryne fucicola (de Filippi, 1866)

Halobotrys fucicola de Filippi, 1866: 383, pl. 2.
Coryne fucicola – Brinckmann-Voss, 1970: 53, fig. 58.

Distribution – Mediterranean.

Remarks – *Coryne fucicola* was described from an aquarium culture. De Filippi's (1866) account is quite precise, especially his figures. The gonophores are clearly sessile sporosacs and they could be in the upper axils of the tentacles. The hydranths of *C. fucicola* are very large and reach 5-6 mm in length. This size, however, seems to be unrealistic. Picard (1960) thought that it might correspond to *C. filiformis*, although no filiform tentacles are present in Filippi's figure.

Coryne graeffei Jickeli, 1883

Coryne graeffei Jickeli, 1883: 607, pl. 26 figs 11-22, pl. 28 fig. 4.

Remarks – *Coryne graeffei* is an inadequately described species that is not identifiable. It was postulated as a new species by Jickeli (1883) in a paper studying the microscopic structure of hydroids. Jickeli stated that it differs from *C. pusilla* by the presence of only one medusa bud [sic!] and by the absence of a perisarc on the caulus. If Jickeli's hydroid really produced medusae, then it could belong to one of several species and the species is here regarded as doubtful.

Coryne longicornis Bonnevie, 1898

Coryne longicornis Bonnevie, 1898a: 492, pl. 27 figs 50-50a.
Type locality – Husø, Oslofjord.

DESCRIPTION – (after Bonnevie, 1898a) Colony on sponge, stolonal, 1-2 mm high, perisarc not annulated. About 10-12 long capitae tentacles. Gonophores develop below capitate tentacles, most probably released as medusae.

DISTRIBUTION – Type locality.

REMARKS – *Coryne longicornis* is insufficiently described and not recognisable. The association with a sponge and the gonophore production below the tentacles compare favourably with *Dipurena simulans*.

Coryne heroni Pennycuik, 1959

Staurocoryne heroni Pennycuik, 1959: 158, pl. 1 fig. 1.
TYPE LOCALITIES – Heron Island and Low Island, Queensland, Australia.

DESCRIPTION – (after Pennycuik, 1959) Stolonal colonies, creeping stolons, hydranth on short caulus, covered with perisarc that widens or not towards distal. Young hydranths with one whorl of 4 longer oral tentacles, 3 whorls with each 3 shorter tentacles, 4-6 aboral filiform tentacles. Older hydranths with 4 more tentacles in indistinct whorls, filiform tentacles lost. Gonophores unknown.

SUBSTRATES – On rock and sea-weeds.

DISTRIBUTION – Type localities.

REMARKS – This species is not recognisable as it matches several other species. New material from the type locality and the life cycle of this species must be examined.

Coryne minima (von Lendenfeld, 1884)

Sarsia minima von Lendenfeld, 1884a: 584, pl. 21 figs 34-35; Kramp, 1953: 309; Kramp, 1961: 29.
TYPE LOCALITY – Port Jackson, New South Wales, Australia.

REMARKS – Only the polyp stage and the young medusa are known from this species. The medusa is different from *C. radiata* by having a manubrium that protrudes from the bell opening. Kramp (1953) re-examined the type material and found the species indeterminable. At the moment, *C. minima* is not recognisable and a re-examination of material from the type locality is needed.

Coryne nutans Allman, 1869

Coryne nutans – Allman, 1871: 271.
TYPE LOCALITY – Burraforth Caves, Shetland.

REMARKS – An unrecognisable species, perhaps *C. pusilla*. The gonophores are unknown. Even Allman (1871) himself considered it provisional and indeterminable.

Coryne occidentalis (Fewkes, 1889)

Syncoryne occidentalis Fewkes, 1889a: 99, pl. 3 figs 2-3.
? *Coryne rosaria* – Fewkes, 1889a: 100, pl. 4 figs 1 & 4.
Sarsia rosaria – Fewkes, 1889b: 597, pl. 25 fig 7, text figs 8-9.
TYPE LOCALITIES – Monterey Bay, San Francisco, and Santa Barbara; California.

REMARKS – Fewkes (1889a) based his new species on a medusa and considered it to be quite common in California. He apparently had mature medusae and his figures show a medusa with an apical canal. *Coryne occidentalis* is likely a valid species that can be recognised again. The medusa much resembles *Coryne cliffordi* (Brinckmann-Voss, 1989).

Fewkes (1889a) also found an abundant hydroid on wharf piles of California which he formally allocated to *Coryne rosaria* sensu A. Agassiz. Fewkes made no rearing experiments, but nevertheless thought that this hydroid produced the medusa he described as *Sarsia occidentalis*. Later, Fraser (1937: 28, fig. 12, as *S. mirabilis*) again described hydroid material that certainly belonged to same population. Fewkes' hydroids developed their medusae buds independent from the tentacles and may thus also belong to *C. cliffordi*. New life-cycle investigations on Californian corynid polyps and medusae have to clarify the status of Fewkes' hydroid and medusa.

Coryne radiata (von Lendenfeld, 1884)

Sarsia radiata von Lendenfeld, 1884b: 584; von Lendenfeld, 1884a: 583, pl. 20 figs 31-32, pl. 30 figs 1-4; von Lendenfeld, 1885: 637, pl. 30; Kramp, 1961: 30; Watson, 1978: 305, fig. 2A-D.

TYPE LOCALITY – Port Jackson, Australia.

MATERIAL EXAMINED – Museum of Victoria Melbourne, slide 1184, *Sarsia radiata*, coll J. Watson, Halibut oil station, Bass Strait, Mid littoral, June 1975 (described in Watson, 1978), contains branched corynid without gonophores, perisarc annulated.

DISTRIBUTION – southern Australia.

REMARKS – The adult medusa of *S. radiata* remains unknown. After Watson (1978), the polyp stage of *S. radiata* is identifiable without problems due to the microbasic euryteles. However, in the figure of Watson (1978), these microbasic euryteles appear atypical. Janette Watson told me recently, that these capsules had been misidentified due to unsuitable microscopic equipment. Most probably, *Coryne radiata* is conspecific with *C. eximia*.

Coryne repens Fraser, 1938

Coryne repens Fraser, 1938: 13, pl. 1 fig. 6.

TYPE LOCALITY – Black Beach, Charles Island, Galapagos Archipelago.

MATERIAL EXAMINED – RBCM 976-131-1, Fraser's original material from Charles Island, this material must be considered type material (see Arai, 1976), one slide with rather poorly preserved material, female gonophores present.

DESCRIPTION – Colonies stolonal or sparingly branched up to second order. Perisarc annulated over some stretches, otherwise smooth, without funnel-shaped dilation at end of cauli. Hydranths 1-1.5 mm, fusiform, with an oral whorl of 4 tentacles and below them additional 10-12 tentacles scattered over whole length of the hydranth. Mouth without button of high gland cells. Spherical gonophores arise in the upper axils of the lowest tentacles, sessile sporosacs without canal system. Largest gonophores seen were 0.13 mm in diameter, probably not fully mature. Nematocysts: probably only stenoteles.

BIOLOGY – Grows on coralline algae at low-water mark.

DISTRIBUTION – Known from first description only.

REMARKS – Fraser (1938) distinguished this species from *C. crassa* on account of its lesser degree of branching, the stouter hydranth and the more numerous and more slender tentacles. The first two characters are certainly of little value for distinguishing corynids and the tentacle number is well within the range of other similar species. The species differs little from *C. pusilla*, with perhaps the exception of the gonophore size. However, it is likely that the gonophores in the type material are not fully grown yet. For biogeographic reasons *C. repens* can be regarded as separate from *C. pusilla*. However, a re-description based on new material from the type locality is needed to consolidate its validity.

Coryne rosaria L. Agassiz, 1862

Coryne rosaria L. Agassiz, 1862: 340.
Sarsia rosaria – Haeckel, 1879: 18; Hartlaub, 1907: 50, fig. 45; Mayer, 1910: 59; Kramp, 1961: 31; Kramp, 1968: 7, fig. 4; Arai & Brinckmann-Voss, 1980: 18.
not *Coryne rosaria* – Fewkes, 1889a: 100, pl. 4 figs 1 & 4.
not *Sarsia rosaria* – Fewkes, 1889b: 597, pl. 25 fig 7, text figs 8-9.
TYPE LOCALITY – Strait of Rosario, North-eastern Pacific.

REMARKS – Agassiz' (1862) description refers to a corynid medusa with a manubrium longer than the bell. Agassiz (1862) states that his species resembles *Coryne pusilla* (sic!) from the English Channel. There is nothing in Agassiz's description that renders this species distinguishable from other species of the *Sarsia tubulosa*-like medusae occurring in the region. Later, his son (A. Agassiz, 1865) allocated a hydroid from the same region to this species. This was not based on rearing experiments and thus this identification is highly unreliable.

Coryne vanbenedenii Hincks, 1868

Syncoryne pusilla – van Beneden, 1844: 52, pl. 3 figs 1-10.
Coryne VanBenedenii Hincks, 1868: 45, pl. 9 fig. 1.
Actinogonium pusillum– Allman, 1871: 273.
TYPE LOCALITY – Belgium.

DESCRIPTION – (after van Beneden, 1844 and Hincks, 1868) Polyp colony small and very delicate (13-19 mm); stem flexuous, irregularly branched, bearing many short, non-polypiferous ramules; perisarc transparent, paper-like, pale-yellow, with few obscure wrinkles. Polyps small, subclavate, with slight membranous cup round the base. Tentacles from 12-16, sometimes more. Gonophores few in number (2-3), very large, pedunculate, situated below or among the lowest tentacles. Gonophores remain fixed as sporosacs. Radial canals present, tentacles rudimentary. Gonophores produce 1-4 larva that leave the gonophore as a juvenile polyp with four filiform tentacles.

BIOLOGY – Grows on crabs.

REMARKS – A little known species, but perhaps valid. It is mainly characterised by its vivipary. Hincks (1868) described material he obtained from van Beneden and which the latter had previously identified as *Syncoryne pusilla*. Hincks realised that it could not be this species and proposed the new name *vanbenedenii*. Although coming from a well investigated area, the species has not been found ever since. However, it should be recognisable, if it is not based on a misinterpretation.

Coryne wortleyi (Rotch, 1872)

Staurocoryne wortley Rotch, 1872: 126.
Coryne wortleyi – Rees, 1936: 140, table 1.

REMARKS – An altogether unrecognisable species known from an aquarium culture only.

Dicodonium cornutum Haeckel, 1879

Dicodonium cornutum Haeckel, 1879: 27, pl. 1 fig. 6; Mayer, 1910: 46, fig. 12; Kramp, 1961: 20
TYPE LOCALITY – Tur, Sinai, Red Sea (Haeckel, 1879).

REMARKS – *Dicodonium cornutum* has no ocelli and has its tentacular nematocysts concentrated into abaxial clusters. Haeckel described no exumbrellar nematocyst tracks, but even without them it seems clear that *Dicodonium cornutum* is more likely referable to the Tubulariidae. The resemblance to other medusae of the genus *Ectopleura* is obvious and it probably belongs to this genus. *Dicodonium cornutum* is the type species for the genus *Dicodonium*. Because *D. cornutum* is most probably an *Ectopleura* species, the genus *Dicodonium* can thus no longer be placed among the Corynidae, a family it was traditionally placed in (see Kramp, 1961). New investigations at the type locality, however, could probably identify this medusa again. Further knowledge of the species is thus crucial for the validity of genus *Dicodonium*. Kramp (1959a: 83), Brinckmann-Voss & Arai (1998) and others considered *Dicodonium* a doubtful genus, characterised by the presence of only two well developed tentacles. The species usually placed into this genus, where recognisable at all, obviously belong to different families. Only *Dicodonium floridana* is reasonably well described. However, it differs very much from others of the genus. Arai & Brinckmann-Voss (1998) moved *Dicodonium punctatum* to a new genus, *Paulinium*. *Paulinium* is at present not allocated to a family (Capitata *incerta sedis*).

Dicodonium adriaticum Graeffe, 1884

Dicodonium adriaticum Graeffe, 1884: 351; Mayer, 1910: 47; Neppi & Stiasny, 1913: 31, pl. 1 fig. 1; Kramp, 1959: 84, fig. 28; Kramp, 1961: 20.
TYPE LOCALITY – Trieste, Adriatic Sea.

REMARKS – The original description of Graeffe indicates that *Dicodonium adriaticum* was probably a member of the Pandeidae, perhaps an *Amphinema* species. Graeffe's species had stiff sensory cilia around the ocelli and might thus be recognisable again. Although it is not clear whether Neppi & Stiasny's (1913) *Dicodonium adriaticum* was really that species, their medusa is obviously also a juvenile pandeid.

Dicodonium dissonema Haeckel, 1879

Dicodonium dissonema Haeckel, 1879: 27; Mayer, 1910: 46; Kramp, 1968: 9.

TYPE LOCALITY – Australia.

REMARKS – There exist no figures of this species and its original description is not sufficient enough to recognise it, even more so as Haeckel gives no exact type locality. It has not been recorded again. The species could belong to several different families.

Dicodonium floridana Mayer, 1910

Dicodonium floridana Mayer, 1910: 46, pl. 2 fig. 5; Kramp, 1959: 83, fig. 27.
Type locality – Tortugas, Florida, USA.

Description – (after Mayer, 1910) bell about 4 mm high, 3 mm wide, with thin, uniform walls and a slight apical projection. With two equally-developed, diametrically opposed tentacles, each about 3/4 as long as bell-height. Near the distal end of the tentacles a knob-like swollen region, hollow, with a thin terminal process. Marginal bulbs small, without ocelli. In addition to the large tentacles there are 2 small, tapering, rudimentary tentacles placed at 90° to the large tentacles. Four narrow, straight radial canals and circular canal present. Manubrium flask-shaped, thickened in middle region. The gonads develop around the manubrium. The rudimentary tentacles may occasionally develop so as to be nearly as long as the pair of large tentacles.

Remarks – The very peculiar shape of the tentacles make this species easily recognisable. Although Mayer observed several specimens, the species has not been found again. The absence of ocelli is a good argument for not allocating this species in the Corynidae. New life cycle observations and information on the nematocysts are needed to allow a correct placement of this species. It is presently best classified as Anthoathecata *incerta sedis.*

Dicodonium punctatum Vanhöffen, 1911

Dicodonium punctatum Vanhöffen, 1911: 196, fig. 1.
Paulinium punctatum – Brinckmann-Voss & Arai , 1998: 56, fig. 8.
Type locality – Valdivia station 168, north New Amsterdam, southern Indian Ocean, depth 200 m.

Description – Medusa bell 1 mm, higher than wide, jelly evenly thick, provided with coloured inclusion along radial canals that are most probably zooxanthellae. Manubrium short, broad. With four broad radial canals and circular canal. Four marginal bulbs, one opposite pair larger than the other, without ocelli. One pair of tentacles larger, relatively short, ending in a spherical nematocyst cluster. The other pair of tentacles very small, without capitation. Gonads not observed.

Remarks – Vanhöffen based his description of *Dicodonium punctatum* on only one preserved medusa taken at 200 m depth. On account of its capitate tentacles, Brinckmann-Voss & Arai (1998) removed it from the Corynidae and placed it into the new genus *Paulinium*, together with another newly described species that has perhaps four tentacles. The higher systematic position of *Paulinium* is not clear and Brinckmann-Voss & Arai (1998) classified it as Capitata *incertae sedis.*

Dinema jeffersoni Mayer, 1900

Dinema jeffersoni Mayer, 1900b: 30, pl. 37 fig. 126.
Dicodonium jeffersoni – Mayer, 1910: 46, pl. 2 fig. 4, pl. 3 fig. 1; Vanhöffen, 1913a: 415; Kramp, 1959: 83, fig. 25.
Type locality – Tortugas, Florida, USA.

Remarks – A simple, small, *Sarsia*-like medusa with unequally developed tentacles. Life-cycle observations must be made before this species can reliably be allocated to a higher taxon, but it could belong to the Corynidae. If so, it can easily be placed in the genus *Coryne*. Mayer (1910) mentioned it to be quite common at the Tortugas in May and early June.

Dipurena dolichogaster Haeckel, 1864

Dipurena dolichogaster Haeckel, 1864: 337; Haeckel, 1879: 25, pl. 2 figs 1-7; Russell, 1953: 75; Kramp, 1961: 22.
TYPE LOCALITY – Nice, Mediterranean.

REMARKS – A doubtful species, possibly conspecific with *Dipurena ophiogaster*.

Dipurena pyramis (Haeckel, 1879)

Bathycodon pyramis Haeckel, 1879: 26.
Dipurena pyramis – Kramp, 1961: 23.
TYPE LOCALITY – Corfu, Mediterranean, 40 m, on ascidian.

REMARKS – According to Haeckel (1979), this *Dipurena*-like medusa has four stiff tentacles ending in suckers, four meridional exumbrellar ridges with nematocysts, and gland cells along the radial canals. Haeckel found only one specimen and the species has not been found since. If it is not a hoax, it might be recognised again due to these peculiarities and I would not consider it a doubtful species as Kramp (1961) did.

Sarsia erythrops Romanes, 1876

Sarsia erythrops Romanes, 1876: 274, note.

REMARKS – In his experimental studies on the nervous system of medusae, Romanes (1876) mentions *Sarsia erythrops*. It was not supplemented by any description nor figure and is therefore not a validly described species. Bedot (1912: 465) thinks Romanes' medusa was *Coryne eximia*.

Sarsia frutescens (Allman, 1871)

Syncoryne frutescens Allman, 1871: 281, pl. 6 fig. 4-6; Hartlaub, 1907: 37, fig. 29; Mayer, 1910: 54, fig. 17.
TYPE LOCALITY – Kingstown, Dublin, Ireland.

BIOLOGY – Occurs on floating timber.

REMARKS – Only the hydroid stage and juvenile medusae are known of this species. Its hydranths correspond to the ones of *S. tubulosa*. It differs from typical *S. tubulosa* in having much larger colonies 2.5 to 5 cm that are branched up to the third order, thus resembling *Sarsia densa*. Hartlaub (1907) kept it separate from this species on account of Allman's (1871) figure of the medusa which shows no terminal nematocyst cluster. This is, however, most probably erroneous.

Sarsia hargitti (Mayer, 1910)

Sarsia producta Hargitt, 1902: 550, fig. 3.
Sarsia hargitti Mayer, 1910: 63 fig. 26, new name; Kramp, 1959: 78 fig. 11; Kramp, 1961: 28.
TYPE LOCALITY – Woods Hole Massachusetts, USA.

Description – Medusa 1.5 mm high, 1 mm wide, apex dome-like, very thick. Manubrium may project far beyond velar opening, its terminal end bulb-like, in its proximal part a whorl of medusae buds (or medusiform gonads). Small, round apical chamber. Tentacles with large bulbs.

Remarks – Hargitt (1902) described this species from a single medusa and it has never been found again, despite coming from a well investigated area. Mayer (1910) gave it a new name because the former name was preoccupied by *Sarsia producta* (Wright, 1858). Hargitt was somewhat unclear in his description as he mentions "medusiform gonads". Most probably he was not referring to gonads in the usual sense, but to medusae buds. Later Kramp (1959a) interpreted them as sac-shaped gonads. With this interpretation, the species becomes difficult to integrate into the Corynidae. Considering his comparisons with *S. gemmifera,* it is thus much more probable that Hargitt (1902) observed normal medusae buds. The only difference of Hargitt's species to *Dipurena gemmifera* is that the medusae buds are in a whorl at the very base of the manubrium and not spread over it. If it was based on a healthy specimen, Hargitt's medusa could be recognised again. However, I suspect that it was *D. gemmifera.*

Sarsia marii Schierwater & Ender, 2000

Sarsia marii Schierwater & Ender, 2000: 119, fig. 1.
Type locality – Banyuls-sur-Mer, France, Mediterranean.

Diagnosis – Hydroid growing on *Ulva lactuca,* with one whorl of 4 oral capitate tentacles and one aboral whorl of filiform tentacles. Gonophores develop in zone between filiform and capitate tentacles, liberated as free medusae. Newly released medusa similar to other corynid medusae, tentacles with one spherical terminal nematocyst cluster. Development, adult medusa, and cnidome are unknown.

Remarks – This is an insufficiently described species, but its growth on *Ulva* as well as the known 16S ribosomal DNA sequence should render it recognisable. Because the adult medusa is not known it cannot be allocated to a genus unambiguously. Because there are no *Coryne* species known with only one whorl of capitate tentacles, and because its molecular phylogeny placed it closer to *Sarsia tubulosa* than to *Dipurena reesi*, it is here left in the genus *Sarsia*. The capitate tentacles of the medusa, however, suggest more affinities with *Dipurena*. Formally, *Sarsia marii* is not distinguishable from *Dipurena strangulata*, except for the different substrates of the hydroid (*Ulva* versus sponge).

Sarsia nana Stechow, 1923

Sarsia nana Stechow, 1923b: 40, fig. B,
Type locality – European coasts.
Material examined – ZSM, slide, *Coryne nana*, locality: Europäische Küsten, is most probably type material.

Remarks – The description of this species was based on infertile polyp material. As a distinguishing character Stechow (1923b) gave the pronounced annulation of the stem. This is of course no valid trait and the species is definitely not recognisable anymore. It may belong to any of several species. Re-examination of the type material also did not give any further cues to the identity of this species.

Sarsia ocellata Busch, 1851

Sarsia ocellata Busch, 1851: 16, pl. 2 figs 1-3; Hartlaub, 1907: 68, fig. 63.
Dicodonium ocellatum – Kramp, 1961: 21.
TYPE LOCALITY – Trieste, Adriatic Sea, Mediterranean.

REMARKS – Mayer (1910) thought this to be an abnormally developed *Sarsia* medusa, while Kramp (1959a) qualifies it as an "altogether doubtful species". It is likely that Busch based his description on mutilated specimens as he noted (cited in Hartlaub, 1907) that the medusa has normally four tentacles and that in the two tentacled specimen the missing ones seemed to have fallen off. Somewhat unique are the black tufts of nematocysts on the exumbrella, but this could have been due to deterioration. Hartlaub (1907) thought it to be conspecific with the equally doubtful *Sarsiella dinema*. I favour Mayer's view that *D. ocellatum* was based on mutilated or abnormally developed specimens of a *Sarsia* spec.

Sarsia pattersoni Haddon, 1886

Sarsia pattersoni Haddon, 1886: 525; Kramp, 1961: 29.
TYPE LOCALITY – Ireland.

REMARKS – Could be *S. tubulosa,* doubtful species.

Sarsia polyocellata Uchida, 1927

Sarsia polyocellata Uchida, 1927: 182, fig. 25; Kramp, 1961: 29; Kramp, 1968: 8, fig. 9.
TYPE LOCALITY – Misaki, Japan.

DIAGNOSIS – Medusa 2 mm high, 2.2 mm wide, without apical projection, jelly soft, equally thick throughout. Manubrium short and wide, mouth small. Gonads dispersed on manubrium. Tentacle bulbs triangular, each with five ocelli, ocelli arranged in triangle. Tentacle bulbs apparently without gastrodermal chamber. Tentacles with patches of nematocyst clusters on whole length. Gonads vermilion, ocelli black.

DISTRIBUTION – Known from the type locality only.

REMARKS – This species is almost certainly not a member of the Corynidae. Uchida (1927) speaks of "separate gonads" and his figure shows a number of patches on the manubrium which must be interpreted as gonads. All Corynidae have gonads that encircle the manubrium without interruption. Furthermore, his figure quite clearly shows that the tentacle bulbs have no gastrodermal chambers. These traits, combined with the five ocelli per bulb exclude this species from the Corynidae. *Sarsia polyocellata* is perhaps a member of the Sphaerocorynidae, although no presently known genus is suitable to place it in. Most likely, a new genus will have to be created for it. Because no type material could be found and its nematocysts, and more importantly its life-cycle, remain unknown, I refrained from doing so in this publication. We have to wait for new findings of this species.

Sarsia pulchella Forbes, 1848

Sarsia pulchella Forbes, 1848: 57, pl. 6 fig. 3; Hartlaub, 1907: 36, fig. 28.
TYPE LOCALITY – Great Britain.

Remarks – This is probably *S. tubulosa.* Forbes distinguished it from *S. tubulosa* on account of its size (25 mm for *S. tubulosa* and 6 mm for *S. pulchella*).

Sarsia turricula McCrady, 1859

Sarsia turricula McCrady, 1859: 36, pl. 8 figs 6-8; Kramp, 1961: 32.
Type locality – Charleston Harbor, USA.

Remarks – Not identifiable medusa known only from immature specimen, may be *S. tubulosa.*

Sarsiella dinema Hartlaub, 1907

Dinema slabberi – Haeckel, 1879: 28.
[not *Dinema slabberi* van Beneden, 1866 = ? *Leuckartiara octona* (Fleming, 1823)]
Sarsiella dinema Hartlaub, 1907: 67, new name; Kramp, 1961: 33.
Type locality – Coast of Normandy.

Remarks – Hartlaub (1907) thought that Haeckel (1879) misidentified a corynid medusa from the Channel coast with *Dinema slabberi* van Beneden, 1866. *Dinema slabberi* van Beneden, 1866 clearly belongs to the Pandeidae, and it probably is a synonym of *Leuckartiara octona.* Although there is no reason to assume that Haeckel had a corynid medusa, Hartlaub (1907) proposed the new name *Sarsiella dinema* for Haeckel's medusa. Hartlaub even created a new genus based on the assumption that it has only two marginal bulbs. He thought that *Dicodonium* differed from *Sarsiella* by having four marginal bulbs. There exists no figure of Haeckel's medusa and it must be considered unrecognisable. I tend to follow the opinion of Mayer (1910: 47) that it was based on an abnormal or mutilated specimen.

Syncoryne loveni van Beneden, 1867

Syncoryne loveni van Beneden, 1867: 121, pl. 5 figs 6-8; Allman, 1871: 285.

Remarks – An indeterminable, dubious species, not to be confounded with *Sarsia lovenii* (M. Sars, 1846).

Syncoryne johnstoni van Beneden, 1867

Syncoryne johnstoni van Beneden, 1867: 120, pl. 5 figs 1-3.

Remarks – An indeterminable, dubious species.

Syncoryne listerii van Beneden, 1844

Syncoryne listerii van Beneden, 1844: 54, pl. 3 figs 11-12.

Remarks – An indeterminable, dubious species. See also comments by Hincks (1868: 40). Bedot (1910) referred it to *C. pusilla.*

5.9. Unnamed Corynidae

Many findings of Corynidae cannot be identified due to lack of life cycle information. Some authors therefore correctly avoided naming new species when there is clearly not enough information available. Some morphotypes will nevertheless be recognisable and in the following some of these species are listed, although the list is incomplete.

Sarsia spec. of Uchida (1927: 187, fig. 26) could not be sufficiently examined by the author as the material was lost in an earthquake, it resembles *C. eximia* and *C. japonica*.

Sarsia spec, II of Menon (1932: 5, pl 1 fig. 8) is probably an *Euphysora* species (Kramp, 1961).

Syncoryne spec. from Florida described by Berrill (1953) develops its medusae buds below the capitate tentacles at a very early stage. Later, the capitate tentacles also start to grow in the zone occupied by the medusae buds. This course of development is quite unusual and Berrill's *Syncoryne* species might belong to an undescribed species or perhaps *C. angulata*. See also discussion under *C. eximia* and *C. angulata*.

Sarsia sp. of Brinckmann-Voss (1970: 69, fig. 79) from a Cave at Nisida (Naples, Mediterranean), has four oral tentacles and filiform aboral tentacles. Its gonophores had the typical corynid marginal bulbs provided with black ocelli. There were no gonads around the manubrium.

Sarsia sp. of Arai & Brinckmann-Voss (1980: 29, fig. 14), from British Columbia and Pudget Sound (Canada, Pacific Ocean), is similar to *Sarsia tubulosa* but with thicker nematocyst pads of the marginal bulbs.

Coryne spec. 1 of Schuchert (1996) from Wellington, New Zealand, is perhaps not a corynid due to the presence of desmonemes in the polyp. Its stout appearance and the characteristic cnidome render this hydroid recognisable. Schuchert (1996) speculated that it might be the polyp of *Tiaricodon coeruleus*, a species with some superficial resemblance to corynids. In view of the currently known life cycle of *Tiaricodon coeruleus* and related species (see Xu & Chen, 1998; Mills, 2000), this seems now less likely.

Coryne spec. 2 of Schuchert (1996) from Wellington, New Zealand, is certainly a corynid, but it cannot be allocated to the correct genus because no information on the gonophores is available. Its nematocysts will probably allow a future identification of material from New Zealand. The presence of a basitrichous isorhiza and the close approximation of the tentacles indicates that this species more probably belongs to the genus *Dipurena* or *Sarsia*.

Coryne spec. in Gibbons & Ryland (1989: 385, fig 4), lack of information on the sporosacs preclude an identification at the moment.

5.10. **Species not referable to Corynidae**

Syncoryne flexibilis Fraser, 1938 must be transferred to the genus *Sphaerocoryne*. Part of the syntype material of *Syncoryne flexibilis* Fraser, 1938 was examined for this study (BCPM 976-138-1 and BCPM 976-138-2, Secas Island). It was compared with type material of *Sphaerocoryne bedoti* Pictet, 1893 (MHNG INVE 27134). The material from Secas Island has no gonophores, but Fraser (1938: 15, fig. 8) described them as medusae buds originating distal to the tentacle whorls. *Syncoryne flexibilis* is indistinguishable from *Sphaerocoryne bedoti* (see Millard, 1975;

Calder, 1988; Petersen, 1990 for descriptions). Because there are also *Sphaerocoryne* medusae for which we do not know the polyp phase, *Sphaerocoryne flexibili* cannot a priori synonymised with *S. bedoti*. The full life cycle of *Sphaerocoryne flexibilis* from the type localities must be examined before a valid comparison is possible. Perhaps there is a relationship to *Sarsia* (*Sphaerocoryne*?) *coccometra* Bigelow, 1909 (see discussion under this species).

The type material of *Syncoryne crassa* Pictet, 1893 (MHNG INVE 25777) was re-examined for this study. Although the polyps are rather poorly preserved, it is evident that they have moniliform tentacles and conform rather well to the genus *Pteroclava* as described by Boero, Bouillon & Gravier-Bonnet (1995). Also the few gonophores revealed that they consist of a liberable medusae with two tentacle bulbs only. The material closely resembles *Pteroclava krempfi* (Billard, 1919) that they might indeed be conspecific. However, as *Pteroclava krempfi* is only known to occur on Octocorallia while *Pteroclava crassa* was found on the hydrorhiza of hydroid *Macrorhynchia philippina*. Boero, Bouillon & Gravier-Bonnet (1995) regarded them therefore as separate species. This seems to be a preferable solution until perhaps further records will widen the host range of *P. krempfi*.

Sarsia nodosa Busch, 1851 is perhaps an aberrant *Hydractinia carnea* (M. Sars, 1846), see also Russell (1953: 481).

Coryne sessilis Gosse, 1853 is *Zanclea sessilis* (Gosse, 1853), see Boero, Bouillon & Gravili (2000).

Coryne pelagica Alder, 1857 was referred to *Zanclea costata* by Russell (1953), see also Cornelius & Garfath (1980).

Gymnocoryne coronata Hincks, 1871 is probably a *Zanclea* species.

Coryne gigantea Bonnevie, 1898 is a synonym of *Monocoryne gigantea* (Bonnevie, 1898) (family Candelabridae).

Dipurella clavata Hargitt, 1902 is probably a young *Sphaerocoryne agassizii* (McCrady, 1859) (Calder, 1970).

Sarsia flammea Linko, 1905 is a synonym of *Euphysa flammea* (Linko, 1905).

Sarsia japonica Maas, 1909 and *Sarsia flammea* Foerster, 1923 are synonyms of *Euphysa japonica* (Maas, 1909).

Sarsia resplendens Bigelow, 1909 is a synonym of *Hydrocoryne miurensis* Stechow, 1907 (family Hydrocorynidae).

Sarsia brevia Uchida, 1947 is a synonym of *Euphysomma brevia* (Uchida, 1947) (see Kramp, 1962).

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8. INDEX

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Abundance and phenology of Schizomida (Arachnida) from a secondary upland forest in Central Amazonia

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Abundance and phenology of Schizomida (Arachnida) from a secondary upland forest in Central Amazonia. - The 357 Schizomida (short-tailed whipscorpions) collected within 12 months from the soil (0-7 cm depth) of a secondary upland forest (60.4 ± 32.2 ind./m^2/month) near Manaus are represented by the hubbardiids *Surazomus mirim* and *S. rodriguesi* (99.7% and 0.3% of the total catch, respectively). About 74% of all specimens of *S. mirim* inhabited the organic soil layer (0-3.5 cm depth) where monthly catches of juveniles were negatively correlated with temperatures of the soil. Females were twice as abundant as males. The lack of a distinct reproductive period and the presence of juveniles (in particular the first nymphal instar) and adults (both sexes) throughout the year indicate a plurivoltine mode of life. Few specimens were caught on the soil surface, none on tree trunks. Abundance of *S. mirim* is compared with that of the Palpigradi (micro whipscorpions) and Uropygi/Thelyphonida (vinegaroons) from the same study site. Schizomids obtained from the soil of four other upland forests in Central Amazonia (0-14 cm depth) accounted for ≤ 0.1% of the total arthropod fauna at these localities and were represented by three additional species.

Key-words: abundance - phenology - Schizomida - Amazon - Neotropics.

INTRODUCTION

Terrestrial arthropods of Central Amazonian forests have been investigated for several years (cf. Adis & Schubart, 1984; Adis, 1997; Adis *et al.*, 1996, 1997a,b) cooperatively between the National Institute for Amazonian Research (INPA) at Manaus /Brazil and the Tropical Ecology Working Group at the Max-Planck-Institute for Limnology in Plön/Germany (Projeto INPA/Max-Planck). Data on abundance and phenology of Schizomida sampled in a secondary upland forest over a 12-month

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period are now available, as their time-consuming taxonomical evaluation has been completed (Cokendolpher & Reddell, 2000). The order Schizomida presently comprises about 220 described species (Adis & Harvey, 2000). Few studies have been conducted on their ecology and biology. Schizomids are considered to be hygrophilous, photophobic, hemiedaphic inhabitants of soils, particularly in the tropics and subtropics. Some species are termitophiles, myrmecophiles, nidicoles or troglobites (cf. Humphreys *et al.*, 1989; Moritz, 1993; Reddell & Cokendolpher, 1995; Rowland, 1972). Our data given here on *Surazomus mirim* represent the second contribution on the phenology of a Neotropical schizomid species (cf. Adis *et al.*, 1999). The results of this contribution were orally presented at the 15th International Congress of Arachnology (March 2001) in Badplaas, South Africa.

STUDY AREA, MATERIAL AND METHODS

Schizomids were collected between 1981 and 1983 in the course of ecological studies on Central Amazonian arthropods from a secondary upland forest where the vegetation was previously cut but unburned. This forest is located at Rio Tarumã Mirím (03°02'S, 60°17'W), a tributary of the Rio Negro near Manaus, and was previously investigated and described (cf. Adis, 1992; Franklin *et al.*, 1997). The area is subject to a rainy season (December-May: average precipitation 1550 mm; 258.8 ± 36.8 mm/month) and a "dry" season (June-November: average precipitation 550 mm; 91.8 ± 43.8 mm/month and each month with some rain events; cf. Ribeiro & Adis, 1984). The yellow latosol (= ferrasol in Jordan, 1984) of the secondary upland forest is supported by a 2-3 cm thick humus layer, interspersed with fine roots, and a thin surface covering of leaf-litter. One ground photo-eclector (emergence trap) and one arboreal photo-eclector for trunk ascending invertebrates (funnel trap) were installed in the forest (cf. Adis & Schubart, 1984) and remained there from December 1981 to December 1982. The distribution of schizomids in the soil was studied between September 1982 and August 1983 (Rodrigues, 1986). Twelve soil samples were taken once a month every two meters along a randomly selected transect. The split corer, composed of a steel cylinder with lateral hinges (diameter 21 cm, length 33 cm), was driven into the soil by a mallet. Each sample of 7 cm depth was then divided into two subsamples of 3.5 cm each for extraction of animals, following a modified Kempson method (Adis, 1987). The combined area of the 12 samples represented 0.42 m^2. Calculated average abundances per m^2 are given with sample standard deviation. The monthly collection data of schizomids from the two soil layers in relation to changing abiotic conditions (precipitation, temperature and humidity of the air near the forest floor; moisture content, temperature and pH of the soil) were statistically evaluated with a linear, parametric correlation test (Cavalli-Sforza, 1972) using the original field data (cf. Rodrigues, 1986). All Schizomida sampled were classified as juveniles, subadults and adults (males and females, respectively; cf. Reddell & Cokendolpher, 1995). Juveniles were tentatively assigned to three size classes, based on measurements of the cephalothorax length. They presumably represent the three development stages in nymphs, apart from the subadult stage (cf. Brach, 1976; Dumitresco, 1973; Rowland, 1972).

Voucher specimens have been deposited at the Systematic Entomology Collections of the Instituto Nacional de Pesquisas da Amazônia (INPA) in Manaus/ Brazil, at the Texas Memorial Museum, Austin/ Texas and at the Muséum d'histoire naturelle in Geneva/Switzerland.

RESULTS

Schizomida obtained from the secondary upland forest under study at Rio Tarumã Mirím were represented by *Surazomus mirim* and *S. rodriguesi* (cf. Cokendolpher & Reddell, 2000) with 99.7% and 0.3% of the total catch, respectively.

A total of 357 schizomids was collected. Out of these, 99% were identified to their developmental stages. Schizomids were mostly found in the soil and never caught on tree trunks. Only one specimen was captured in a pitfall trap inside the ground photo-eclector while active on the soil surface. Schizomids represented 0.3% of the total arthropods extracted from soil samples within 12 months (excluding Acari & Collembola; cf. Rodrigues, 1986). Their abundance in 0-7 cm soil depth was lower than that of the Palpigradi (722 versus 1141 ind./m^2), whereas abundance of the Thelyphonida (7 ind./m^2) was even lower (cf. Adis *et al.*, 1997a). This is also true for the dominant species in each group (Fig. 1; Adis *et al.*, 1999). An average abundance of 60.4 ± 32.2 schizomids/m^2 /month was recorded in 0-7 cm soil depth (*S. mirim*: 60.2 ± 32.5 ind./m^2/month; *S. rodriguesi*: 0.2 ± 0.7 ind./m^2/month; cf. Table 1).

Most specimens of *S. mirim* inhabited the organic soil layer (Fig. 2: 0-3.5 cm) and a few (26%) the mineral subsoil (3.5-7.0 cm depth). About 70% (41.9 ± 21.9 ind./m^2/month) of the total catch was represented by juveniles (Fig. 2), 9% by subadults (5.8 ± 3.4 ind./m^2/month) and 21% by adults (12.5 ± 10.1 ind./m^2/month). Sex ratio (adult males to females) was 1:2.0 (all adults could be sexed). No significant difference between subadult males and subadult females was found for the cephalothorax length (Chi-square test). Juveniles could not be sexed.

The monthly abundance of *S. mirim* juveniles obtained from the organic soil layer (0-3.5 cm depth) was negatively correlated with soil temperature (23.8-26.4 °C; average: 25.3 ± 0.7 °C), i.e. catch numbers increased with decreasing temperatures (total catch: $r=-0.58534$, $p<0.05$; $n=12$). The total catches of specimens obtained during the dry season were higher than those in the rainy season: 63% versus 37%. However, there was no distinct reproductive period because juveniles (in particular the first nymphal instar) as well as adults (both sexes) occurred throughout the year (Figs. 3, 4). These results indicate a plurivoltine mode of life.

DISCUSSION

The data on abundance and vertical distribution of schizomid species in the secondary forest investigated can be compared with those obtained during a similar study between 1981 and 1983 in a primary upland forest on yellow latosol (Adis *et al.*, 1999). This primary forest was located at Reserva Florestal A. Ducke (= Reserva Ducke; 02°55'S, 59°59'W), about 26 km from Manaus. The total abundance of the two different schizomid species collected there (Table 1) was about 1.6 times higher than the total number of schizomids obtained from the secondary forest. This was also

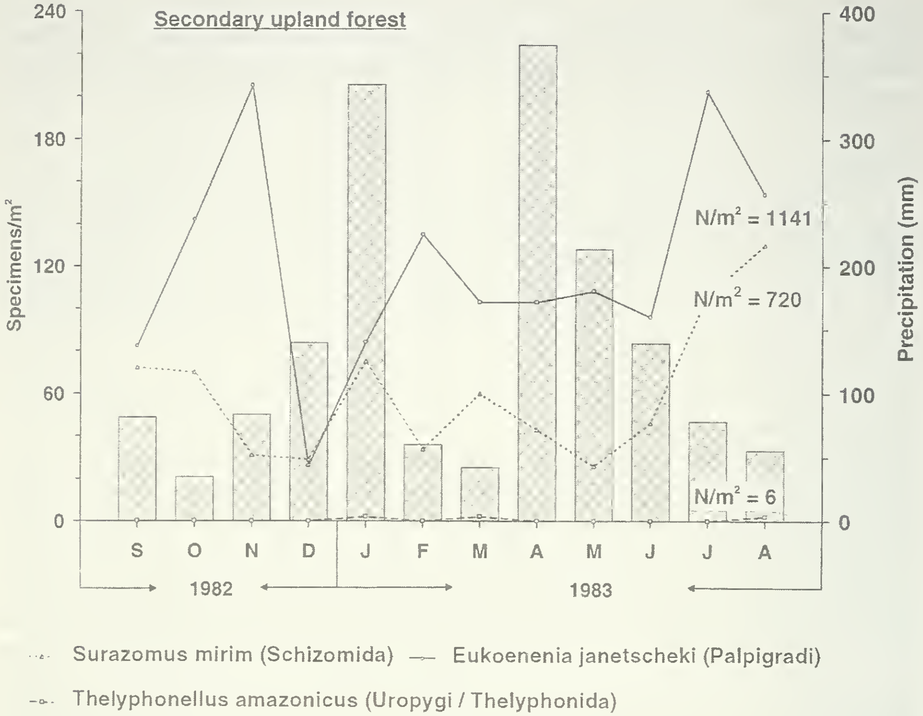

FIG. 1

Distribution of *S. mirim* Cokendolpher & Reddell (Schizomida), *E. janetscheki* Condé (Palpigradi) and *T. amazonicus* (Butler) (Thelyphonida) in the soil of a secondary upland forest near Manaus. Samples taken monthly at 0-7 cm depth between September 1982 and August 1983. (N = total number of specimens). Total precipitation per month given as bars between sampling dates (= in the middle of each month). The low rainfall observed in early 1983 was due to a strong El Niño-event (cf. Adis & Latif, 1996).

observed for the palpigrads (Table 1) and the geophilomorphs (Adis *et al.*, 1996), which both were four times more abundant in the secondary upland forest. In each forest type, one of the two schizomid species present was eudominant and more abundant in the organic soil layer (Table 1). The presence of juvenile schizomids seems to be influenced by soil temperatures: monthly abundances of *S. mirim* in the upper soil of the secondary forest were negatively correlated, whereas those of *S. brasiliensis* (Kraus) from the primary forest were positively correlated. One reason for this (see below) might be different microclimates, as annual average soil temperatures in the upper 3.5 cm were 1.5 °C higher in the secondary forest than in the primary forest (cf. Adis *et al.*, 1999).

Further comparable data on the abundance and vertical distribution of the soil fauna in four other upland forest types of Central Amazonia were obtained by Adis and collaborators (cf. Adis *et al.*, 1987a,b, 1989a,b; Ribeiro, 1994). During rainy and dry seasons arthropods were collected to a soil depth of 14 cm and extracted with the

TABLE 1

Average abundance (N/m^2±SD) and dominance (%) of Schizomida species (all in the Hubbardiidae) and of *Eukoenenia janetscheki* (Palpigradi) in the soil of a primary and a secondary upland forest near Manaus, Brazil. Samples taken monthly at 0-3.5 and 3.5-7.0 cm soil depths between September 1982 and August 1983 (see text for details).

	N/m^2 per month			%
	0 - 3.5 cm	**3.5 - 7.0 cm**	**0 - 7.0 cm**	**0 - 7.0 cm**
Schizomida				
Primary upland forest				
Surazomus brasiliensis	24.4 ± 13.4	11.7 ± 7.6	36.1 ± 16.8	96.0
Adisomus duckei	-	1.4 ± 1.7	1.4 ± 1.7	4.0
Total	24.4 ± 13.4	13.1 ± 8.9	37.5 ± 16.8	100.0
Secondary upland forest				
Surazomus mirim	44.6 ± 25.9	15.6 ± 10.3	60.2 ± 32.5	99.7
Surazomus rodriguesi	0.2 ± 0.7	-	0.2 ± 0.7	0.3
Total	44.8 ± 25.7	15.6 ± 10.3	60.4 ± 32.2	100.0
Palpigradi				
Primary upland forest				
Eukoenenia janetscheki	6.5 ± 6.4	22.9 ± 15.7	29.4 ± 20.2	100.0
Secondary upland forest				
Eukoenenia janetscheki	33.7 ± 18.7	86.4 ± 37.8	120.1 ± 50.8	100.0

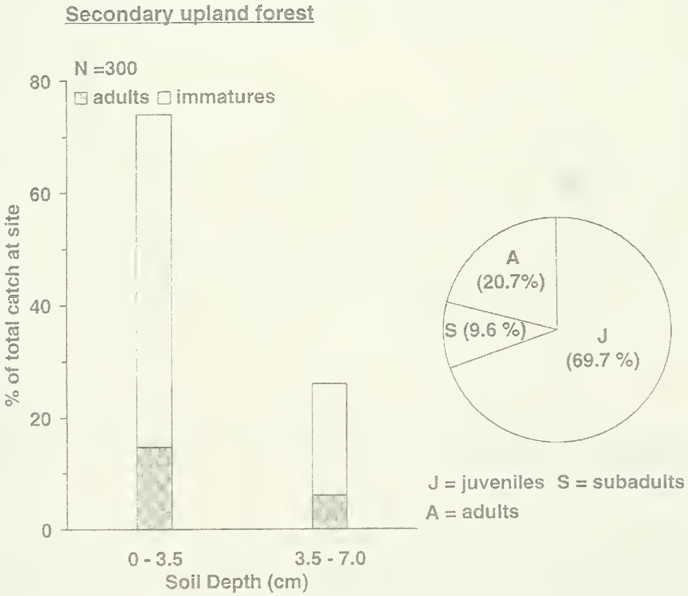

FIG. 2

Distribution of *Surazomus mirim* in the soil according to soil depth and percentage of developmental stages in a secondary upland forest near Manaus (total catch = 100%). Samples taken monthly at 0-3.5 and 3.5-7 cm depths between September 1982 and August 1983. (N = total number of specimens).

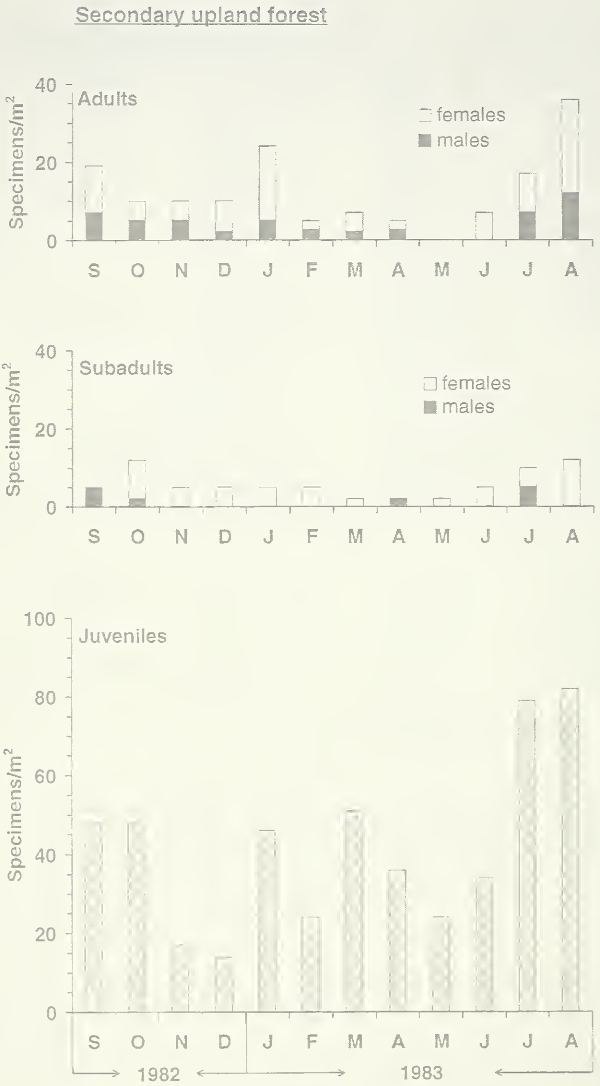

FIG. 3

Temporal occurrence of developmental stages of *Surazomus mirim* in the soil (N/m^2 in 0-7 cm depth) of a secondary upland forest near Manaus. Monthly samples taken between September 1982 and August 1983.

Kempson method as described above. Between 75% and 92% of all arthropods were found to inhabit the top 7 cm when Acari and Collembola were included in the total catch numbers and 69%-84% when they were omitted. Data on Schizomida are now available.

One study was conducted during October 1985 and April 1986 in a secondary upland forest on yellow latosol (Capoeira) at the INPA campus in Manaus (03°08'S.

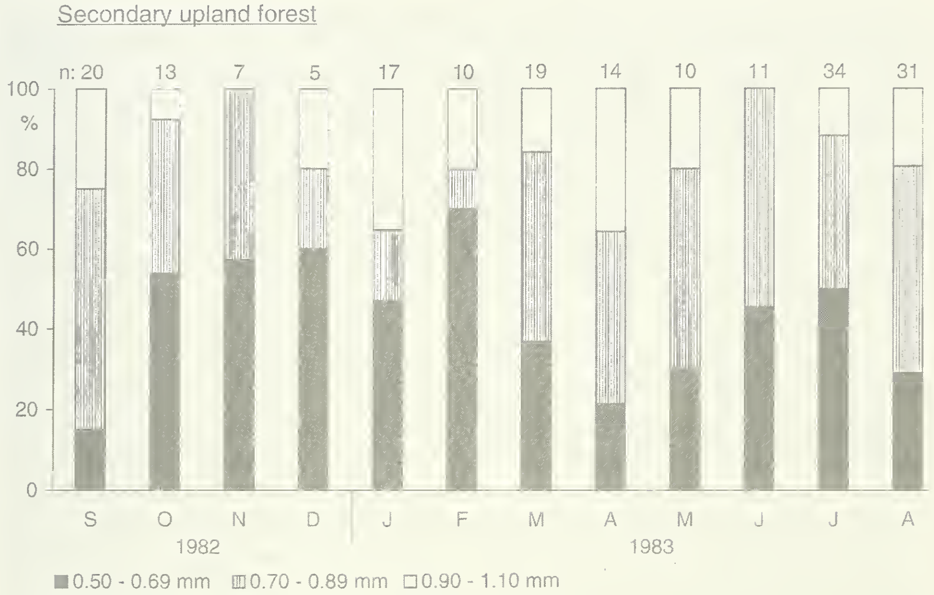

FIG. 4

Temporal occurrence of three tentatively assigned size classes (according to cephalothorax length) in juveniles of *Surazomus mirim*. Specimens, obtained from 0-7 cm soil depth, presumably represent the three developmental stages in nymphs, apart from the subadult stage. Monthly samples taken between September 1982 and August 1983 in a secondary upland forest near Manaus. (Number of specimens examined per month = 100%; 191 (91.4%) out of 209 juvenile specimens could be measured).

60°01'W), where the vegetation was previously cut but unburned (Adis *et al.*, 1987a,b). Schizomids represented 0.1% of the total number of arthropods when Acari and Collembola are included (dry season: 50.448 ind./m^2, rainy season: 63.850 ind./m^2) and 0.3-0.4% when they are omitted from the total catch numbers (dry season: 11.934 ind./m^2, rainy season: 17.886 ind./m^2). In the upper soil layer (0-7 cm depth), the abundance of schizomids during the dry season (48.1 ind./m^2) was similar to that of the rainy season (52.9 ind./m^2). No schizomids were caught in the mineral subsoil (7-14 cm) during both seasons. One species is presently known from this study site: *Surazomus manaus* (cf. Cokendolpher & Reddell, 2000).

Another study was made from August 1990 to February 1991 in a secondary upland forest on yellow latosol (Capoeira), about 50 km north of Manaus (03°34'S, 60°60'W), where the vegetation was previously cut and burned (Ribeiro, 1994). Schizomids represented <0.1% of the total number of arthropods when Acari and Collembola are included (dry season (Aug.-Oct.): 29.064 ind./m^2, rainy season (Dec.-Febr.): 19.793 ind./m^2) and 0.1% when they are omitted from the total catch numbers (dry season: 7.720 ind./m^2, rainy season: 7.176 ind./m^2). In the mineral subsoil (7-14 cm), the abundance of schizomids during the rainy season amounted to 9.6 ind./m^2 (50% of the total catch) but no specimens were here obtained during the dry season. The schizomid material from this study site was not available for identification.

A third study was made during March and August 1988 in a primary forest on whitesand soil (Campinarana), about 45 km north of Manaus (02°35'S, 60°01'W; Adis *et al.,* 1989a,b). Schizomids represented <0.1% of the total number of arthropods when Acari and Collembola are included (dry season: 57.703 ind./m^2, rainy season: 74.255 ind./m^2) and 0.2% when they are omitted from the total catch numbers (dry season: 14.119 ind./m^2, rainy season: 15.023 ind./m^2). The abundance of schizomids in the mineral subsoil (7-14 cm) during the dry season amounted to 14.5 ind./m^2 (50% of the total catch) but no specimens were here obtained during the rainy season. One species is presently known from this study site: *Surazomus brasiliensis* (cf. Cokendolpher & Reddell, 2000).

The fourth study was conducted during April and October 1987 in the primary upland forest on yellow latosol at Reserva Ducke (see above) (Adis *et al.,* unpubl.). Schizomids represented ≤ 0.1% of the total number of arthropods when Acari and Collembola are included (dry season: 38.727 ind./m^2, rainy season: 25.905 ind./m^2) and 0.1-0.2% when they are omitted from the total catch numbers (dry season: 11.742 ind./m^2, rainy season: 11.005 ind./m^2). The abundance of schizomids in the mineral subsoil (7-14 cm) during the dry and rainy seasons was similar (4.8 ind./m^2) and represented 20% and 50% of the total catch, respectively. Two species are presently known from this study site: *Adisomus duckei* and *Surazomus brasiliensis* (cf. Cokendolpher & Reddell, 2000).

All these data indicate that abundances of Schizomida (as well as of Palpigradi, Chilopoda and total Arthropoda) in formerly cut and unburned upland secondary forests on latosol of Central Amazonia are higher than in primary upland forests on latosol and whitesand soil. The reasons for this (e.g., different microclimates, more available food (particularly springtails, mites and termites) in secondary forests; cf. Adis, 1988; Morais, 1985; Rodrigues, 1986) remain to be clarified. However, in secondary upland forests which were formerly cut and burned, abundances of Schizomida, Chilopoda and total Arthropoda are generally lower within the first 15 years compared to primary forests (cf. Ribeiro, 1994).

Based on all studies hitherto realized on Central Amazonian schizomids in the Manaus region (cf. Cokendolpher & Reddell, 2000), *Adisomus duckei* and *Surazomus brasiliensis* might be potential bioindicators for primary upland forests whereas *S. mirim* and *S. rodriguesi* for secondary upland forests.

The low number of schizomids in samples from the ground photo-eclector in the secondary upland forest treated here indicates that representatives of this group were not active on the soil surface. This conclusion is supported by two other studies in the primary upland forest of the Reserva Ducke near Manaus: no schizomids were collected here in 20 baited pitfall traps and in one or several ground photo-eclectors during a sample period of 12 months (Adis *et al.,* 1999; Penny & Arias, 1982) or from tree crowns by fogging canopies with pyrethrum (cf. Adis *et al.,* 1998). Schizomida were not found in the soil of man-made pastures (0-14 cm depth) adjacent to upland forests in Central Amazonia. One reason for this might be the low humidity and high temperature of the soil around noon, particularly during the dry season (Adis & Franklin, unpubl.).

To which depth schizomids occur in the soil of Central Amazonian upland forests is unknown. Our studies in various forest types near Manaus (see above) revealed their presence to a soil depth of 14 cm.

Schizomids are easily mistaken for young spiders, particularly if their flagellum or front legs are broken. This might explain their "absence" in other studies on the Neotropical arthropod fauna in 0-30 cm soil depth (e.g. Harada & Bandeira, 1994a,b; Macambira, 1997; Serafino & Merino, 1978).

Parthenogenesis has been reported for several schizomid species (cf. Reddell & Cokendolpher, 1995). In *S. mirim* both sexes were present. However, more than twice as many females as males were captured. This was also observed in *S. brasiliensis* from the primary upland forest at Reserva Ducke near Manaus (Adis *et al.*, 1999) and in the euedaphic palpigrad *Eukoenenia janetscheki* Condé (Adis *et al.*, 1997a). Predominance of females assures the continuation of a species. The number of females in three species of Symphyla from the secondary upland forest at Rio Tarumã Mirím and the primary upland forest at Reserva Ducke was 2-4 times higher than of males (Adis *et al.*, 1997b).

Different schizomid species were recorded in Central Amazonian upland forests when compared to those found in Central Amazonian inundation forests (cf. Cokendolpher & Reddell, 2000). The presence of non-winged terricolous arthropods in the latter biotope requires flood resistance, horizontal migration according to the high-water line or vertical migration onto the trunk or into the canopy in response to annual flooding of 5-7 months duration (Adis, 1997). Reproduction cycle and duration of life stages have to be synchronized with the periodic fluctuations in water-level (cf. Adis, 1997, 1988; Adis *et al.*, 1997b). So far our field data indicate that *S. brasiliensis* (primary upland forest) and *S. mirim* (secondary upland forest) do not meet two of these premises: the species were not collected on or above the soil surface and had no distinct reproductive period.

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Réponse anormale du zoobenthos (oligochètes et chironomides) à la baisse du phosphore dans le lac de Neuchâtel

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Anomalous response of zoobenthos (oligochaetes and chironomids) to the decrease of phosphorus in Lake Neuchâtel. - In Lake Neuchâtel (Switzerland), total phosphorus concentrations in the water have decreased from 45 mg/m^3 in 1982 to 13 mg/m^3 in 1999. The response of oligochaete and chironomid communities to this improvement was studied at a depth of 40 m in 1992, 1997, and 2000. As expected, total biomass of zoobenthos decreased between 1992 et 2000. But the percentage of individuals belonging to species indicative of oligotrophic conditions (*Stylodrilus heringianus*, *Spirosperma velutinus* and *Micropsectra*) decreased from 33% in 1992 to 20% in 2000 instead of increasing to 48%, as predicted from the decrease of phosphorus concentrations. In the same time, the abundance of species indicative of mesotrophic conditions (*Potamothrix vejdovskyi* and *Limnodrilus hoffmeisteri* mostly) increased whereas that of species indicative of eutrophic conditions (*Potamothrix hammoniensis* and *Tubifex tubifex*) was unchanged. These anomalous responses could indicate either a restoration going astray for natural reasons or the presence in the sediment of pollutants (such as pesticides), inhibiting the reproduction of the less tolerant species.

Key-words: Chironomids - eutrophication - indicator - lake - oligochaete - pesticides - recovery - zoobenthos.

INTRODUCTION

Comme le Léman et d'autres lacs suisses (Fricker, 1980), le lac de Neuchâtel (215 km^2, 13.8 km^3, profondeur moyenne 64 m) a connu une phase d'eutrophisation croissante entre 1950 et 1980. Cependant, malgré l'augmentation de l'abondance des algues résultant de l'accroissement des concentrations en phosphore, les concentrations en oxygène ne sont jamais descendues en-dessous de 4 mg/l, même à -153 m la profondeur maximale (Pokorni, 2000). Cette particularité a été attribuée au fait que le lac, sur sa plus grande longueur, est orienté dans l'axe des deux vents dominants ce

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qui assure chaque année une circulation totale des eaux. A partir de 1982, la phase de dégradation a été suivie d'une phase de restauration sous l'effet des mesures d'assainissement prises dans le bassin versant (Pokorni, 2000). C'est ainsi que les concentrations moyennes en phosphore total, mesurées dans l'eau lors de la circulation totale, ont baissé de 45 mg/m^3 en 1982 à 13 mg/m^3 en 1999. Au cours de cette période, la densité des populations d'algues planctoniques a diminué à cause de la limitation croissante des nutriments (Pokorni, 2000) et le lac a passé d'un état méso-eutrophe à un état oligo-mésotrophe (Fricker, 1980).

La diminution de l'abondance des algues entraîne celle de la sédimentation organique (Baines & Pace, 1994) qui influence directement la composition du zoobenthos, c'est-à-dire la faune des sédiments profonds (Johnson *et al.*, 1993). Moins de sédimentation signifie moins de nourriture arrivant à la surface du sédiment mais plus d'oxygène disponible à l'interface eau-sédiment, dans cette fine couche d'eau de 5 à 20 mm d'épaisseur où respire la faune benthique (Brinkhurst, 1974). Cependant, lors de la phase de restauration, les concentrations en oxygène peuvent y rester longtemps inférieures à 1 mg/l même si elles dépassent déjà 8 mg/l quelques décimètres plus haut (Müller, 1992). Ce manque d'oxygène persistant va inhiber la reproduction de certaines espèces sensibles. De ce fait, le critère d'une restauration biologique réussie sera le rétablissement des communautés d'oligochètes et de chironomides qui colonisaient la zone profonde avant la phase d'eutrophisation croissante. Ce rétablissement permettra de conclure que l'amélioration observée au niveau de l'eau s'est étendue au sédiment (Hakanson & Jansson, 1983; Sas, 1989).

En 1918 (Monard, 1919), les espèces d'oligochètes indicatrices de conditions oligotrophes étaient présentes dans 90% des prélèvements effectués dans le lac de Neuchâtel. On peut estimer par analogie (aucun comptage de cette époque n'étant disponible) que les individus appartenant à ces espèces constituaient en moyenne 70% des communautés, comme dans un autre grand lac oligotrophe de la période contemporaine (Lang, 1990), le Lac Supérieur (Canada et USA). Ce pourcentage qui n'était plus que 16% en 1984 à 40 m de profondeur, après la phase d'eutrophisation croissante du lac de Neuchâtel, est remonté à 33% en 1992 en réponse à la baisse du phosphore (Lang, 1999). En 1997 cependant (Lang, 1999), l'abondance des espèces d'oligochètes oligotrophes diminue au profit de celle des espèces de chironomides (surtout *Micropsectra*). Ces autres espèces oligotrophes semblent avoir été favorisées par la présence d'algues planctoniques de grande taille qui se déposaient intactes sur le fond, leur fournissant ainsi une nourriture abondante. Les algues arrivent intactes sur le sédiment parce que la transparence accrue de l'eau leur permet de se développer normalement plus en profondeur (jusqu'à -40 m) qu'auparavant (Pokorni, 2000).

La présente étude analyse la composition du zoobenthos dans le lac de Neuchâtel en 2000. Son but est de déterminer si l'évolution particulière amorcée en 1997 se poursuit ou si le zoobenthos répond de nouveau à la baisse du phosphore comme celui du Léman, c'est-à-dire par une augmentation régulière de l'abondance des espèces d'oligochètes indicatrices de conditions oligotrophes (Lang, 1998, 2000b).

STATIONS ET MÉTHODES

Le zoobenthos de la rive sud du lac de Neuchâtel a été étudié en mai 1992, 1997 et 2000. Chaque année, 30 stations de prélèvements, localisées au moyen d'un récepteur GPS (sauf en 1992 où des repères terrestres ont été utilisés), sont visitées à six reprises. Distantes de 500 m les unes des autres, elles sont placées sur un transect de 15 km de longueur parallèle à la côte, qui va de Portalban à Font. Au cours de chaque visite, une carotte de sédiment d'une longueur de 30 cm, couvrant une surface de 16 cm^2, est prélevée à une profondeur moyenne de 40 m au moyen d'un carottier descendu depuis la surface.

En laboratoire, l'épaisseur des trois couches verticales qui constituent le sédiment récolté est mesurée. De la surface vers le fond, nous avons: la couche brune oxydée, la couche noire réduite et la couche d'argile grise. L'épaisseur de la couche noire donne une estimation grossière de la quantité de matière organique déposée (Hakanson & Jansson, 1983) ce qui permet de classer les stations de prélèvements en fonction de l'intensité de la sédimentation organique (Lang, 1998). Après cette inspection visuelle effectuée en 1997 et 2000 seulement, le sédiment est tamisé (vide de maille: 0.2 mm) et le refus du tamis est conservé dans du formol 5%. Les tubificidés, les lumbriculidés et les larves de chironomides, séparés du sédiment et comptés sous une loupe, sont ensuite pesés (biomasse totale) après passage sur du buvard pour enlever l'eau en excès. Seuls les oligochètes dont le diamètre dépasse 0.29 mm, sont montés (Reymond, 1994) et identifiés. De cette façon, les jeunes individus dont les variations saisonnières influencent trop l'estimation de l'abondance des espèces, sont éliminés (Lang, 1999).

Les larves de chironomides sont identifiées d'après Wiederholm (1983) et la valeur indicatrice des taxons est donnée par Saether (1979). En 1997 et 2000, les chironomides sont comptés et identifiés dans chaque carotte séparément. En 1992 au contraire, si les larves sont également comptées carotte par carotte, elles sont seulement identifiées en bloc dans l'ensemble des carottes. Le pourcentage de chironomides exprimé par rapport à l'abondance totale des oligochètes et des chironomides peut être utilisé comme indicateur parce qu'il tend à augmenter lorsque l'état d'un lac s'améliore (Wiederholm, 1980).

Les espèces d'oligochètes sont classées en trois groupes d'après leur valeur indicatrice (Lang, 1990): celles qui indiquent des conditions oligotrophes (Tab. 1: espèces 1 à 3), mésotrophes (espèces 4 à 7) ou eutrophes (espèces 8 et 9). Les deux espèces du genre *Limnodrilus* sont classées comme indicatrices de conditions mésotrophes sur la base des tendances observées dans le Léman (Lang, 2000b), contrairement à leur précédente classification comme espèces eutrophes (Lang 1998). Elles sont comptées ensemble parce que leurs immatures ne peuvent pas être différenciés avec certitude. Pour la même raison, les deux espèces eutrophes sont analysées en bloc. Pour chaque espèce ou pour chaque groupe d'espèces, la fréquence (le nombre de carottes dans lesquelles l'espèce est présente), l'abondance (le nombre d'individus présents par m^2) et l'abondance relative (définie ci-dessous) sont déterminées.

Comme celle des autres espèces, l'abondance relative des espèces indicatrices de conditions oligotrophes, appelées pour simplifier espèces oligotrophes (EO), est calculée en rapportant, sous forme de pourcentage, le nombre d'individus appartenant à ces espèces au nombre total de tubificidés et de lumbriculidés adultes (diamètre > 0.29 mm) présents dans une carotte. En 1997 et 2000, l'abondance relative des espèces d'oligochètes et de chironomides indicatrices de conditions oligotrophes est calculée pour chaque carotte de la même façon que pour les oligochètes. En 1992, elle est calculée seulement à partir du nombre total d'individus présents dans les carottes parce que les chironomides n'ont pas été identifiés carotte par carotte. Cependant, vu la rareté des espèces de chironomides oligotrophes en 1992 (Lang, 1999), l'abondance relative des espèces d'oligochètes oligotrophes permet d'estimer de façon satisfaisante l'état du sédiment.

Les variations de l'abondance des espèces entre 1992 et 2000 sont comparées d'abord au niveau des 30 stations considérées en bloc et ensuite au niveau de trois groupes de 10 stations définissant trois zones: la zone 1 (stations 1 à 10) qui s'étend de Portalban à Chevroux, la zone 2 de Chevroux à la Corbière (stations 11 à 20) et la zone 3 de la Corbière à Font (stations 21 à 30).

Les abondances relatives moyennes de EO obtenues pour ces différents ensembles sont comparées aux valeurs de référence suivantes (Lang, 1990): EO est égal à zéro si les conditions à la surface du sédiment sont celles d'un milieu eutrophe, les valeurs de EO varient entre 1% et 17% dans un milieu méso-eutrophe, entre 18% et 52% (valeur centrale: 35%) dans un milieu mésotrophe, entre 52% et 69% dans un milieu oligo-mésotrophe, enfin EO dépasse 69% dans un milieu oligotrophe.

L'abondance relative (%) moyenne de EO peut également être calculée (EOC) à partir des concentrations moyennes (mg/m^3) en phosphore total (PT) mesurées dans l'eau du lac au cours des 5 années précédant le prélèvement du zoobenthos (Lang, 1990):

$$\mathrm{EOC} = 80.29 - 8.35\ \mathrm{PT}^{0.5} \quad (r^2 = 0.81,\ n = 15).$$

Cette relation empirique est basée sur 15 campagnes effectuées dans 6 lacs d'Europe et 3 lacs d'Amérique du Nord dont le Lac Supérieur. Les concentrations moyennes du PT sur 5 ans sont utilisées parce que le zoobenthos ne réagit pas immédiatement à une variation de ce nutriment (Lang, 1998). Si la valeur moyenne de EO observée dans une série de prélèvements est inférieure à EOC, la valeur calculée, cela signifie que la restauration de l'état biologique du sédiment est en retard par rapport à l'état trophique indiqué par PT. Ce retard peut être causé par un manque d'oxygène, par un excès de sédimentation organique ou par la présence de substances toxiques (Lang & Reymond, 1996).

La biomasse du zoobenthos (g/m^2) est également calculée à partir des concentrations en phosphore total dans l'eau (mg/m^3) en utilisant la relation empirique suivante établie dans d'autres lacs:

$$\log_{10} \text{biomasse} = 0.708 \log_{10}\text{phosphore} + 0.092 \quad \text{(Hanson \& Peters, 1984)}$$

Les valeurs calculées sont ensuite comparées aux valeurs observées.

TABLEAU 1. - Communautés d'oligochètes et de chironomides du lac de Neuchâtel à 40 m de profondeur en 1992 (n = 171), en 1997 (n = 175) et en 2000 (n = 180). Espèces: (1) *Bichaeta sanguinea* Bretscher, (2) *Stylodrilus heringianus* Claparède, (3) *Spirosperma velutinus* Grube, (4) *Spirosperma ferox* (Eisen), (5) *Potamothrix vejdovskyi* (Hrabe), (6) *Limnodrilus hoffmeisteri* (Claparède), (7) *Limnodrilus profundicola* (Verrill), (8) *Potamothrix hammoniensis* (Michaelsen), (9) *Tubifex tubifex* (Müller), (10) toutes les espèces de chironomides (Lang 1999, Tab. 3), (11) seulement les espèces de chironomides oligotrophes (*Micropsectra* surtout)

	Fréquence (%)				Nombre d'individus par m^2				Abondance relative (%)			
Espèce	1992	1997	2000	P[a)]	1992	1997	2000	P[b)]	1992	1997	2000	P[b)]
1	20.5	12.6	27.2	0.003	157[c)]	82	205	0.003	7.3	5.1	9.6	- [d)]
					(26)	(17)	(30)	-	(1.3)	(1.2)	(1.6)	
1 et 2	46.8	16.6	28.3	0.000	555	107	212	0.000	24.4	6.6	9.9	-
					(60)	(19)	(30)	-	(2.5)	(1.4)	(1.6)	
3	19.3	11.4	11.7	0.057	164	82	76	0.057	8.6	4.8	3.2	-
					(30)	(18)	(16)	-	(1.6)	(1.2)	(0.8)	
1 à 3	59.1	28.0	35.6	0.000	720	189	288	0.000	33.0	11.4	13.1	0.000
					(63)	(24)	(37)	0.043	(2.7)	(1.7)	(1.7)	0.000
4	13.5	19.4	20.0	0.209	102	129	153	0.209	5.4	7.0	5.7	-
					(22)	(20)	(26)	-	(1.3)	(1.3)	(1.0)	
5	23.4	42.9	51.1	0.000	259	696	1118	0.000	9.2	23.5	24.8	-
					(47)	(84)	(118)	0.000	(1.5)	(2.4)	(2.1)	
6 et 7	28.1	49.1	64.4	0.000	289	661	931	0.000	12.0	24.7	26.6	-
					(49)	(78)	(81)	0.001	(1.8)	(2.4)	(2.0)	
8 et 9	67.3	62.0	68.3	0.442	895	821	875	0.318	40.4	33.4	29.9	-
					(74)	(76)	(72)	0.000	(2.8)	(2.6)	(2.2)	
10	80.1	84.0	62.8	0.000	979	1693	746	0.000	12.9	21.4	10.0	0.000
					(66)	(139)	(60)	0.233	(1.0)	(1.5)	(0.9)	0.000
11	-	73.1	36.1	0.000	-	1211	337	0.000	-	63.0	30.2	-
						(127	(43)	-		(3.2)	(3.2)	
1 à 3	-	79.4	58.9	0.000	-	1400	625	0.000	-	35.0	20.1	0.000
11						(131)	(56)	-		(2.1)	(1.8)	0.000

a) Probabilité associée avec le test de Chi^2

b) Probabilité associée avec l'analyse de variance: effet de l'année (en haut), effet de la zone (en dessous)

c) Valeur moyenne et erreur standard en dessous (entre parenthèses)

d) Résultats manquants ou tests statistiques non calculés

RESULTATS

Dans le lac de Neuchâtel, la fréquence et l'abondance des espèces d'oligochètes indicatrices de conditions oligotrophes diminuent entre 1992 et 2000 à 40 m de profondeur (espèces 1 à 3, Tab. 1). C'est l'espèce *Stylodrilus heringianus* qui décroît le plus. Dans le même temps, l'abondance des espèces caractéristiques des lacs eutrophes, *Potamothrix hammoniensis* et *Tubifex tubifex*, ne change pas. Au contraire, l'espèce mésotrophe *Potamothrix vejdovskyi* qui a colonisé le lac de Neuchâtel à partir de 1984 (Lang, 1999), devient de plus en plus abondante. *Limnodrilus hoffmeisteri* et, dans une moindre mesure, *L. profundicola* suivent la même évolution. Dans le Léman (Petit Lac), l'augmentation de ces deux espèces dans la zone profonde (entre 40 et 70 m) entre 1994 et 1999 a été interprétée comme indiquant une amélioration de l'état du sédiment (Lang, 2000b).

Les espèces de chironomides indicatrices de conditions oligotrophes, en particulier *Micropsectra*, dont l'abondance accrue en 1997 avait compensé la baisse de celle des oligochètes oligotrophes (Lang, 1999), deviennent moins abondantes en 2000 (Tab. 1). Le pourcentage du nombre des chironomides par rapport à celui des oligochètes qui avait augmenté à 21% en 1997, retombe d'ailleurs à 10% en 2000. La biomasse du zoobenthos diminue entre 1992 et 2000 en réponse à la baisse du phosphore (Fig. 1a). La valeur moyenne observée en 2000, 6.5 g/m^2, est d'ailleurs très proche de 8.4 g/m^2, la biomasse calculée à partir d'une concentration en phosphore de 15 mg/m^3 (voir Stations et méthodes).

Les biomasses (Fig. 1a) diminuent entre la zone 1 (Portalban) et la zone 3 (Font). La colonisation des sédiments par *P. vejdovskyi*, l'espèce en expansion dans le lac, est plus rapide dans la zone 1 que dans la zone 3 (Fig. 1b). L'abondance des deux espèces eutrophes typiques diminue également entre les zones 1 et 3 (Fig. 2a). Les nombres de chironomides qui ne sont pas significativement différents entre les trois zones (Tab. 1), sont particulièrement élevés en 1997 (Fig. 2b). L'abondance relative des individus appartenant à des espèces d'oligochètes et de chironomides indicatrices de conditions oligotrophes diminue entre 1992 et 2000 (Fig. 3). Les pourcentages observés augmentent entre les zones 1 et 3. En 2000, les espèces oligotrophes ne constituent que le 30.1% du zoobenthos dans la zone 3, la plus favorable. Or, d'après la concentration du phosphore mesurée dans l'eau (15 mg/m^3), cette valeur devrait être de 47.9% (voir Stations et méthodes).

La composition du zoobenthos se modifie entre les zones 1 et 3 comme elle le ferait dans un gradient de sédimentation organique décroissante (Lang, 2000b). Les caractéristiques du sédiment récolté confirment cette interprétation: l'épaisseur de la couche noire oxydée diminue entre Portalban et Font (Fig. 4). Cette diminution indique que le sédiment devient de plus en plus compact, donc moins liquide et moins organique (Hakanson & Jansson, 1983). Ces différences pourraient résulter du fait que, à la profondeur des stations de prélèvements, la pente du fond augmente entre Portalban et Font. De ce fait, la matière organique s'accumule davantage au niveau des stations du côté de Portalban que du côté de Font, où elle va glisser et se concentrer (focusing) plus en profondeur (Blais & Kalff, 1995).

DISCUSSION

Si le zoobenthos du lac de Neuchâtel avait réagi de la même façon que celui du Léman à la baisse des concentrations en phosphore dans l'eau (Lang, 1998, 2000b), l'abondance relative des espèces indicatrices de conditions oligotrophes aurait augmenté régulièrement entre 1984 et 2000 dans les communautés d'oligochètes présentes à 40 m de profondeur. Cette évolution a certes été observée entre 1984 et 1992 (Lang, 1999), mais elle ne s'est pas poursuivie entre 1997 et 2000. En 1997 (Lang, 1999), les espèces de chironomides oligotrophes ont pris de l'importance par rapport aux oligochètes, faisant croire qu'elles allaient à l'avenir dominer le zoobenthos, avant de diminuer à nouveau en 2000. De ce fait, l'abondance relative des

Fig. 1a

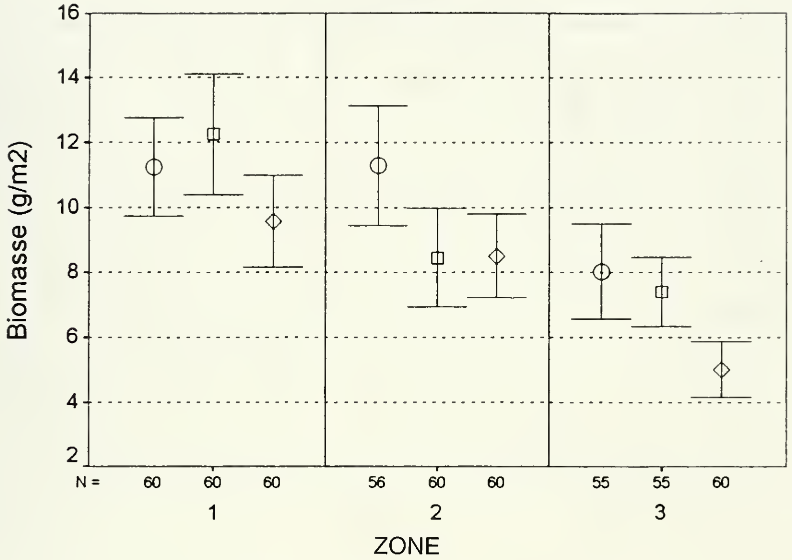

Fig. 1b

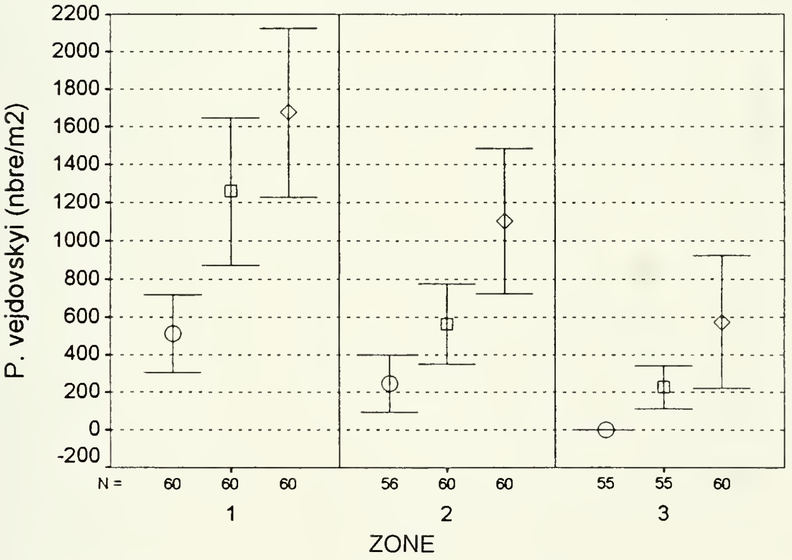

FIG. 1. – 1a. Variations de la biomasse moyenne du zoobenthos (g/m^2) avec l'intervalle de confiance de 95% dans les trois zones du lac de Neuchâtel visitées en 1992 (cercles), en 1997 (carrés) et en 2000 (losanges). La zone 1 s'étend de Portalban à Chevroux, la zone 2 de Chevroux à la Corbière, la zone 3 de la Corbière à Font. N = nombre de carottes de sédiment récoltées dans chaque zone pour chaque année. – 1b. Variations du nombre moyen par m^2 de *Potamothrix vejdovskyi* en fonction de la zone et de l'année.

Fig. 2a

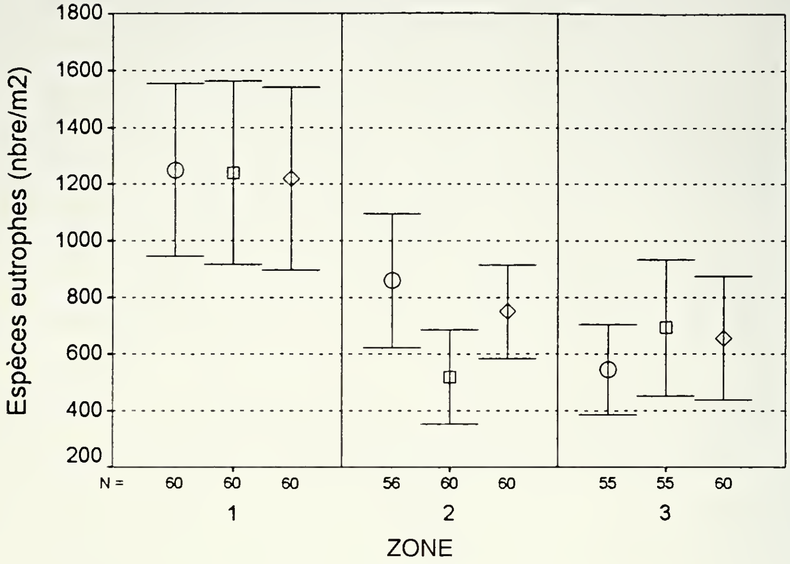

Fig. 2b

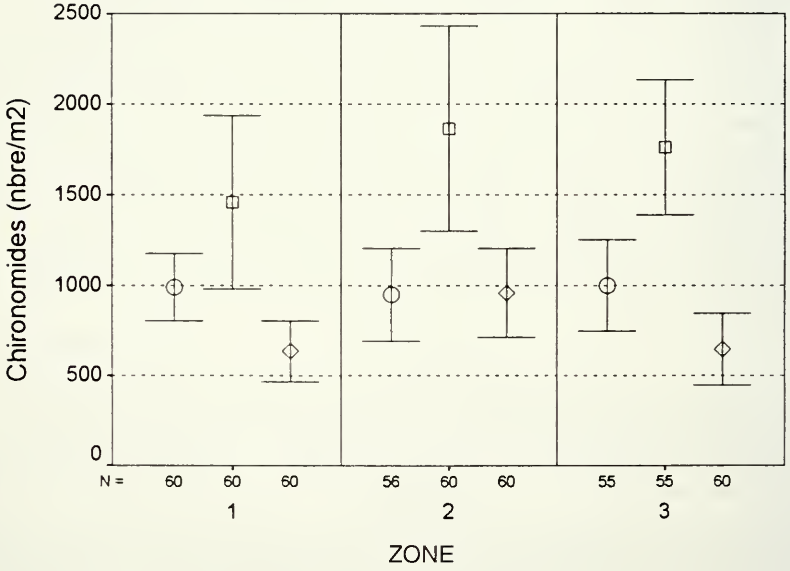

FIG. 2. – 2a. Variations du nombre moyen par m^2 des espèces d'oligochètes eutrophes (Tab. 1, espèces 8 et 9) en fonction de la zone et de l'année (légende voir Fig. 1a). – 2b. Variations du nombre moyen par m^2 des larves de chironomides en fonction de la zone et de l'année.

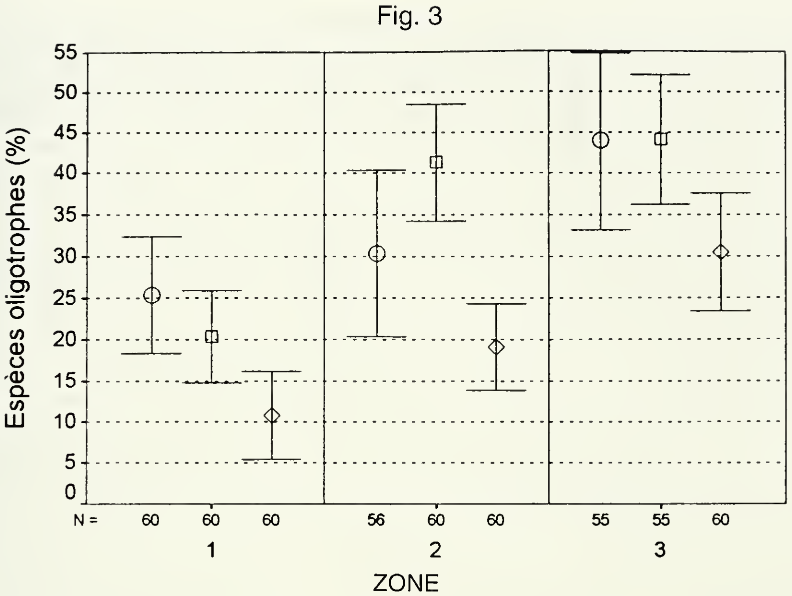

FIG. 3. Variations du pourcentage d'individus appartenant à des espèces d'oligochètes et de chironomides oligotrophes (Tab. 1, espèces 1 à 3 et espèce 11) en fonction de la zone et de l'année (légende voir Fig. 1a).

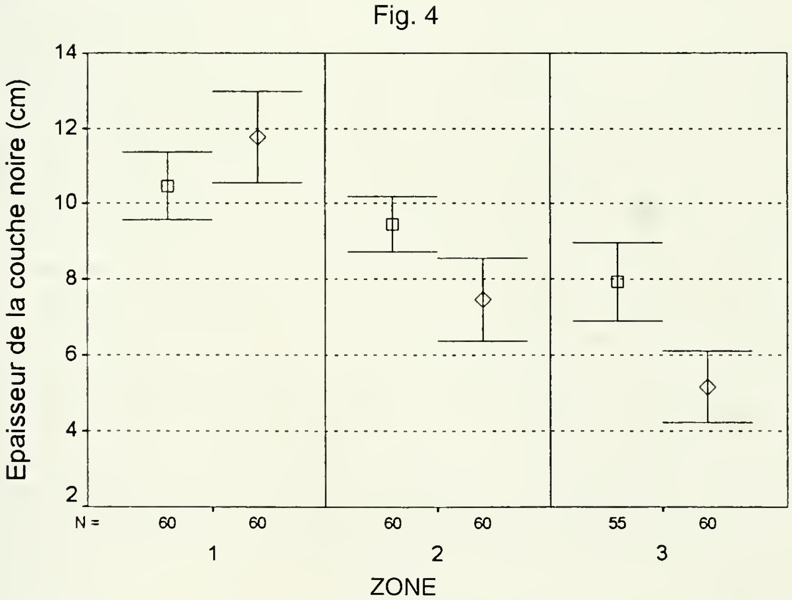

FIG. 4. Variations de l'épaisseur moyenne (cm) de la couche de sédiment noir en fonction de la zone et de l'année (1992: pas de résultats; 1997: carrés; 2000: losanges).

individus appartenant à des espèces d'oligochètes et de chironomides indicatrices de conditions oligotrophes diminue, passant de 33% en 1992 à 20% en 2000 dans le lac de Neuchâtel (Tab. 1). Or, d'après la baisse des concentrations en phosphore dans l'eau, cette valeur devrait être proche de 48% en 2000. La biomasse du zoobenthos diminue au contraire en accord avec la baisse du phosphore (voir Résultats). En d'autres termes, le zoobenthos réagit de façon conforme aux prévisions sur le plan quantitatif (biomasse), mais pas sur le plan qualitatif (composition de la communauté). Comme dans le lac de Neuchâtel, la biomasse des oligochètes diminue dans le lac de Constance en réponse à la baisse du phosphore mais les espèces oligotrophes, pour une raison encore inexpliquée, sont absentes en 1992 et en 1994 entre 50 m et 250 m de profondeur (Wagner *et al.*, 1998). Pourtant l'une de ces espèces, *Stylodrilus heringianus*, était encore présente dans cette zone en 1985 (Probst, 1987).

Dans la zone profonde d'un lac eutrophe comme le lac de Morat (Lang, 2000a), *Tubifex tubifex* et *Potamothrix hammoniensis* constituent presque 90% des communautés d'oligochètes. Si la diminution de l'abondance des espèces oligotrophes entre 1992 et 2000 signifiait que le lac de Neuchâtel se rapproche à nouveau de l'état méso-eutrophe de 1982, l'abondance relative de ces deux espèces caractéristiques des lacs eutrophes aurait augmenté. Leur diminution entre 1992 et 2000 (Tab. 1) au profit des espèces mésotrophes indique au contraire que la restauration du lac se poursuit, mais dans une direction différente de celle prise par le Léman (Lang, 2000b).

L'augmentation spectaculaire de l'espèce mésotrophe *Potamothrix vejdovskyi* entre 1992 et 2000 montre la capacité qu'ont certaines espèces introduites à coloniser un nouveau milieu: cette espèce qui n'était en effet pas présente dans le lac de Neuchâtel en 1980, y a été observée pour la première fois en 1984 (Lang, 1999). Son extension pourrait avoir été favorisée par l'augmentation de la température de l'eau (Lang, 1998) qui a été constatée au cours de cette période (Pokorni, 2000). Dans le Léman, où cette espèce était bien installée en 1950 déjà (Juget, 1967), son abondance a augmenté aux dépens de celle des espèces oligotrophes lors de l'accroissement des concentrations en phosphore avant de suivre la tendance inverse pendant la phase de restauration (Lang, 1998, 2000b). L'évolution de cette espèce mésotrophe et des espèces oligotrophes dans le lac de Neuchâtel entre 1992 et 2000, en phase d'eutrophisation décroissante, ressemble donc à celle qui s'est déroulée dans le Léman lors de la phase d'eutrophisation croissante. Toutefois cette comparaison n'est valable qu'en terme d'importance relative, les nombres d'individus par m^2 restant bien inférieurs dans le lac de Neuchâtel. Notons enfin que, dans le Léman, *P. vejdovskyi* colonise des sédiments nettement plus pollués par les métaux lourds que ceux où se rencontrent les espèces oligotrophes (Lang & Lang-Dobler, 1979). La reproduction de cette espèce est donc favorisée par une augmentation de la température de l'eau, tout en étant moins inhibée par la présence de substances toxiques que celle des espèces oligotrophes.

La façon dont la composition du zoobenthos se modifie entre 1992 et 2000 montre que le lac de Neuchâtel s'écarte de l'évolution que la baisse des concentrations en phosphore permettait de prévoir. Comme dans le lac de Constance (Wagner *et al.*, 1999) et contrairement au Léman (Lang, 1998, 2000b), les espèces indicatrices de conditions oligotrophes ne redeviennent pas abondantes dans les communautés benthiques. En simplifiant, cette évolution inattendue peut être interprétée de deux façons opposées: soit il s'agit d'un phénomène naturel, soit d'une pollution par des substances toxiques.

La première explication peut s'énoncer ainsi: lorsque le phosphore diminue, l'abondance des espèces oligotrophes n'augmente pas toujours de façon continue (comme dans le Léman) mais parfois de façon discontinue ou cyclique (comme dans les lacs de Neuchâtel et de Constance). Ces cycles d'abondance varient d'amplitude d'une année à l'autre en fonction de l'impact des conditions météorologiques sur la nutrition et la reproduction du zoobenthos. La situation observée en 1992 résulterait ainsi du succès de la reproduction des oligochètes oligotrophes au cours des années précédentes; en 1997, ce sont les chironomides qui auraient été favorisés et les oligochètes défavorisés par la sédimentation d'algues de grande taille (Lang, 1999); en 2000 au contraire, aucun des deux groupes n'atteint un sommet d'abondance, d'où une baisse générale des espèces oligotrophes. Si cette interprétation est correcte, les campagnes de prélèvements ne devraient plus être effectuées tous les trois ou cinq ans seulement, mais chaque année de manière à pouvoir saisir les différentes phases de cette évolution discontinue. Cependant, si cette stratégie était adoptée, le nombre de prélèvements à analyser chaque année deviendrait excessif en regard des moyens disponibles. Il faudrait donc diminuer la surveillance biologique des autres lacs et cours d'eau du canton de Vaud.

La deuxième explication possible serait la présence, au sein du sédiment et de l'eau interstitielle, de substances toxiques qui perturberaient davantage la reproduction des espèces oligotrophes que celle d'autres espèces plus résistantes, telles que *P. vejdovskyi*. La composition du zoobenthos serait ainsi infléchie dans une direction différente de celle que la baisse du phosphore laissait prévoir. Pour illustrer les effets subtils des toxiques, notons, par exemple, que le nombre de trichoptères du genre *Limnephilus* capables de se reproduire normalement diminue significativement lorsqu'une concentration de lindane de 1 ng/l est atteinte (Schulz & Liess, 1995). Dans le même ordre d'idée, de faibles concentrations de pesticides empêchent le rétablissement de la diversité des plécoptères, des éphéméroptères et des trichoptères dans certaines rivières vaudoises (Lang *et al.*, 2000). Pour le moment, un seul fait laisse supposer que la situation décrite ci-dessus pourrait s'appliquer au lac de Neuchâtel: les concentrations en atrazine qui atteignent 100 ng/l dans l'eau du lac (B. Pokorni, com. pers.), soit le double de celles mesurées dans le Léman (Blanc *et al.*, 2000). Signalons enfin que les effets de la météorologie et de substances toxiques sur la reproduction du zoobenthos pourraient parfaitement se combiner.

En conclusion, l'étude du zoobenthos complète utilement les analyses classiques basées sur la chimie de l'eau (nutriments et oxygène) et les algues planctoniques (Sas, 1989). En effet, seules les variations de la composition du zoobenthos, convenablement interprétées, permettent de détecter certaines anomalies dans le déroulement de la restauration biologique des sédiments profonds. Une fois les causes de ces anomalies identifiées, il devient possible de prendre, le cas échéant, des mesures correctives. En ce qui concerne le lac de Neuchâtel, les causes exactes de l'anomalie détectée entre 1992 et 2000 restent encore à déterminer. Il faut donc poursuivre la surveillance biologique des sédiments en l'intensifiant et la compléter, si nécessaire, par une étude écotoxicologique.

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A new species of *Harpactus* Shuckard (Hymenoptera: Sphecidae) from the Balkan Peninsula

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A new species of *Harpactus* Shuckard (Hymenoptera: Sphecidae) from the Balkan Peninsula. - The new species *Harpactus priscus* is described from several localities of Bulgaria, based on five males.

Key-words: Hymenoptera - Sphecidae - *Harpactus* - taxonomy.

INTRODUCTION

Since the first member of the genus *Harpactus* was described in 1792 by Latreille, 101 species and subspecies names have been proposed. A total of 72 species and 7 subspecies are valid now. Species of the genus occur in the Afrotropical, Holarctic and Oriental zoogeographic Regions.

Thirteen species of *Harpactus* are currently known from the Balkan Peninsula: *affinis* (Spinola), *consanguineus* (Handlirsch), *croaticus* Vogrin, *elegans* (Lepeletier), *exiguus* (Handlirsch), *formosus* (Jurine), *laevis* (Latreille), *lunatus* (Dahlbom), *moravicus* (Snoflak), *niger* (A. Costa), *picticornis* Vogrin, *tauricus* Radoszkowsky, and *tumidus* (Panzer) (Handlirsch, 1888, 1895; Maidl, 1922; Vogrin, 1954; de Beaumont, 1965, 1967; Scobiola-Palade, 1967, 1972, 1974; Barbier, 1992; Ljubomirov, 1996; Lyubomirov, 2000 among others). Two of them, *croaticus* and *picticornis* are probably endemic. The species described below is supposed to be endemic as well.

Abbreviations used in description are: AOD, anterior ocellus diameter; OOL, shortest distance from a posterior ocellus to nearer eye margin; POL, shortest distance between posterior ocelli; PD, puncture diameter.

Harpactus priscus sp. n. Figs 1, 3, 5

Material examined : Holotype: male, Bulgaria: Iskar Valley: 1km NW Passarell vill. - 820m, 9. VII. 1995, T. Ljubomirov. Paratypes: 3 males, Bulgaria: Strouma Valley: Yavorov Station - 210m, 1. V. - 1. VI. 1993, Moericke trap, V. Sakalian; 1 male, Bulgaria: Tundza Valley: Lessovo vill. - 80m, 24. V. 1995, I. Stoyanov. Holotype and one paratype (from Strouma Valley; genitalia lost) are deposited in the collection of Muséum d'histoire naturelle, Geneva. Other material is deposited in the authors collection, Institute of Zoology, Bulgarian Academy of Sciences.

DIAGNOSIS

The following combination of features differs *Harpactus priscus* sp. n. from other species of the genus: 1. Body without clear-cut red coloration; 2. Gastral terga

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I-V with ivory white bands at least lateroapically; 3. Propodeal enclosure 1.7x as wide as long, entirely smooth (excluding median longitudinal furrow); 4. Body setae scattered, not concealing integument.

DESCRIPTION (holotype)

Colour. Black with extensive pale coloration. Following structures yellow: scape and pedicel (except black above); flagellum beneath; clypeus; labrum; mandible except reddish brown apex; subantennal sclerite; band along ventral 3/4 of inner orbits (width of band equal to antennal socket diameter); the three apical maxillary palpimeres; collar and pronotal lobe; small spot on tegula; scutellum; small spot on mesosternal surface in front of midcoxae; fore- and midtibiae and tarsi entirely; fore- and midfemora in front, beneath and apically; apical half of fore coxae; apical spots on midcoxae and midtrochanters; extreme apex of hindfemur on outer surface; hindtibiae in front, beneath and apically. Following structures ivory white: transverse subapical band on gastral tergum I, narrowly interrupted in middle and slightly broadened laterally; transverse subapical band on gastral tergum II largely narrowed in middle; transverse subapical bands on gastral terga III and IV almost equal in width medially and laterally; slightly broadened in middle transverse subapical spot on gastral tergum V. Following testaceous to reddish: small spots behind vertex adjacent to orbit, one behind each eye; apical half of gastral tergum I (excluding ivory white coloration); hindtarsi. Wings clear, veins dark brown.

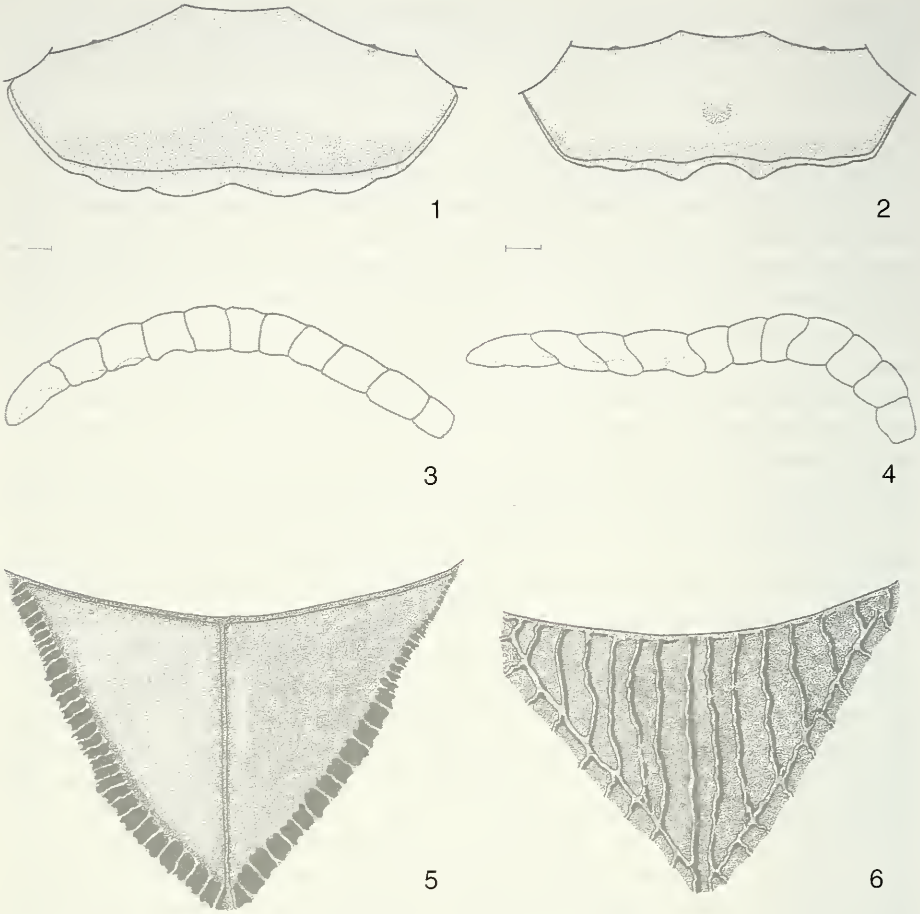
Structure. Head in frontal view subcircular. Clypeus moderately convex, clypeal free margin with translucent lip wide about 1/6 of clypeal height (Fig. 1), clypeal surface finely granulated with shallow punctures which are one diameter apart from each other (PD=1/4 AOD). Labrum finely granulated, dull, its free margin without notch. Frons finely granulated, dull in lower half and relatively shining in upper. On the upper half micropunctures separated by 0.5x of their own diameters (PD=1/8 AOD) as well as macropunctures separated by 1.0-2.0x of their own diameters (PD=1/4 AOD) are present. Diameter of antennal sockets equal to 1.2x AOD, space between antennal sockets - 0.75x AOD, shortest distance between each antennal socket and nearer eye margin equals to AOD, shortest distance between antennal socket and frontoclypeal suture - 0.5x AOD. Vertex shiny, with micropunctures slightly smaller and rather scattered than on upper frons but obviously denser in intraocellar area. OOL:POL=2:1. Posterior ocelli placed at the level of posterior ocular margins. Head behind punctured as vertex but macropunctures become slightly scattered downward. Flagellomeres I to VII without notches, flagellomeres VIII to X each with shallow preapical notch ventrally (notch on flagellomer VIII deepest), flagellomer XI slightly incurved (Fig. 3.). Pronotal collar finely granulated with posterior margin narrowly translucent. Scutum with regular micropunctures separated by 0.5-1.0x their own diameters (PD=1/10 AOD), and with macropunctures separated by 1.0-3.0x of their own diameters (PD=1/4 AOD). Scutellum shiny, with micropunctures sparser than scutal micropunctures and with macropunctures separated by 2.0-6.0x of their own diameters (PD=1/5 AOD). Metanotum with macropunctures same as scutellum, micropunctures are denser forming irregular groups. Mesopleuron shiny, with micropunctures separated by 0.5-2.0x of their own diameters (PD=1/8-1/9 AOD) and macropunctures presented mainly in central area where they are separated by 0.5-1.0x of their own diameters (PD=1/3-1/4 AOD). Metapleuron less shiny, with micropunctures same as mesopleuron, without macropunctures. Propodeal enclosure (Fig. 5.) 1.7x as wide as long, smooth, with deep median furrow, with subcontiguous micropunctures (PD=1/10 AOD), and without macropunctures; remaining dorsum sculptured as propodeal enclosure. Hind propodeal surface sculptured as propodeal enclosure but micropunctures are rather scattered and fine: in upper half micropunctures separated by 2.0 - 3.0x of their own diameters but in lower half become 4.0-5.0x of their own diameters. In the upper end of hind propodeal surface just behind the apex of propodeal enclosure is placed deep fossa giving downward median carina. Propodeal sides sculptured as propodeal enclosure but relatively dull before spiracular grooves. First gastral tergum shiny, finely microrugose, with micropunctures separated by 1.0-1.1x of their own diameters (PD=1/9 AOD) slightly sparser in apical half, and macropunctures separated by 2.0 - 4.0x of their own diameters (PD=1/6 AOD). Second gastral tergum shiny, finely transversely microrugose (but coarser than first tergum), with micropunctures separated by 1.0-1.5x of their own diameters (PD=1/8 AOD) and with macropunctures separated by 1.0-2.5x of their own diameters (PD=1/4 AOD). Remaining visible terga (excluding seventh) shiny, with micropunctures separated by 0.5-1.0x of their own diameters (PD=1/8 AOD), and with macropunctures separated by 2.0-4.0x of their own diameters (macropunctures are not present in anterior third of each tergum). Second gastral sternum shiny, finely microsculptured, with micropunctures separated by 1.0-2.0x their own diameters (PD=1/9 AOD), and with macropunctures separated by 1.0-2.0x of their own diameters (PD=1/5 AOD). Remaining visible sterna with the same but somewhat weaker sculpture.

Vestiture. Body setae appressed to suberect, not concealing integument. Upper clypeal half and face under antennal sockets covered with appressed silvery setae as long as 0.6-1.3x AOD. Same type of pubescence occurs on mesopleuron in front of omaulus and ventrally in front of midcoxae, apicolaterally on dorsal propodeal surface and behind spiracular groove on propodeal sides. Rest of the body covered with greyish suberect pubescence (setae averaging about 1.0x AOD excluding vertex, where setae are as long as 1.2-1.3x AOD).

Length. 6.1mm.

VARIATION

The paratype from Tundza Valley has no reddish coloration behind vertex nor on gastral tergum I; ivory white subapical spot on gastral tergum V is not broadened in middle, whitish subapical bands on gastral terga III and IV are slightly interrupted in middle. Paratypes from Strouma Valley have much more reduced reddish coloration (adjacent just to ivory white coloration) on gastral tergum I compared to the holotype; whitish subapical bands on gastral terga III and IV are slightly interrupted in middle; propodeal enclosure has several irregular obscure rugae in anterior half; gastral sternum II is slightly coarser micropunctured. The paratype from Tundza



FIGS 1-6

1: *Harpactus priscus* sp. n.. holotype - clypeus. 2: *Harpactus quinquefasciatus* Kazenas, holotype - clypeus. 3: *Harpactus priscus* sp. n., paratype. Strouma Valley - flagellum. 4: *Harpactus quinquefasciatus* Kazenas, holotype - flagellum. 5: *Harpactus priscus* sp. n., paratype, Tundza Valley - propodeal enclosure. 6: *Harpactus quinquefasciatus* Kazenas, holotype - propodeal enclosure. Scale bars = 0.1 mm.

Valley is slightly smaller than the holotype (6.0mm). Paratypes from Strouma Valley range in length from 4.9 to 5.4mm. Length-width ratio of the last four flagellomeres is presented in Table 1. All examined specimens have two apical midtibial spurs.

ETYMOLOGY

Priscus is a latin adjective meaning ancient, with reference to a combination of plesiomorphic character states in this species (lack of clear-cut red coloration and presence of yellow subapical bands on gastral terga I to V).

TABLE 1. Length-width ratio of the last four flagellomeres in type series.

Material	flagellomere 8	flagellomere 9	flagellomere 10	flagellomere 11
Holotype	11/10	10.10	10/10	11/8
Paratype: Tundza Valley	11/10	10/10	10/10	16/9
Paratype: Strouma Valley	12/8	10/9	9/8	13/7
Paratype: Strouma Valley	10/9	9/9	9/8	14/8
Paratype: Strouma Valley	10/9	9/9	10/9	12/8

DISCUSSION

In most structural respects *H. priscus* sp. n. resembles *H. quinquefasciatus* Kazenas (Kazenas, 1989). The latter is still known by its holotype only (examined) from Betpakdala desert (Kazakhstan). The new species can be distinguished from *quinquefasciatus* by the shape of clypeal free margin (compare Figs 1 and 2), the shape of penultimate flagellomeres (compare Figs 3 and 4), and the sculpture of the propodeal enclosure (compare Figs 5 and 6). There are some additional differences. *H. quinquefasciatus* has clypeal disc swollen in ventral quarter just before clypeal lip. In *H. priscus* sp. n. clypeal disk is evenly convex. *H. quinquefasciatus* has sparser punctuation on frons, scutum, gastral terga I - II and gastral sterna II - III, in the new species these parts are densely punctured. *H. quinquefasciatus* has yellow spotted metanotum, which is black in *H. priscus*. Most of the characters of *H. priscus* sp. n. resemble also those of *H. betpakdalensis* Kazenas from Betpakdala desert (Kazakhstan) (Kazenas, 1988). There are some important differences between the two species. *H. priscus* sp. n. has macropunctures on scutum and scutellum which are lacking in *H. betpakdalensis*. Propodeal enclosure in *H. priscus* n. sp. is smooth, but microreticulated in *H. betpakdalensis* (according to Kazenas`s description). Body setae in *H. priscus* sp. n. are not concealing integument anywhere. In *H. betpakdalensis*, according to Nemkov (1996), vestiture is abundant, concealing integument on mesopleuron and propodeum. The described new species differs from most species of *Harpactus* from Balkan Peninsula in having black/white thorax and smooth propodeal enclosure. The only other *Harpactus* with a black/white thorax and in some degree smooth propodeal enclosure are: *lunatus* (Dahlbom), *niger* (A. Costa), *picticornis* Vogrin, and *tumidus tumidus* (Panzer). In *H. picticornis* the comparison is made following the original description of Vogrin (1954). The four species can be distinguished from *H. priscus* by lacking a pale coloration on gastral terga I, III, and IV. In *H. priscus* gastral terga I - V possess each a pale band. In addition, propodeal enclosure in *H. niger* has few punctures and gastral terga I - II are red in *H. tumidus tumidus*.

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REVUE SUISSE DE ZOOLOGIE 108 (4): 911-917; décembre 2001

Review of Palaearctic *Autalia* Leach in Samouelle, 1819. IV. New species and additional records (Coleoptera, Staphylinidae, Aleocharinae)

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Review of Palaearctic *Autalia* Leach in Samouelle, 1819. IV. New species and additional records (Coleoptera: Staphylinidae: Aleocharinae). - *Autalia breviflagellata* sp. n. (Nepal) and *A. limata* sp. n. (China: Sichuan) are described, figured, and distinguished from similar congeners. The previously unknown female sexual characters of *A. formosa* Assing from Taiwan are described and illustrated. Additional records of *A. smetanai* Pace and *A. longicornis* Scheerpeltz are presented; the latter is recorded from Syria for the first time.

Key-words: Coleoptera - Staphylinidae - Aleocharinae - *Autalia* - Palaearctic region - Nepal - Himalaya - China - Taiwan - Syria - taxonomy - new species.

INTRODUCTION

The genus *Autalia* currently includes 24 species worldwide, nine of them occurring in the Palaearctic region (Assing 1997, 1998, 1999). An examination of previously unidentified material especially from the collections of the Museum d'Histoire Naturelle, Genève (MHNG) not only yielded some faunistically remarkable records, but also the previously unknown female of *A. formosa* Assing and two species new to science, which are here described. The material listed below is deposited in the MHNG, the author's collection (cAss), and in the collection of B. Feldmann, Münster (cFel).

NEW SPECIES AND RECORDS OF PALAEARCTIC *AUTALIA*

Autalia longicornis Scheerpeltz

Material examined: 1♂, 1♀, Syria, Kassab, 5.V.1990, leg. Reuter (cAss, cFel).

This widespread W-Palaearctic species is here for the first time recorded from Syria.

Autalia smetanai Pace

Material examined: Nepal: 10 ex. [partly teneral], Khandbari Distr., Kosi, Chichila, S Ahale, 2200m, 4.IV.1984, leg. Löbl & Smetana (MHNG, cAss); 14 ex., Khandbari Distr., Kosi, Induwa Khola valley, 2000-2050m, 14.-17.IV.1984, leg. Löbl & Smetana (MHNG, cAss); 1♂, Kosi, forest NE Kuwapani, 2350m, 5.IV.1984, leg. Löbl & Smetana (cAss).

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Autalia breviflagellata sp. n. Figs 1-4

Holotype ♂: NEPAL Kathmandu, Dis. Siwapuri, Dara, 2500m, 1.V.1985, A. Smetana / Holotypus ♂ *Autalia breviflagellata* sp. n. det. V. Assing 2000 (MHNG).

Description: Of similar size and general appearance as *A. smetanai*, but distinguished as follows:

Pronotum with more distinct and somewhat denser puncturation, especially in posterior half; median and lateral furrows shallower and less clear-cut; postero-lateral grooves anteriorly extending into short shallow furrow (in *A. smetanai*, this extension is usually absent). Tibiae shorter and less slender, metatibia in the holotype 0.36 mm (in *A. smetanai* usually at least 0.45 mm, rarely shorter). Abdomen with the anterior impressions of terga III-V with distinct microreticulation and almost mat (in *A. smetanai* without distinct microsculpture) and with 5 distinct carinae (in *A. smetanai*, the carinae between the median carina and the lateral carinae are usually less pronounced); puncturation of terga V-VII somewhat denser and less fine than in *A. smetanai*.

♂: tergum VIII posteriorly weakly concave (Fig. 3); posterior margin of sternum VIII distinctly pointed in the middle (Fig. 4); tergum X relatively short and broad, anterior two thirds with dense and very stout setae (Fig. 2); aedeagus with apex of median lobe of similar shape as in *A. rivularis* (Gravenhorst), much shorter and less slender than in *A. smetanai*; basal part of median lobe somewhat resembling that in *A. smetanai*, but with weakly prominent crista apicalis; flagellum shorter and wider than in other Palaearctic congeners, and apically distinctly bent (Fig. 1).

♀: unknown.

Derivatio nominis: The name (Lat., adj.) refers to the remarkably short flagellum in the internal sac of the aedeagus, which distinguishes this species from its Palaearctic congeners.

Comparative notes: For distinction from the similar Himalayan *A. smetanai* see description above. From other Palaearctic representatives of the genus, it particularly differs in the morphology of the median lobe of the aedeagus.

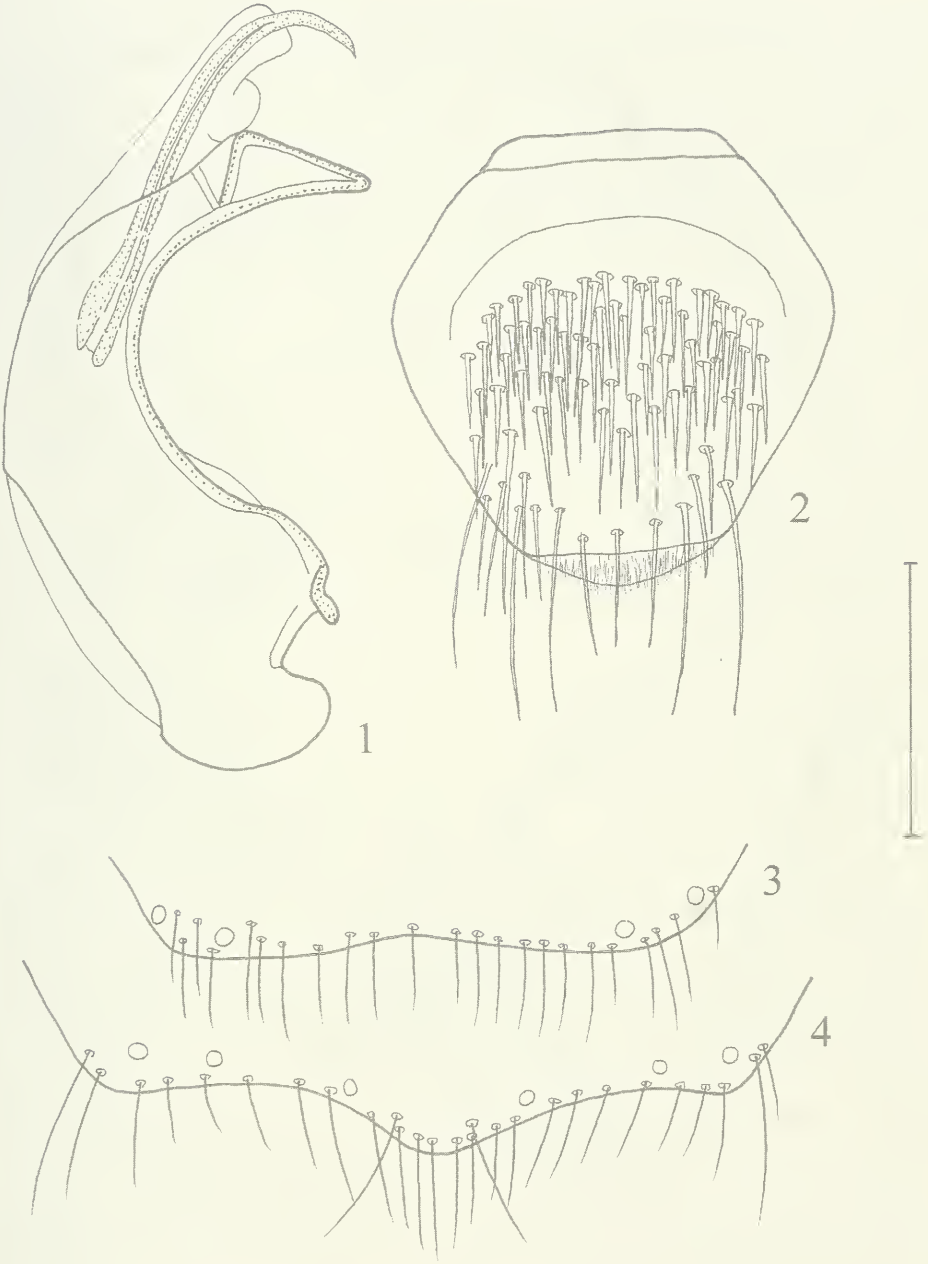
Distribution: The species is known only from central Nepal, where it was collected in the beginning of May at an altitude of 2500m. As can be inferred from the fully developed hind wings, it is probably more widespread at least in the Himalayas.

Autalia limata sp. n. Figs 5-11

Holotype ♂: China, Sichuan, Xiling Mt., 1600-2400m, litter, 30.07-4.8.96, leg. S. Kurbatov / Holotypus ♂ *Autalia limata* sp. n. det. V. Assing 2000 (MHNG). Paratypes: 4♀♀, same data as holotype (MHNG, cAss).

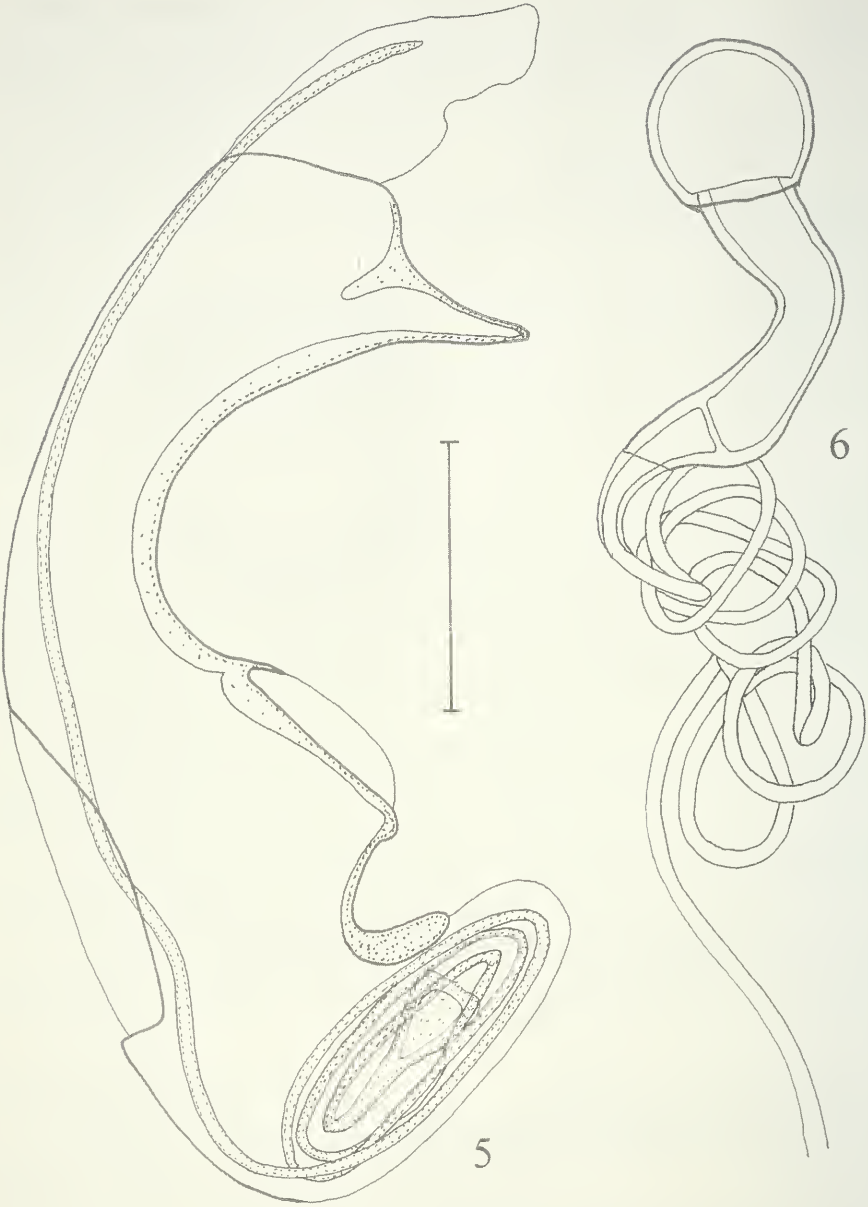
Description: Highly similar and apparently closely related to *A. schuelkei* Assing from W-Sichuan, distiguished only by the following characters:

Pronotum with extremely fine puncturation; punctures in area between antero-lateral furrows noticeable only at very high magnifications. (In *A. schuelkei*, the puncturation in this area is fine, but well-defined and visible at a magnification of 50x.).



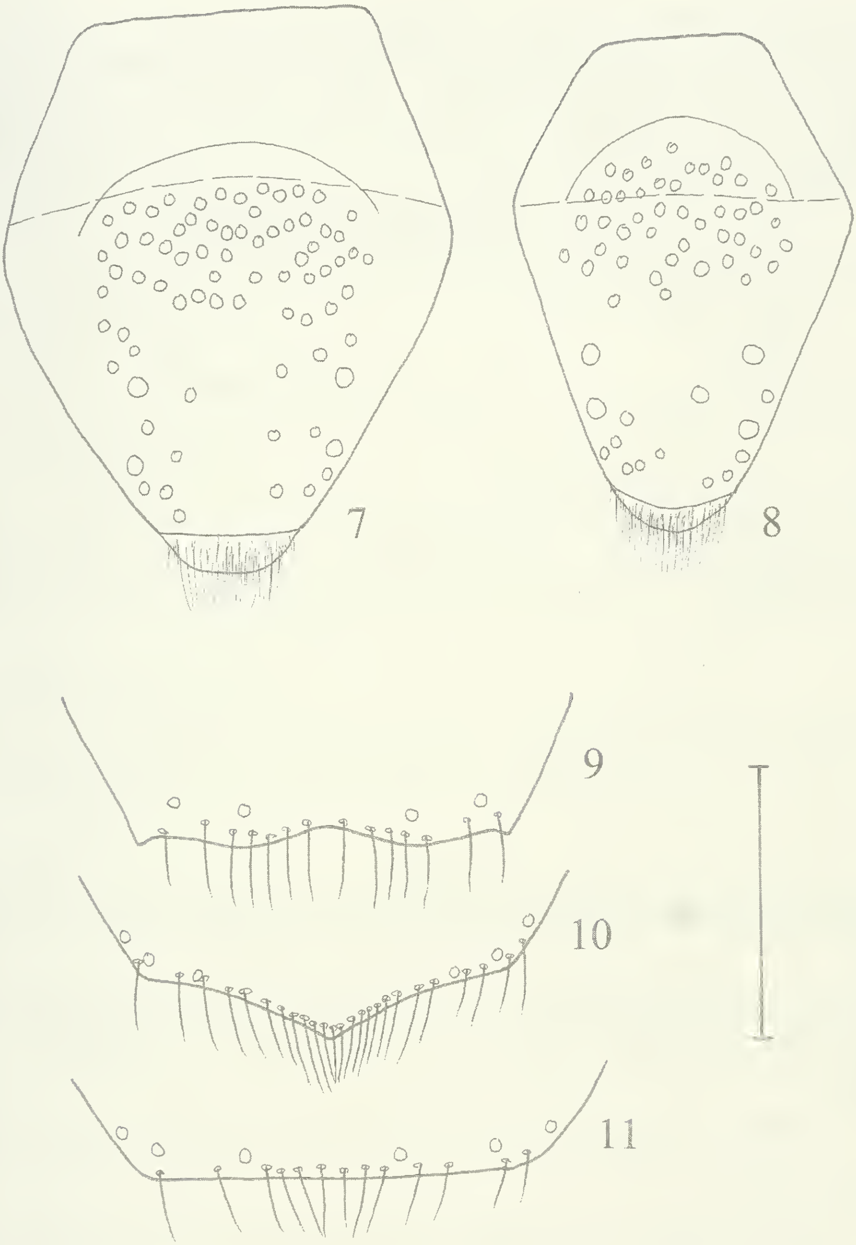
FIGS 1-4

Autalia breviflagellata sp. n. (holotype): median lobe of aedeagus in lateral view (1); ♂ tergum X (2); posterior margin of ♂ tergum VIII (3); posterior margin of ♂ sternum VIII (4); long setae omitted in 3 - 4. Scale: 0.1 mm.



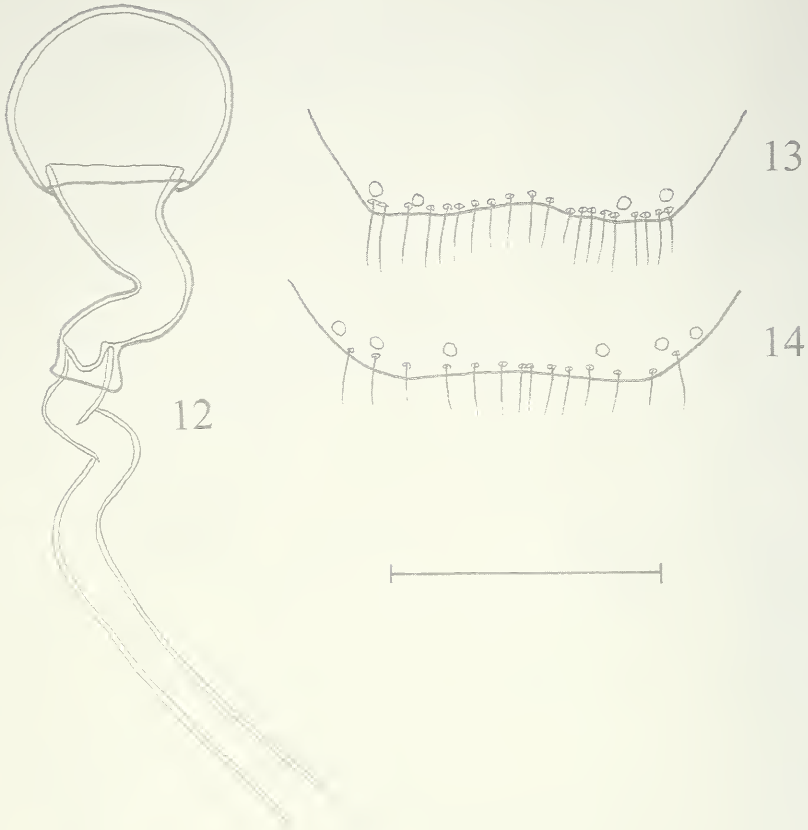
Figs 5-6

Autalia limata sp. n. (5: holotype): median lobe of aedeagus in lateral view (5); spermatheca (6). Scale: 0.1 mm.



Figs 7-11

Autalia limata sp. n. (7, 10: holotype): ♂ tergum X (7); ♀ tergum X (8); posterior margin of ♀ tergum VIII (9); posterior margin of ♂ sternum VIII (10); posterior margin of ♀ sternum VIII (11); all setae omitted in 7-8, long setae omitted in 9-11. Scales: 7-8: 0.1 mm, 9-11: 0.2 mm.



Figs 12-14

Autalia formosa Assing: spermatheca (12); posterior margin of ♀ tergum VIII (13); posterior margin of ♀ sternum VIII (14); long setae omitted in 13 - 14. Scale: 12: 0.1 mm, 13 - 14: 0.2 mm.

♂: tergum VIII posteriorly as in ♀; posterior margin of sternum VIII distinctly pointed in the middle (Fig. 10); tergum X more slender than in *A. schuelkei* (Fig. 7); median lobe of aedeagus in lateral view less strongly bent and with shorter apex (Fig. 5).

♀: tergum VIII posteriorly sinuate (Fig. 9); hind margin of sternum VIII truncate (Fig. 11); tergum X apically less acute than in *A. schuelkei* (Fig. 8); spermatheca as in Fig. 6.

Derivatio nominis: The name (Lat.: smoothened) refers to the very shiny pronotum with barely discernible puncturation, the only external character distinguishing this species from *A. schuelkei*.

Comparative notes and phylogenetics: Judging from external characters (pronotal puncturation and furrows, short elytra, reduced hind wings), the secondary sexual characters (shape and chaetotaxy of tergum VIII, sternum VIII, and tergum X), and from the highly similar morphology of the aedeagus and the spermatheca, *A. limata* is a very close relative, probably the sister species of *A. schuelkei*, which, too, occurs in Sichuan. For illustrations of the primary and secondary sexual characters of that species see Assing (1998). All other Palaearctic congeners are readily distinguished from *A. limata* by their larger eyes (in *A. limata* less than half the length of postgenae and not distinctly projecting from lateral outline of head in dorsal view), relatively longer and wider elytra (distinctly wider than abdomen), the presence of hind wings, and by the completely different morphology of the genitalia.

Distribution: *A. limata* is known only from the type locality in Sichuan (China). As can be inferred from the reduced elytra and wings, it probably has a restricted distribution.

Autalia formosa Assing Figs 12-14

Material examined: Taiwan: 2♀♀, Chiai Hsien, Alishan, 2200m, 26.IV.1990, leg. Smetana (MHNG, cAss).

The species is here reported from Taiwan for the second time. Since only the male holotype of this species was previously known, the female sexual characters are here described and illustrated: Tergum X relatively broad and short, posteriorly acute; posterior margins of tergum and sternum VIII as in Figs 13 - 14; spermatheca with relatively short and wide duct (Fig. 12).

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Hemerophis, a new genus for *Zamenis socotrae* Günther, and a contribution to the phylogeny of Old World racers, whip snakes, and related genera (Reptilia: Squamata: Colubrinae)

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Hemerophis, a new genus for Zamenis socotrae Günther, and a contribution to the phylogeny of Old World racers, whip snakes and related genera. - External morphology, skull bones, vertebrae, visceral topography and hemipenis features of the Sokotra racer were examined. Considerable differences exist vis-à-vis Palaearctic and East African racers and the insular species is thus referred to a monotypic genus, *Hemerophis*. The isolated position of *H. socotrae* (Günther, 1881) is confirmed by nucleotide sequences of two mitochondrial genes, cytochrome c oxydase I and 12S rRNA. As to its phylogenetic relationship, *H. socotrae* requires further comparison with Afrotropical colubrids.

Based on morphology and molecular data (mtDNA), the whip snake *Tyria najadum* Eichwald and related eastern Mediterranean species, the East African *Coluber florulentus* group, and the Arabian endemics *Zamenis elegantissimus* Günther and *Z. variabilis* Boulenger are referred to *Platyceps* Blyth. *Hemorrhois* Boie is composed of the western *H. algirus* (Jan) and *H. hippocrepis* (Linnaeus), and an eastern subgroup with *H. nummifer* (Reuss) and *H. ravergieri* (Ménétries). *Hemorrhois* and *Platyceps* spp. belong to a monophyletic group including the mainly Saharo-Sindian genus *Spalerosophis* Jan.

The composition and systematic content of *Hierophis* Fitzinger remain unclear. To judge from mtDNA data, eastern Mediterranean species including *H. caspius* (Gmelin) are much closer to *Eirenis modestus* (Martin) than to the purely European *H. gemonensis* (Laurenti) and *H. viridiflavus* (Lacépède). Additional studies with more taxa are necessary to scrutinize the sister group relationship of *Eirenis* Jan with *Hierophis* spp. and to assess their phylogenetic affinities with other Palaearctic racer genera.

Key-words: *Hemerophis* gen. n. – *Eirenis* – *Hemorrhois* – *Hierophis* – *Platyceps* – *Spalerosophis* – morphology – mtDNA – phylogeny – Sokotra.

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INTRODUCTION

The colubrine *Zamenis socotrae* Günther, 1881 is endemic to the Sokotra archipelago off the Horn of Africa. Günther (1881) thought that this species "is most nearly allied to" the western Arabian *Z. elegantissimus* Günther.

Parker (1949) noted that "the very striking similarity in colour pattern undoubtedly played a part, perhaps an unduly large part, in influencing Dr. Günther to this conclusion". He had "little doubt" that *Coluber* (sensu lato) *socotrae* "is allied to the *florulentus* group of species (including *elegantissimus*) which it resembles in its lepidosis and colour pattern" (Parker, 1949). This opinion has been followed by Schätti & Desvoignes (1999) who pleaded for affinities of the species from Sokotra with East African racers of the *C.* (s. l.) *florulentus* group. Based on cytochrome b sequences, Nagy *et al.* (2000) concluded a different origin of *C.* (s. l.) *socotrae* and Palaearctic racers.

Many Palaearctic species formerly grouped in *Coluber* (sensu Schätti & Wilson, 1986) belong to the genera *Hemorrhois* Boie, *Hierophis* Fitzinger and *Platyceps* Blyth (Schätti, 1986a, 1987, 1988a, 1988b, 1993a). For reasons explained elsewhere (Schätti & McCarthy, 2001; Schätti *et al.*, 2001), the whip snake *Tyria najadum* Eichwald and related species have so far been assigned to *Coluber* sensu lato. This nomen operandum has also been applied to a few racers with hitherto unclarified affinities including Arabian endemics (e.g., *Zamenis elegantissimus* Günther) and the mainly Afrotropical *florulentus* group (Schätti, 2001b) as well as endemic species of the western Sahel, the Horn of Africa, and Namibia (Broadley & Schätti, 1999).

This paper gives a detailed description of *Coluber* (s. l.) *socotrae* and a morphological comparison with Old World racers. The main purpose is to assess the systematic status of the insular taxon and its relationship with Palaearctic and East African racer genera. Their phylogenetic affinities are evaluated on the basis of molecular data from twenty species of the genera *Hemorrhois*, *Hierophis*, and *Platyceps*, the Sokotra racer as well as one representative each of the assumedly related Palaearctic genera *Eirenis* Jan and *Spalerosophis* Jan.

MATERIAL AND METHODS

External morphological features were studied in a total of 27 specimens of *Coluber* (s. l.) *socotrae* including two living individuals. The preserved material is deposited in the following institutions: The Natural History Museum, London (BMNH), Museum of Comparative Zoology, Cambridge (MCZ), Muséum d'Histoire naturelle, Geneva (MHNG), Museo zoologico dell'Università (La Specola), Florence (MZUF), Naturhistorisches Museum, Vienna (NMW), and Zoologisches Museum der Universität Hamburg (ZMH).

The examined specimens (n=28) are: BMNH 1946.1.14.97-99: "Socotra" (type series, I. B. Balfour 1880): BMNH 99.12.5.119: "Hadibu Plain" [Hawlaf] (halfgrown ♀, W. R. Ogilvie-Grant & H. O. Forbes 1898/99): BMNH 1953.1.8.24: "Socotra" (hgr. ♀, G. B. Popov March 1953); BMNH 1962.936-937: "Socotra" (♂, juv., N. L. Corkill) [1962.936: skull, vertebra, ventral 75]; BMNH 1965.1460: "Wadi Ashur, Dihams Plain, W. Socotra" (hgr. ♀, "Joint Services Exp. Socotra 1964", i.e., Royal

Geographic Society & Royal Air Force expedition). MCZ 25884: "Socotra" (♀, O. Simony 1898/99). MHNG 2443.4: Hadibu ["Tamarida", see text] (♂, E. Riebeck & G. Schweinfurth 1881, formerly ZMH 2506); MHNG 2581.92: lower Wadi Di-Farhoh (♂, B. Schätti March 1995) [midbody vertebrae]; MHNG 2610.88: Wadi Qishn, c. 250 m (♂, B. Schätti April 2000) [skull]; MHNG 2610.89-90: Fikhah [Ras Momi] (♂♀, B. Schätti April 2000, living specimens). MZUF 4470: "Hanefu R.[iver]" [Wadi Manifoh] (♂, G. B. Popov 1953, formerly BMNH 1953.1.8.25). NMW 25447.1-5: Samhah ("Insel Samheb", ♂, ♀♀, O. Simony January 1899); NMW 25447.6-8: Ras Shuab (♂♂, ♀, O. Simony January 1899) [25447.8: skull]; NMW 25447.9-10: Hawlaf (♂♂, O. Simony February 1899); NMW 25449: Aqarhi ["Hakari nächst der Mündung des Wadi Felink", Steindachner, 1903] (♂, O. Simony 1899) [vertebra, ventral 140]; NMW 25467: Qalansiyah (♂, O. Simony January 1899). ZMH 2507: Hadibu ["Tamarida", see text] (♂, E. Riebeck & G. Schweinfurth).

Methods and definitions used in the descriptive part are explained in Schätti (1987, 1988b). The term subtemporal denotes the scale situated between the posterior supralabial and anterior temporal scales; anteriorly, it borders the lower postocular and the posterior subocular. The subtemporal corresponds to the upper part of the supralabial that follows the posterior subocular, i.e., usually the seventh. Its posterior tip may or may not touch the lowest temporal of the second row. Except for its usually smaller size, the subtemporal cannot be properly distinguished from the anterior temporals.

Vertebra measurements and their abbreviations used in the text are: length of centrum (lc), length of neural crest (nc), least width of neural arch (wn), and width across prezygapophyses between outer edge of articular facets (wp). These measurements as well as further vertebra features used in the following text are explained and figured in Auffenberg (1963) and Helfenberger (2001). Anatomical data and the position of dorsal scale row reductions along the body (i.e., mean counts of right and left side values) are given in terms of ventrals and in percent of their total number (% vs). The length of the hemipenis and the *M. retractor penis magnus* are expressed in absolute numbers of subcaudals and as a percentage thereof (% cs). We follow Dowling & Savage (1960) with regard to hemipenis terminology.

Osteological data and descriptions are based on a limited number of specimens (see text). Apart from a few circumstantial observations, visceral features of *Hemerophis socotrae* were examined in five males and a single female specimen, i.e., MHNG 2610.88, NMW 25447.2 (♀), NMW 25447.5, and NMW 25447.8-10.

A more detailed synonymy of the Sokotra racer and coordinates of the collecting sites are given in Schätti & Desvoignes (1999). The pertinent references for morphological characters of Palaearctic and Afrotropical racers discussed in this study are quoted at their appropriate place in the following text.

The "*Coluber florulentus* group" is made up of the name bearing species and a number of mainly East African taxa (e.g., *Zamenis b. brevis* Boulenger, *Z. b. smithi* Boulenger [see Schätti in Lanza, 1990], *C. taylori* Parker) including *C.* (s. l.) *largeni* Schätti from the Dahlak archipelago (Schätti, 1988b, 2001b). *C.* (s. l.) *florulentus* *perreti* (Schätti) from Cameroon and Nigeria might be a valid species. For the purpose of this paper, the Saharo-Sindian region is considered to be part of the Palaearctic realm.

Besides *Hemerophis socotrae*, the mitochondrial genes cytochrome c oxydase I (COI) and 12S rRNA of seventeen Palaearctic and Afrotropical racers as well as *Eirenis modestus*, *Spalerosophis diadema*, and *Coelognathus* [*Elaphe*] *flavolineatus* (see Helfenberger, 2001) were sequenced (see Appendix). All except an endemic Arabian taxon (*variabilis*) were included in the phylogenetic analyses (Figs 8-9). Among various colubrid taxa evaluated (e.g., *Elaphe* spp. sensu Helfenberger, *Ptyas korros*), the Indo-Malayan *C. flavolineatus* (Schlegel) turned out to be most appropriate as an outgroup for the present study. Its basal position vis-à-vis the examined racer taxa was checked including the phylogenetically more distant *Dinodon semicarinatus* (Cope). The scientific names of the taxa with their author and year of description are listed in the Appendix compiling the tissue samples used for the present study.

MtDNA was isolated from fresh liver tissue (Spolsky & Uzzell, 1986) and purified by phenol/chloroform extraction and ethanol precipitation (Maniatis *et al.*, 1982). Pure mtDNA was re-suspended in TE buffer (10mM Tris-HCl, pH 8, 1mM Na_2EDTA) and stored at -70°C. For some specimens (see Appendix) genomic DNA was extracted from shed skin, liver preserved in 70% ethanol, or frozen muscle using the DNeasy Tissue Kit from Qiagen. Highest DNA yields from shed skin were obtained with Protocol A for isolation of genomic DNA from insects (Qiagen).

Two fragments of the mitochondrial genome, viz. 12S rDNA and COI, were amplified using the polymerase chain reaction (PCR) under the following conditions: a total volume of 50μl contained 1 x PCR buffer, 200μM of each dNTP (Roche), 0.6μM of each primer, 2.5 u *Taq* polymerase (Qiagen), and either 1 x Q-Solution (Qiagen, for 12S rDNA) or 2mM $MgCl_2$ (COI). PCR primers applied are 12S268(+), 5'-GTGCCAGCGACCGCGGTTACACG-3', 12S916(-), 5'-GTACGCTTACCAT GTTACGACTTGCCCTG-3', COI(+)deg1, 5'-AAGCTTCTGACTNCTACCACC NGC-3', and COI(-)bdeg, 5'-ATTATTGTTGCYGCTGTRAARTAGGCTCG-3'.

All primers were developed by the junior author (Utiger, in prep.). PCR was performed with a PTC-100™ thermocycler (MJ Research, Inc.) using the following thermal profile: 3 min at 94°C, followed by 35 cycles of 1 min at 94°C, 1 min at 65°C, 1 min at 72°C, and a final step of 10 min at 72°C. Double-stranded PCR products were purified with the QIAquick PCR Purification Kit (Qiagen) and both strands were sequenced following the ABI Prism® BigDye™ Terminator Cycle Sequencing Ready Reaction Kit protocol, version 2.0, using the ABI 377 automated sequencing system (PE Biosystems). The 12S rDNA has 677 base pairs including primers, COI 632. The fragments correspond to the positions 303-980 and 6519-7151, respectively, of *Dinodon semicarinatus* (GENBANK accession No. NC 001945). The DNA sequences of all individuals except MHNG 2456.71 (*variabilis*) are deposited in the GENBANK (accession numbers AYO39126-39201). The alignment data file is available from the junior author's homepage (www.unizh.ch/ zoolmus/eHerpetologie.html).

A total of 610 positions including insertions or deletions (indels) of the 12S rDNA and 513 base pairs of COI sequences of 38 individuals belonging to twenty species were edited with the *Seqlab* program of the Wisconsin Package (Genetics Computer Group, 1999) and aligned with Clustal X (Thompson *et al.*, 1994). The initial alignment of the 12S rDNA fragment was improved in a second step using the aligned sequences of *Alligator mississippiensis* and *Homo sapiens* (Maidak *et al.*, 2000) as well as the secondary structure information of *H. sapiens* (Gutell *et al.*, in prep.) and the scincid lizard *Oligosoma nigriplantare polychroma* (Hickson *et al.*, 1996). The alignment includes 29 indels at 19 different regions and is unambiguous. Thirteen of them consist of one position, two of two positions, and four indels of three.

Phylogenetic analyses and descriptive statistics were performed with PAUP* versions 4.0b4a, 4.0b5, and 4.0b6 (Swofford, 1998). The pattern of DNA evolution between two taxa and the probability of saturation effects were examined separately for each codon position of the amplified COI gene fragment, as well as for the entire sequence in both the COI and 12S rRNA genes.

For the 12S rDNA fragment, 224 (207 without indels) of 610 (581) aligned sites are variable and 171 (162) parsimony informative including gaps as a fifth character state. The ranges of base frequencies of the L-strand are 39.3-41.3% (mean: 40.4%) for A, 22.0-25.6% (23.9%) C, 18.3-20.5% (19.5%) G, and 15.5-17.3% (16.2%) T. The values for the coding L-strand of the COI fragment (513 aligned sites) are 186, 179, and 25.9-29.8% (28.4%) A, 24.4-29.2% (26.9%) C, 14.6-17.2% (15.9%) G, and 27.2-31.4% (28.7%) T, respectively. Uncorrected pairwise sequence divergence of COI was plotted against the same measure of 12S rDNA (Fig. 1). In contrast to the substitution values for 12S rDNA, which increase without an apparent upper limit, COI shows considerable saturation tendency by losing the linear correlation with 12S rDNA at approximately 14% and tapering off to a value of 17% (Fig. 1). The third position of the codon is responsible for most of the overall variation (87.6%). Whereas there is no substitution in the second position at all, relatively few first position changes are observed (12.4%).

The model of DNA evolution which best fits the data under the maximum likelihood criterion was estimated with the program MODELTEST (Posada & Crandall, 1998). For phylogenetic reconstruction, maximum likelihood, maximum parsimony and neighbour joining methods were performed with PAUP*. Neighbour joining and maximum likelihood analyses were executed with heuristic searches, tree-bisection reconnection (TBR) branch swapping, and different models of evolution. The latter include the general time-reversible (GTR), the Hasegawa-Kishino-Yano (HKY), and the Jukes-Cantor model (Hasegawa *et al.*, 1985; Jukes & Cantor, 1969; Kishino & Hasegawa, 1989). The GTR+G+I model assumes that substitution rates follow a γ distribution with shape parameter α (G), and that some sites are invariable with proportion (I), estimated via maximum likelihood. Nonparametric bootstrap values (Felsenstein, 1985) were calculated including 1000 replicates for neighbour joining and maximum parsimony, and 100 replicates using the faststep search option for the maximum likelihood method. Heuristic maximum parsimony analysis with TBR branch swapping was performed treating gaps as a fifth character state.

In order to determine whether the phylogenetic information contained in the two data sets (partitions) was significantly different, the incongruence length

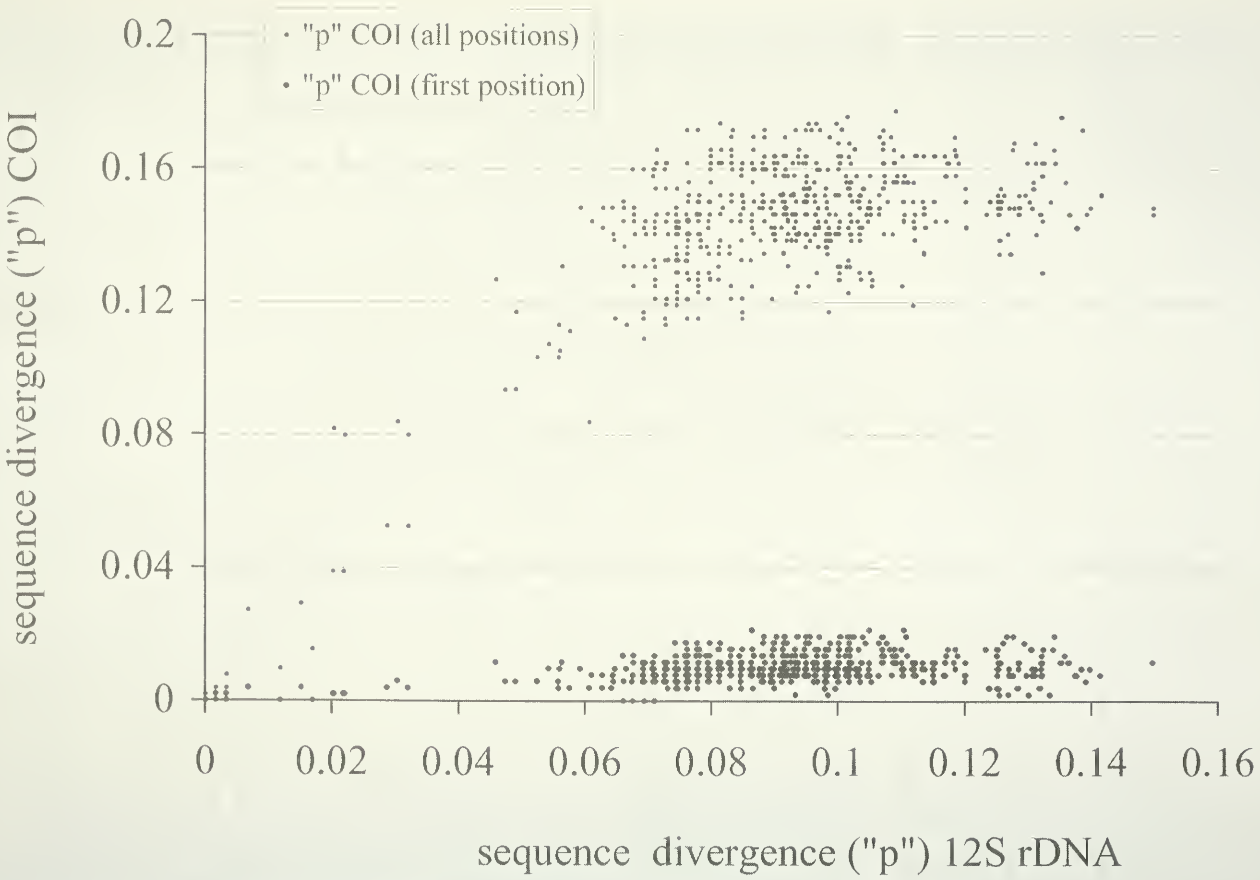


FIG. 1. Uncorrected pairwise sequence divergences "p" of the coding COI versus "p" of 12S rDNA.

difference test (ILD test, Farris *et al.*, 1995), implemented as partition homogeneity test in PAUP*, was performed with ten random stepwise additions using TBR branch swapping and 1000 randomisations. If the data sets were not significantly different, it was assumed that both data sets provide an estimate of the same phylogenetic tree and, therefore, can be combined for subsequent analyses. Significantly incongruent data sets should be analysed separately (e.g., Vidal & Lecointre, 1998).

However, it is often unclear whether a significant test value stems from real incongruence due to a structured contradictory signal or results from random noise that arises from multiple substitutions at particular sites. The latter can produce highly significant results in the ILD test as demonstrated by Dolphin *et al.* (2000). To differentiate between these two phenomenons, these authors described a procedure using randomly generated data sets.

The operation of Dolphin *et al.* (2000) was slightly adapted for our analysis. For all investigated taxa, the character states of ten, twenty, thirty, forty and fifty randomly chosen, variable, parsimony informative characters of one gene were shuffled successively in Microsoft Excel to produce partially randomized data sets. Eight runs of this procedure were performed, and the ILD test was executed with the original data set of one partition and a shuffled data set of the other one. The *P* value resulting from this procedure was plotted against the number of shuffled characters and regressions were calculated. To determine the behaviour of the *P* values with increasing number of shuffled characters, it was tested whether the slope of the regression line is different from zero.

If randomizing the noisier data set increases the significance of conflict, an assessment of real incongruence is difficult to make (K. Dolphin, pers. comm.). On the other hand, increasing *P* values from the ILD test, with the less noisy data set shuffled, indicate that both the permutated and the already noisy data set contain the same random information as found in the partitions for the null length distribution of the ILD test.

RESULTS

The species from Sokotra differs in many respects from Palaearctic and Afrotropical racers and whip snakes and is herewith referred to a new monotypic genus.

Hemerophis gen. n.

Derivatio nominis. This genus is named for its placid nature. *Hemerophis* stems from the Greek words *hemeros* (ημερος), meaning mild, gentle, or kind, and *ophis* (οφις), i.e., snake; the gender is masculine.

Diagnosis. Nine to eleven supralabials, one (usually fifth) in contact with eye. Preocular normally paired; with a posterior subocular (much larger than anterior subocular) and a subtemporal scale; posterior chin shields often reduced. Dorsals smooth, with paired apical pits; second longitudinal row made up of comparatively large and interspersed smaller scales; 23 longitudinal rows on neck (25th ventral), 23 at midbody and 17 (rarely 15) prior to anal plate; posterior reductions involving lower lateral (one pair) and paravertebral (two pairs) levels. 217-237 ventral scales, 112-125 subcaudals (sexual dimorphism insignificant). 17-20 maxillary teeth, diastema varies in size, last tooth not or only slightly offset laterad; pterygoid with 23-28 teeth. Median processus of palatinum not reaching beyond anterior border of choanal processus. Parasphenoid basally constricted, postero-lateral area of basisphenoid distinctly emarginated. Least width of neural arch of midbody vertebrae 1.3 to 1.4 times in centrum length. Posterior organs, particularly gonads (i.e., testes) and kidneys, shifted backwards vis-à-vis Palaearctic and Afrotropical racers. Hemipenis comparatively short, subcylindrical, basally spinose, with distinct apical depressions; sulcus spermaticus simple. A single species from Sokotra and Samhah Island is known.

Hemerophis socotrae (Günther, 1881)

Zamenis socotrae Günther, 1881: 463, Plate 41. – "Socotra" (three syntypes).
Zamenis socotrae. – Peters, 1882: 46 ("Socotra"); Boulenger, 1893: 408 ("types").
Zamenis sokotrae [sic]. – Steindachner, 1903: 14 (Aqarhi, Hawlaf, Qalansiyah, Ras Shuab, Samhah).
Zamenis socotrae. – Werner, 1929: 65, 70 ("Sokotra").
Coluber socotrae. – Parker, 1949: 44 (review, relationship); Corkill & Cochrane, 1966: 484 (Hadibu, "Hanefu" [Wadi Manifoh], "Hasu").
Coluber socotranus [sic]. – Balletto, 1968: 212 (biogeography).
Haemorrhois [sic] *socotrae*. – Welch, 1982: 155 (checklist).
Eremiophis socotrae. – Welch, 1983: 108 (Old World racer genera [nomen dubium]).
Coluber socotrae. – Schätti & Wilson, 1986: 399 (checklist, key).
Coluber (sensu lato) *socotrae*. – Schätti & Desvoignes, 1999: [101] 125 (Sokotra reptiles).

Description. Rostral broader than deep. Internasals smaller and shorter than prefrontals. Frontal longer than its distance from the tip of the snout, at least one and a half times as long as wide, broad in front, usually not in contact with the upper preocular, lateral margins slightly concave (i.e., bell-shaped). Parietals longer than frontal, truncated behind.

Nasal divided, upper border of nostril in contact with internasal. Loreal pentagonal (sometimes hexagonal), distinctly longer than wide, posterior part situated below upper preocular. Usually ten (nine to eleven) supralabials, fifth or sixth entering orbit (Fig. 2). Normally two preoculars, upper larger; suture in some cases incomplete or, rarely, with only a single preocular (MHNG 2610.89). Anterior subocular more or less the same size as lower preocular. MZUF 4470 with an additional small scale between the anterior subocular and loreal on the left side. Two postoculars, lower somewhat smaller. Posterior subocular larger than postoculars, usually corresponding to upper part of sixth supralabial; NMW 25447.10 with two posterior suboculars of smaller than usual size (Fig. 2B).

Arrangement and size of scales in the temporal region variable (Fig. 2). Subtemporal usually situated above seventh supralabial, mostly in contact with lower postocular (see Material and methods). Usually two enlarged temporals in first row, and sometimes up to four including subtemporal; a single proper anterior temporal, wider than long, on left side of BMNH 1946.1.14.99 (syntype). Second row of temporals made up of three or four scales.

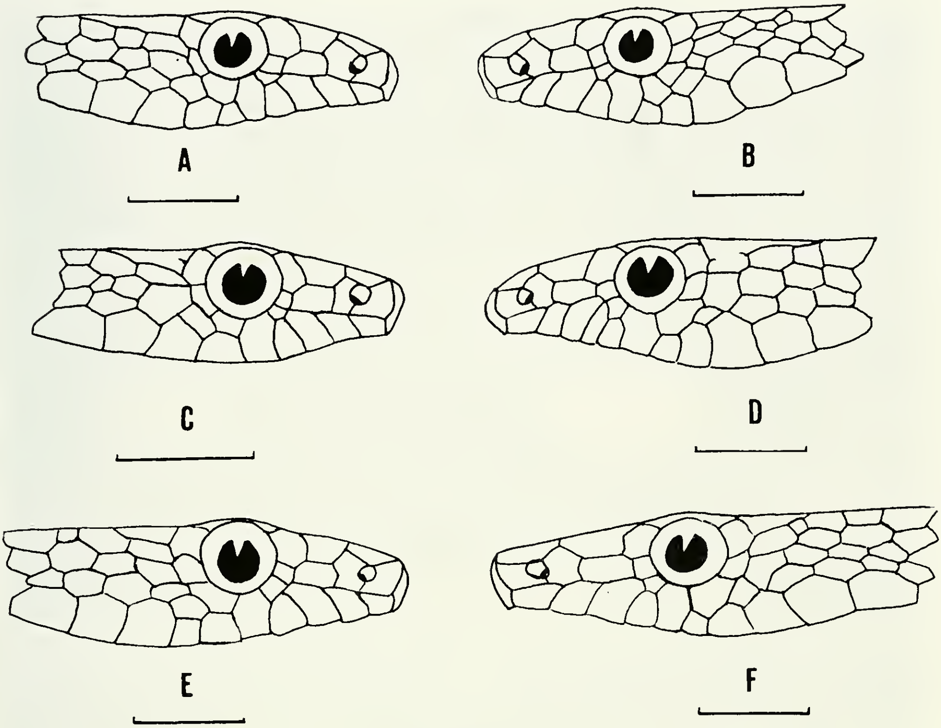


FIG. 2

Lateral view of upper head scales in *Hemerophis socotrae*. NMW 25447.1 (A), NMW 25447.10 (B), NMW 25447.3 (C), NMW 25467 (D), NMW 25447.9 (E), and NMW 25449 (F). Scale (line): 5 mm.

Ten to twelve sublabials, four or five anteriormost on each side in contact with first pair of chin shields, sixth or seventh (rarely fifth or eighth) largest. Posterior chin-shields narrow and usually separated from each other by two to five sometimes concealed series of scales of different size and shape; more or less equal in length to anterior chin shields but in some cases distinctly reduced in size (e.g., MHNG 2610.90), divided (NMW 25447.8) or virtually absent (MCZ 25884). Normally with five to six (rarely four) rows of scales running obliquely between the posterior end of the chin shields and the first ventral scale.

Dorsal scales smooth (not keeled as inadvertently stated in Schätti & Desvoignes (1999) and mixed up with *Ditypophis vivax* in their key and text) and with two apical pits. First longitudinal row composed of enlarged scales. Second row made up of comparatively large scales vis-à-vis those on flanks and back and irregularly interspersed scales of significantly smaller size. Normally in 25 rows across body at level of tenth ventral, 23 rows at 25th ventral and midbody and 17 rows five ventrals prior to cloaca. Reduction on neck involves second and third or third and fourth row between ventral 15 and 23 (7-10% vs) in males, and 14-22 (6-8%) in females, respectively (see Material and methods). Exceptions from this pattern are found in four males: NMW 25447.8 discards third row already at the ninth ventral; paravertebral rows, between ventrals 12-17, are involved in NMW 25447.10; MHNG 2581.92 and NMW 25467 (ventrals 85-100) have partly 24 dorsals near midbody due to anomalies in the vertebral row.

First and second reduction of dorsal scales on posterior part of body involving lower lateral (usually second and third row, exceptionally first and second in BMNH 1953.1.8.24) and paravertebral rows of variable sequence between ventral 120 and 156 (53-68% vs) in males, and 124-141 (53-62%) in females. Reduction from 19 to 17 longitudinal rows invariably paravertebral, situated between ventral 175 and 202 (means of right and left side, extremes 167-214) or 77-88% in males, and 170-191.5 (extremes 159-203) or 75-83% in females. NMW 25447.6 (♂, 22 rows at ventral 120) with a fourth posterior reduction to 15 dorsal scales including second and third row at ventral 213 (94% vs).

Ventrals 217-237 (♂♂ 222-231, ♀♀ 217-237); anal plate divided; 112-125 (118-125, 112-123) usually paired subcaudals (anterior ones partly single in NMW 25447.4). Corkill & Cochrane (1966) noted 133 subcaudals in an individual collected by N. L. Corkill. However, the specimens obtained by this collector (BMNH 1962.936-937) have 118 (juvenile) and 122 (♂) subcaudals, respectively.

Maximum total length in males 1480 mm (1110 + 370 mm, MZUF 4470), females 1007 mm (760 + 247 mm, NMW 25447.4). Tail / body length ratio (including head) in preserved specimens 0.33-0.38 (♂♂) and 0.32-0.37 (♀♀); 0.34 in a subadult (340 + 115 mm, MCZ 25884).

Pileus olive, dark brown or black. Snout sometimes greyish brown or olive above, with two narrow transverse lighter bars along the posterior border of the internasals (may be conspicuously white, see Plate 1) and between the preoculars. Freno-parietal, temporal and nuchal region often uniformly darkened. Loreal area may be olive or light brown. Supralabials, preocular and postocular predominantly whitish, or periocular region with a hazel tinge. Supralabials sometimes with very fine black lines along their adjoining edges. Chin and throat whitish, light yellow or, posteriorly, with an orange hue.

Dorsal colour pattern on neck and forebody light reddish, pink ("salmon-coloured"), orange or yellowish, with broad irregular transverse blotches, either olive or dark brown and usually edged with black, or generally darkened. Dorsal markings broadest in vertebral area; usually not including lowermost longitudinal scale rows. Borders of blotches distinctly jagged and lighter interspaces mottled with short olive or black lines, particularly in the midbody region (Plate 1). Apical pits may be distinctly pigmented with black (e.g., NMW 25447.10). Posterior part of body and tail uniformly olive or darkened. Venter reddish, orange (e.g., MHNG 2610.88), yellowish or pale olive; toward midbody and posteriorly lateral edges of ventrals mottled with black flecks or impinged upon by darker dorsal coloration; underside sometimes uniformly dark posteriorly. In some individuals (e.g., BMNH 1965.1460), dorsal pattern only visible on neck and foremost part of trunk, remainder of body and tail uniformly darkened. A juvenile specimen (probably BMNH 1962.937) was "canary yellow, barred dorsally with bright cobalt blue" when alive (Corkill & Cochrane, 1966).

PLATE 1

Male (MHNG 2610.88, above) and female (MHNG 2610.89) specimen of *Hemerophis socotrae.*

The maxilla has 17-20 teeth, the last two usually enlarged and separated by a diastema of variable size (comparatively narrow or distinct), last tooth not or only slightly offset laterad. Counts for remaining dentigerous bones are 9-12 (palatinum), 23-28 (pterygoid), and 20-22 (dental), respectively (vouchers BMNH 1962.936, MHNG 2610.88, NMW 25447.8, and NMW 25467). Palatine processus of maxilla with a long straight lateral border (Fig. 3). Posterior tip of lateral processus of palatinum not reaching distinctly beyond anterior extension of choanal processus. Pterygoid constricted behind lateral processus (Fig. 4). Anterior projection of basisphenoid (i.e., parasphenoid) basally constricted, transverse ridges slightly concave, crista basisphenoidea poorly developed, postero-lateral area (Vidian foramen) with a distinct emargination (Fig. 5).

Hypapophyses developed to the heart region (lacking posteriorly, fide Boulenger, 1893). Articular surface of prezygapophyses of midbody vertebrae semi-orbicular, accessory process distally obtuse, dorsal border of zygosphene convex. Length of midbody vertebra centrum divided by least width of neural arch (lc/wn) 1.32-1.36, length of centrum / width across prezygapophyses between outer edge of articular facets (lc/wp) 0.73-0.77, length of neural crest / least width of neural arch (nc/wn) 1.00-1.06 (MHNG 2581.92). Proportions for vertebrae from the anterior and posterior region 1.23-1.27 (lc/wn), 0.70-0.73 (lc/wp), and 0.94-1.00 (nc/wn), respectively (based on a single vertebra, see Material and methods).

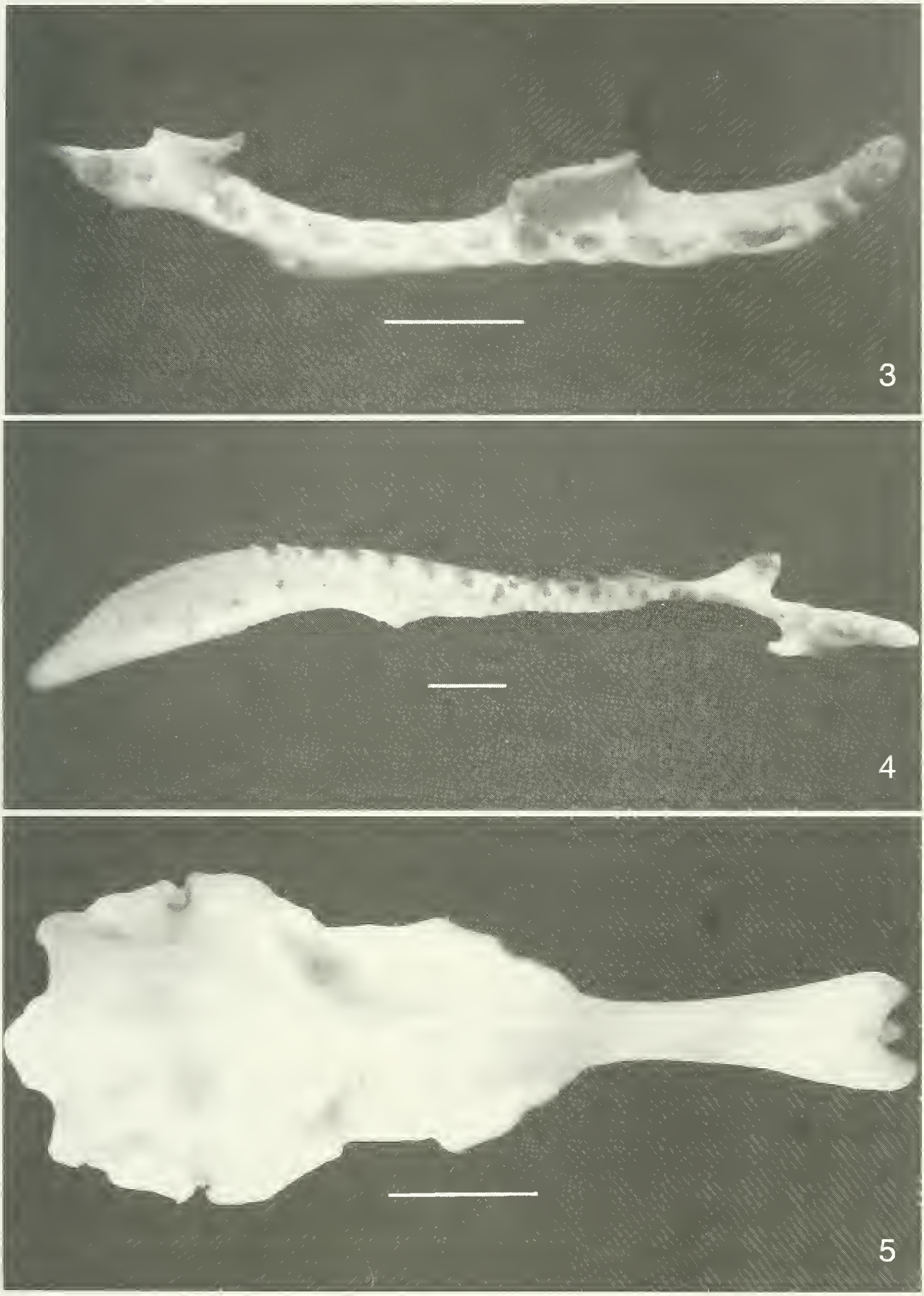
Posterior tip of heart at level of ventral 56 or 57 (25% vs, n=2), liver situated between ventral 67 and 116 (29-52%), anterior tip of pancreas 137-141 (60-62%), right testes 173-180 (75-79%), left testes 181-193 (80-83.5%), and right kidney 192-213 (85-92%) in five males and a female specimen checked for these features (see Material and methods).

Hemipenis subcylindrical, distinctly spinose at the basis, sulcus spermaticus simple (undivided); spines reducing in size toward central part of organ; distally with spinulate (denticulate) retiform ridges on the asulcate side and furrow-like perpendicular depressions along the sulcus spermaticus (Fig. 6a). Apex in situ reaching to subcaudals 8-9 (c. 6.5-7.5% cs). Insertion of *M. retractor penis magnus* at subcaudal 22-24 (18-20%).

Samhah population. In terms of external morphology including colour pattern, the Samhah population (NMW sample) is generally similar to Sokotra specimens except for its slightly larger number of ventral scales, i.e., 231 in one male (NMW 25447.5) and 228-237 in four females (instead of 217-227 and 222-231, respectively, for the Sokotra sample).

Distribution and natural history notes. Hemerophis socotrae is recorded from Sokotra and Samhah, an island situated c. 50 km southwest of Ras Shuab, the western tip of Sokotra. Samhah and its sister island Darsa are commonly referred to as The Brothers (al-Ikhwan).

On Sokotra, the species was collected from the Noged Plain along the southern coast (i.e., at Aqarhi ["Hakari"] or from the mouth of Wadi Falanj, Steindachner, 1903) and the northern littoral between Qalansiyah and Ras Momi, notably at "Hasu", around Ghubbah, in the vicinity of Diham (e.g., BMNH 1965.1460), from the plain



Figs 3 – 5
Left maxilla (3), left palatinum and pterygoid (4), and basisphenoid (5) of *Hemerophis socotrae* (MHNG 2610.88). Lines equal 2 mm.

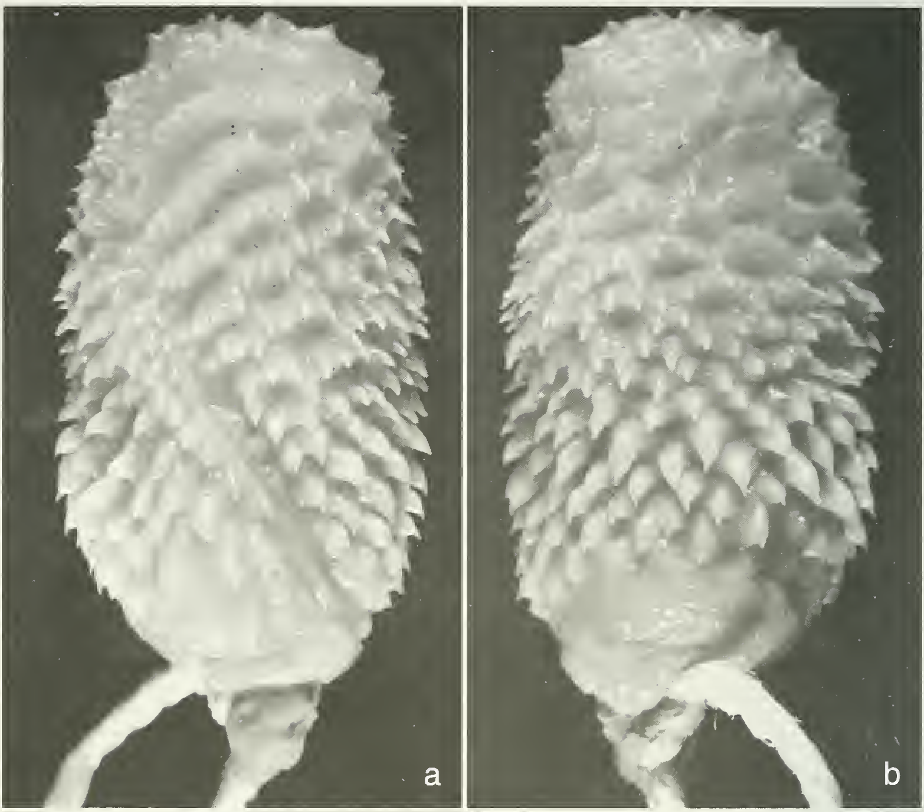


FIG. 6

Sulcate (a) and asulcate view of the everted right hemipenis of *Hemerophis socotrae* (MHNG 2610.88). Original length 15 mm. Photo B. Cerotti.

and hills near Hadibu including Hawlaf and Wadi Manifoh, and at Fikhah near the eastern tip (Ras Momi) of the island (Bent & Bent, 1900; Boulenger, 1903; Corkill & Cochrane, 1966; Showler, 1994; Wranik, 1998).

Some specimens from Sokotra including the syntypes (Günther, 1881) are without precise locality data. Three individuals obtained by Riebeck & Schweinfurth (Taschenberg, 1883) including MHNG 2443.4 and ZMH 2507 from "Tamarida" may have been collected on the southern slopes of the Hajhir massif or around Hadibu (Schätti & Desvoignes, 1999: footnote 19; the specimen registered in the Berlin collection (ZMB 10114) is missing).

Generally, *Hemerophis socotrae* inhabits rocky areas, hard (compacted) substrata, or fine sandy grounds (Fig. 7). The species is encountered near the course of rivers and creeks, around springs, pools, estuaries or lagoons and elsewhere along the shoreline. NMW 25467, for instance, was collected next to papyrus swamps ("nächst den *Cyperus* Sümpfen") near Qalansiyah (Steindachner, 1903). Bent & Bent

FIG. 7
Habitat of *Hemerophis socotrae* at Fikhah near Ras Momi.

(1900: 376) observed a probably subadult specimen at the mouth of a cave near Ras Momi. All records with definite origins are from lowland stations. However, specimens most probably of this species were sighted among rocks in densely vegetated places below the Dihaal pass at c. 900 m in upper Wadi Qishn (Schätti & Desvoignes, 1999).

Hemerophis socotrae is a most timid, agile, and fast-moving snake hiding at the slightest disturbance. It may, therefore, easily escape the attention of an inexperienced naturalist. This could explain why Ogilvie-Grant & Forbes collected a single female near Hawlaf (BMNH 99.12.5.119) but had not seen any other specimen during their visit of two and a half months in winter 1898/99 (Boulenger, 1903), whereas, virtually simultaneously, the Austrian expedition (O. Simony) obtained at least seven individuals from coastal areas.

Moreover, Simony and his companions collected five specimens on Samhah. This island is devoid of sweet water. There, the snakes were collected among rocks near the coastline ("in Felslöchern nahe dem Strande") where they preyed on small sea fish ("Gobiiden", Simony, 1899).

Hemerophis socotrae is probably most active in the early morning and late afternoon. To judge from observations in the field (i.e., fresh tracks in sand) and in captivity, this species also hunts mice and lizards at night. Neither when captured nor later did any of the collected specimens ever attempt to bite, hence its generic name (see Derivatio nominis).

MHNG 2610.89 laid unfertilised eggs in the last third of September.

COMPARATIVE MORPHOLOGY

Hemerophis socotrae differs from Eurasiatic *Hierophis* species in, for instance, a larger number of supralabials (nine or more versus eight in *Hierophis*) of which a single one contacts the eye (two), paired preoculars (single), the reduction pattern of dorsal scale rows on the posterior part of the trunk involving paravertebral rows (instead of purely lateral reductions, except in *H. cypriensis*), and in the position of the testes and kidneys (Schätti, 1987, 1988a; Twerenbold, 1987).

Vis-à-vis *Hierophis* and Saharo-Sindian *Platyceps* species, differences exist in the presence of a posterior subocular (absent in *Hierophis* and most *Platyceps* spp.) and subtemporal scale (absent in both Palaearctic genera), heterogeneous scalation of the second row of dorsals (homogeneous), midbody scale counts (23 rows in *Hemerophis* against 17 or 19), skull bones (e.g., palatinum, basisphenoid), vertebra ratios (particularly lc/wn), and in hemipenis morphology, i.e., shape and ornamentation as well as length of the organ and the *M. retractor penis magnus* (Schätti, 1987, 1988a).

Details of the palatine (e.g., shape of choanal processus) and basisphenoid (area lateralis, transverse ridges), proportions of midbody vertebrae (lc/wp), the position of the gonads and kidneys, and hemipenial ornamentation also separate *Hemerophis socotrae* from *Hemorrhois hippocrepis* and related species (Schätti, 1986b, 1987, 1988b: Fig. 4, 1993b; Twerenbold, 1987).

Zamenis elegantissimus Günther and other Arabian endemics, viz. *Coluber thomasi* Parker (see Incertae sedis) and *Z. variabilis* Boulenger, differ from *Hemerophis socotrae* in various features including fewer supralabials, the absence of a posterior subocular and subtemporal scale, fewer midbody dorsal scale rows (19 or less in Arabian species), a smaller number of teeth on the maxilla (11-15 vs. 17-20), pterygoid (14-19 vs. 23-28) and dental (13-16 vs. 20-22), and in the shape of midbody vertebrae.

Compared with *Coluber florulentus* Geoffroy and related species (see Material and methods), *Hemerophis socotrae* exhibits differences in, for instance, the presence of a posterior subocular (i.e., one supralabial entering the eye), a larger number of teeth on the maxilla (17-20 vs. 14-16 in East African populations of *florulentus* [see below and Appendix], and also 13-16 in *brevis smithi*) and pterygoid (23-28 vs. 18-20 in *florulentus*, Schätti, 1987, 1988b), and in characters separating *Hemerophis* from all Old World racer genera, i.e., the occurrence of a subtemporal and heterogeneous scalation in the second longitudinal row of dorsals.

To conclude from morphological evidence, and without taking into account osteology (e.g., palatinum, basisphenoid, number of teeth on maxilla and pterygoid, vertebrae), visceral topography (testes, kidneys), and hemipenis features, *Hemerophis socotrae* shows a number of derived external features which justify generic status for this taxon. These character states include (mostly) paired preoculars, an increased number of supralabials (nine or more), the presence of a posterior subocular (i.e., a single supralabial entering the eye) and subtemporal, reduction of the posterior chin shields, heterogeneous scalation of second dorsal row, and comparatively high midbody scale counts (23 rows) with paravertebral reductions on the posterior part of the trunk.

For the time being, we are not in a position to designate the sister group of *Hemerophis*. Additional studies, in particular comparison with endemic racer species from the Horn of Africa and further Afrotropical genera, are necessary to clarify the phylogenetic affinities of *H. socotrae* (see Discussion).

PALAEARCTIC AND AFROTROPICAL RACER GENERA

Lumping together 23 Palaearctic and Afrotropical taxa, some of them of doubtful status, Welch (1983) resurrected *Eremiophis* Fitzinger, 1843. This is a nomen dubium (Schätti, 1988a).

Based on morphological characters, Schätti (1986a, 1987, 1988a, etc.) presumed that Palaearctic racers (including Saharo-Sindian species) belong to at least three distinct genera, namely *Hemorrhois* Boie, 1826 (type species *Coluber hippocrepis* Linnaeus), *Hierophis* Fitzinger, 1843 (*C. viridiflavus* Lacépède) and *Platyceps* Blyth, 1860 (*P. subfasciatus* Blyth, syn. *C. ventromaculatus* Gray).

Regarding external morphology, the genus *Hemorrhois* and Saharo-Sindian species of *Platyceps* differ from *Hierophis* spp. in a larger number of supralabials (nine or more versus eight) and the presence of paravertebral reductions of dorsal scale rows (absent in *Hierophis*). Concerning hemipenis features, *Hemorrhois* and *Platyceps* spp. have an organ evenly widened from the base to the apex with irregular apical depressions, instead of distinctly bulbous distally and regularly reticulated as in *Hierophis*. Differences also exist in, for instance, a number of osteological characters (dentigerous bones, neurocranium, and vertebrae) and dorsal colour pattern.

Without taking into account osteological and visceral features for which transformation series and their polarity are not established, *Hierophis* appears to be primitive vis-à-vis *Hemorrhois* and *Platyceps* on the basis of plesiomorphic character states of external morphology such as, for instance, two supralabials entering eye, low number of supralabials, and absence of paravertebral reductions. Striking differences in hemipenis features (see Schätti, 1987: Fig. 3c-e) separate *Hierophis* spp. from the genera *Hemorrhois* and *Platyceps*.

Morphologically, *Tyria najadum* Eichwald and related taxa from the eastern Mediterranean region and the southern Zagros Mountains (Iran) are remarkable for having single instead of paired apical pits. Due to their overall similarity, these whip snake species are assumed to be phylogenetically closest to *Platyceps* spp. (Schätti, 1993a; Schätti & McCarthy, 2001; Schätti *et al.*, 2001).

This is also the case with *Coluber florulentus* Geoffroy and related East African species (see Material and methods). As a matter of fact, there is not a single phylogenetically significant scalation, hemipenis or vertebra feature that seems to distinguish this mainly Afrotropical group from Saharo-Sindian *Platyceps* spp., i.e., *P. karelini* (Brandt), *P. rogersi* (Anderson), *P. rhodorachis* (Jan), and *P. ventromaculatus* (Gray), the type species of this genus (Schätti, 1987: Table 1, Fig. 3f; Schätti, 1988a: Figs 7A and 7D; Schätti, 1988b: Fig. 4). The same applies to the Arabian *Zamenis elegantissimus* Günther that has, for instance, high vertebra ratios typical for most *Platyceps* species (Schätti, 1987: Table 1).

Nucleotide sequences confirm the reality of the genera *Hemorrhois* Boie and *Platyceps* Blyth as well as their monophyletic origin as implied by Schätti (1986b, 1988b, etc.). This radiation group includes *Spalerosophis* Jan (Figs 8-9, see Discussion), a genus comprising Saharo-Sindian and Somalian species.

Hierophis spp. belong to a different cluster of Palaearctic racers. The southern European *H. gemonensis* and *H. viridiflavus* are combined with their eastern Mediterranean presumed congenerics *H. caspius* (this species is also found in the Balkans), *H. jugularis*, and *H. schmidti* by comparatively low bootstrap values (Figs 8-9). Surprisingly, the latter species group includes *Eirenis modestus* (see Discussion).

Molecular data support earlier findings based on morphological evidence, i.e., the assumption that *Coluber nummifer* Reuss and *C. ravergieri* Ménétries from the eastern Mediterranean region to Central Asia are closely related to *Hemorrhois hippocrepis* and *H. algirus* from northern Africa and the Iberian peninsula (Schätti, 1986b, 1987). Sister species status of *nummifer* and *ravergieri* is also supported by electrophoretic data (Helfenberger, unpubl.). These eastern taxa (see below) are herewith formally referred to *Hemorrhois* Boie.

Furthermore, nucleotide sequences confirm a close phylogenetic relationship of the *najadum* and *florulentus* group with Saharo-Sindian racers. Therefore, *Coluber florulentus* Geoffroy, *C.* (s. l.) *largeni* Schätti, *C. taylori* Parker, *Zamenis brevis* Boulenger, the whip snakes *C.* (s. l.) *schmidtleri* Schätti & McCarthy, *Tyria najadum* Eichwald, and *Z. dahlii* var. *collaris* Müller as well as the western Arabian *Z. elegantissimus* Günther are herewith assigned to *Platyceps* Blyth. This genus also includes *Z. variabilis* Boulenger, a southern Arabian endemic species (in prep.).

Some sequenced species exhibit considerable intraspecific molecular distances (Fig. 8) and thus warrant further investigation (see Appendix). In *Platyceps florulentus* and *Spalerosophis diadema*, for instance, pairwise sequence divergence is high (approx. 7%), approaching values found between closely related species (e.g., *P. rhodorachis* and *P. rogersi*). Furthermore, our DNA data argue for a comparatively recent speciation of *Hemorrhois nummifer* from *H. ravergieri*, the latter being paraphyletic.

INCERTAE SEDIS

For the time being, nine Old World racer species await definite generic classification. We consider it appropriate and best to retain them in, or refer to, *Coluber* sensu lato. This compilation does not take account of three nominal species: *C. bholanathi* Sharma is probably a junior synonym of *C.* (s. l.) *gracilis*; *C. atayevi* Tunijev & Shammakov and *C. thomasi* Parker may be conspecific with *Platyceps najadum* (Eichwald) and *P. variabilis* (Boulenger), respectively.

Coluber sensu lato is a hotchpotch comprising highly diverse Palaearctic and African taxa, including a few enigmatic species such as *C.* (s. l.) *andreanus* (Werner) from the Zagros Mountains in Iran, *C.* (s. l.) *dorri* (Lataste) from the arid region of West Africa and the Somalian *C.* (s. l.) *scorteccii* (Lanza).

Coluber (s. l.) *andreanus* has single apical pits, merely seven supralabials, enlarged parietals, and thus only a single anterior temporal, extremely high ventral counts in females (not so in males), and a single lateral reduction of dorsal scale rows which is sometimes lacking (Schätti, 2001a). As to its phylogenetic relationship, Andreas' racer badly requires comparison with *Platyceps najadum*, other Palaearctic racer genera, and *Eirenis* spp.

In terms of external morphology, *Coluber* (s. l.) *dorri* is outstanding among Old World racers for various morphological features including the absence of an anterior subocular, high midbody dorsal scale counts (29-33; 17-19 prior to the anal), and reductions thereof which are confined to lateral levels, i.e., the first involving rows 7-9, the fourth rows 3-6, and the last rows 3-5. The hemipenis is comparatively short and spinose. This western Sahel endemic might only be distantly related to other African racers and is in need of further studies.

Coluber (s. l.) *scorteccii* merits comparison with *Hemerophis socotrae*, Palaearctic and East African racers and supposedly related genera (see Discussion). In any case, *scorteccii* may only be distantly related to other endemics from the Horn of Africa, viz. *C.* (s. l.) *messanai* Schätti & Lanza and *C.* (s. l.) *somalicus* (Boulenger) which are known only from their holotypes. The latter two species most probably belong to the genus *Platyceps* (in prep.).

Coluber (s. l.) *gracilis* (Günther) from northwest India, *C.* (s. l.) *sinai* (Schmidt & Marx), and the Farasan racer *C.* (s. l.) *insulanus* (Mertens) from the southern Red Sea are probably related to *Platyceps* spp. The insular species is only known from the holotype and a sloughed skin (Mertens, 1965).

At the moment, the phylogenetic affinities of *Coluber* (s. l.) *zebrinus* Broadley & Schätti from Namibia are difficult to evaluate because of plesiomorphic conditions in external characters. Additional investigation is required to assess its relationships.

DISCUSSION

Following Parker (1949), Schätti & Desvoignes (1999) considered *Hemerophis socotrae* to be related to East African racers of the *Platyceps florulentus* group. This assumption was based on biogeographical considerations, dorsal scale reduction pattern, i.e., a single lateral fusion and two or more paravertebral reductions, skull bones, and vertebrae. For instance, *H. socotrae* has vertebra ratios mostly within the range of *P. florulentus* (Schätti, 1987: Table 1). The basisphenoid of *P. brevis smithi* (voucher BMNH 1963.51) and that of *H. socotrae* are similar regarding the shape and extent of the area lateralis, the course of the transverse ridges, and the emargination of the postero-lateral area. Moreover, these species show similarities in some aspects of hemipenis morphology, e.g., comparatively short organs with distinct spines restricted to the basal portion (Schätti, 1988b: Fig. 6D).

A considerable number of apomorphic conditions in external morphology, osteological features, details of visceral topography (in particular a caudal shift of the testes and kidneys), hemipenis morphology (apical depressions with spinulate ridges), a transversally blotched dorsal colour pattern, and aspects of behaviour (e.g., no attempt to bite) indicate that *Hemerophis socotrae* occupies an isolated position vis-à-vis Palaearctic and Afrotropical racers.

Based on nucleotide sequences, *Hemerophis* branched off from a hypothetical ancestral stock prior to the radiation leading to recent Old World racer genera (Figs 8-

9). A long independent evolutionary history of *Hemerophis* is in accordance with the isolation of the Sokotra archipelago from the African continent since ancient times.

The present structure and morphology of Sokotra Island is dated "Post-Lower Miocene" (Beydoun & Bichan, 1970). However, the archipelago may have broken away from the Horn of Africa in the Oligocene (25 mybp or older) as a result of the formation of the Gulf of Aden (Girdler, 1984). Some authors postulate that the separation of Sokotra dates back to an even more ancient era (see Schätti & Desvoignes, 1999).

To judge from geological evidence and the relationships of the endemic Sokotran reptile genera, viz. *Haemodracon* Bauer *et al.*, *Hakaria* Steindachner, *Pachycalamus* Günther, and the opisthoglyph *Ditypophis* Günther, there is reason to believe that *H. socotrae* is phylogenetically closest to Afrotropical, and possibly Malagasy, colubrids (see Schätti & Desvoignes, 1999)$^{1)}$.

Interestingly, with respect to external morphology, *Hemerophis socotrae* is similar to *Coluber* (s. l.) *scorteccii* from the Horn of Africa which is geographically closest to the Sokotra archipelago. The latter species has, for instance, an increased number of supralabials (9-10), a posterior subocular (usually with a series of scales separating the eye from the supralabials) and reduced posterior chin shields (Lanza, 1963: Fig. 1). Scortecci's racer has 27-29 dorsal scale rows at midbody and a reduction pattern involving mostly paravertebral rows, namely four out of five fusions. Derived external character states found in *H. socotrae* and *C.* (s. l.) *scorteccii* are due to parallelism or convergence. In this context, it must be emphasized that a large number of supralabials and midbody scale rows, the presence of a posterior subocular, and paravertebral reductions are characteristic of *Hemorrhois hippocrepis* and related species.

Nagy *et al.* (2000) analysed cytochrome b sequences of *Hemerophis socotrae* and six Palaearctic racers (*algirus*, *caspius*, *gemonensis* [as *laurenti*], *jugularis*, *ravergieri*, and *viridiflavus*, all taxa as *Coluber* spp.). They deduced a different origin of *H. socotrae* ("Phylogenetisch können [...] verschiedene Ursprünge angenommen werden"), supposed Palaearctic species to be monophyletic, and found that *Hemorrhois ravergieri* and *Hierophis caspius* cannot be distinguished ("anhand des Cytochrom b nicht zu unterscheiden"). However, these species have, for instance, completely different hemipenes and basisphenoids (Schätti, 1987: Figs 1 and 3; Schätti, 1988a: Fig. 6; Schätti & Agasian, 1985: Fig. 1) and they clearly belong to distinct genera.

With regard to *Hierophis*, molecular data reveal a western (*H. gemonensis*, *H. viridiflavus*) and eastern species group as was discovered with cytochrome b

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1) Schätti & Desvoignes (1999) supposed close phylogenetic relationship of *Ditypophis vivax* Günther with Madagascan "lycodontines". This conclusion is based on the stunning resemblance of hemipenis morphology in MHNG 2596.22 with that in the genus *Madagascarophis* Mertens. This specimen agrees with *D. vivax* in scale characters but is outstanding for its striking dorsal colour pattern and a more slender habitus than is usually encountered in this species (Schätti & Desvoignes, 1999: Fig. 40). Therefore, comparison with additional material is required. Further, this qualifies some comments (e.g., Schätti & Desvoignes, 1999: footnote 60) and opens again the debate of phylogenetic affinities of *Ditypophis* with the Southwest African monotypic genus *Pythonodipsas* Günther (Schätti & McCarthy, 1987).

sequences (Nagy *et al.*, 2000). Furthermore, our results indicate that *H. caspius*, *H. jugularis*, and *H. schmidti* form a monophyletic group with *Eirenis modestus*, the type species of this genus. Despite low bootstrap values, this result is confirmed with the consensus and the total evidence approach (Figs 8-9). Based on morphological evidence and mtDNA (unpubl.), the endemic Cyprus racer, *H. cypriensis* (Schätti, 1985), is most closely related to congeneric European species (in prep.).

As far as hemipenis morphology is concerned, there is no doubt that *Eirenis* spp. are very closely related to *Hierophis* Fitzinger (Schätti, 1988a). In particular, the copulatory organ of *E. modestus* is most similar to those of *H. viridiflavus* and *H. jugularis* (Schätti, 1988a: Figs 6A, 6G, and 7I). However, the sister group relationship of Anatolia-Iranian *Eirenis* with eastern *Hierophis* spp. conflicts with other morphological evidence. Apart from apical pits (single in *Eirenis*, paired in *Hierophis*), dwarf snakes differ from *Hierophis* spp. in, for instance, lacking a subocular scale, having fewer supralabials, only a single anterior temporal, and partially absent reductions of dorsal scales (e.g., *Eirenis modestus*, see Schmidtler & Baran, 1993).

Head and body scale rows character states found in *Eirenis* are very probably plesiomorphic. Thus, it has to be concluded that either eastern and western species of *Hierophis* acquired their scalation conditions independently, or that *Eirenis* spp. lost these characters secondarily. Clarification of the phylogenetic relationships of these genera certainly demands further studies, namely the consideration of more characters and additional species including possibly hitherto undescribed taxa. Furthermore, the presumed monophyly of *Eirenis* Jan, as presently understood including the subgenus *Collaria* Docenko as well as *Pseudocyclophis* Boettger (see Docenko, 1989), requires a detailed investigation (J. F. Schmidtler, in litt.).

The phylogeny of Old World racers, i.e., the reality of the genera *Hemorrhois*, *Hierophis*, and *Platyceps* is beyond any doubt. The same overall pattern including the isolated position of *Hemerophis socotrae* results when using Palaearctic ratsnakes (*Elaphe* spp. sensu Helfenberger, 2001) as outgroup species (in prep.).

Morphological evidence (see above) as well as nucleotide sequences of 12S rDNA and COI (Figs 8-9) clearly indicate a common origin for the genera *Hemorrhois* and *Platyceps* as well as *Spalerosophis diadema*. Based on molecular data, *Hemorrhois* has, unlike *Platyceps*, a clear intrageneric structure.

Irrespective of the method used (maximum likelihood, maximum parsimony, neighbour joining), all phylogenies which are inferred from the combined data set of both DNA fragments result in similar topologies except for the branching pattern within *Platyceps* and the position of *Spalerosophis diadema*.

Using neighbour joining analysis and the GTR+G+I model from the combined data set, *Platyceps elegantissimus* and *P. ventromaculatus* appear as the sister group of all other species in this genus, whereas the Jukes-Cantor model (Fig. 8) assigns this position to *P. florulentus, P. rhodorachis*, and *P. rogersi*. In the case of the maximum likelihood analyses with both models, *P. florulentus* is the sister species of the remaining congeneric taxa. The maximum parsimony analysis places *P. rhodorachis* and *P. rogersi* as a group opposed to the other species of *Platyceps*. The strict consensus approach also produces a topology with an unresolved branching pattern

FIG. 8

Neighbour joining tree with the Jukes-Cantor substitution model based on combined data sets of COI and 12S rDNA (1125 base pairs). Numbers above branches represent neighbour joining bootstrap support with 1000 replicates, those on the branches are based on 100 replicates under maximum likelihood and a GTR+G+I model, and those below from 1000 replicates under maximum parsimony including gaps as a fifth state. Bootstrap values are shown for all nodes where support under at least one algorithm is greater than 50%.

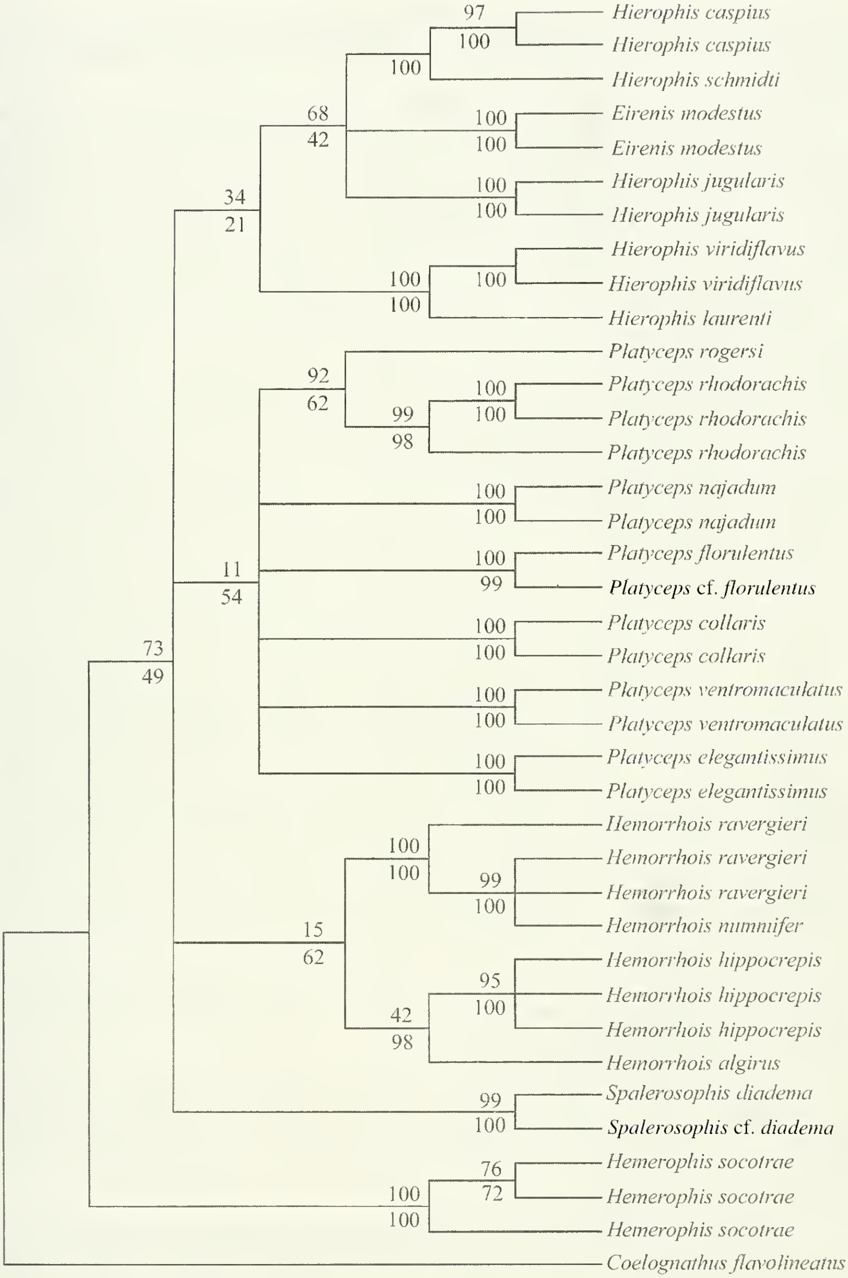

FIG. 9

Strict consensus tree of separately calculated neighbour joining trees of COI and 12S rDNA. Bootstrap values over 50% calculated from 1000 nonparametric replicates are shown. Values above the branches are from the COI data set, using a HKY+G model, and those below from the 12S rDNA data with Jukes-Cantor distances.

within this genus (Fig. 9). Apparently, this discrepancy cannot be resolved with the molecular markers analysed in the present study and must be addressed using alternative genes.

Irrespective of the model of DNA evolution, maximum likelihood analyses place *Spalerosophis diadema* as the sister taxon of *Platyceps*. Neighbour joining and maximum parsimony analyses group *S. diadema* with *Hemorrhois*. This uncertain position is reflected by low bootstrap values (< 50%, Fig. 8). Because of this, we continue, at least for the time being, to consider *Spalerosophis* to be most closely related to *Hemorrhois* spp. (Schätti, 1986a, 1986b; Schätti & McCarthy, 1987).

The result of the ILD test for the two partitions of 12S rDNA and COI is significant at a low level ($P = 0.046$). Subsequent shuffling procedure with eight replicate P values for each of five re-shufflings was performed to calculate a linear regression slope for each data set (Fig. 10). The stable slope of zero ($P = 0.617$) for the shuffled COI partition suggests that the significance of the original ILD test is a consequence of multiple substitutions rather than structured contradictory information. In contrast, the values increased with fast and significant incline ($P = 0.002$) when the less noisy 12S rDNA was shuffled. Presumably, it converges to a value that normally is observed when the differences of phylogenetic information within each data set are as similar as between each data set ($P \approx 50\%$), i.e., when both are perfectly congruent, or completely saturated at random. Consequently, the increase of the P values is a clear indication that relatively few saturation events occurred in the 12S rDNA prior to shuffling. It leads to the visualisation of structured phylogenetic information of the 12S rDNA and confirms the noisy nature of the COI partition.

In contrast to an incongruent data set, noise can provide traces of congruent information. However, the obstructing effects of noise can be minimized with an appropriate model of DNA evolution. These findings suggest that combining and analysing both data sets is justified (Fig. 8). For comparison, the more conservative approach of evaluating the two data sets separately and combining the results in a strict consensus tree (Fig. 9) was also pursued. For this purpose, the neighbour joining tree of the 12S rDNA data set without a noticeable amount of noise was calculated from Jukes-Cantor distances. This measure gives each mutation equal weight and is considered to be appropriate because the 12S rDNA data set did not show any sign of saturation in the preceding analyses (Fig. 1).

The neighbour joining tree of the COI data set containing obvious homoplasies was calculated from a more complex HKY+G model that counts each specific mutation event differently. This is judged to be suitable for the COI partition because it identifies characters with high mutation frequencies and consequently downweights sites affected by homoplasy.

Using Jukes-Cantor distances, a UPGMA tree resulted in a similar topology as the neighbour joining tree (Fig. 8) with only minor differences in the branching pattern within *Platyceps*. In particular, the monophyly of the different genera and comparable branch lengths are retained. Consequently, mutations occurred with similar frequencies in each branch, and the neighbour joining tree comes close to a molecular clock, i.e., reflects the historical events in chronologically correct order.

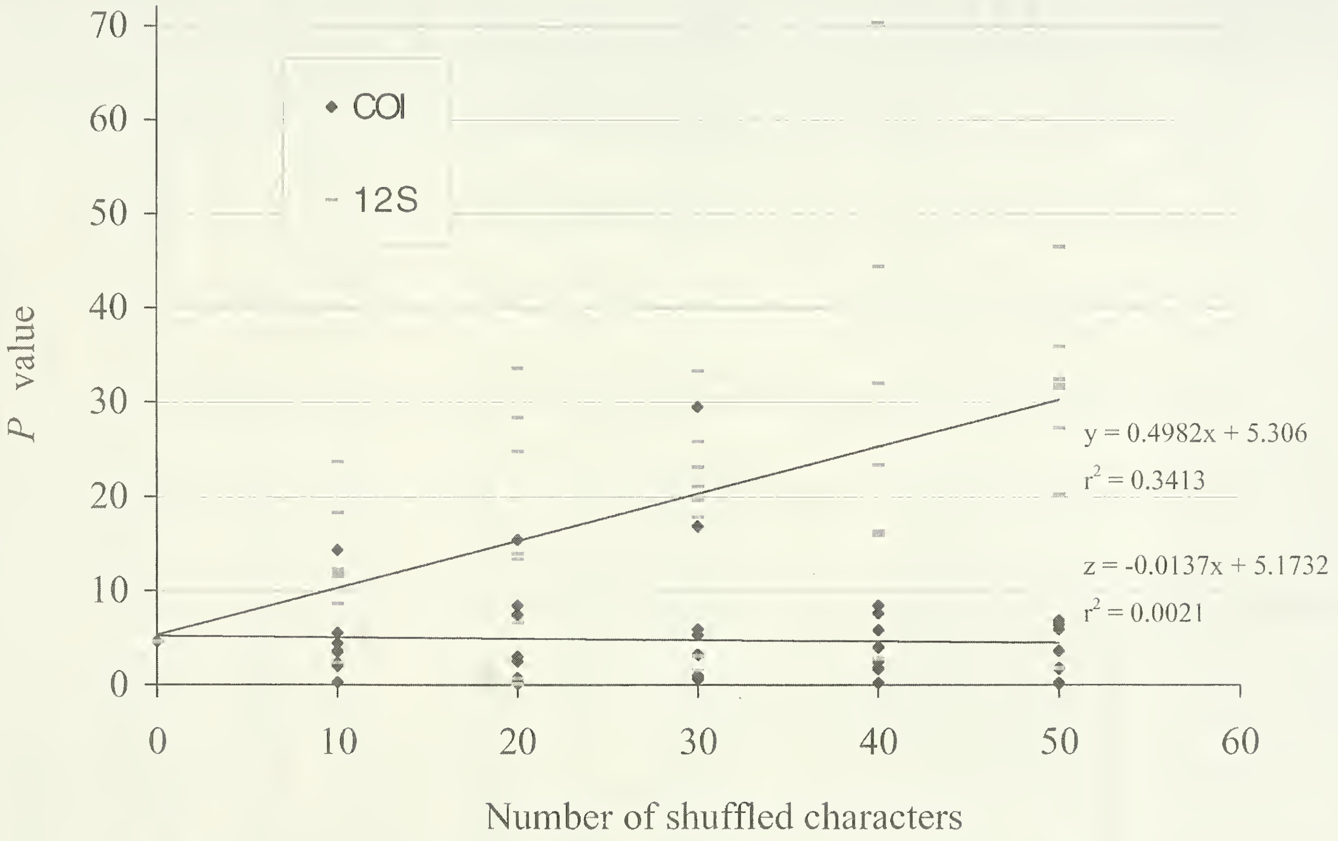

FIG. 10. *P* values of the ILD test after eight runs with a discrete number of shuffled characters in the 12S rDNA and COI sequence.

12S rRNA and COI are often used in phylogenetic analyses, with a generally good performance on different taxonomic levels (e.g., Heise *et al.*, 1995; Zardoya & Meyer, 1996). However, the high proportion of invariable characters and the increasing saturation effects observed, in particular at the third position of the amino acid codon, make the application of COI for systematic purposes in colubrines questionable. Although there is some benefit from this gene in our analyses, the modest results require the testing of additional molecular markers so far little used in phylogenetic analyses.

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APPENDIX. DNA samples used for this study. If not otherwise stated, mtDNA from liver was used; in other cases, genomic DNA from muscle (+), liver (*), or skin (#) was sequenced. SH: tissue collection of Notker Helfenberger; SS and SU: collections of the senior and junior author. *Coelognathus* [*Elaphe*] *flavolineatus* (Schlegel, 1837): *SH 1077 (Java). – *Eirenis modestus* ssp. (Martin, 1838): SH 1115 (Turkey, Konya Prov.), SH 1117 (Turkey, Kars [village]). – *Hemerophis socotrae*: *MHNG 2610.88 (Sokotra, Wadi Qishn), #MHNG 2610.89-90 (Sokotra, Fikhah). – *Hemorrhois algirus* (Jan, 1863): +MHNG 2415.6 (Tunisia, Tozeur). *H. hippocrepis* (Linnaeus, 1758): #SU 5 (Morocco), +MHNG 2415.94 (Morocco, Agadir area), +MHNG 2415.100 (Morocco, Rabat area). *H. nummifer* (Reuss, 1834): SH 548 (?Turkmenistan). *H. ravergieri* (Ménétries, 1832): SH 561 (Turkey), SH 1287 and 1291 (Kazakhstan). – *Hierophis caspius* (Gmelin, 1789): SH 547 (Ukraine), SH 1148 (Turkey). *H. gemonensis* (Laurenti, 1768): SH 557 (Greece). *H. jugularis* (Linnaeus, 1758): MHNG 2542.96 (Turkey), SH 1080 (Turkey). *H. schmidti* (Nikolskij, 1909): SH 964 (Turkey). *H. viridiflavus* (Lacépède, 1789): +SU 2-3 (Sardinia). – *Platyceps collaris* (Müller, 1878): +MHNG 2447.74-75 (Israel, Tel Aviv). *P. elegantissimus* (Günther, 1879): +MHNG 2456.72 (Saudi Arabia, Taif-Abha), +MHNG 2542.6 (Saudi Arabia, S of Taif). *P. florulentus* (Geoffroy, 1827): +SS 11 (Egypt). *P.* cf. *florulentus*: MHNG 2574.82 (Ethiopia). *P. najadum* (Eichwald, 1831): MHNG 2542.88 (Turkey), +MHNG 2447.53 (Greece, Lamia). *P. rhodorachis* (Jan, 1863): *MHNG 2542.47 (Yemen: Wadi Warazan), *MHNG 2554.13 (Yemen: Jabal Mafluq), *MHNG 2554.14 (Yemen: Wadi Mahsoos). *P. rogersi* (Anderson, 1893): +SS 16 (Israel). *P. variabilis* (Boulenger, 1905): +MHNG 2456.71 (Yemen: Wadi Damad). *P. ventromaculatus* (Gray, 1834): +MHNG 2443.10 (Pakistan), +SS 5 (origin to be verified). – *Spalerosophis* cf. *diadema* (Schlegel, 1837): MHNG 2547.44 (Yemen: Az-Zaydiyah), +MHNG 2414.68 (Pakistan).

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Pauropoda (Myriapoda) from Sabah (East Malaysia) (Pauropoda and Symphyla of the Geneva Museum XI)

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Pauropoda (Myriapoda) from Sabah (East Malaysia) (Pauropoda and Symphyla of the Geneva Museum XI). - A collection of Pauropoda from Sabah, the East Malaysian part of Borneo, contains 64 specimens from 14 species. They belong to the genera *Allopauropus*, *Stylopauropus*, *Pauropus*, *Hemipauropus*, *Brachypauropoides*, *Samarangopus* and *Sphaeropauropus*. The following nine species are described as new to science: *Allopauropus kinabaluensis* sp. n., *Allopauropus yoshii* sp. n., *Pauropus borneensis* sp. n., *Brachypauropoides prolatus* sp. n., *Samarangopus longipenes* sp. n., *Samarangopus ternarius* sp. n., *Samarangopus proekes* sp. n.. *Sphaeropauropus penicillius* sp. n. and *Sphaeropauropus arcuatus* sp. n.

Key-words: Borneo - Malaysia - Sabah - Pauropoda - taxonomy - biogeography - rain forest - soil zoology.

INTRODUCTION

It is well-known that the infrastructure of the Geneva Museum is well accommodated with all the resources necessary for advanced soil zoology studies, both with regard to personnel and materials. The curating activities from collecting and preserving to storing and cataloguing have been continued with plenty of ambition for about 100 years. This has made it possible to create the valuable collections now in the Arthropoda and Entomology sections and also to make them available to soil zoologists for their studies and to publish the results in Geneva. From the earliest days J. Carl has to be remembered and the traditions from his time have been continued and developed by H. Gisin, C. Besuchet and B. Hauser. Their purposeful work for the improvement and expansion of the soil fauna studies has lead to large collections of great value. Material collected by means of various automatical extraction methods (Tullgren-Berlese, Winkler-Moczarski, and modifications of them) strongly contributed to important taxonomical results in several animal groups, among them Symphyla and Pauropoda. A remarkable collection of material from the latter group is reported below.

In April-May 1982 Dr Bernd Hauser visited Borneo – following an invitation of Prof. Dr R. Yoshii (formerly Kyoto, at this time working in Sepilok) – and collected 64 specimens of Pauropoda in the State of Sabah, East Malaysia. The material comes from both coastal areas and from the mountainous region around

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Mount Kinabalu. Almost all samples were taken in primary rain forests, from dipterocarp lowland forests at 30 m a.s.l. to *Lithocarpus-Castanopsis* forests at 3270 m.

Animals were collected from litter and subsoil mainly by means of automatical extraction (Berlese funnels and Winkler-Moczarski apparatus) and to a less degree manually.

Fourteen species are present in the material collected by Dr Hauser. They belong to 7 genera in 3 families: 4 in Pauropodidae (*Allopauropus*, *Pauropus*, *Stylopauropus*, *Hemipauropus*), one in Brachypauropodidae (*Brachypauropoides*) and 2 in Eurypauropodidae (*Samarangopus*, *Sphaeropauropus*). With this material it has been possible to add 12 species to the Bornean fauna and to describe 9 new species. The latter are *Allopauropus kinabaluensis* sp. n., *A. yoshii* sp. n., *Pauropus borneensis* sp. n., *Brachypauropoides prolatus* sp. n., *Samarangopus longipenes* sp. n., *S. ternarius* sp. n., *S. proekes* sp. n., *Sphaeropauropus penicillius* sp. n. and *S. arcuatus* sp. n. Unless stated otherwise, all material was collected by Dr Bernd Hauser and is deposited in the Natural History Museum of Geneva.

PREVIOUS KNOWLEDGE

Pauropods were reported for the first time from Borneo by Scheller *et al.* (1994). Though only 35 specimens were studied, they represented 7 species: *Allopauropus proximus* Remy, *A. borneonesiota* Scheller, *A. asymmetricus* Scheller; *Rabaudauropus dispar* Scheller and an unidentified species of *Stylopauropus* (Pauropodidae); *Brachypauropoides penanorum* Scheller (Brachypauropodidae) and *Samarangopus segniter* Scheller (Eurypauropodidae).

SYSTEMATICS

PAUROPODIDAE

Four described species in this family were previously known from Sabah: *Allopauropus* (*D.*) *proximus* Remy, *A.* (*D.*) *borneonesiota* Scheller, *A.* (*D.*) *asymmetricus* Scheller and *Rabaudauropus dispar* Scheller (Scheller *et al.*, 1994). Seven named species of Pauropodidae are present in Dr Hauser's collection, 4 of them described earlier and 3 new species described below. Among these 7 species one (*A. proximus*) was reported earlier and 6 are new to Sabah (i.e. *Allopauropus* (*D.*) *maoriorum* Remy, *A.* (*D.*) *bouini* Remy, *A.* (*D.*) *kinabaluensis* sp. n., *A.* (*D.*) *yoshii* sp. n., *Pauropus borneensis* sp. n., *Hemipauropus melanesicus* Scheller). Thus 10 described species of Pauropodidae from 4 genera are now known from Sabah.

Genus ***Allopauropus*** Silvestri, 1902
Subgenus ***Allopauropus*** s. str.

Allopauropus (*A.*) *maoriorum* Remy

Allopauropus (*A.*) *maoriorum* Remy, 1956a: p. 19-21, fig. 4, 1-5.

Material examined. SABAH, West Coast Residency, Mt Kinabalu, "Summit Trail", below "Panar Laban Huts", soil sample in *Leptospermum* forest, Berlese extraction, alt. 3270 m, 10 ad. 9[1] (2♂, 8♀), 2 subad. 8 (♂,♀), 1 juv. 6, 30.IV.1982 (Loc. Sab-82/22).

Total number. 13 specimens.

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[1] abbreviations: ad. ...., subad. ... and juv. ... = an adult, a subadult or a juvenile specimen with the number of pairs of legs indicated.

General distribution. The species seems to have a wide range on the south hemisphere but has not often been collected. Two sites are know from New Zealand (Remy, 1956a, b), one from New Caledonia (Scheller, 1993) and one from southern Chile (Scheller, 1968). It is known from a hothouse in Switzerland too (glasshouse in the Botanical Garden, Geneva) (Remy, 1957c).

Subgenus ***Decapauropus*** Remy, 1957

Allopauropus (D.) bouini Remy

Allopauropus (*D.*) *bouini* Remy, 1955: p. 129-130, fig. 8.

Material examined. SABAH, Sandakan Residency, 24 km W Sandakan, Sepilok, "Kabili-Sepilok Forest Reserve", near "Pond", secondary lowland forest, litter, Berlese extraction, 1 ad. 9(♀), 10.V.1982 (Loc. Sab-82/41).

Total number. 1 specimen.

General distribution. Like the preceding species, *A. bouini* is rare but has a wide range. It has been collected in Angola (Remy, 1955; Scheller, 1975), Florida (Remy, 1959a) and Canada (Scheller, 1983).

Allopauropus (D.) proximus Remy

Allopauropus (D.) proximus Remy, 1948: p. 572-573, fig. 4.

Material examined. SABAH, Sandakan Residency, 24 km W of Sandakan, Sepilok, "Kabili-Sepilok Forest Reserve", forest near "Orang-Utan Rehabilitation Station", soil sample from between buttresses of Dipterocarpacae trees, Berlese extraction, 1 ad. 9(♀), 23.IV.1982 (Loc. Sab-82/4-II); ibidem, path in the mangrove, in the transition zone rain forest/mangrove, lowland Dipterocarpacae forest, near "Cottage" (old *Hevea* plantation), soil sample, Berlese extraction, 5 ad. 9(♀), 2 juv. 6, 2 juv. 5, 7.V.1982 (Loc. Sab-82/34); ibidem, near "Pond", secondary lowland forest, litter, Berlese extraction, 1 juv. 6, 10.V.1982 (Loc. Sab-82/41). Interior Residency, road to Kimanis, 14 km from Keningau, "Checkpoint", under stones near the barracks, alt. 950 m, 4 ad. 9(♀), 1 juv. 6, 14.V.1982, leg. B. Hauser (Loc. Sab-82/52).

Total number. 16 specimens.

A. proxinus was previously known from Sabah, 3 sites in the Mendolong tree nursery (near Sipitang) and 2 sites just S of Mendolong (Scheller *et al.,* 1994).

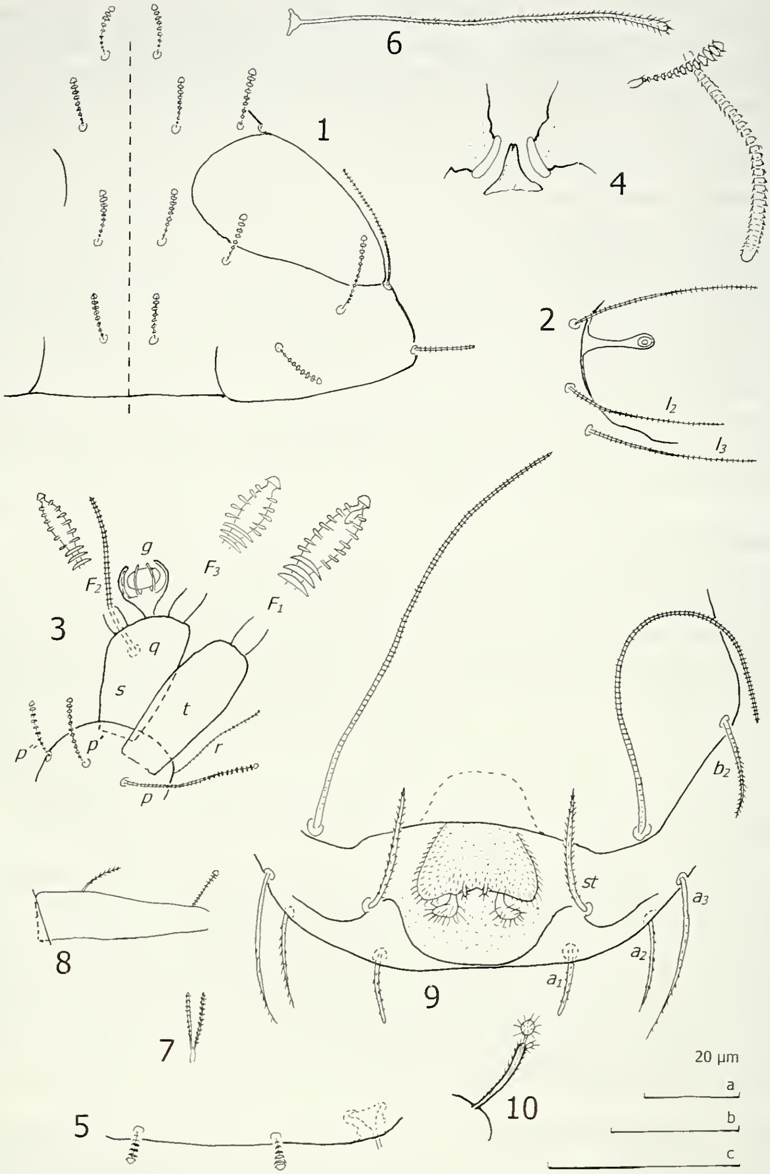
General distribution. The species has a wide discontinuous range in the tropics and subtropics of the Americas, Africa and southern Asia. From southeastern Asia it was previously known from the Malaysian part of Borneo (Scheller *et al.,* 1994), the Seychelles (Scheller, 1982), Pondichéry (Remy, 1962), Sri Lanka (Scheller, 1970) and the Palau Islands (Remy, 1957d).

Allopauropus (D.) kinabaluensis sp. n. Figs 1-10

Type material. **Holotype:** ad. 9 (♀), SABAH, West Coast Residency, Mount Kinabalu, "Summit Trail" (path connecting "Power Station" with the top), before "Carson's Camp", cloud forest, alt. 2480 m, 29.IV.1982, leg. B. Hauser (Loc. Sab-82/18). **Paratype:** ad. 9 (♀), SABAH, West Coast Residency, Mount Kinabalu, "Bukit Ular Trail" (path connecting "Kambarangan Road" with "Power Station"), *Lithocarpus-Castanopsis* forest, alt. 1850 m, 28.IV.1982, leg. B. Hauser (Loc. Sab-82/13).

Other material: SABAH, Sandakan Residency, 24 km W of Sandakan, Sepilok, "Kabili-Sepilok Forest Reserve", forest near "Pond", secondary lowland forest, sample of litter and decaying wood, Berlese extraction, 1 subad. 8(♀), 10.V.1982 (Loc. Sab-82/42).

Total number. 3 specimens.



Figs 1-10

Allopauropus (*D.*) *kinabaluensis* sp. n., holotype, ad. 9(♀). 1, head, median and right part, tergal view; 2, temporal organ, posterior part, right side, lateral view; 3, right antenna, tergal view; 4, collum segment, median and left part, sternal view; 5, tergite VI, posteromedian and right posterior part; 6, T_3; 7, seta on coxa of leg 9; 8, tarsus of leg 9; 9, pygidium, median and left part, sternal view; 10, anal plate, lateral view. Scale a: Figs 5, 7, 8; b: Figs 1, 4, 6; c: Figs 2, 3, 9, 10.

Diagnosis. A. (*D.*) *kinabaluensis* is well delimited from all other species of *Decapauropus* by the shape of the anal plate (proportionally broad, strongly pubescent, with 4 appendages, two of which are clavate and bent perpendicularly outwards).

Etymology. A latinized adjective of the name of Mt Kinabalu.

DESCRIPTION

Length. (0.52-)[2] 0.59 mm.

Head. Tergal setae of medium lengths, somewhat clavate, annulate, blunt; lateral ones rather long, thin, cylindrical, striate. Relative lengths of setae, 1st row: $a_1 = 10$, $a_2 = (8)$; 2nd row: $a_1 = 10$, $a_2 = 12(13)$, $a_3 = (17)$; 3rd row: $a_1 = 10$, $a_2 = 10(12)$, 4th row: $a_1 = 9$, $a_2 \approx 10$, $a_3 = 16$, $a_4 = 12$; lateral group of setae: $l_1 = (24)25$, $l_2 = 20$, $l_3 = 19(21)$. The ratio a_1/a_1-a_1 is: 1st row 1.0, 2nd row 0.5, 3rd row 0.8 and 4th row 0.9. Temporal organs widest in anterior part, 1.5 times as long as the shortest distance between them, aperture in posterior part distinctly anterior of posterior margin. Head cuticle glabrous.

Antennae. Segment 4 with 4 cylindrical annulate blunt setae, r very thin, relative lengths of setae: $p = 100$, $p' = 47(50)$, $p'' = (41)43$, $r = 73(85)$. Tergal seta p 0.9 of the length of tergal branch t. The latter fusiform, (2.1)2.5 times as long as its greatest diameter and 1.2 times as long as sternal branch s which is 1.6 times as long as its greatest diameter; anterodistal corner of s distinctly truncate. Seta q as seta p of 4th segment, 1.3 times as long as s. Relative lengths of flagella (with base segments included) and of base segments alone: $F_1 = 100$, $bs_1 = (4)5$, $F_2 = 32$, $bs_2 = (2)3$; $F_3 = 68(71)$, $bs_3 = 5$. The F_1 5.2(5.9) times as long as t, F_2 and F_3 (1.9)2.0 and 4.2 times as long as s respectively. Distal calyces hemispherical, smallest on F_2; distal part of flagella axes distinctly fusiform, more on F_1 and F_3 than on F_2. Globulus g 1.1 times as long as wide with (8)9 bracts, capsule flattened; width of g 0.8 of the greatest diameter of t. Antennae glabrous.

Trunk. Setae of collum segment simple, thick, somewhat clavate, densely but distinctly annulate; sublateral setae 2.1 times as long as submedian ones; sternite process subtriangular, anterior extension narrow and with small apical incision; appendages subconical, caps flat but wide, process and basal segment of appendages with minute pubescence.

Setae on tergites similar to median head setae, setae on anterior tergites only slightly longer than those on most posterior tergites. 4+4 setae on tergite I, 6+6 on II-IV, 6+4 on V, 4+2 on VI. Submedian posterior setae on tergite VI 0.2 of their distance apart and as long as pygidial setae a_1. Tergites almost glabrous.

Bothriotricha. Relative lengths of bothriotricha: $T_1 = 100$, $T_2 = (107)$, $T_3 = 81$ and 94(93), $T_4 = (95)$, $T_5 = 132(152)$. They have simple, straight axes, thin in all but T_3. Axes of T_3 growing thicker outwards, with blunt tips. Hairs on T_1, T_2, T_4 and T_5 short, simple, almost erect, on T_3 stronger, sparser and oblique.

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[2] Measurements taken from adult paratypes are given in brackets.

Legs. Setae on coxa and trochanter of leg 9 similar, furcate, branches cylindrical, striate, blunt. These setae on legs 1-8 simple, striate, on leg 1 cylindrical, on legs 2-8 somewhat clavate. Tarsus of leg 9 tapering, 3.0 times longer than its greatest diameter. Proximal seta very thin and with oblique pubescence, its length 0.3 of the length of tarsus and about as long as distal seta, the latter somewhat clavate, annulate, blunt. Cuticle of tarsus glabrous.

Pygidium. Tergum. Posterior margin evenly rounded but with a large lobe on its sternal side between *st*. Relative lengths of setae: $a_1 = 10$, $a_2 = 16(18)$, $a_3 = (22)26$, $st = 21(24)$. All these setae with a short oblique pubescence, strongest on *st*. The a_1 cylindrical, blunt, somewhat curved inwards, a_2, a_3 and *st* tapering and pointed; a_2 and a_3 directed posteriorly, curved inwards, *st* of the same shape but directed downwards. Distance a_1 - a_1 2.8(3.2) times as long as a_1; distance a_1 - a_2 1.7 times as long as distance a_2 - a_3, distance *st* - *st* 0.6 of the length of *st* and 1.1 times as long as distance a_1 - a_1. Cuticle granular between the *st*.

Sternum. Posterior margin between b_1 with broad and shallow indentation below anal plate. Relative lengths of setae ($a_1 = 10$): $b_1 = 64(67)$, $b_2 = 16(17)$. All these setae thin, subcylindrical, striate. The b_1 1.3 times as long as their interdistance, b_2 0.7 of the length of distance b_1 - b_2.

Anal plate narrowest anteriorly, (1.5)1.6 times as broad as long and with convex lateral margins and rounded posterolateral corners. Posterior margin with broadly V-shaped indentation and 4 appendages: 2 large and 2 small. The former strongly clavate, with distal half thickened and bent outwards perpendicularly to the median line of the body; their length one third of the greatest width of the plate. The latter appendages close to each other at the median line, very short, cylindrical, directed posteriorly from the posterosternal side. Plate and appendages with distinct oblique pubescence, longest on posterolateral corners and on distal half of clavate appendages.

RELATIONSHIPS

The new species may be related to *A. (D.) blandinae* Remy from the Ivory Coast (Remy, 1957b) as indicated by similarities in the groundplan of the anal plate and similar antennae and T_3.

Allopauropus (*D.*) *yoshii* sp. n. Figs 11-18

Type material. **Holotype:** ad. 9 (♀), SABAH, Sandakan Residency, 24 km W of Sandakan, Sepilok, "Kabili-Sepilok Forest Reserve", near "Pond", secondary lowland forest, litter, Berlese extraction, 10.V.1982 (Loc. Sab-82/41).

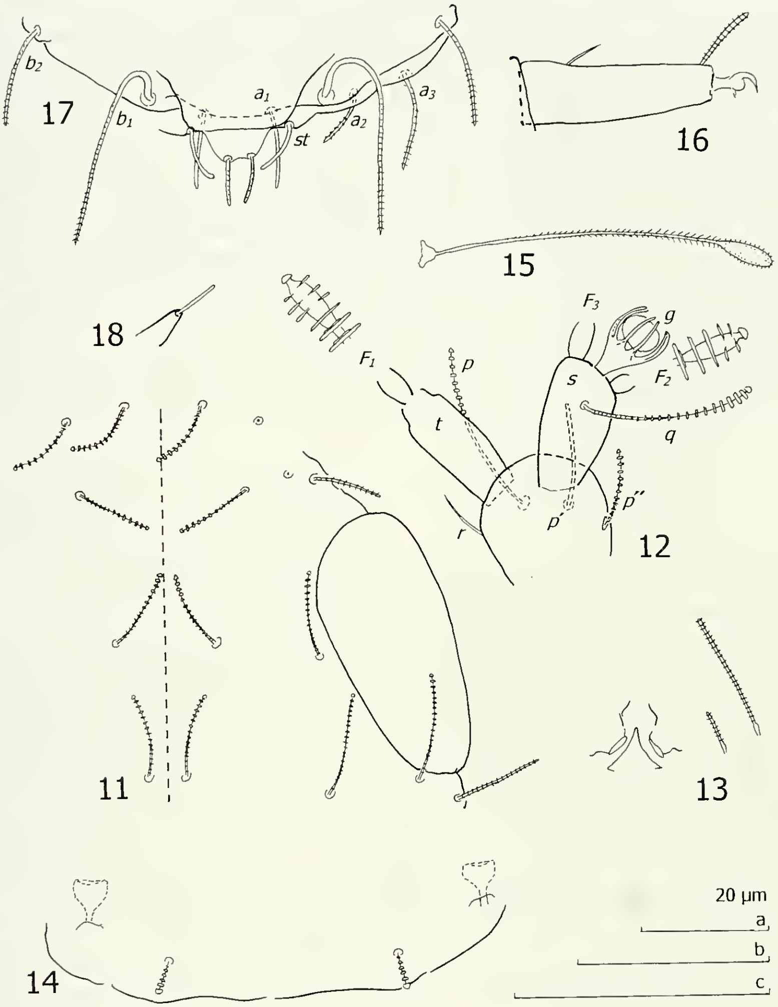
Total number. 1 specimen.

Etymology. Dedicated to the renowned collembologist and specialist of soil and cave faunas, the late Professor Dr Riozo Yoshii, for his kind help and great encouragement in connection with Dr Hauser's expedition.

DESCRIPTION

Length. 0.32 mm.

Head. Tergal setae of medium lengths, thin, cylindrical, annulate, blunt. Relative lengths of setae, 1st row: $a_1 = 10$, $a_2 = 9$, 2nd row: $a_1 = a_3 = 10$, $a_2 = ?$; 3rd row: $a_1 =$



FIGS 11-18

Allopauropus (*D.*) *yoshii* sp. n., holotype, ad. 9(♀). 11, head, median and right part, tergal view; 12, right antenna, sternal view; 13, collum segment, median and left part, sternal view; 14, tergite VI, posterior part; 15, T_3; 16, tarsus of leg 9; 17, pygidium, posterior part, sternal view; 18, anal plate, lateral view. Scale a: Figs 13, 15; b: Figs 16-18; c: Figs 11, 12, 14.

10, $a_2 = 12$; 4th row: $a_1 = 11$, $a_2 = 14$, $a_3 = 13$, $a_4 = 12$, lateral group of setae: $l_1 = l_2 = 13$, $l_3 = 17$. The ratio $a_1/a_1 - a_1$ is in 1st row 1.0, 2nd row 0.5, 3rd row 0.9 and 4th row 1.6. Temporal organs widest in anterior part, their length 0.9 of their shortest interdistance; posterior aperture not found. Head cuticle glabrous.

Antennae. Segment 4 with 4 cylindrical setae, *r* very thin; *p*, *p*' and *p*'' annulate, blunt. Their relative lengths: $p = 100$, $p' = 57$, $p'' = 46$, $r = 32$. Tergal seta *p* 1.4

times as long as length of tergal branch *t*. The latter fusiform, 2.2 times as long as its greatest diameter and almost as long as sternal branch *s* which is 1.5 times as long as its greatest diameter; anterodistal corner of *s* distinctly truncate. Seta *q* somewhat clavate, annulate, 1.3 times as long as *s*. Relative lengths of flagella (with base segments included) and of base segments alone: $F_1 = 100$, $bs_1 = 5$; $F_2 = 38$, $bs_2 = 3$; $F_3 = 77$, $bs_3 = 5$. The F_1 5.3 times as long as *t*, F_2 and F_3 1.9 and 3.9 times as long as *s*, respectively. Distal calyces very small, somewhat flattened, distal part of flagella axes fusiform. Globulus *g* 1.2 times as long as wide with 11 bracts, capsule subspherical; width of *g* 1.1 times as long as greatest diameter of *t*. Antennae glabrous.

Trunk. Setae of collum segment simple, somewhat increasing in thickness outwards, densely annulate; sublateral setae 2.9 times as long as submedian ones; sternite process triangular, anterior lengthening narrow and pointed; appendages small, indistinct, with flat caps; process and appendages glabrous. Setae on tergites similar to median head setae. Tergite VI with 4+2 setae, submedian posterior setae almost 0.2 of their distance apart and 0.4 of pygidial setae a_1. Tergites glabrous.

Bothriotricha. Lengths of bothriotricha: $T_1 = ?$, $T_2 = 70$, $T_3 = 55$, $T_4 = 61$, $T_5 = 104$ µm. All but T_3 with very thin, simple, straight axes. Axes in the latter thicker with ovoid endswelling, 2.8 times as long as wide. Pubescence on T_1, T_2, T_4 and T_5 on distal half only, hairs very short, simple, almost erect; pubescence on axes of T_3 stronger, oblique, on end-swelling short, dense, erect.

Legs. Setae on coxa and trochanter of leg 9 not studied. More anteriorly these setae being simple, annulate, blunt, with rudimentary secondary branches. Tarsus of leg 9 tapering, 2.9 times as long as its greatest diameter. Proximal seta short, thin, pointed, its length 0.2 of the length of tarsus and 0.6 of the length of distal seta. The latter cylindrical, striate, blunt, its length almost 0.4 of the length of tarsus. Metatarsus short, annular. Cuticle of tarsus glabrous.

Pygidium. Tergum. Posterior part with a low bulge being somewhat broader than the distance between *st*; posterior margin of lobe straight. Relative lengths of setae: $a_1 = 10$, $a_2 = 7$, $a_3 = 14$, $st = 9$. These setae thin, cylindrical, blunt, curved inwards; a_1 and *st* almost glabrous, a_2 and a_3 striate; a_1 and a_3 directed posteriorly, a_2 and *st* converging. Distance a_1 - a_1 0.9 of the length of a_1; distance a_1 - a_2 1.4 times as long as distance a_2 - a_3; distance *st* - *st* as long as *st* and 1.4 times as long as distance a_1 - a_1. Cuticle glabrous.

Sternum. Posterior margin between b_1 with large trapeziform lobe below anal plate. Relative lengths of setae ($a_1 = 10$): $b_1 = 31$, $b_2 = 15$. These setae thin, cylindrical, striate. The b_1 1.4 times as long as their distance apart, b_2 0.9 of the length of distance b_1 - b_2.

Anal plate broadest anteriorly, 2.2 times as broad as long and with almost straight lateral margins and short posterior margin with shallow median indentation and two appendages; the latter thin, cylindrical, directed posteriorly, somewhat curved inwards. Plate glabrous, appendages indistinctly striate.

RELATIONSHIPS

Among the species of the subgenus, *A.* (*D.*) *yoshii* sp. n. may be most close to *A.* (*D.*) *pachyflagellus* Scheller, from Central Amazonia (Scheller, 1997). *A.* (*D.*)

furcosus Remy from Mauritius (Remy, 1959b) and *A.* (*D.*) *presbyteri* Remy from Algeria (Remy, 1947). The new species has similarities to *A. pachyflagellus* in the shape of the antennae, the bothriotricha and the anal plate, but they are distinguished by e.g. the shape of the antennal seta *q* (striate, not annulate), the shape of the posteromedian setae of tergite VI (clavate and annulate, not thin and cylindrical) and the pubescence of the bothriotricha T_1, T_2 and T_4 (very short, not long and whorled). The connections with *A. furcosus* are in the general shape of the T_3, similar setae on the tarsi of leg 9 and the general shape of the anal plate. Best distinguishing characters are the length of the antennal seta *r* (0.3 of the length of *p*, not 0.8), the shape of the end-swelling of the T_3 (3.4 times as long as wide, not 1.6-1.8) and the form of the anal plate (trapeziform, not square). The similarities between *A. yoshii* sp. n. and *A. presbyteri* are less pronounced and the two species are easily distinguished by the proportion *p/t* (1.4, not 2.0) and the shape of the T_3 (with cylindrical axis and distinct end-swelling, not clavate).

Genus ***Stylopauropus*** Cook, 1896

Subgenus ***Donzelotauropus*** Remy, 1957

The genus *Stylopauropus* is mainly Holarctic, with only a few records from southern countries. There is a dubious record from Argentina and two species, probably introduced, have been reported from Australia (vide Scheller *et al.*, 1994). Moreover, two species in the nominate subgenus have been reported from Madagascar (Remy & Bello, 1960) and Sri Lanka (Remy, 1962) respectively.

In a sample from a *Lithocarpus-Castanopsis* forest on Mount Kinabalu the genus *Stylopauropus* (s.g. *Donzelotauropus*) appeared with a single juv. 6 specimen (Mount Kinabalu, "Bukit Ular Trail", path connecting "Kambarangan Road" and "Power Station", alt. 1850 m, 28.IV.1982, Loc. Sab-82/13). The genus and subgenus was breviously reported from Borneo by Scheller *et al.* (1994), with a juv. 3 specimen collected in a secondary forest in southernmost Sabah (Mendolong, about 30 km SE Sipitang, forest logged ca 1960, sanitation felling in 1989, flotation of humus, 2.IX.1989, Loc. L41/2, leg. P. Brinck & P. H. Enckell). None of these two specimens could have been described, but they seem to belong to two different species.

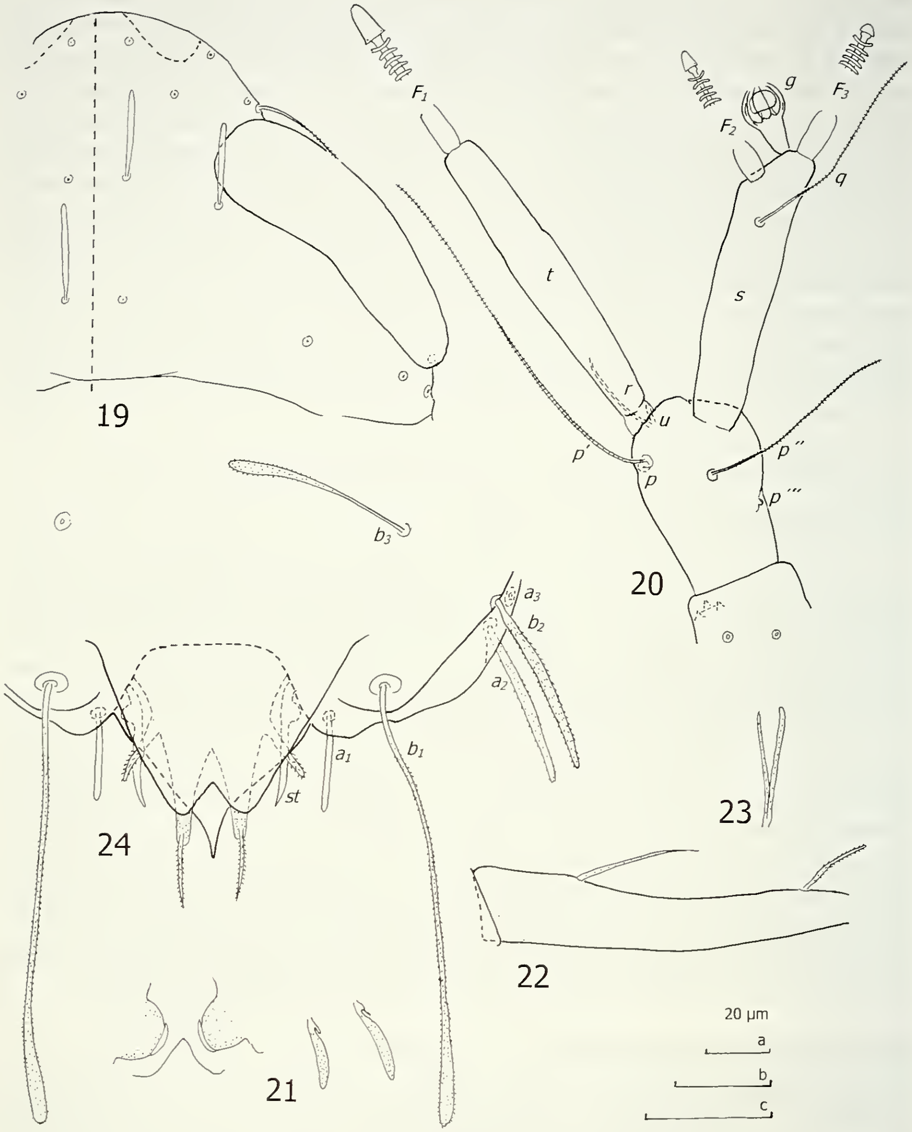
Genus ***Pauropus*** Lubbock, 1867

Pauropus borneensis sp. n. Figs 19-24

Type material. **Holotype:** 1 ad. 9(♀), SABAH, Sandakan Residency, 24 km W of Sandakan, Sepilok, "Kabili-Sepilok Forest Reserve", near "Pond", secondary lowland forest, litter, Berlese extraction, 10.V.1982 (Loc. Sab-82/41).

Total number. 1 specimen.

Diagnosis. P. borneensis may be closest to *P. wieheorum* Remy from Mauritius (Remy, 1959b). They have distinct similarities in the antennae and some of the pygidial setae and also in the shape of the anal plate. The following pygidial characters are good for distinguishing the species: setae a_1 (glabrous in *P. borneensis* sp. n., with distinct pubescence in *P. wieheorum);* the lateral appendages of the anal plate



FIGS 19-24

Pauropus borneensis sp. n., holotype, ad. 9(♀). 19, head, median and right part, tergal view; 20, left antenna, sternal view; 21, collum segment, median and left part, sternal view; 22, tarsus of leg 9; 23, seta on trochanter of leg 9; 24, pygidium, posterior part, sternal view. Scale a: Figs 21-23, b: Fig. 19; c: Figs 20, 24.

(straight, tapering, pubescent, not curved inwards, cylindrical, glabrous); the *st* (with proximal thickening on outer side, not on inner side); setae b_1 (with distinct end-swelling, not evenly thickening outwards); setae b_2 (1.2 times as long as distance b_1 - b_2, not 1.9). There are connections also with *P. salvatgei* Remy from Madagascar (Remy, 1960) particularly in the shape of the sternal antennal branch (distinctly truncate in anterodistal end) and the pygidium (similar shape of the setae and the posterior lobe of the tergum) but the two species are dissimilar in many details. To a less degree the new species shows affinities also to *P. difficilis* Remy from Pondichéry (Remy, 1962).

Etymology. A latinized adjective of the name Borneo.

DESCRIPTION

Length. 0.85 mm.

Head. Most tergal setae lacking, those studied rather long, somewhat lanceolate, blunt, glabrous. a_3 of 2nd row inserted laterally, thin, striate, tapering, and pointed. Lengths of setae, 1st row: a_1 = ?, a_2 = ?; 2nd row: a_1 = ?, a_2 = ?, $a_3 = 22$, 3rd row: $a_1 = 19$, $a_2 = 18$; 4th row: $a_1 = 12$, a_2 = ?, a_3 = ?, a_4 = ? µm; lateral group of setae not studied. The ratio a_1/a_1- a_1 in 3rd row 1.6 and in 4th row 1.7. Anterior part of temporal organs in tergal view only somewhat broader than posterior part, 1.3 times as long as their shortest distance apart and each with an aperture in posterior part. Head cuticle glabrous.

Antennae. Segment 4 with 5 thin setae, *u* cylindrical, the others tapering, pointed, striate. Their lengths: p = ?, $p' = 61$, $p'' = 33$, p''' rudimentary knob, $r = 16$, $u = 1.5$ µm. Tergal branch *t* slender, fusiform, 6.2 times as long as its greatest diameter and 1.1 times as long as sternal branch *s*. The latter slender and 4.5 times as long as its greatest diameter; anterodistal corner of *s* strongly truncate. Seta *q* as seta *p*' of 4th segment, 0.8 of the length of *s*. Relative lengths of flagella (base segments included) and base segments: $F_1 = 100$, $bs_1 = 6$; $F_2 = 67$, $bs_2 = 5$; $F_3 = 81$, $bs_3 = 6$. The F_1 2.8 times as long as *t*, F_2 and F_3 2.1 and 2.6 times as long as *s*, respectively. Distal calyces of F_1 almost subcylindrical, those of F_2 more conical, those of F_3 subhemispherical; distal part of flagella axes cylindrical, not widened. Globulus *g* 1.5 times as long as wide, with 8 bracts, capsule bottom flattened; width of *g* 0.9 of the greatest diameter of *t*. Antennae glabrous.

Trunk. Setae of collum segment furcate, primary branch thick, fusiform, blunt, with very short pubescence; secondary branch rudimentary, pointed; sublateral setae 1.1 times as long as submedian ones; sternite process subtriangular, not divided anteriorly; appendages short, wide, with low caps, process glabrous, appendages with short minute pubescence.

Setae on tergites fusiform, with short pubescence. 4+4 setae on tergite I, 6+6 on II-V, 4+? on VI. Tergites almost glabrous.

Bothriotricha. Axes thin and pubescence short.

Legs. Setae on coxa and trochanter of leg 9 similar, furcate, branches cylindrical, tapering distally, with very short pubescence. Tarsus of leg 9 slender, tapering, somewhat curved, 5.1 times as long as its greatest diameter. Setae with short oblique pubescence, proximal one tapering, pointed, its length 0.3 of the length of tarsus and 1.7 times as long as subcylindrical, tapering distal seta. Cuticle of proximal third of tarsus with minute pubescence.

Pygidium. Tergum. Posterior margin between $a_1$with large posteriorly directed lobe with rounded lateral margins and a distinct posteromedian point. Relative lengths of setae: $a_1 = 10$, $a_2 = 18$, $a_3 = 21$, $st = 14$. a_1 and *st* glabrous and directed posteriorly, the former cylindrical, blunt, the latter pointed, weakly S-shaped and with a distinct lateral swelling in proximal third; a_2 and a_3 blunt, fusiform, very weakly curved inwards, diverging and with short oblique pubescence. Distance a_1 - a_1 2.5 times as long as a_1; distance a_1 - a_2 5.8 times as long as distance a_2 - a_3, distance *st* - *st* 1.2 times as long as *st* and 0.7 of distance a_1 - a_1. Cuticle glabrous.

Sternum. Posterior margin between b_1 with large posteriorly directed lobe below anal plate, lobe 1.5 times as broad as long and most posteriorly with distinct V-shaped incision. Relative lengths of setae ($a_1 = 10$): $b_1 = 50$, $b_3 = 21$. These setae thin but with distal clavate swelling; pubescence very short on b_1, especially on the swelling, short but distinct on b_3. The b_1 2.4 times as long as their distance apart, b_3 0.5 of the length of distance b_3 - b_3.

Anal plate broadest anteriorly, 1.3 times as long as its greatest width and with concave lateral margins and a deep V-shaped posterior incision. Plate with 4 subcylindrical appendages: two lateral ones directed obliquely backwards, their pubescence distinct; two posteriorly directed ones protruding from the posterosternal side of the posterior lobes of the plate, thin, tapering, pointed and with short erect pubescence. Length of lateral and posterior appendages 0.3 and 0.4 of the length of the plate, respectively. Distal part of plate with minute pubescence.

Genus ***Hemipauropus*** Silvestri, 1902

Hemipauropus melanesicus Scheller

Hemipauropus melanesicus Scheller, 1993: p. 56-58, figs 131-140.

Material examined. SABAH, Sandakan Residency, 24 km W of Sandakan, Sepilok, "Kabili-Sepilok Forest Reserve", secondary lowland forest close to "Pond", litter sample, Berlese extraction, 1 subad. 8(♂), 10.V.1982 (Loc. Sab-82/42).

Total number. 1 specimen.

General distribution. This is the second record of *H. melanesicus*, the species was previously known from New Caledonia only (Scheller, 1993).

BRACHYPAUROPODIDAE

Genus ***Brachypauropoides*** Remy, 1952

Eight species have been described in *Brachypauropoides* but the full range of the genus is still unknown and its generic limits are unclear (the taxon is defined by the number of digitiform appendages of the temporal organs and the number of tergal setae). *Brachypauropoides* has been collected on Madagascar, Borneo and New Zealand but it will certainly appear in many Asian and Australian places in future collections. Eight previously known species can be listed:

Species	Distribution	References
B. actaeus Remy & Rollet	Madagascar	Remy & Rollet, 1960
B. baculifer Remy & Rollet	Madagascar	Remy & Rollet, 1960
B. massoti Remy	Madagascar	Remy, 1956c
		Remy & Bittard, 1957
		Remy & Bello, 1960
		Remy & Rollet, 1960
B. norberti Remy & Bello	Madagascar	Remy & Bello, 1960
B. penanorum Scheller	Sabah (Mendolong)	Scheller *et al.,* 1994
B. permolestus Remy & Rollet	Madagascar	Remy & Rollet, 1960
		Remy & Bello, 1960
B. pistillifer Remy	New Zealand	Remy, 1952
		Remy, 1956c
		Remy & Rollet, 1960
B. praestans Remy	New Zealand	Remy, 1956c

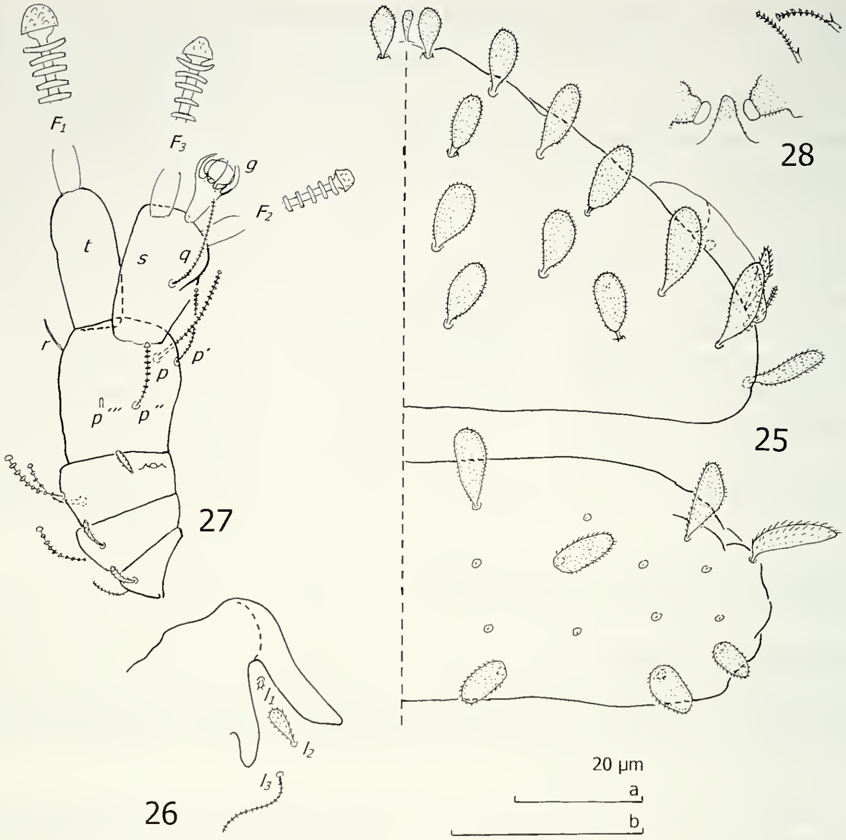
A ninth species is described in the following:

Brachypauropoides prolatus sp. n. Figs 25-38

Type material. **Holotype:** ad. 9 (♂), SABAH, Interior Residency, road to Kimanis, 16 km from Keningau, alt. 1170 m, soil sample from between buttresses of a dead tree, Berlese extraction, 13.V.1982 (Loc. Sab-82/50).

Total number. 1 specimen.

Diagnosis. Because the species of *Brachypauropoides* are so incompletely known the relationships of the new species is impossible to trace. It may, however, be most close to *B. praestans* Remy from New Zealand (Remy, 1956a) and to *B. massoti* Remy and *B. norberti* Remy & Bello, the latter two from Madagascar (Remy, 1956c; Remy & Bello, 1960). The similarities among these species are mainly of general character (the shape of the anal plate and the setae of the head and the tergites). The new species can be distinguished from them by the shape of the temporal organs (3 uplifted appendages in *B. prolatus* sp. n., one only in *B. praestans*, *B. massoti* and *B. norberti).* Other distinctive characters of *B. praestans* are the shape of the tergal antennal branch *t* (2.1 times instead of 3 times as long as its greatest width), the proportion t/F_1 (0.6, not 0.3), the shape of the pygidial setae a_2, a_3 and *st* (the two former tapering, broadest in the middle, the latter fungiform in *B. prolatus* sp. n., the two former clavate, broadest in distal half and claviform, respectively, in *B. praestans*). Apart from the shape of the temporal organs, good distinctive characters can also be found in relation to *B. massoti* and *B. norberti.* In *B. massoti* the setae of the tergites are different (thick, bladder-shaped in *B. prolatus* sp. n., thinner and clavate in *B. massoti*) and so are the appendages of the anal plate (cylindrical, not clavate). The setae on the central part of the tergal side of the head are uniform in *B. prolatus* sp. n. but in *B. norberti* two setae are very small and two others are distinctly



FIGS 25-28

Brachypauropoides prolatus sp. n., holotype, ad. 9(♂). 25, head and tergite 1, right half, tergal view; 26, temporal organ with lateral group setae, posterior part, left side; 27, right antenna, sternal view; 28, collum segment, median and left part, sternal view. Scale a: Fig. 28; b: Figs 25, 26, 27.

longer; the tergites are almost glabrous, not distinctly granular and the *st* are fungiform, not cylindrical.

Etymology. From Latin prolatus = extended (anal plate).

DESCRIPTION

Length. 0.51 mm.

Head. Tergal and lateral sides with 31 setae arranged as in figs 25 and 26; transversal rows difficult to interpret. Relative lengths of the 5 submedian setae: 10, 14, 14, 14, 14; lateral group: l_1 short, bladder-shaped, relative length (first submedian seta = 10) = 2, l_2 subclavate = 14, l_3 thin, striate, pointed = 22. All setae but l_3 bladder-shaped with distinct oblique-erect pubescence. Temporal organs complicated (posterior part in fig. 26) with three uplifted tube-like appendages, two posterior and one anterior. Longest appendage about ≈ 0.5 of the length of organ and protruding downwards from the posterior end; the two other appendages short, one near the mouth and the other anterior of the longest appendage. Tergal side of head and temporal organs glabrous.

Antennae. Segment 3 with 3 setae, one short clavate, distinctly pubescent and inserted near a rudimentary globulus, the other two somewhat clavate annulate setae. Segment 4 with 5 setae, *p*''' and *r* cylindrical and glabrous, the others subcylindrical and annulate; relative lengths of them: $p = 100$, $p' = 72$, $p'' = 64$, $p''' = 9$, $r = 36$. Tergal seta *p* 0.7 of the length of tergal branch *t*. The latter subcylindrical, distal part tapering, 2.1 times as long as its greatest width, as long as sternal branch *s*. The latter thickest in distal 1/3, with anterodistal corner truncate, 1.7 times as long as its greatest diameter; its seta *q* subcylindrical, tapering, pointed, annulate, 0.7 of the length of *s*. Relative lengths of flagella (base segments included) and of base segments alone: $F_1 = 100$, $bs_1 = 8$; $F_2 = 74$, $bs_2 = 6$, $F_3 = 83$, $bs_3 = 7$. The F_1 3.6 times as long as *t*, F_2 and F_3 2.7 and 3.0 times as long as *s* respectively. The F_2 thinner than F_1 and F_3. Distal calyces subhemispherical, with short pubescence. Globulus *g* with slender stalk, 1.7 times as long as its greatest diameter being 0.6 of the greatest diameter of *t*. Antennal stalk and branches glabrous, calyces with sparse pubescence.

Trunk. Setae of collum segment furcate, primary branch cylindrical, blunt, annulate; secondary branch rudimentary glabrous; sublateral seta 1.1 times as long as submedian one. Sternite process blunt, appendages conical with glabrous caps; process and appendages with short pubescense.

Tergites I, III, V, VI entire, II and IV weakly divided transversely. Number of setae on tergites (if two values they are the anterior and posterior groups respectively): I 30, II 15+18 = 33, III 36+19 = 55, IV 24+19 = 43, V 27, VI 4+2 = 6. Setae bladder-shaped, with distinct oblique-erect pubescence, stalk inserted unsymmetrically. Cuticle of tergites pubescent.

Bothriotricha. Relative lengths of bothriotricha: $T_1 = 100$, $T_2 = 112$, $T_3 = 82$, $T_4 = 85$, $T_5 = 104$. They have simple axes, being glabrous most proximally. Pubescence on T_1, T_2 and T_4 distinct and consisting of erect hairs arranged in whorls; T_5 curled distally, its pubescence very short, almost erect. Proximal half of T_3 strongly clavate, almost glabrous, surface with many ring-shaped folds; distal half very thin with short pubescence arranged in whorls.

Genital papillae[3]. Short, 1.3 times as long as their greatest diameter, widest in proximal half, glabrous, seta almost 0.6 of the length of papilla.

Legs. All legs 5-segmented. Setae on coxa and trochanter of leg 9 similar, simple, cylindrical, annulate, blunt, without traces of secondary branches. These setae are more anteriorly somewhat thinner and with short cylindrical glabrous rudiments of secondary branches on legs 2, 3 and 4.

Tarsus of leg 9 short, tapering, 2.2 times as long as its greatest diameter.

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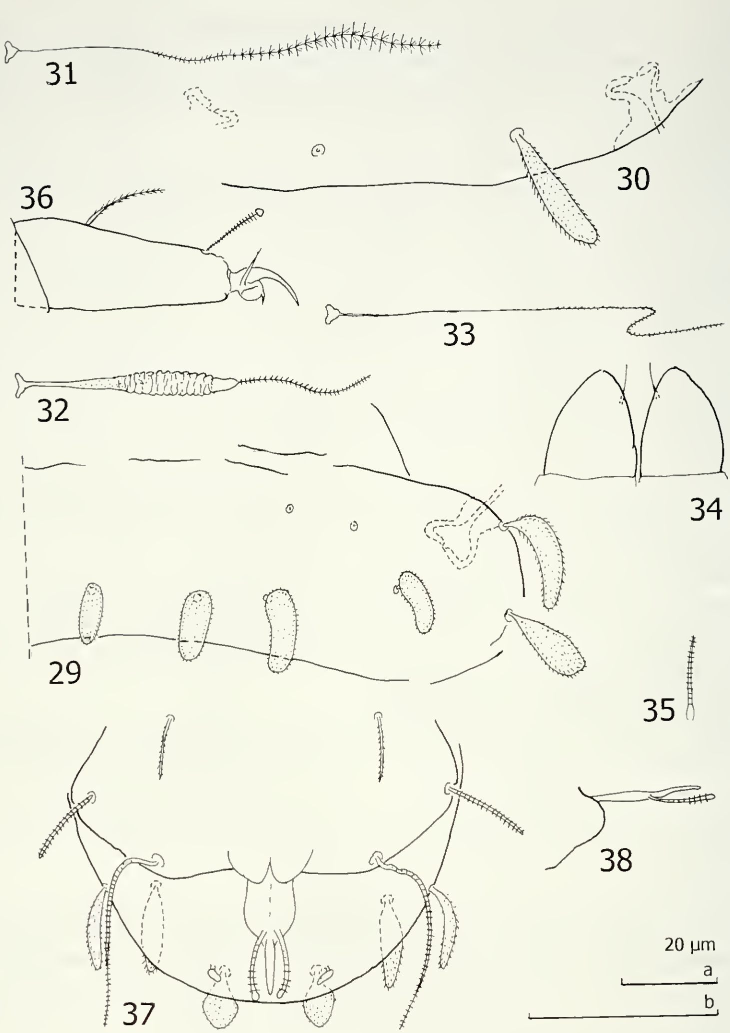
[3] The "penes" in Pauropoda are not transferring sperm from the male genital orifice directly into the female genital orifice. Thus, they are not copulatory organs in the proper sense of the word and consequently "penis, penes" are here replaced by "genital papilla, genital papillae".



FIGS 29-38

Brachypauropoides prolatus sp. n., holotype, ad. 9(♂). 29, tergite II, anterior part, right side; 30, tergite VI, posteromedian and right posterior part; 31, T_1; 32, T_3; 33, T_5; 34, genital papillae, anterior view; 35, seta on coxa of leg 9; 36, tarsus of leg 9; 37, pygidium, sternal view; 38, anal plate, lateral view. Scale a: Figs 31-33; b: Figs 29, 30, 34-38.

Proximal seta 0.4 of the length of tarsus, with oblique pubescence; distal seta somewhat clavate, annulate, blunt, 0.3 of the length of tarsus and 0.8 of the length of proximal seta. Cuticle of tarsus almost glabrous.

Pygidium. Tergum. Hind margin evenly rounded. Relative lengths of setae: $a_1 = 10$, $a_2 = 16$, $a_3 = 15$, $st = 3$. The a_1 and a_2 similar to setae on tergites, a_1 posteriorly directed, broadly clavate, with very short erect pubescence, a_2 and a_3 lanceolate, with distinct oblique pubescence, a_2 straight and directed posteriorly, a_3 diverging and curved inwards; *st* short, fungiform, glabrous, ovoid, with sparse but distinct oblique pubescence, these setae very similar to those on the tergites. Distance a_1 - a_1 1.7 times as long as a_1, distance a_1 - a_2 considerably longer than distance a_2 - a_3; distance *st* - *st* 6 times longer than *st* and 1.2 times as long as distance a_1 - a_1. Tergum glabrous.

Sternum. Sternum hexagonal, posterior margin between b_1 with shallow indentation and a semicircular lobe below anal plate; lobe with distinct posterodistal incision. Relative lengths of setae (pygidial $a_1 = 10$): $b_1 = 45$, $b_2 = 16$, $b_3 = 12$. The b_1 thin, subcylindrical, tapering, striate, pointed, b_2 and b_3 cylindrical, striate, the latter thinner than the former. The b_1 1.1 times as long as distance b_1 - b_1, b_2 about as long as distance b_1 - b_2 and b_3 0.3 of distance b_3 - b_3.

Anal plate 1.8 times as long as its greatest width, somewhat widening from its base, lateral margins almost straight, broadest just behind the middle; distal part narrow with parallel lateral margins and blunt end; two thin cylindrical, sparsely striate appendages protruding backwards from the middle of the sternal side, appendages curved inwards, their length 0.6 of the plate length.

EURYPAUROPODIDAE

Six species in the family are now known from Sabah. One species was reported previously, *Samarangopus segniter* Scheller (Scheller *et al.*, 1994), but Dr Hauser's collection indicates a much more diversified eurypauropodid fauna. Three more species in *Samarangopus* and two species in *Sphaeropauropus* appeared in his collection, all new to science.

Genus *Samarangopus* Verhoeff, 1934

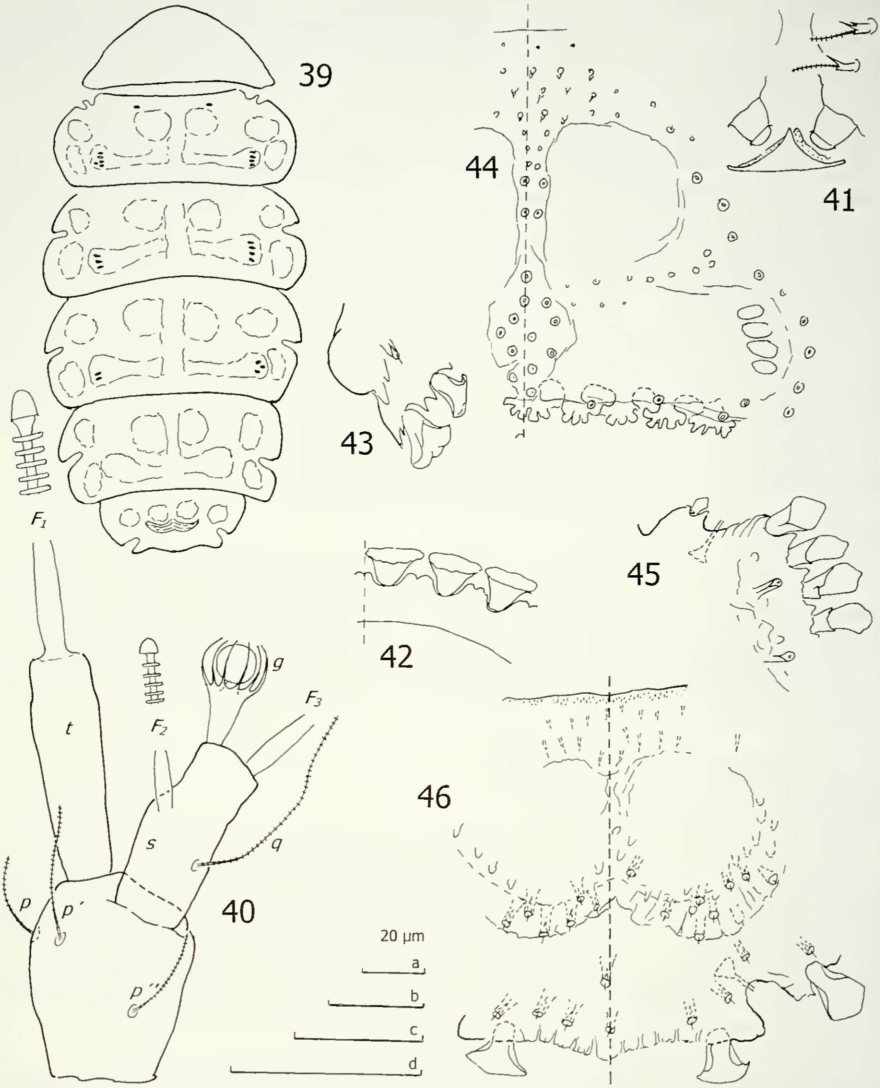
Samarangopus longipenes sp. n. Figs 39-53

Type material. **Holotype:** ad. 9(♂), SABAH, Sandakan Residency, 24 km W of Sandakan, Sepilok, "Kabili-Sepilok Forest Reserve", lowland Dipterocarp forest near "Orang-Utan Rehabilitation Station", sifting of litter from between buttresses of large trees, Winkler-Moczarski extraction, 3.V.1982 (Loc. Sab-82/27). **Paratypes:** 1 ad. 9(♂), SABAH, Interior Residency, road to Kimanis, 26 km from Keningau, helicopter port, sifting in cloud forest, alt. 1380 m, Berlese extraction, 12.V.1982 (Loc. Sab-32/43b). 1 ad. (♀); SABAH, Sandakan Residency, Sepilok, "Kabili-Sepilok Forest Reserve", secondary lowland forest close to "Pond", litter sample, Berlese extraction, 10.V.1982 (Loc. Sab-82/42).

Total number. 3 specimens.

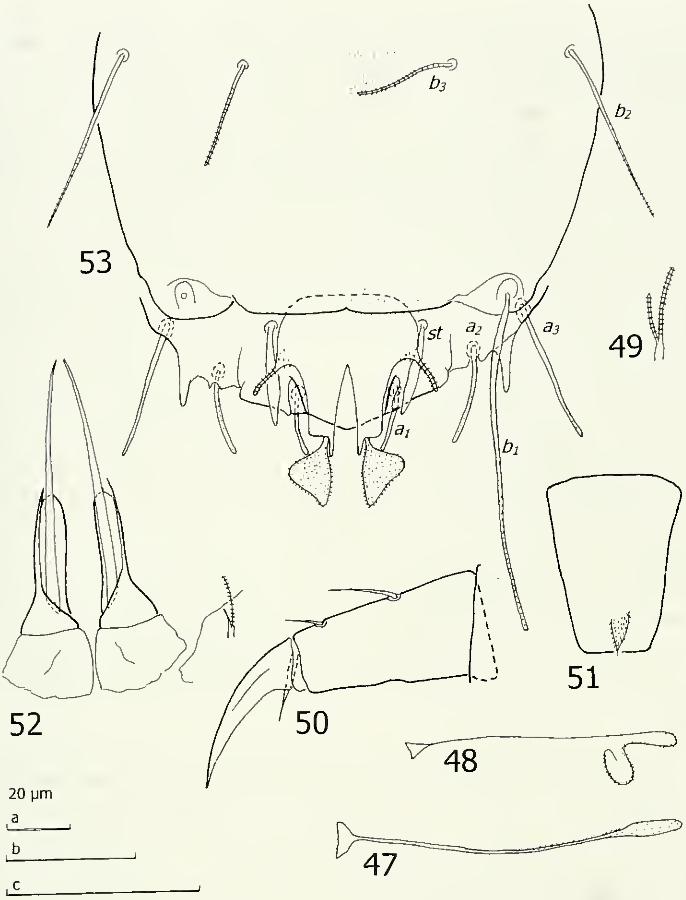
Diagnosis. S. longipenes sp. n. may be grouped together with *S. palearum* Scheller from New Caledonia (Scheller, 1993) and *S. flabrarius* Remy from Madagascar (Remy, 1956c). The former species and *S. longipenes* sp. n. have similarities in the structure of the tergites (several surface details) and comparing it with *S. flabrarius*, e.g., the anal plate and the number of lateral protuberances of the tergites are similar. The shape of the genital papillae in *S. flabrarius*, with their long and thick setae, is another character which indicates relationships to that species.

Distinctive characters in relation to *S. palearum* are: the shape of the calyces of the antennal flagella F_1 (longish in *S. longipenes* sp. n., short in *S. palearum*); the length of the seta *q* (about as long as or longer than *s*, not much shorter than *s*); the shape of the genital papillae (with tube-like lengthening and very long and thick seta.



Figs 39-46

Samarangopus longipenes sp. n., holotype, ad. 9(♂). 39, body with tergites I-VI showing the shape of the depressions (marginal setae not shown); 40, left antenna, sternal view; 41, collum segment, median and left part, sternal view; 42, tergite I, part of anterior margin, sternal view; 43, tergite I, left posterior corner, sternal view; 44, tergite I, median and submedian part, right side; 45, tergite II, right anterolateral corner, tergal view; 46, tergite VI, median part. Scale a: Figs 43-45; b: Figs 41, 46; c: Fig. 42; d: Fig. 40.



FIGS 47-53

Samarangopus longipenes sp. n., holotype, ad. 9(♂). 47, T_3; 48, T_4; 49, seta on trochanter of leg 9; 50, tarsus of leg 9; 51, femur of leg 1 with appendage; 52, genital papillae and seta on coxa of leg 2, anterior view; 53, pygidium, sternal view. Pubescence only partly drawn in 53. Scale a: Fig. 52; b: Figs 47-51; c: Fig. 53.

not of normal shape and with short seta); the shape of the central part of tergite VI (two raised rounded bulges vs. no bulges at all).

Diagnostic characters which allow to distinguish *S. longipenes* sp. n. from *S. flabrarius* are: the shape of the stalk of the antennal globulus (long and slender in *S. longipenes* sp. n., not short and thick); the shape of the distal part of the T_3 (clavate end-swelling, not a swelling with incision), the shape of the genital papillae (with tube-like lengthening in *S. longipenes* sp. n., no lengthening in *S. flabrarius*).

Etymology. From Latin longus = long and penis = male genital papilla.

DESCRIPTION

Length. 0.84(-0.92) mm.

Head. Setae hidden.

Antennae. Antennae glabrous; chaetotaxy of segments 1-4: 2/2/2/3; g' not identified; setae thin, cylindrical, striate-annulate, their lengths on segment 4: p = 10, p' = 15, p'' = 14; no p''', u and r. Sternal branch s subcylindrical but with distinct anterior truncation, anterior margin = (10-) 11, posterior margin = 18(-20), Ø of base = (6-)7, maximum Ø = 8(-10), q thin, tapering, cylindrical, annulate-striate, l = (20-)23 µm. Posterior margin/length of g 1.6(-1.8), posterior margin/maximum Ø = (2.0-)2.2, maximum Ø/Ø of base = 1.1(-1.6). Tergal branch subcylindrical, widest in distal half, l = (23-)24, Ø of base = 5, maximum Ø = 7 µm, pore not ascertained; length of t/maximum Ø = 3.3(-3.4). Globulus g, l = 11, maximum Ø = (6-)7 µm, length/maximum Ø = 1.6 (-1.8), number of bracts (8-)9, their length = 7, capsule spherical, Ø = 4 µm. Relative lengths of flagella (base segments included): F_1 = 100, F_2 = (41-)46, F_3 = 79(-89). Lengths of base segments, bs_1 = 12, bs_2 = 6(-7), bs_3 = (9-)10(-11) µm. The F_1 3.2(-3.4) times as long as t, F_2 and F_3 (1.6-)1.8 and 3.1(-3.3) times as long as s respectively. The F_2 thinner than F_1 and F_3. Calyces conical, those of F_1 longish, those of F_2 and F_3 subhemispherical.

Trunk. Setae of collum segment similar to each other; furcate; main branch subcylindrical, tapering, striate, pointed; secondary branch rudimentary, pointed, glabrous; both setae l = 13 µm. Sternite process broadly triangular, appendages barrel-shaped, caps with collar; process with short pubescence on margins, appendages and caps glabrous.

Tergites. Tergites with broadly campanulate protuberances arranged in a single row on the anterior and lateral margins of tergite I, lateral margins of II-V and posterior margin of VI. 3 types of subcuticular structures present: simple conical structures under the epicuticula on the anterior parts of tergites II-VI and subcylindrical structures opening in the epicuticula, some with a very narrow opening and others with a funnel-shaped opening, on the lateral and posterior parts of all tergites.

Tergites I-VI with a symmetric but complicated pattern of depressions with bare bottom surrounded by raised cuticle with the above mentioned subcylindrical structures (figs 39, 44, 46). On VI two such depressions posteriorly separated by a broadly V-shaped incision. Number of campanulate marginal protuberances: I 23; II, 1 small — T_1 — (8-) 9; III, 1 small + 3 — T_2 — 6; IV, 1 small 1 + 4 — T_3 — 4(- 5); V, 1 small + (4-) 5 — T_4 — 3(-4); VI, 1 small + (4-)5 — T_5 — 1. Length/width ratio of tergites: I = 0.5, II = III = IV = 0.4, V = VI = 0.4(-0.5).

Bothriotricha. All bothriotricha but T_3 curled distally and with very thin axes; these glabrous except for a minute pubescence in their distal third. The T_3 with thicker axes and the distal fourth increasing in width, forming a distal clavate end-swelling with minute pubescence; length of end-swelling about 1/5 of the length of bothriotrix. Relative lengths of bothriotricha (holotype only): T_1 = 100, T_2 = 99, T_3 = 55, T_4 = 83, T_5 = 77.

Genital papillae. Base segments in the shape of truncated cones, relatively long.

Length of papillae = (40-)45-50, greatest Ø = 18, length of seta = (80-)81 µm. Proximal part of papillae strongly tapering outwards, distal 2/3 forming an anteriorly open tube enclosing the long and thick setae with 1.3(-1.7) times the length of the papillae. Papillae (2.4-2.7) times as long as greatest diameter. Cuticle glabrous. Coxal seta of leg 2 as on leg 1, length = 20 µm.

Legs. All legs 5-segmented. Seta on coxa and trochanter of leg 9 subsimilar, furcate, striate, bases glabrous; length of secondary branch 0.5 of primary one. More anteriorly these setae thinner and with rudimentary pointed glabrous secondary branches. Tarsi short, tapering, those of leg 9 1.6(-1.8) times as long as its greatest diameter; two tergal setae, both pointed glabrous; length of proximal one 11(-14) µm, distal one 6(-8) µm. Proximal setae 0.3(-0.4) of the length of tarsus and (1.7-)1.8 times as long as distal seta. Cuticle of tarsus almost glabrous. No proximal seta on tarsus of leg 1. All legs with large main claw and small setose anterior secondary claw; in leg 9 the former reaching 0.9 of the length of tarsus. On anterior side of femur of leg 1 a pointed appendage with short pubescence, length = (6-)7 µm.

Pygidium. Tergum. Posterior margin between the b_1 divided into 3 lobes, a posteriorly triangular median one and on each side of it a less pronounced lobe. Outside these lobes and between a_2 and a_3 a posteriorly directed digitiform appendage with almost the length of a_1. The a_1 and a_2 cylindrical, blunt, glabrous, somewhat curved inwards and converging; a_3 subcylindrical, tapering, glabrous, diverging; *st* knife-like somewhat converging. Lengths of setae: a_1 = (7-)8, a_2 = 9(-10), a_3 = (11-)15, *st* = 10(-13) µm. Distance a_1 - a_1 = 10(-11), a_2 - a_2 = 27(-30), a_3 - a_3 = (30)32, a_1 - a_2 = (7-)8, a_2 - a_3 = (5-)7, *st* - *st* = (16-)17 µm. Distance a_1 - a_1 1.2(-1.5) times as long as a_1, distance a_1 - a_2 1.2(-1.4) times as long as distance a_2 - a_3; distance *st* - *st* (1.2-) 1.7 times as long as *st* and 1 -1.3 times as long as distance a_1 - a_1. Cuticle glabrous.

Sternum. Posterior margin almost straight but with 3 shallow indentations, two submedian and a smaller median one. Setae thin, b_3 striate, b_1 and b_2 glabrous but with indistinct striation most distally. Lengths of setae: b_1 = (35-)37(-43), b_2 = 20(-23), b_3 = (11-)12 µm. Distance b_1 - b_1 = 34(-36), b_2 - b_2 = 47(-49), b_3 - b_3 = 22(-23), b_1 - b_2 = (25-)26, b_2 - b_3 = 12(-13) µm. Distance b_1 - b_1 (0.8-)0.9(- as long as) the length of b_1, b_2 0.8(-0.9) of distance b_1 - b_2, b_3 0.5 of the distance b_3 - b_3.

Anal plate 1.1 times as long as broad, widest anteriorly, broadest part about twice as wide as distal part; broadest part forming posterolateral corners, from there two short, thin, cylindrical, blunt, striate appendages protruding obliquely backwards; appendages 0.2 of the length of plate; posterior 2/5 of plate divided into two tapering branches by a narrow V-shaped incision, each branch cut squarely and provided with two appendages: a submedian short straight glabrous one and a stalked bladder of triangular shape in sternal view. Bladder-shaped appendages 0.4 of the length of plate. Plate glabrous, bladder-shaped appendages with short erect pubescence.

Samarangopus ternarius sp. n. Figs 54-70

Type material. **Holotype:** ad. 9(♂), SABAH, Sandakan Residency, 24 km W of Sandakan, Sepilok, "Kabili-Sepilok Forest Reserve", lowland dipterocarp forest near "Orang-Utan Rehabilitation Station", sifting of litter from between buttresses of large trees, Winkler-

Moczarski extraction, 3.V.1982, (Loc. Sab-82/27). **Paratypes:** 1 subad. 8(♂), same locality and date as for the holotype. 2 ad. 9 (♀), "Kabili-Sepilok Forest Reserve", secondary lowland forest close to "Pond", litter sample, Berlese extraction, 10.V.1982 (Loc. Sab-82/41).

Other material. SABAH, Sandakan Residency, 24 km W of Sandakan, Sepilok, "Kabili Sepilok Forest Reserve", lowland dipterocarp forest near "Orang-Utan Rehabilitation Station", sample from rotten log, Berlese extraction, 1 juv. 6, 1 juv. 5, 24.-26.IV. 1982 (Loc. Sab-82/5-I). Ibidem, 1 subad. 8(♂), 26.IV.-2.V. 1982 (Loc. Sab-82/5-II). Ibidem, secondary lowland forest close to "Pond", litter and rotten log sample, Berlese extraction, 1 ad. 9 (♀), 10.V.1982 (Loc. Sab-82/42).

Total number. 8 specimens.

Diagnosis. S. ternarius sp. n. is well defined by the unique shape of the genital papillae and the styli, and it might be closely related to *S. jacobsoni* (Silvestri) from Java (Silvestri, 1930; Scheller, 1998). They are similar as to the shape of the subcuticular organs of the tergites and the shape of the protuberances of the anterior margin of tergite I. The antennae are similar too, as are the large winged pygidial setae b_2. They are easily distinguished by the number of marginal protuberances on tergite I (27 in *S. ternarius* sp. n., 22 in *S. jacobsoni*), by the shape of the calyces of the antennal flagella F_1 (conical, not subhemispherical), as well as by the shape of the styli and the anal plate (stalked lanceolate styli and in sternal view triangular bladder-shaped appendages of the anal plate in *S. ternarius* sp. n., in *S. jacobsoni* both the styli and the bladder-shaped appendages of the anal plate are clavate).

A few characters indicate relationships to *S. palearum* Scheller from New Caledonia (Scheller, 1993) and *S. flabrarius* Remy and *S. saproxylophilus* Remy from Madagascar (Remy, 1956c). *S. palearum* is similar in both the cuticular structures and the transversal ridges of the tergites but is easily distinguished from *S. ternarius* sp. n. by the shape of the large protuberances of the tergites, the pygidial setae a_2, a_3, *st* and b_2, as well as by the distal appendages of the anal plate. The two Madagascan species have similarities with *S. ternarius* sp. n. in the distribution of the large protuberances of the tergites and in the shape of the distal appendages of the anal plate, *S. flabrarius* additionally by its large setae on the genital papillae. They are, however, easy to distinguish from *S. ternarius* sp. n. by the shape of the antennal globulus, the T_3 and the genital papillae (*S. flabrarius*), and by the shape of the posterolateral appendages of the pygidial tergum and the distal part of the anal plate (*S. saproxylophilus*).

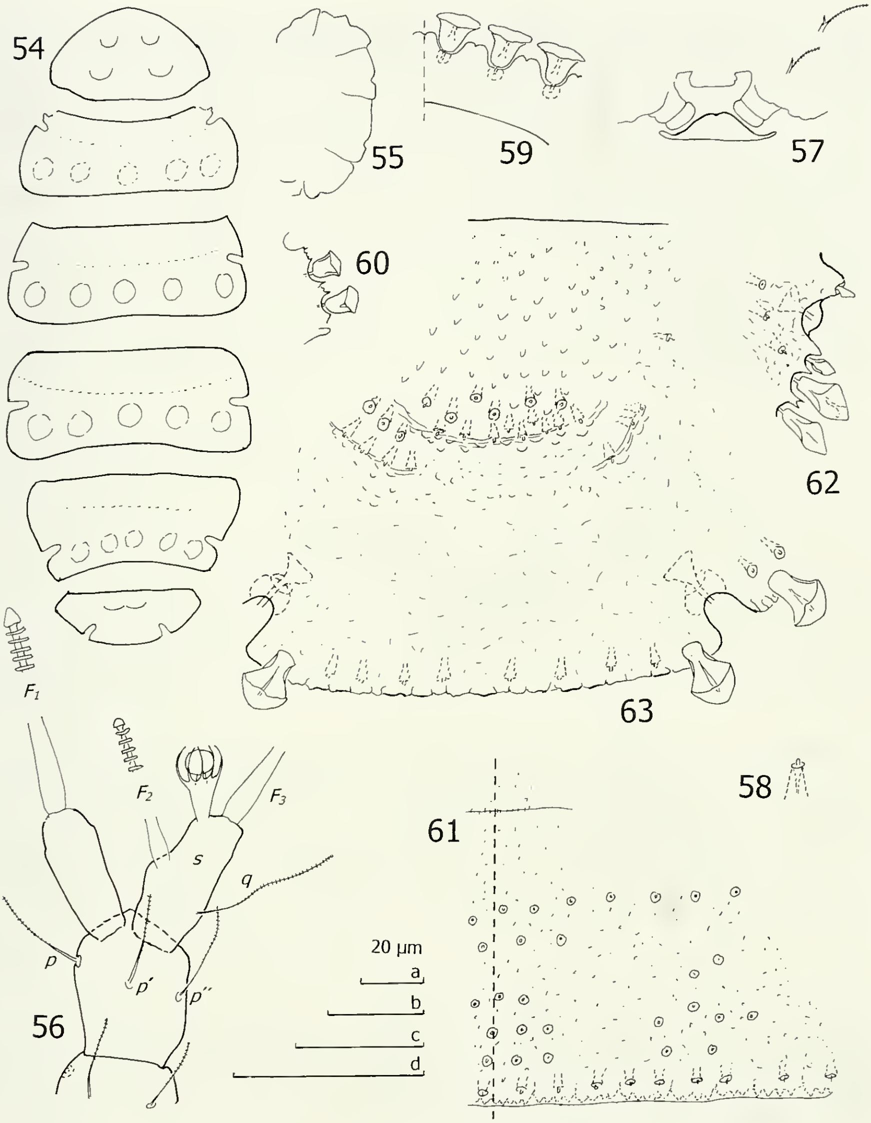
Etymology. From Latin ternarius = consisting of three (referring to the three digitiform appendages surrounding each genital papilla).

DESCRIPTION

Length. (0.62-)0.87 mm.

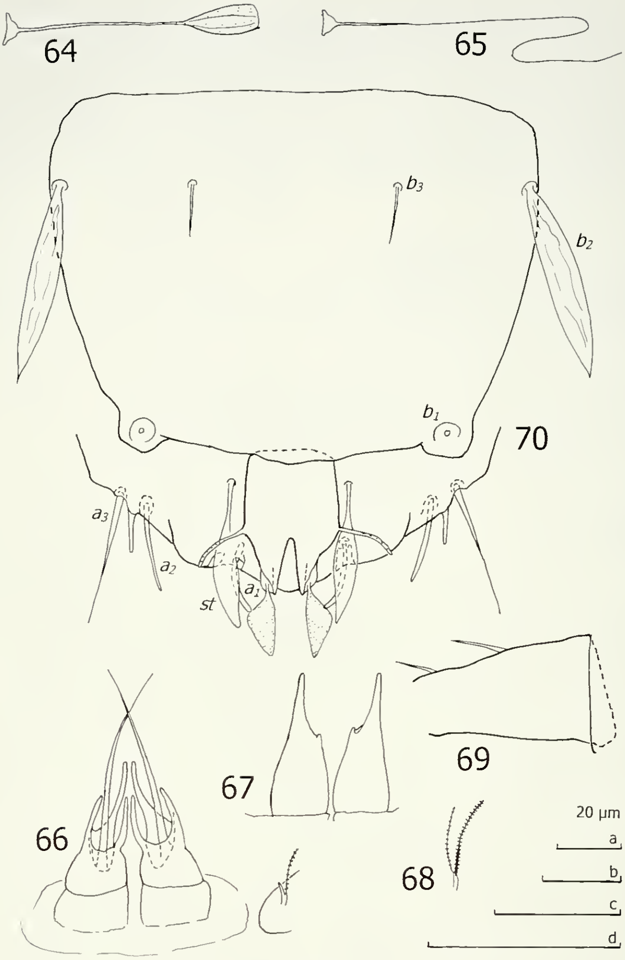
Head. Setae hidden.

Antennae. Antennae glabrous; chaetotaxy of segments 1-4: 2/2/2+*g*'/3; setae very thin tapering, striate-annulate, their lengths on segment 4: *p* = ?(12-13), *p*' = 9(-14), *p*" = 8(-13) µm; no *p*''', *u* and *r*. Sternal branch subcylindrical but with anterior truncation, anterior margin = 7(-8), posterior margin = 15(-18), Ø of base = 5(-6), maximum Ø = 7(-9), *q* thin tapering cylindrical annulate-striate, l = 15(-16) µm. Posterior margin/length of *g* 1.9(-2.2), posterior margin/maximum Ø = (1.8-)2.1(-2.5), maximum Ø/Ø of base = (1.3-)1.4. Tergal branch subcylindrical, widest in distal half,



FIGS 54-63

Samarangopus ternarius sp. n., holotype, ad. 9(♂). 54, body with tergites I-VI showing distribution of shallow depressions in the cuticle (marginal setae not illustrated); 55, body, lateral view showing the transversal ridges on the tergites; 56, left antenna, sternal view; 57, collum segment, median and left part, sternal view; 58, tube-like organ in the cuticle of the tergites; 59, tergite I, part of anterior margin, sternal view; 60, tergite I, left posterior corner, sternal view; 61, tergite II, posteromedian part; 62, tergite II, right anterolateral corner, sternal side; 63, tergite VI, median and posterior part. Scale a: Figs 60-62; b: Figs 57, 63; c: Fig. 59; d: Figs 56, 58.



FIGS 64-70

Samarangopus ternarius sp. n., 64-66, 68-70 holotype, ad. 9(♂), 67 subad. 8(♂). 64, T_3; 65, T_4; 66, genital papillae and seta on coxa of leg 2, anterior view; 67, genital papillae, subad 8, anterior view; 68, seta on trochanter of leg 9; 69, tarsus of leg 9; 70, pygidium, sternal view. Scale a: Fig. 66; b: Fig. 67; c: Figs 64, 65, 68, 69; d: Fig. 70.

l = 14(-17), Ø of base = 3, maximum Ø = 6(-7) μm: pore not ascertained; length of *t*/maximum Ø = 2.3(-2.4). Globulus *g*, l = (7-)8(-9), maximum Ø = 5(-6) μm; length/maximum Ø = 1.4 (-1.6); number of bracts (7-)8(-9), their length = (4-)5, capsule spherical, Ø = 3 μm. Relative lengths of flagella (base segments included): F_1 = 100, F_2 = (40-)43(-50), F_3 = 76(-83). Lengths of base segments, bs_1 = (9-)10, bs_2 = ?(5-6), bs_3 = 8(-9) μm. The F_1 (4.6-)5.0 times as long as *t*, F_2 and F_3 (1.7-)2.0(-2.2) and 3.5(-3.7) times as long as *s* respectively. The F_2 thinner than F_1 and F_3. Calyces conical, those of F_2 and F_3 smaller than those of F_1.

Trunk. Setae of collum segment similar, furcate, main branch subcylindrical, tapering, striate, pointed; secondary branch rudimentary, pointed, glabrous, sublateral seta 1 = (12-)13, submedian seta 1 = 11(-12) µm. Sternite process low, rounded anteriorly and with a shallow anterior incision, appendages barrel-shaped, height of caps at least 1/3 of the length of appendage, no collar; collum segment glabrous.

Tergites. Tergites with transversal ridges and behind them a row of shallow depressions in the cuticle (figs 54, 55). Tergite VI with a central rounded bulge. The protuberances arranged in a single row on anterior and lateral margins of I, on lateral margins of II-V and on posterolateral margins of VI. Protuberances campanulate, symmetrical, short and broad on tergite I, longish and open on sternal side on lateral margins of II-V, probably folioform with distal part turned downwards on VI. Subcuticular subcylindrical structures with very small tube-like opening in the cuticle present.

Number of campanulate marginal protuberances: I, 27; II, 1 small — T_1— 1 small + 9-10; III, 1 small + 4 — T_2 — 1 small + 6; IV, 1 small + (4-)5 — T_3 — 1 small + 4; V, (6-)7 — T_4 — 1 small + 3, VI, 6 — T_5 — 1. Length/width ratio of tergites: I = 0.6, II = 0.3(-0.4), III = IV = V = 0.4(-0.5), VI = (0.4-)0.5(-0.6).

Bothriotricha. All bothriotricha but T_3 curled distally and with very thin glabrous axes. The T_3 with thicker axes and a spatulate end-swelling 2.4 times as long as its greatest width; end-swelling with minute pubescence, length of end-swelling 1/4 of the length of bothriotricha. Relative lengths of bothriotricha (some bothriotricha seemingly broken): T_1 = 100, T_2 = (78-)100, T_3 = (64-)80(-81), T_4 = 60(-127), T_5 = 62(-106).

Genital papillae. Base segments in the shape of truncated cones, proportionately long. Length of papillae = (40-)45, greatest Ø = (17-)19, length of seta = 60(-72) µm. Papillae with a constriction in the middle around the sternally directed opening. Genital orifice very wide and surrounded by 3 digitiform appendages, two anterior ones only somewhat longer than proximal subcylindrical part of genital papilla and one much longer posterior appendage. Setae very long, proximal half thick, their length 1.3(-1.6) times as long as genital papillae. Papillae (2.3-)2.4 times as long as greatest diameter. Cuticle glabrous. Coxal seta of leg 2 as on leg 1, length = 20 µm.

Legs. All legs 5-segmented. Seta on coxa and trochanter of leg 9 subsimilar, furcate, branches tapering, pointed, striate; bases glabrous, length of secondary branch 0.8 of primary one. More anteriorly these setae with rudimentary pointed glabrous secondary branches. Tarsi short, tapering, those of leg 9 1.6(-2.0) times as long as their greatest diameter; two tergal setae, both pointed glabrous; length of proximal one 10(-12), distal one (6-)7 µm. Proximal setae 0.3(-0.4) of the length of tarsus and (1.3-)1.4(-1.5) times as long as distal seta. Cuticle of tarsus glabrous. No proximal seta on tarsi of leg 1. All legs with large main claw and small setose anterior secondary claw; in leg 9 the former reaching 0.5(-0.6) of the length of tarsus. On anterior side of femur of leg 1 a blunt, shortly pubescent appendage, length = 5 µm.

Pygidium. Tergum. Posterior margin divided into 3 lobes, the median one between a_1 rounded posteriorly. Outside these lobes, between a_2 and a_3, a posteriorly directed narrow and digitiform appendage present, its length almost that of a_1. Setae glabrous, a_1 and a_2 cylindrical, blunt, curved inwards and somewhat converging, a_3 straight, tapering, pointed, diverging, *st* in the shape of a straight, narrow, stalked, lanceolate, pointed leaf. Lengths of setae: a_1 = (6-)7, a_2 = (8-)9, a_3 = (13 -)14(-15), *st* = (12)15 µm. Distance a_1 - a_1 = (10-)11, a_2 - a_2 = 27(-29), a_3 - a_3 (33-)35, a_1 - a_2 = (8-)10, a_2 - a_3 = 5, *st* - *st* = (11-) 12 µm. Distance a_1 - a_1 1.6(-1.8) times as long as a_1, distance a_1 - a_2 (1.6-)2.0 times longer than distance a_2 - a_3; distance *st* - *st* 0.8(-0.9) of the length of *st* and (1.0-) 1.1 times as long as distance a_1 - a_1. Cuticle glabrous.

Sternum. Posterior margin with low triangular bulge below anal plate; posterolateral corners lobate around insertion points of b_1. The b_1 not studied in the holotype, in paratypes subcylindrical, striate distally; b_2 very broad, lanceolate, with transparent wings; b_3 very thin, glabrous, pointed. Lengths of setae: b_1 = ? (30-34), b_2 = (19-)20, b_3 = 7(-11) µm. Distance b_1 - b_1 = (31-)32(-33), b_2 - b_2 = (47-)49, b_3 - b_3 = (20-)21(-23), b_1 - b_2 = (25-)26, b_2 - b_3 = (12-)13 µm. Distance b_1 - b_1 ?(0.8-0.9) of the length of b_1, b_2 0.8 of distance b_1 - b_2, b_3 0.4(-0.5) of the distance b_3 - b_3.

Anal plate 1.5 times as long as broad, widest in the middle, lateral margins almost straight with rounded lateral corners just behind the middle; from the posterolateral corners two thin, cylindrical, distally somewhat curved appendages protruding outwards-backwards at almost right angles; distal part of plate divided by a V-shaped incision into two subcylindrical branches; each branch cut squarely and provided with two appendages: a submedian short straight glabrous one and a stalked bladder of triangular shape in sternal view. Bladder-shaped appendages 0.5 of the length of plate. Plate glabrous, lateral appendages indistinctly striate, bladder-shaped appendages minutely pubescent.

Stage subad. 8. Number of campanulate marginal protuberances: I, ?; II, 1 small — T_1 — 1 small + 8; III, 1 small + 4 — T_2 —1 small + 5; IV, 5 —T_3 — 1 small + 3; VI, 6 — T_5 — 3.

Genital papillae with two appendages, one long digitiform and the other very short, no seta present. Setae b_2 on pygidial sternum not lanceolate.

Stage juv. 6. Number of campanulate marginal protuberances: I, 23; II, 0 or 1 — T_1— 1 small + 7; III, 4 — T_2 — 4 or 5; IV, 5 — T_3 — 3; VI, 4 — T_5 — 1. Setae b_2 on pygidial sternum not lanceolate.

Stage juv 5. Number of campanulate marginal protuberances: I, 21; II, 1 — T_1 — 7; III, 4 — T_2— 4; VI, 4 — T_5 — 1. Setae b_2 on pygidial sternum not lanceolate.

Samarangopus proekes sp. n. Figs 71-91

Type material. **Holotype:** ad. 9(♀), SABAH, Sandakan Residency, 24 km W of Sandakan, Sepilok, "Kabili-Sepilok Forest Reserve", secondary lowland forest close to "Pond", litter sample, Berlese extraction, 10.V.1982 (Loc. Sab-82/41). **Paratype:** ad. 9(♂), same locality and date as for the holotype.

Total number. 2 specimens.

Diagnosis. The genus *Samarangopus* seems to be morphologically heterogeneous as to the cuticular structures of the tergites. The great variation in the characters of the tergites is evident from the enlarged anterolateral corners of tergite II and the structure of both the cushion-like organs and the rod-like lateral protuberances of the tergites in *S. proekes* sp. n.. None of these characters has been observed in other species. Its isolation in relation to other species is underlined by the almost cylindrical shape of the appendages of the collum segment and the very long slender claws. The relationships of *S. proekes* sp. n. cannot be traced at present.

Etymology. From Greek proekes = pointed in front (referring to the shape of tergite II).

DESCRIPTION

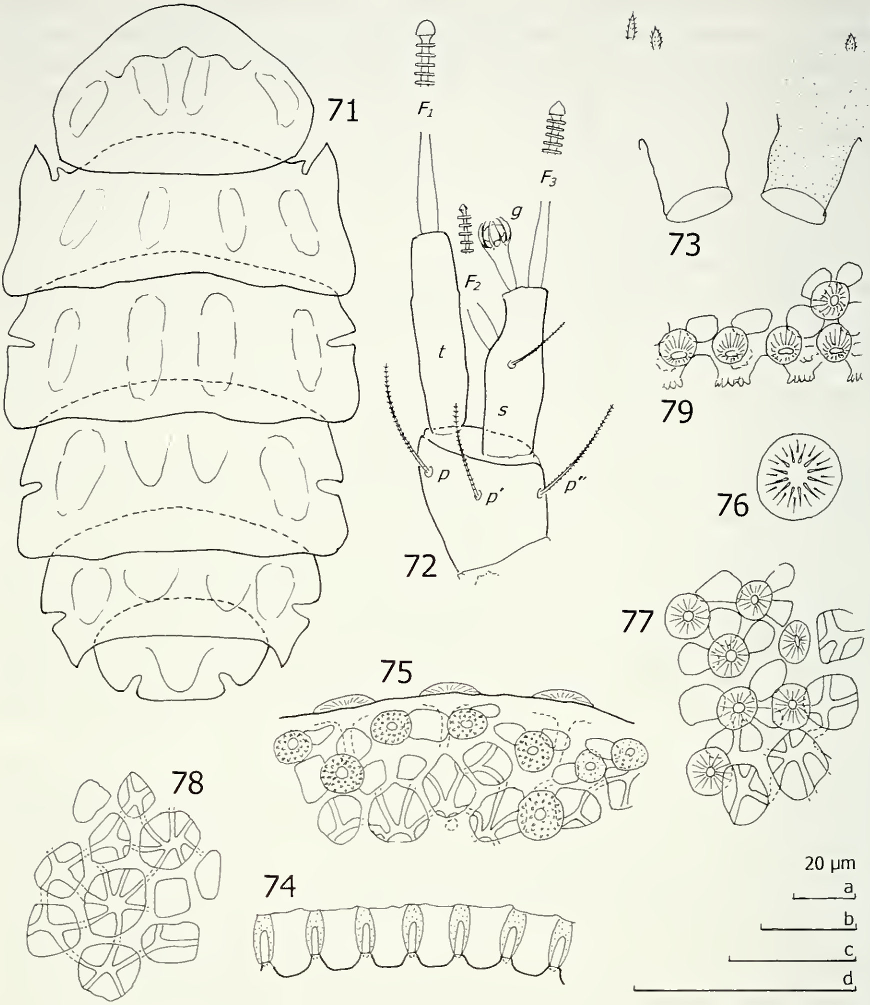
Length. (0.90-)1.11 mm.

Head. Setae hidden.

Antennae. Antennae glabrous; chaetotaxy of segments 1-4: 2/2/2 $+g'$/3; setae thin, tapering, pointed, with short oblique pubescence, their lengths on segment 4: p = (22)24, p' = 22, p'' = 25 µm; no p''', u and r. Sternal branch subcylindrical but with distinct anterior truncation, anterior margin = 20, posterior margin = 34, Ø of base = 10, maximum Ø = 12(13), q as setae on segment 4, l = (12)15 µm. Posterior margin/length of g 2.2(2.8), posterior margin/maximum Ø = (2.6)2.8, maximum Ø/Ø of base = 2.4(2.6). Tergal branch subcylindrical, widest in the middle, l = (33)41, Ø of base = 3, maximum Ø = (9)10 µm; pore not ascertained; length of t/maximum Ø = (3.7)4.1. Globulus g, l = (12)15, maximum Ø = (7)8 µm; length/maximum Ø = (1.7)1.9; number of bracts 12, their length = 3, capsule somewhat flattened, Ø = 4 µm. Relative lengths of flagella (base segments included): F_1 = 100, F_2 = 39(44), F_3 = 75(86). Lengths of base segments, bs_1 = (20)21, bs_2 = 10, bs_3 = (17)18 µm. The F_1 3.5(3.7) times as long as t, F_2 and F_3 1.6 and (3.1)3.2 times as long as s respectively. The F_2 thinner than F_1 and F_3. Calyces of F_1 subhemispherical, those of F_2 and F_3 subconical.

Trunk. Setae of collum segment similar to each other, short, simple, subconical-lanceolate, pointed, with dense short oblique pubescence; submedian setae l = 5, sublateral setae l = 6 µm. Sternite process not studied. Appendages cylindrical, with very short dense pubescence, caps flat and glabrous.

Tergites. Tergites I-V each with 4 oval depressions in a transversal row (fig. 71), tergite VI with posterolateral depressions; depressions on I-V with bare bottom, surrounded by raised cuticle. Posterior margins of anterior tergites serrate with teeth in small groups separated by V- or U-shaped incisions. Tergite II with large pointed lobes just behind the insertion pit of T_1; lobes directed anteriorly, triangular, longer than broad. Raised cuticle with complicated surface: 1. round transparent cushion-like structures, Ø = 10-15 µm, with a central vertical hole narrowing downwards and being surrounded by about 20 radiating canals widest in inner part (fig. 76); 2. deep cavities with steep inner walls, opening rounded or angular with rounded corners (figs 75, 77, 78), through the bottom a wide network of large canals most often with the junctions below the bottom of the cavities visible. Oval depressions of tergites only with cavities. Anterior and lateral margins of tergite I, lateral margins of II-V and posterior margin and posterolateral corners of VI with a single row of fusiform rods coated by a likewise fusiform, somewhat transparent, granular capsule; rods with capsules joined by a thin and transparent membrane (fig. 74). Number of rod-like marginal protuberances: I, 41(42); II, 1 small (0) — T_1 — 1 small + 15(16); III, 7 + 1

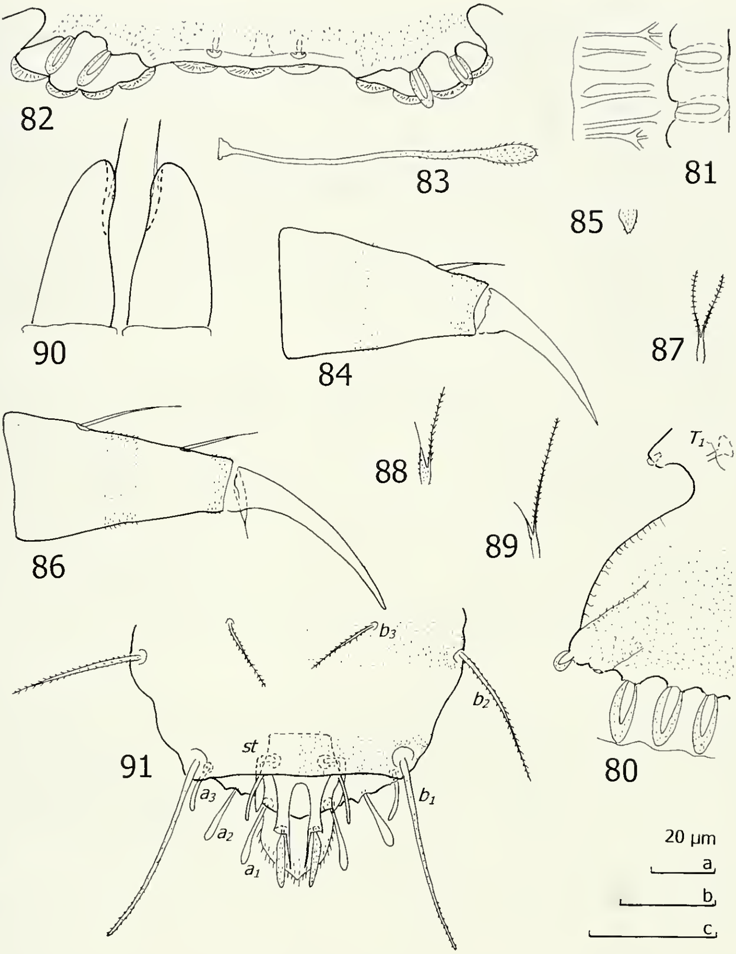


FIGS 71-79

Samarangopus proekes sp. n., holotype, ad. 9(♀). 71, body with tergites I-VI showing distribution of shallow depressions in the cuticle (marginal setae not illustrated); 72, left antenna, sternal view; 73, collum segment, appendages and setae; 74, tergite I, anterior margin, sternal view; 75, tergite I, anterior part, tergal view; 76, tergite I, cushion-like structure, tergal view; 77, tergite I, central part between depressions; 78, tergite I, central part, bottom of depression; 79, tergite I, posterior margin. Pubescence only partly drawn in 73. Scale a: Figs 77-79; b: Figs 72-74; c: Fig. 75; d: Fig. 76.

small — T_2 —1 small + 7 (+ 1 small); IV, 8 — T_3 — 7; V, (8)9 — T_4 — 5 + 1(0) small; VI, (6)7 — T_5 — 2. Length/width ratio of tergites: I = 0.6, II = (0.3)0.4, III = IV = (0.4)0.5, V = 0.5, VI = (0.4)0.6.

Bothriotricha. All bothriotricha but T_3 with very thin axes, these glabrous except for a minute pubescence in their distal 1/5. The T_3 with thicker axes and outer



FIGS 80-91

Samarangopus proekes sp. n., 80-89, 91 holotype, ad. 9(♀), 90 paratype, ad. 9 (♂). 80, tergite II, right anterolateral corner with insertion pit of T_1; 81, tergite II, lateral margin with fusiform protuberances, sternal view; 82, tergite VI, posteromedian part, sternal view; 83, T_3; 84, tarsus of leg 1; 85, appendage on femur of leg 1; 86, tarsus of leg 9; 87, seta on trochanter of leg 9; 88, seta on coxa of leg 5; 89, seta on trochanter of leg 5; 90, genital papillae, anterior view; 91, pygidium, sternal view. Pubescence only partly drawn in 84, 86, 91. Scale a: Figs 80-82, 90; b: Figs 84-89, 91; c: Fig. 83.

fourth increasing in width forming a distal clavate end-swelling, 2.5 times as long as wide; T_3 with short oblique pubescence on distal half. Relative lengths of bothriotricha (holotype only): $T_1 = 100$, $T_2 = 100$, $T_3 = 45$, $T_4 \approx 100$, $T_5 = 73$.

Genital papillae (paratype). Base segments short, papillae somewhat tapering with rounded tip. Length of papillae = 52, greatest Ø = 25, length of seta = 25 µm; length/ Ø = 2.1, setae 0.5 of the length of papillae. Cuticle glabrous.

Legs. All legs 5-segmented. Setae on coxa and trochanter of leg 9 similar to each other, furcate, with branches of the same length, pointed, striate. More anteriorly these setae being longer, especially on trochanter, with rudimentary pointed secondary branches. Primary branch on coxa of leg 5 twice longer than secondary one, on trochanter 3.8 times as long as secondary branch. Tarsi short, strongly tapering, those of leg 9 1.8(1.9) times as long as their greatest diameter; two tergal setae, both pointed and glabrous; length of proximal one 21(24) μm, distal one (12)16 μm. Proximal setae 0.4(0.5) of the length of tarsus and 1.3 times as long as distal seta. Cuticle of tarsus with short pubescence. No proximal seta on tarsus of leg 1. All legs with large main claw and small setose anterior secondary claw; in leg 9 the former reaches almost 0.9 of the length of tarsus. On anterior side of femur of leg 1 a linguiform appendage with short pubescence, l = 5 μm.

Pygidium. Tergum. Posterior part broadly triangular and with large posteromedian plate; the latter 1.1 times as long as broad, leaf-shaped, posterior end pointed, distal and lateral parts with distinct oblique pubescence. No posterolateral digitiform appendages. The a_1 and a_2 clavate, with very short pubescence distally, diverging; a_3 subcylindrical, glabrous, curved inwards and somewhat diverging; *st* knife-like, with knee-like flexure near base, glabrous. Lengths of setae: a_1 = 14, a_2 = 13, a_3 = 9(10), *st* = 10 μm. Distance a_1 - a_1 = (12)13, a_2 - a_2 = (26)27, a_3 - a_3 = (38)39, a_1 - a_2 = 7, a_2 - a_3 = (7)8, *st* - *st* = (9)10 μm. Distance a_1 - a_1 0.9 of the length of a_1, distance a_1 - a_2 about as long as distance a_2 - $a_{3;}$ distance *st* - *st* about 0.8 of distance a_1 - a_1. Cuticle glabrous.

Sternum. Posterior margin straight. Setae thin, tapering, b_1 blunt, b_2 and b_3 pointed; b_1 with very short pubescence, diverging; b_2 and b_3 with distinct oblique pubescence, the former diverging and the latter converging. Lengths of setae: b_1 = 43, b_2 = 30, b_3 = (15)16 μm. Distance b_1 - b_1 = (42)43, b_2 - b_2 = 66, b_3 - b_3 = (24)30, b_1 - b_2 = (24)25, b_2 - b_3 = (18)20 μm. Distance b_1 - b_1 as long as the length of b_1, b_2 1.2 times as long as distance b_1 - b_2, b_3 0.5(0.6) of the distance b_3 - b_3.

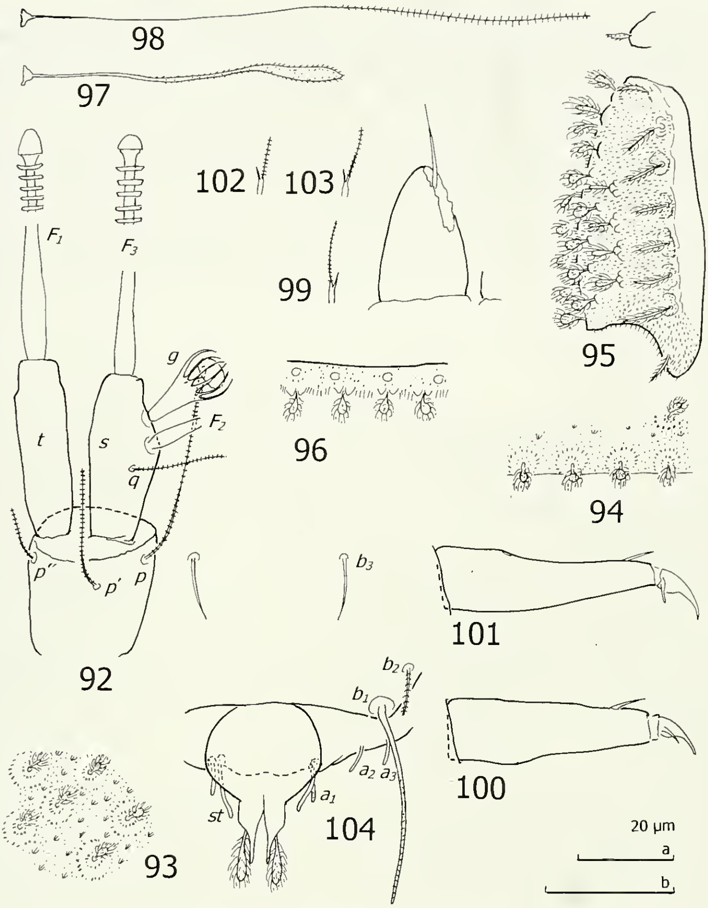
Anal plate 2.3(2.4) times as long as broad, widest in anterior third; broadest part with evenly rounded margins, two thin, cylindrical, blunt, appendages protrude obliquely backwards from it; appendages 0.3 of the length of plate; posterior 3/5 of plate divided by a U-shaped incision into two branches, these somewhat narrower in the middle than posteriorly; each branch cut squarely and provided with two appendages: a submedian straight glabrous pointed one and a stalked narrow fusiform bladder. Bladders 0.4 of the length of plate. Plate glabrous, appendages with minute pubescence. Sternum with short pubescense.

Genus ***Sphaeropauropus*** Silvestri, 1930

Sphaeropauropus penicillius sp. n. Figs 92-104

Type material. **Holotype**: ad. 9(♂), SABAH, Sandakan Residency, 24 km W of Sandakan, Sepilok, "Kabili-Sepilok Forest Reserve", lowland dipterocarp forest near "Orang-Utan Rehabilitation Station", sifting of litter from between buttresses of large trees, Winkler-Moczarski extraction, 3.V.1982 (Loc. Sab-82/27). **Paratypes:** 2 subad. 8(♀), 1 juv. 6, same locality and date as for the holotype.

Total number. 4 specimens.



FIGS 92-104

Sphaeropauropus penicillius sp. n., holotype, ad. 9(♂). 92, right antenna, anterior view; 93, tergite I, central part; 94, tergite I, posteromedian margin; 95, tergite II, right laterosternal furrow, sternal view; 96, tergite VI, posteromedian margin, sternal view; 97, T_3; 98, T_5; 99, left genital papilla and seta on coxa of leg 2; 100, tarsus of leg 1; 101, tarsus of leg 9; 102, seta on coxa of leg 9; 103, seta on trochanter of leg 9; 104, pygidium, median and left part, sternal view. Scale a: Figs 93-96, 99-103; b: Figs 92, 97, 98, 104.

Diagnosis. S. penicillius sp. n. is in most characters very close to *S. malayus* Silvestri from Java (Silvestri, 1930) but is easily distinguished from that species by the shape of the endswelling of the bothriotrix T_3 (>6 times as long as wide in *S. penicillius* sp. n., ≈ 2 in *S. malayus*) and the claws (distinctly curved in *S. penicillius* sp. n., almost straight in *S. malayus*). Relationships may be traced also with *S. martensi* Scheller and *S. breviglobulatus* Scheller, both described from Nepal (Scheller, 2000). There are similarities especially in the shape of the end-swelling of the bothriotrix T_3. Good distinctive characters are the shape of the tuft-like setae, e.g., on the central part of tergite I, a distinctly clavate stalk and proportionately long hairs in *S. penicillius* sp. n., versus a somewhat clavate stalk and proportionately short hairs in *S. martensi* and *S. breviglobulatus*. The new species is, besides dissimilarities in the details of the pubescence of the tergites, distinguished from *S. martensi* by the shape of the anal plate (distal appendages with pointed inner lengthening in *S. penicillius* sp. n., not short, broadly triangular, submedian) and from *S. breviglobulatus* by the shape of the antennal globulus *g* (wider than tergal branch *t* in *S. breviglobulatus*, not so in *S. penicillius* sp. n.).

Etymology. From Latin penicillus, penicillum = brush (referring to the setae on the tergites).

DESCRIPTION

Length. 0.65 mm.

Head. Head and temporal organ hidden behind the antennae and not studied.

Antennae. Antennae glabrous. Chaetotaxy of segments 1-4: 2/2/2+?*g*'/3. Setae subcylindrical, annulate-striate, their lengths on segment 4: $p = 33$, $p' = 19$, $p'' = 10$ µm. Sternal branch with distinct anterodistal truncation, anterior margin = 15, posterior margin 25, Ø of base = 6, maximum Ø = 11, Ø of top = 7, $q = 15$ µm. Anterior margin/length of *g* 1.1; posterior margin/length of $q = 1.7$; anterior margin/posterior margin = 0.6; posterior margin/maximum Ø = 2.3; maximum Ø/Ø of base = 1.8. Tergal branch *t* somewhat fusiform, length = 28, Ø of base = 5, maximum Ø = 8.5 µm, length of *t*/maximum Ø = 3.3. Globulus *g* almost straight, stalk conical, length of $g = 14$, maximum Ø = 7.5 µm; 9 bracts, their length = 6 µm; capsule with flattened bottom, length = 3, Ø = 5 µm. Relative lengths of flagella (base segments included): $F_1 = 100$, $F_2 = 44$, $F_3 = 61$. Length of base segments: $bs_1 = 21$, $bs_2 = 8$, $bs_3 = 17$ µm. The F_1 3.1 times as long as *t*, F_2 and F_3 1.6 and 2.2 times as long as *s* respectively. Calyces of F_1 largest, conical, those of F_2 and F_3 subhemispherical.

Trunk. Collum segment hidden, not studied. Tergal sides of tergites with tuft-like setae, those on anterior part of tergite I broadly clavate, ovoid, with subcylindrical stalk, those on posteromedian part clavate. Cuticle between tuft-like setae with short but distinct pubescence, hairs partly arranged in dense groups forming scattered small sessile organs of candelaber-like shape; pubescence longest on lateral parts of tergites. Around each tuft-like seta two whorls of short hairs with a glabrous area in between.

The laterosternal furrows of the tergites with tuft-like setae on both margins, setae clavate on outer margin but thin subcylindrical blunt or pointed on inner margin.

Bothriotricha. All bothriotricha with simple axes; all but T_3 very thin, with sparse short and mostly erect pubescence of straight hairs. The T_3 with thicker axes and distal fusiform somewhat pointed swelling, its length almost 1/3 of the length of bothriotrix, distal 2/3 of T_3 covered with a short dense pubescence of oblique hairs. Relative lengths of bothriotricha: $T_1 = 100$, $T_2 = 95$, $T_3 = 56$, $T_4 = 73$, $T_5 = 58$.

Genital papillae. Base segments short, length of papillae = 30, greatest Ø = 19, length of seta = 18 µm. Papillae conical with rounded tip, 1.6 times as long as greatest diameter, seta 0.6 of the length of papilla. Cuticle glabrous. Coxal seta of leg 2 as on leg 1, length = 18 µm.

Legs. All legs 5-segmented. Setae on coxa and trochanter of leg 9 subsimilar, furcate, primary branch tapering, pointed, annulate; secondary branch rudimentary, pointed, glabrous, seta on coxa l = 12, on trochanter l = 15 µm. Secondary branches of these setae on more anterior legs similar to each other but primary branches longer.

Tarsi of leg 9 slender, tapering, 3.3 times as long as greatest diameter, minutely pubescent most distally; two tergal setae, both tapering, pointed, glabrous, proximal one = ?, distal one 6 µm. No proximal seta on tarsus of leg 1. A short lanceolate glabrous appendage (l = 7 µm) on anterior side of femur of leg 1.

Main claw of all legs thin, weakly curved; anterior secondary claw small, setose. In leg 1 main claw = 18, secondary claw = 7 µm, in leg 9 main claw = 21, secondary claw = 8 µm, main claw 0.3 of the length of tarsus in all legs. On anterior side of femur of leg 1 a disciform, triangular, blunt, appendage with short pubescence, length = 4(-5) µm. Cuticle of tarsi faintly pubescent.

Pygidium. Tergum. Setae almost uniform, cylindrical, blunt, with short oblique pubescence, a_1, a_2 and a_3 somewhat curved inwards, a_1 also converging, *st* somewhat S-shaped. Index of tergal setae: a_1 = (8-)9, a_2 = (9-)10, a_3 = (9-)10(-11); a_1 - a_1 = (18-)22 (-23), a_2 - a_2 =(22-)24(26); a_3 - a_3 = (54-)58(-63), *st* = (12-)14, *st* - *st* = (17-)20(-21) µm; *st* - *st*/a_1 - a_1 = (0. 8-) 1.0, a_1/a_1 - a_1 = 0.4(-0.5), a_1/a_1 - a_2 = 0.8(-1.0), a_1 - a_1/ a_2 - a_3 = (3.0-)3.7. Posteromedian part of tergum with short pubescence.

Sternum. Posterior margin between b^1 somewhat convex, posterolateral lobes at the insertion points of b_1 small; setae thin, tapering, pointed, with short oblique pubescence or striate. Index of sternal setae: b_1 = (42-)47(-50), b_2 = (14-)15(-19), b_3 = (17-)25, b_1 - b_1 = (40-)51(-53), b_2 - b_2 = (61-)73(-76), b_3 - b_3 = (40-)43(45), b_1 - b_2 = (12-)15 µm, b_1/b_1 - b_1 = (1.1-)1.3, b_1/b_2 = (2.4-)3.1, b_2/b_1 - b_2 = 1.0(-1.6), b_3/b_3 - b_3 = (0.5-)0.6(-0.7).

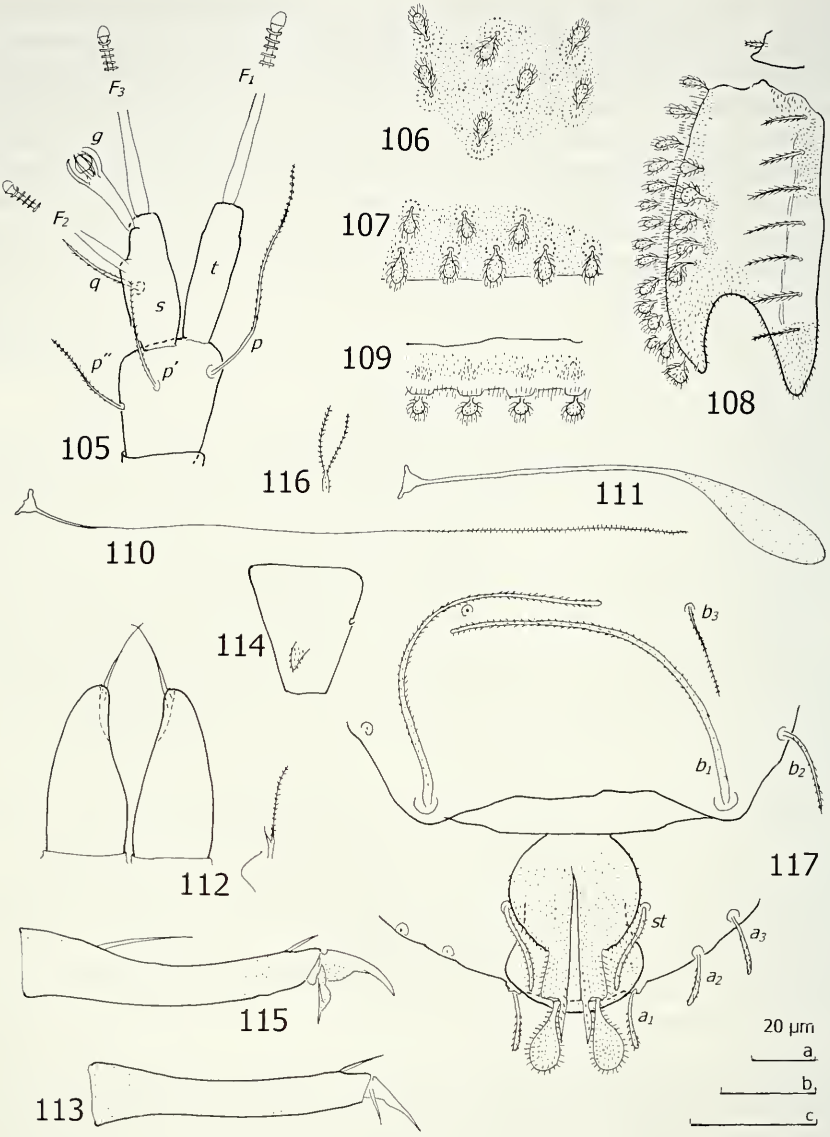
Anal plate almost circular and with two short subcylindrical branches protruding backward from posterior part of sternal side; branches separated by a narrow V-shaped incision and with posterolateral truncations on sternal side and with two distal appendages: a submedian tapering one and a median clavate one. The latter (3.1-)3.2(-3.3) times as long as its greatest width and 1/4 of the length of the plate. Plate glabrous; clavate appendages with distinct pubescence of curved hairs.

Sphaeropauropus arcuatus sp. n. Figs 105-117

Type material. **Holotype:** ad. 9(♀), SABAH, Interior Residency, road to Kimanis, 26 km from Keningau, helicopter port, sifting in cloud forest, alt. 1380 m, Berlese extraction, 12.V.1982 (Loc. Sab-82/43b). **Paratypes:** 1 ad. 9(♀), same locality and date as for the holotype, Winkler-Moczarski extraction (Loc. Sab-82/43a); 1 ad. 9(♀), SABAH, Sandakan Residency, 24 km W Sandakan, Sepilok, "Kabili-Sepilok Forest Reserve", secondary lowland forest near "Pond", sifting of litter and dead wood, Winkler-Moczarski extraction, 23.IV.1982 (Loc. Sab-82/7).

Other material. SABAH, West Coast Residency, Mount Kinabalu, "Bukit Ular Trail" (path between "Kambarangan Road" and "Power Station"), 1850 m, litter from *Lithocarpus-Castanopsis* forest, 1 ad. 9(♂), 28.IV.1982, Berlese extraction (Loc. Sab-82/16); ibidem, sample from near foot of large tree, Berlese extraction, 1 subad. 8(♀), 1 juv. stad.?, 28.IV.1982 (Loc. Sab-82/17). Sandakan Residency, 24 km W of Sandakan, Sepilok, "Kabili-Sepilok Forest Reserve", secondary lowland forest close to "Pond", litter sample, 1 ad. 9 (♀), 10.V.1982, Berlese extraction (Loc. Sab-82/42).

Total number. 7 specimens.



FIGS 105-117

Sphaeropauropus arcuatus sp. n., 105-111, 113-117 holotype ad. 9(♀), 112, paratype, ad. 9(♂). 105, right antenna, sternal view; 106, tergite I, central part; 107, tergite I, posteromedian margin; 108, tergite II, right laterosternal furrow, sternal view; 109, tergite VI, posteromedian margin, sternal view; 110, T_1; 111, T_3; 112, genital papillae and seta on coxa of right leg 2, anterior view; 113, tarsus of leg 1; 114, appendage on femur of leg 1; 115, tarsus of leg 9; 116, seta on coxa of leg 9; 117, pygidium, sternal view. Pubescence only partly drawn in 108, 113, 115. Scale a: Figs 105, 108, 110, 112-115; b: Figs 106, 107, 109, 111, 116; c: Fig. 117.

Diagnosis. The new species shows close affinities to *S. penicillius* sp. n. but is distinguished from it by the shape of the stalk of the antennal globulus *g* (subcylindrical, not distinctly conical), the genital papillae (longer and curved inwards distally, not short and straight), the setae on coxa and trochanter of leg 9 (secondary branch well developed, not rudimentary), the T_3 (end-swelling <4 times as long as wide, not >5), the setae on the pygidial tergum (distinctly pubescent, not glabrous), by the proportion $b_1/b_1 - b_1$ (b_1 longer than their distance apart, not shorter) and by the dimensions of the bladder-shaped appendages of the anal plate (<3 times longer than wide, not ≈ 5).

Etymology. From Latin arcuatus = shaped like a bow (referring to the bent tarsi on leg 9).

DESCRIPTION

Length. (0.89-)1.05 mm.

Head. Head setae hidden, not studied.

Antennae. Antennae glabrous. Chaetotaxy of segments 1-4: 2/2/2+*g*'/3. Setae subcylindrical, tapering, pointed, annulate, their lengths on segment 4: *p* = (55-)76, *p*' = (36)45, *p*'' = (27-)34 µm. Sternal branch with distinct anterodistal truncation, anterior margin = (23-)25, posterior margin = (40-)42, Ø of base = (10-)11, maximum Ø = 17, *q* = (28-)31 µm. Posterior margin/length of *g* = 1.4 and 1.5(-2.1); posterior margin/length of *q* = (1.2-)1.4; anterior margin/posterior margin = 0.6(-0.7); posterior margin/maximum Ø = (2.2-)2.5; maximum Ø/Ø of base = 1.5(-1.7). Tergal branch *t* somewhat fusiform, length = (40-)44, Ø of base = 8, maximum Ø = (11-)12 µm, length of *t*/maximum Ø = 3.5 (-3.6). Globulus *g* somewhat curved with slender stalk, length of *g* = (22-)27 and 30, maximum Ø = (10-)11 µm; 9(-10) bracts, their length = 7-9 µm; capsule somewhat flattened, its stalk widened in its upper part, length of capsule = 5, Ø = 6 µm. Relative lengths of flagella (base segments included): F_1 = 100, F_2 = 57(-67), F_3 = (87-)99. Length of base segments: bs_1 = (28-)36, bs_2 = (13-)16, bs_3 = (24-)33 µm. The F_3 (3.1-)3.5 times as long as *t*, F_2 and F_3 2.1(-2.2) and (2.9-)3.6 times as long as *s* respectively. Calyces subhemispherical, those of F_1 largest, those of F_2 smallest.

Trunk. Collum segment hidden, not studied.

Tergal sides of tergites with tuft-like setae, those on tergite I broadly clavate. Cuticle between tuft-like setae with dense and short pubescence, sparse just around the bases of the setae; small circular groups of dense pubescence hairs scattered between the setae. Setae almost globular at posterior margin of tergite VI.

The laterosternal furrows of the tergites with an inner row of subcylindrical tapering pointed setae with oblique pubescence hairs. Setae on outer margin tuft-like, with clavate stalk.

Bothriotricha. All bothriotricha with simple axes, all but T_3 with very thin axes and short pubescence of straight erect hairs. The T_3 with thick axes and distal ovoid swelling, its length 1/3 of the length of bothriotrix; distal part of T_3 covered with a minute pubescence. Relative lengths of bothriotricha: T_1 = 100, T_2 = (94-)98(-109), T_3 = (39-)45(-49), T_4 = (79-)90, T_5 = ?(60-85).

Genital papillae (paratype). Papillae with short base segments, l = 55, greatest Ø = 25, seta l = 28 µm. Papillae 2.2 times as long as greatest diameter, seta 0.5 of the length of papillae. Cuticle glabrous. Coxal seta of leg 2 as on leg 1, l = 30 µm.

Legs. All legs 5-segmented. Setae on coxa and trochanter of leg 9 similar to each other, furcate, branches subequal, subcylindrical, blunt, pubescent-annulate, l = 20(-22) µm. More anteriorly these setae with rudimentary, pointed, glabrous secondary branches; primary branch there longer, e.g., on leg 3, l = 45 µm.

Tarsus of leg 9 slender, tapering, bow-bent, (4.1-)4.3 times as long as its greatest diameter, minutely pubescent in the distal third; two tergal setae present, both tapering, pointed, glabrous, proximal one = (22-)30, distal one (8-)12 µm, proximal seta 0.3 of the length of tarsus and (2.4-)2.5(-2.6) times as long as distal seta. No proximal seta on tarsus of leg 1. A linguiform and pubescent appendage, l = 10 µm, on anterior side of femur of leg 1.

Main claw of leg 1 almost straight, l = (22-)24(-25), secondary claw seta-like, l = (12-)13 µm; on leg 9 main claw is curved, l = (26-)27, secondary claw widened in the middle, l = (18)20(-21) µm.

Pygidium. Tergum. Setae subsimilar, subcylindrical, blunt, with short oblique pubescence, a_1 somewhat curved outwards, a_2 and a_3 somewhat inwards, a_3 diverging, *st* weakly S-shaped. Index of tergal setae: a_1 = (8-)9(-10), a_2 = 9(- 10), a_3 = 10(- 11); $a_1 - a_1$ = (17-)19, $a_2 - a_2$ = (37-)39; $a_3 - a_3$ = (48-)52, *st* = 14, *st - st* = (20-)21 µm, $st - st/a_1 - a_1$ = (1.0-)1.1, $a_1/a_1 - a_1$ = 0.5, $a_1/a_1 - a_2$ = 0.2(-0.3), $a_1 - a_1/a_2 - a_3$ = 0.4. Posterosternal lobe of tergum with short pubescence.

Sternum. Setae b_1 tapering and b_2 subcylindrical, both with oblique pubescence, b_3 cylindrical, striate. Index of sternal setae: b_1 = (54-)60, $b_2 = b_3$ = 15, $b_1 - b_1$ = (42-)47, $b_2 - b_2$ = (60-)65(-66), $b_3 - b_3$ = (29-)35, $b_1 - b_2$ = (12-)15 µm, $b_1/b_1 - b_1$ = 1.3, b_1/b_2 = (3.6-)4.0, $b_2/b_1 - b_2$ = 0.3(-0.4), $b_3/b_3 - b_3$ = (0.4-)0.6.

Anal plate circular and with two subcylindrical branches protruding backward from posterior part of sternal side; both branches separated by a deep narrow V-shaped incision; branches cut squarely and with two types of posterior appendages, an inner pointed and a submedian clavate one. The latter (2.1-)2.3(-2.4) times as long as its greatest width and 1/3 of the length of the plate. Plate with dense pubescence being very short anteriorly, more distinct on posterior half, hairs longest and erect on clavate appendages.

CONCLUSIONS

Up to now, two collections of pauropods have become available from north Borneo, together containing 99 specimens. Seven species were reported from the smaller collection (Scheller *et al.*, 1994) and 14 have been reported above. Because only one species was common (*Allopauropus proximus*), the pauropods seem to be very diversified on Borneo. This impression is strengthened by the high number of new species, 5 described in Scheller *et al.* (1994) and 9 above. Moreover, the insignificant presence of widely distributed species point in the same direction. Only three species belong there: *Allopauropus maoriorum* previously known from New

Caledonia, New Zealand and Chile, *A. bouini* from New Zealand, Angola and North America and *A. proximus* which is widespread of the tropics in Asia, Africa and South America.

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Records of *Cryptophagus* Herbst, 1792 from the Himalaya, with a new species from Thailand (Coleoptera: Cryptophagidae)

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Records of *Cryptophagus* Herbst, 1792 from the Himalaya, with a new species from Thailand (Coleoptera: Cryptophagidae). - Records of *Cryptophagus* Herbst from the Himalaya are given, including types seen. A new species, *C. reboredae* sp. n., is described and figured from Thailand.

Key - words: Coleoptera - Cryptophagidae - *Cryptophagus* - records - new species - Himalaya - Thailand.

INTRODUCTION

The Indian and especially Himalayan Cryptophagidae have recently been studied by Lyubarsky (1997, 1999). In spite of this, the fauna of the Himalaya and Oriental region is still insufficiently known, despite numerous new species having been described from there in the past (Bruce, 1945, 1952; Johnson, 1970, 1971, 1975; Lyubarsky, 1998, 1999; Sen Gupta, 1978, 1980; Sen Gupta & Basak, 1985; Sen Gupta & Pal, 1980). The object of this work is to contribute to the knowledge of *Cryptophagus* in the Himalaya and Oriental region, based on the abundant material lent to me by Dr I. Löbl. Most of the material studied was collected by sifting forest litter and was extracted from samples by means of the "Winkler-Moczarski" apparatus (Löbl, 1992).

Acronyms are used to indicate the source of material studied as follows: BMNH - British Museum (Natural History); IRSN - Institut Royal des Sciences Naturelles de Belgique; MNHN - Muséum National d'Histoire Naturelle, Paris; SMNH - Swedish Museum of Natural History.

MATERIAL AND METHODS

Terminology and measurements of the new species follow an earlier paper (Otero, 1997), except for the eccentricity of the eyes (E), which is as follows: E = width / $^1/_2$ of the length; width is measured across the widest part of a line joining the anterior and posterior limit of the eye; length is the maximum length of the eye. Generally, L is used for length, W is width, Ø is diameter. All structures were measured using an Olympus SZX12 stereomicroscope equipped with an image analysis system (Micro Image Version 4.0 for Windows) .

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MATERIAL EXAMINED

Cryptophagus atratus Champion, 1922

Holotype (female): India, Kumaon (coll. BMNH).

INDIA. Uttar Pradesh, Garhwal, 1900 m, 18.III.78, 1 ex; 23.X.79, 1 ex; 26.X.79, 1 ex; 28.X.79, 1 ex. (leg. C. Besuchet- I. Löbl). NEPAL. Bagmati, above Shermathan, 2900 m, 6.IV.81, 1 ex; 26.IV.81, 1 ex; Lalitpur, Phulcoki, 2700 m, 16.X.83, 35 ex (leg. A. Smetana- I. Löbl).

Distribution: Northern India and Nepal (Lyubarsky, 1999).

Cryptophagus aurovestitus Bruce, 1945

Holotype (female): N.E. Burma, Kambaiti, 8.IV.1934 (leg. Malaise) (coll. SMNH).

NEPAL. Patan, Phulcoki, 2500 m, 28-29.IV.84, 1 ex; Bagmati, below Thare Pati, 3300 m, 10.IV.81, 3 ex; 11.IV.81, 1 ex; Bagmati prov., Mere Dara, 3200 m, 8.IV.81, 1 ex (I. Löbl- A. Smetana).

Distribution: Burma, Northern India and Nepal (Lyubarsky, 1999).

Cryptophagus cellaris (Scopoli, 1763)

INDIA. West Bengal, Darjeeling, Tigerhill, 2200-2500 m, 13.X.78, 1 ex (leg. C. Besuchet- I. Löbl); Uttar Pradesh, Garhwal, 1900 m, 21.X.79, 4 ex; 28.X.79, 1 ex; Uttar Pradesh, Kumaon, Chaubattia, 1950 m, 14.X.79, 3 ex; Uttar Pradesh, Kumaon, Rangarh, 2000 m, 9.X.79, 12 ex (leg. I. Löbl). NEPAL. Burlang Bhanjyang, 2600 m, 5.IV.81, 1 ex; Kosi, forest S. Mangsingma, 2200 –2600 m, 11-13.IV.94, 1 ex (Leg. I. Löbl- A. Smetana).

Distribution: Cosmopolitan. These are the first records for India and Nepal.

Cryptophagus heteroclitus Lyubarsky, 1997

INDIA. Uttar Pradesh, Garhwal, 20.X.1979, 1 ex; 25.X.1979, 1 ex ; 29.X.79, 1 ex; Kumaon, Bhim Tal, 1800 m, 9.X.79, 1 ex; Kumaon, Rangarh, 2400 m, 10.IX.79, 2 ex; 9.X.79, 7 ex; Kumaon, Chaubattia, 13.X.79, 3 ex (leg. I. Löbl); Meghalaya, Khasi Hills Shillong, 1850-1950 m, 25.X.78, 8 ex; 30.X.79, 1 ex; West Bengal, Darjeeling distr., 2200 m, 14.X.78, 1 ex; IX-X.78, 1 ex; West Bengal, Darjeeling distr., Tigerhill, 2200-2700 m, 13.X.78, 1 ex (leg. C. Besuchet- I. Löbl). NEPAL. Bagmati, Burlang, 2600 m., 5.IV.81, 6 ex; Bagmati prov., Chauvas, 2600 m, 4.IV.81, 4 ex; Bagmati, Dobate ridge, NE Barahbise, 2700-3000 m, 2.V.81, 2 ex; Bagmati, Gokana forest near Kathmandu, 1400 m, 3.III.81, 1 ex ; Bagmati, Phulcoki, near Kathmandu, 1400 m, 1.IV.81, 2 ex; Bagmati prov., Pokhare, NE Barahbise, 3000 m, 3.V.81, 1 ex; 7.V.81, 2 ex; Kathmandu, Phulcoki, 2500 m, 28-29.IV.91, 47 ex; Kosi, pass NE Mangmaya, 2300 m, 6.IV.84, 3 ex; Kosi, ridge NE Mangmaya, 2800 m, 7.IV.84, 4 ex; Kosi prov., Chichila, above Ahale, 2200 m, 4.IV.84, 1 ex; Kosi, forest NE Kuwapani, 2350 m, 5.IV.84, 1 ex; 24.IV.84, 1 ex; Kosi prov., NE Mangmaya, 6.IV.84, 5 ex; Kosi, Val Induwa, 2000 m, 16.IV.84, 2 ex; Lalitpur, Phulcoki, 2500 m, 15.X.83, 3 ex; 16.X.83, 1 ex; NE Kuwapani, 2600 m, 15.IV.82, 2 ex; Phulcoki, 2600 m, 2.IV.82, 2 ex; 21.IV.82, 2 ex (leg. C. Besuchet- I. Löbl).

Distribution: Northern India and Nepal (Lyubarsky, 1999).

Cryptophagus himalaicus Bruce, 1952

INDIA. Uttar Pradesh, Kumaon, 2250 m, 9.X.79, 1 ex (leg. I. Löbl). NEPAL. Bagmati, below Thare Pati, 3300 m, 10.IV.81, 1 ex; Bagmati, Gul Bhanjyang, 2600 m, 6.IV.81, 3 ex (leg. A. Smetana- I. Löbl); Borges de Chobbar, 1300 m, 16.X.77, 2 ex (leg. L. Deharveng); Kathmandu, Phulcoki, 2400-2600 m, 28.IV.84, 1 ex; Kosi, ridge NE Mangmaya, 2800 m, 7.IV.84, 1 ex; Parbat, ridge E Ghoropani pass, 3100 m, 7.X.83, 1 ex (leg. A. Smetana- I. Löbl).

Distribution: Northern India and Nepal (Lyubarsky, 1999).

Cryptophagus honoratus Lyubarsky, 1999

INDIA. Garhwal, Mussoo river, 1700 m, 19.X.1979, 1 ex (leg. I. Löbl). NEPAL, Patan, Phulcoki, 2500 m, 28-29.IV.1984, 2 ex (leg. I. Löbl- A. Smetana).

Distribution: Nepal (LYUBARSKY, 1999). This is the first record from India.

Cryptophagus malaisei Bruce, 1945

Holotype (female): N.E. Burma, Kambaiti, 22.IV.1934 (coll. SMNH).

INDIA. West Bengal, Darjeeling distr., Ghoom-Lopchu 2000 m, 12.X.78, 3 ex; 13.X.78, 7 ex; 15.X.78, 1 ex; West Bengal, Darjeeling distr., Tigerhill, 2200-2300 m, 13.X.78, 3 ex. NEPAL. Bagmati, Gul Bhaanjyang, 2600 m, 6.IV.81, 1 ex; Bagmati, Malemchi, 2800 m, 14.IV.81, 1 ex; Bagmati, Pokhara, NE Barahbise, 2800 m, 2.V.81, 1 ex; 2.VII.81, 1 ex; 3.V.81, 1 ex; Kathmandu distr., forest above Ahale, 2500 m, 10.V.81, 4 ex; Kathmandu distr., Phulcoki, 2600 m., 26.III.82, 1 ex; Khandbari, forest above Ahale, 2400 m, 26.III.82, 1 ex; Kosi prov., pass NE Mangmaya, 2300 m, 6.IV.84, 2 ex; Kosi, forest Mangsingma, 2300 m, 1-13.IV.84, 2 ex; 16.IV.81, 1 ex; Kosi prov., Val Induwa Kois, 2000-2600 m, 16.IV.84 (leg. I. Löbl-Smetana).

Distribution: Burma and Nepal (Lyubarsky, 1999). These are the first Indian records.

Cryptophagus simulator Grouvelle, 1916

Holotype ♀. India, Murree (coll. Grouvelle. MNHN).

INDIA. Garhwal distr., Musorie, 1700 m, 19.X.79, 1 ex; Kumaon distr., Chaubattia, 1950 m, 14.X.79, 1 ex; Kumaon distr., Rangarh, 2250 m, 9.X.79, 1 ex (leg. I. Löbl); Bagmati, Burlang Bhajyang, 2600 m, 5.IV.81, 1 ex; Bagmati, Gokana forest near Kathmandu, 1400 m, 31.III.81, 1 ex; Bagmati, Pokhare, 3000 m, 7.V.81, 1 ex (leg. I. Löbl- A. Smetana); Patan distr., Phulcoki, 2600 m, 21.IV.82, 2 ex; 22.IV.82, 2 ex; 28.IV.84, 11 ex; 28.V.84, 3 ex; Khandbari distr., forest NE Kwapani, 2600 m, 15.IV.82, 2 ex; Kosi, Chichila above Ahale, 2200 m, 4.IV.84, 1 ex (leg. A. Smetana); Kosi, forest S. Maagsingma, 2200 m, 11.IV.84, 1 ex; Patan, Phulcoki, 2700 m, 15.X.83, 2 ex; Manang distr., forest W. Bagarchap, 2200, 21.IX.83, 1 ex (leg. I. Löbl- A. Smetana).

Distribution: Northern India and Nepal (Lyubarsky, 1999).

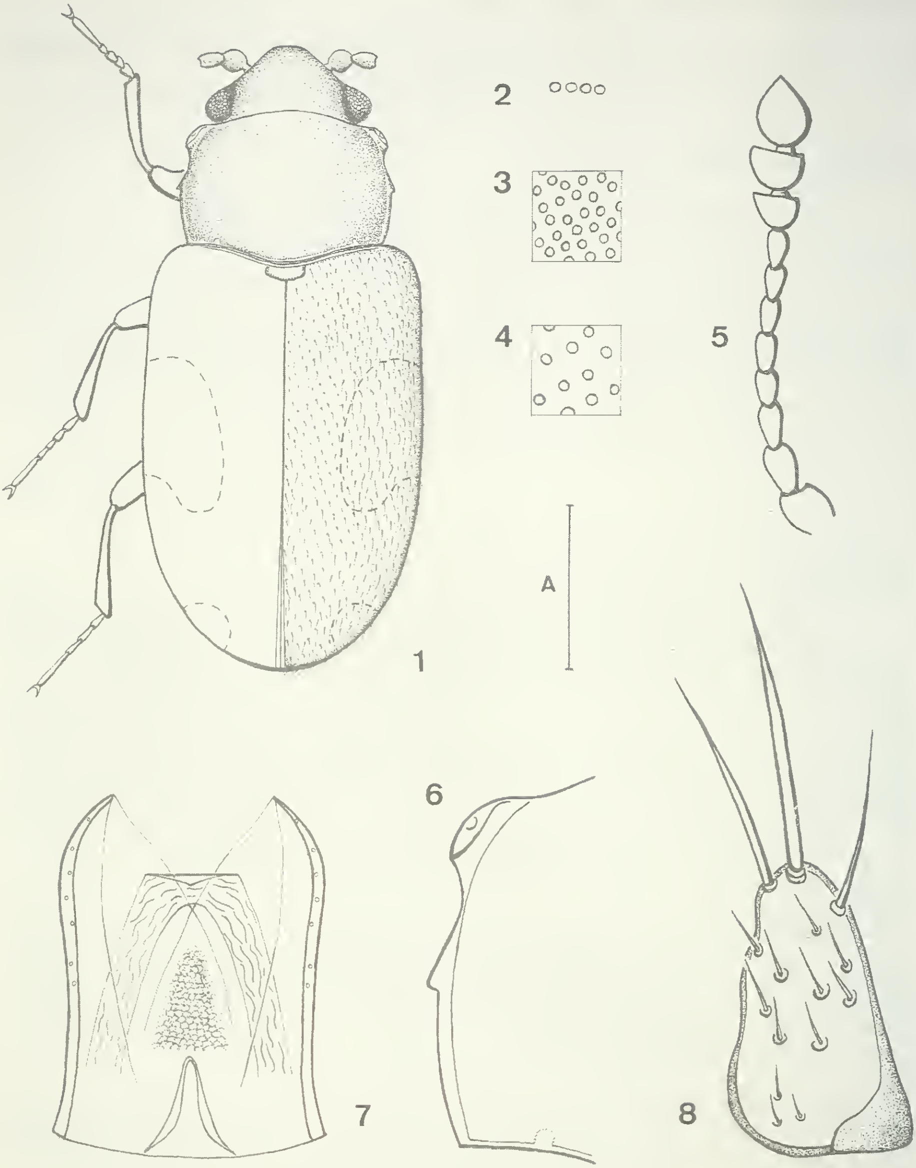
Cryptophagus reboredae sp. n. Figs 1 - 8

Type material: Holotype (male): Thailand, prov. Chiang Mai, Doi Inthanon, 2530 m, 16.II/18.IV.1987 (leg. P. Schwendinger) in coll. MHNG. Paratypes: 2 females, same date as Holotype (leg. P. Schwendinger) in coll. MHNG; 2 females, 17.XII.86/16.II.87, 2000 m (leg. P. Schwendinger) in coll. MHNG; 1 female, 9.I.81, 2500 m (leg. Deharveng-Gouze) in coll. J. C.Otero, University of Santiago de Compostela, Spain.

Description. Length 1.9 - 2.0 mm. Body oval, convex. Coloration yellowish brown, each elytron with a black spot and other smaller apical ones. Elytra with simple (decumbent) pubescence (L= 46,90 μm). Metathoracic wings well developed.

Head transverse, 2.6 times as broad as long. Eyes (L = 0,250 mm) small, slightly prominent (E = 1,46), with ocular facets larger (Ø = 11,52 μm) than the punctures of head (Ø = 9,88 μm) (Fig. 2). Antennae (Fig. 5) long (L = 0,680 mm) reaching beyond base of pronotum.

Pronotum transverse, 1.7 times as broad as long (Fig. 1, 6). Anterior callosities small (1/5 to 1/6 of length of pronotum); angle between the posterior edge of the callosity and the lateral margin of pronotum obtuse. Surface of the callosity scarcely



Figs 1 - 8

Cryptophagus reboredae sp. n. 1: General view (A= 0,401 mm). 2: Size and shape of ocular facets. 3-4: Comparison of punturation between pronotum and elytra. 5: Antennae (A= 0,370 mm). 6: Pronotum (A= 0,356 mm). 7-8: Dorsal view of aedeagus (A= 35,73 μm) and paramere (A= 38,17 μm).

visible in dorsal view, punctured at centre. Lateral tooth in middle of pronotal side. Lateral margin concave between callosity and lateral tooth, convex between lateral tooth and posterior angle. Pronotal puncturation pronounced; punctures separated by a puncture diameter (Ø = 13,16 a 13,52 µm) or less (Fig. 3). Scutellum small, transverse.

Elytra oval, moderately convex; 3 times longer than pronotum. Elytral puncturation somewhat smaller and more dispersed than on pronotum (Ø =13,16 µm) (Fig. 4).

Aedeagus (Fig. 7) (L = 0,153 mm) with preputial sac and endophallic orifice visible. Parameres (Fig. 8) (L = 67,35 µm) with two long apical setae (L = 60,86 - 64,68 µm) and sparse, setae-bearing pores.

Diagnosis. This species belongs to the group characterised by having eyes small and conical, slightly prominent; wings fully developed and dorsum bicolored. *C. reboredae* can be distinguished from other members of this group (*C. anxiosus* Grouvelle and *C. heteroclitus* Lyubarsky) by the structure of the pronotum, antennae, aedeagus and parameres.

Etymology. This species is named in honour of Dra Patricia Reboreda.

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Notes sur le genre *Melanostoma* Schiner, 1860 (Diptera, Syrphidae) à Madagascar et les îles voisines avec descriptions de cinq espèces nouvelles

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Notes on the genus *Melanostoma* Schiner, 1860 (Diptera, Syrphidae) in the Malagasy Region, with descriptions of five new species. - The genus *Melanostoma* is represented in most biogeographical regions of the Old World with a preference for their tropical parts. A review of the species recorded so far from Madagascar and the adjoining islands is given. Five new species are described from Madagascar (*M. incurvum*, *keiseri*, *ochraceum*, *perinetense* sp. n.) and from the Comores (*M. matilei* sp. n.) and one synonymy is revalidated: *M. gymnocera* Bigot (1891) = *M. annulipes* Macquart (1842). An identification key to the taxa is proposed. A brief account of the ♂ genitalia is included.

Key-words: Syrphidae - *Melanostoma* - Malagasy region - taxonomy.

INTRODUCTION

Le genre *Melanostoma* Schiner, 1860 comprend une quarantaine d'espèces réparties dans la plupart des régions de l'Ancien Monde. A l'exception d'une seule espèce paléarctique qui habite aussi le Canada et le nord des Etats Unis, *Melanostoma* fait défaut sur le continent américain. La faune de chacune des grandes régions biogéographiques est bien individualisée et relativement peu d'espèces sont communes à plusieurs d'entre elles. Il n'y a pas de subcosmopolites et un taxon seulement a une aire de répartition qui englobe plus de deux régions. La liste suivante donne un aperçu de la distribution géographique des *Melanostoma* dans le monde. Les chiffres entre parenthèses indiquent le nombre d'espèces qui se retrouvent aussi dans une autre région.

RÉGION BIOGÉOGRAPHIQUE	NOMBRE D'ESPECES
Paléarctique	8 (3)
Néarctique	1 (1)
Orientale	12 (3)
Australasienne	3 (1 ?)
Afrotropicale	18 (1) + 5 spp. n.

L'examen de cette liste montre que le genre est représenté de façon inégale dans les régions tempérées et les zones tropicales avec une préférence pour ces der-

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nières. L'Australasie est la plus pauvre en espèces avec seulement deux endémiques et la présence douteuse d'un élément oriental. *Melanostoma mellinum* (Linnaeus, 1758) a une distribution holarctique tandis que *Melanostoma scalare* (Fabricius, 1794) est commune aux trois régions paléarctique, orientale et afrotropicale. C'est dans le continent africain que se situe la plus grande diversification de *Melanostoma*. La faune y est cependant encore imparfaitement connue et il est vraisemblable que de nouvelles prospections, surtout dans les pays peu ou pas explorés, ajouteront encore d'autres espèces à l'inventaire actuel.

Parmi les 18 espèces de *Melanostoma* décrites ou signalées jusqu'à présent de l'Afrique subsaharienne, 6 ont été trouvées dans la région malgache. Trois de ces taxons sont réputés endémiques insulaires. Une mention spéciale mérite d'être faite des récoltes de F. Keiser pendant son voyage à Madagascar en 1957-1958. A l'exception des spécimens de *M. diffusum* auxquels référence est faite dans la publication des résultats de l'expédition (Keiser, 1971: 223), les autres taxons du genre *Melanostoma* sont restés non identifiés jusqu'à présent. L'étude de ce matériel ainsi que l'examen des collections du MNHN à Paris, permettent d'ajouter cinq espèces nouvelles à l'inventaire des *Melanostoma* de la Grande Ile et de l'archipel des Comores.

Le genre *Melanostoma* est remarquablement homogène à travers toute son aire de répartition. L'habitus de ses représentants est peu variable et les distinctions spécifiques reposent sur un nombre limité de caractères structurels et, dans une moindre mesure, chromatiques. Compte tenu de la palette de variabilité intraspécifique, qui peut être importante, l'identification de certains taxons africains s'avère parfois délicate. Il convient de souligner, à ce propos, qu'il n'existe, à l'heure actuelle, que deux clés d'identification des *Melanostoma* afrotropicales. La première, due à Bezzi (1915: 19), distingue cinq espèces et deux "variétés". La deuxième, établie à partir du matériel dont disposait Curran (1938: 16) énumère huit taxons déjà décrits et deux formes présumées nouvelles désignées par "sp.". Il est clair que ces clés sont, à l'heure actuelle, manifestement incomplètes et inadaptées à la détermination des échantillons de *Melanostoma* récoltés sur le continent africain. En ce qui concerne la faune de Madagascar, les espèces sont cependant suffisamment distinctes et il est relativement aisé d'attribuer correctement les spécimens aux entités spécifiques concernées.

L'objet de cette note est de rassembler et de compléter, si nécessaire, les diagnoses des espèces de *Melanostoma* signalées de la région malgache. On y trouvera une clé dichotomique permettant d'identifier les différents taxons, une description de chacun d'eux ainsi qu'une brève discussion de quelques problèmes de nature taxonomique qui se sont présentés au cours de l'étude. Nous espérons que ce travail, bien que limité à un domaine géographique restreint, sera un apport utile à une future révision des *Melanostoma* afrotropicales.

MATÉRIEL ET MÉTHODES

Les notes qui suivent sont basées sur l'étude de matériel de *Melanostoma* conservé dans les collections des institutions suivantes: American Museum of Natural History, New York (AMNH), Academy of Natural Sciences of Philadelphia, Philadelphia (ANSP), Institut Royal des Sciences Naturelles de Belgique, Bruxelles (IRSNB), Museum National d'Histoire Naturelle, Paris (MNHN), Museum of Natural History, London (BMNH), Musée Royal de l'Afrique Centrale, Tervuren (MRAC), Museum of Zoology, University of Lund (MZUL), Naturhistorisches Museum Basel, Basel (NHMB) et Hope Entomological Collection, Oxford (UMO). Cette note se limite aux espèces qui peuplent la région malgache et ne constitue donc pas une révision taxonomique au sens strict. Dans cette optique, nous n'avons pas cherché à examiner les types, surtout des taxons bien caractérisés souvent cités et dont l'identité paraît bien établie. Parmi le matériel étudié figurent toutefois l'holotype de *M. satyriphilum* et des paratypes de *M. diffusum* et de *M. sylvarum*.

Pour l'étude de l'appareil copulateur ♂ nous avons suivi la procédure classique comportant la macération préalable dans une solution de KOH (10%), neutralisation et éclaircissement par l'acide acétique et montage dans la glycérine. Les genitalia sont conservés dans un microtube fixé sur l'épingle qui porte l'insecte. La terminologie utilisée suit la récente synthèse de Sinclair (2000).

Dans les descriptions des espèces et la discussion, quelques abréviations ont été utilisées, comme suit:

L: longueur totale du spécimen
L_{aile}: longueur de l'aile mesurée entre la tegula et l'apex
I_{front}: rapport de la largeur du front (l_{front}) à la largeur de la tête ($l_{tête}$) chez la ♀
p: patte (p1, p2 et p3 pour les pattes antérieures, médianes et postérieures)
f: fémur
t: tibia
ta: tarse
T: tergite

Les mesures des différents paramètres morphométriques ont été effectuées au moyen d'une échelle micrométrique oculaire. Pour la longueur totale, nous n'avons retenu que les spécimens dont l'abdomen n'était pas distordu.

Une description verbale traditionnelle est donnée pour chacune des espèces. Les traits morphologiques communs à tous les taxons sont résumés en introduction à la description des espèces. Il en va de même pour les genitalia mâles qui sont brièvement discutés plus loin mais qui ne font pas l'objet de commentaires dans les descriptions des taxons. Plusieurs espèces présentent un important gradient de variation dont on trouvera un aperçu à la fin des descriptions, sous l'intitulé "variabilité". Ces informations se limitent bien entendu aux formes dont nous avons vu un matériel suffisamment important. Il n'est toutefois pas possible, en l'état actuel de nos connaissances, de mettre en évidence des formes ou des clines géographiques.

Dans l'énumération du matériel étudié les noms des localités à Madagascar sont cités tels qu'ils figurent sur les étiquettes, suivis lorsqu'ils ont changé, de la nouvelle appellation. Pour les espèces qui habitent aussi le continent africain, nous faisons figurer sous "Matériel supplémentaire examiné", la liste des pays d'où nous avons vu des spécimens. La République Démocratique du Congo (anciennement Zaïre) est désignée dans les listes de répartition par le sigle RDC.

CLE DICHOTOMIQUE DES ESPÈCES

1 Calus facial dédoublé, composé de deux tubercules étroitement, mais distinctement, séparés par un sillon vertical; dessins jaunes de l'abdomen très étendus (figs 2, 8); pattes généralement jaunes, parfois plus ou moins teintées de couleur sombre; pilosité du front brune ou noire .... *bituberculatum*

\- Calus facial entier, circulaire et plus ou moins saillant 2

2 Antennes entièrement noires, en particulier le troisième article *matilei* sp. n. ♀

\- Antennes jaune orange, le bord supérieur et la partie distale brunis ou noircis 3

3 A la fois f3 et t3 jaunes et ornés d'un anneau noir généralement bien délimité, situé au milieu des segments ou, pour f3, dans sa partie subapicale 4

\- f3 et t3 sans anneaux noirs bien définis, jaunes ou brun clair, plus ou moins obscurcis, ou seulement t3 avec un anneau bien marque 6

4 t3 fortement courbé, avec un anneau foncé au milieu (fig. 17); anneau noir de f3 subapical, occupant environ 1/5 de la longueur; pilosité du front noire .... *incurvum* sp. n. ♀

\- t3 presque droit, sans courbure marquée 5

5 Anneau noir de f3 subapical, occupant 1/5-1/4 de la longueur, le genou étant jaune; t3 au milieu avec un anneau noir sur près des 2/5 de sa longueur (fig. 16); pilosité du front fauve; T2 noir avec deux taches jaunes sublatérales ou parfois sans dessin (figs 1, 7) .... *annulipes*

\- f3 avec un large anneau noir central couvrant environ 3/5 de sa longueur; t3 avec une ornementation similaire (fig. 18); pilosité du front brun foncé; T2 entièrement jaune orange (fig. 4) .... *ochraceum* sp. n. ♂

6 T2 jaune orange, une étroite ligne verticale brun noir plus ou moins longue depuis le milieu du bord antérieur, pouvant atteindre l'apex du tergite ou, rarement, se prolonger jusque T4 (♂) ou abdomen avec une bande centrale brun noir égale à 1/4 de la largeur et les marges postérieures des tergites de même couleur (♀) (figs 3, 9); t3 jaune pourvu d'un anneau foncé au milieu, pas toujours bien visible .... *diffusum*

\- T2 noir, avec deux taches soit bleutées, soit jaune orange, parfois obscures ou même absentes; t3 sans anneau central noir 7

7 alula très étroite, de forme approximativement rectangulaire; sa longueur au moins 3,5x sa plus grande largeur; front noir brillant, sans taches de pruinosité grise .... *perinetense* sp. n. ♀

\- alula moins étroite, s'élargissant vers l'extrémité distale; longueur au maximum 3,5x sa plus grande largeur; front de la ♀ avec des taches plus ou moins grandes de pruinosité grise le long de la marge oculaire 8

8 hanches jaunâtres, celles de p3 parfois avec des reflets métalliques; t3 jaune, foncé sur 1/2 à 2/3 de sa partie distale; T2 brun noir sans taches (♂) ou avec deux grandes taches oranges, parfois obscures (♀) (figs 5, 14) .... *satyriphilum*

\- hanches noires; t3 entièrement brun foncé ou bien jaune orange, sans dessins plus foncé 9

9 f3 et t3 jaune orange; T2 avec deux grandes taches jaunes (fig. 11); arista nettement pubescente; aile couverte de microtriches sur toute sa surface . . . . *keiseri* sp. n. ♀

\- f3 et t3 brun foncé ou noirs (fig. 19); T2 noir à reflets bleutés, sans taches claires (♂) ou avec deux petites macules jaune orange, souvent obscurcies (♀) (figs 6, 15); arista pratiquement nue, seulement quelques cils à sa base; les deux cellules basales de l'aile dépourvues de microtriches à la base . . . . *sylvarum*

DESCRIPTION DES ESPÈCES

Genre ***Melanostoma*** Schiner, 1860

Petites mouches ayant la tête et le thorax entièrement noirs et caractérisées par la forme particulière du métasternum. La partie sclérifiée de ce dernier se limite à une étroite bande médiane et deux bras latéraux à son extrémité antérieure. Les caractères énumérés ci-après sont communs à toutes les espèces malgaches et, plus généralement afrotropicales, examinées.

Tête noire, le front et la face saupoudrés partiellement de pruinosité grise ou argentée; chez une espèce, le front de la ♀ est totalement brillant. Yeux toujours glabres. Troisième article antennaire soit noir, soit jaune ou orange, la marge supérieure et la partie distale plus ou moins brunies.

Thorax noir brillant, souvent avec des reflets bleutés sur le mesonotum; pleures plus ou moins ternies par un satiné gris blanc; scutellum comme le scutum, sa marge postérieure avec quelques longues soies. Frange infrascutellaire présente.

Pattes variables, les parties constituantes diversement teintées et souvent avec un dessin typique; la couleur varie du jaune au noir en passant par plusieurs tons de brun. De façon générale, les derniers tarsomères sont obscurcis et contrastent avec le basitarse.

Abdomen noir élancé, cylindrique, souvent étréci au milieu et légèrement spatulé à son extrémité (♂) ou longuement ovalaire (♀); T2-T5 en général avec des paires de taches jaunes à rougeâtres dont la forme, l'extension et l'intensité varient d'une espèce à l'autre. Le contour de ces macules est habituellement net et bien délimité mais il peut devenir flou ou les taches s'effacer en partie ou totalement, laissant l'abdomen entièrement noir. A l'inverse, la couleur jaune ou orange peut envahir une part importante des tergites jusqu'à éliminer pratiquement toute trace de noir. Les dessins de T3 et T4 ont souvent une forme caractéristique pour les diverses espèces; ils passent les marges latérales sur une longueur variable ou sont, au contraire, isolés des bords des tergites. Un dimorphisme sexuel dans l'ornementation de l'abdomen semble être la règle, à en juger par les espèces où les deux sexes sont connus. Par ailleurs, chez quelques taxons, les marques de T2 ont tendance à devenir plus petites, indistinctes ou à disparaître.

Melanostoma annulipes Macquart, 1842 Figs 1, 7, 16, 20, 26
Melanostoma gymnocera Bigot, 1891, syn. revalidé (voir discussion).

MATÉRIEL EXAMINÉ

Madagascar Est: Fanovana Distr., I-V.1937 (*C. Lamberton*), 28♂♂, 43♀♀ (ANSP); Fampanambo, II.1959 (*J. Vadon*), 1 ♂; 1962 (*J. Vadon*), 1♂, 2♀♀ (MRAC); Distr. Sambava, Marojejy, Beondroka, 1200m, VI.1960 (*P. Soga*), 2 ♂♂ (NHMB); Perinet, 500m, 6-12.V.1960 (*K.M. Guichard*), 1♀ (BMNH); Brickaville, VII-VIII.1958 (*Sigwalt*), 1♂, 2♀♀ (MNHN).

Madagascar Centre: Tananarive [=Antananarivo], 1921 (*R. Decary*), 1♀; XII.1929 (*A. Seyrig*), 1♀ (MNHN); La Mandraka forêt, IV.1991 (*Pauly*), 2 ♂♂ (MRAC).

Grande Comore, La Grille, 810m, VIII.1958 (*Raharizonina*), 1♂; Nioumbadjou, 505m, VIII.1958 (*Raharizonina*), 2♀♀ (MHNB).

Maurice: forêt de Macchabé, 19.III.1981 (*L. Matile*), 1♀; Curepipe, XI.1921 (*P. Carlé*), 4♀♀; Mon Désert, V.1912 (*P.Carlé*), 1♀ (MNHN).

La Réunion: place des Palmistes, 1897 (*Ch. Alluaud*), 1♀ (MNHN).

Matériel supplémentaire examiné

RDC: 51♂♂, 99♀♀ (IRSNB), 28♂♂, 32♀♀ (MRAC); Côte d'Ivoire:1♂, 1♀; Liberia: 1♂; Uganda: 1♂, 1♀;Kenya: 1♂, 2♀♀; Tanzanie: 3♀♀ (MRAC); Burundi: 8♂♂, 5♀♀ (IRSNB); Rwanda: 1♀ (IRSNB), 2♂♂, 1♀ (MRAC).

MÂLE

Tête: le haut du front couvert de pruinosité grise qui se prolonge le long des yeux jusqu'au milieu du front. La pilosité est brun clair, mélangée de quelques cils plus foncés. Face noire, couverte de pruinosité grise, à l'exception du calus facial et de l'épistome qui sont brillants. Pilosité de la face blanche. Gènes noirs brillants avec une pilosité blanche assez claisemée. Antennes brun clair, le troisième article brun foncé sur la moitié supérieure. Arista brun clair, plus foncée dans sa moitié distale, faiblement pubescente. Triangle ocellaire noir brillant muni d'une touffe de poils clairs dirigés vers l'avant.

Thorax: mesonotum noir brillant y compris les calus postalaires. Humerus noirs couverts de pruinosité grise. Pilosité du thorax et du scutellum moyennement longue, composée de cils grisâtres de longueur inégale. Scutellum comme le mesonotum avec quelques longues soies brun clair à son extrémité. Pleures noires recouvertes en grande partie d'une pruinosité grise assez légère et portant une courte pilosité de la même couleur.

Aile: vitreuse, en majeure partie recouverte de microtriches. Première cellule basale nue dans sa partie basale ainsi que le long des nervures qui la bordent jusque vers le milieu. Deuxième cellule basale dépourvue de microtriches sur plus de la moitié de sa surface. Nervures brunes. Haltère jaune orange; cuilleron jaune blanchâtre avec une frange blanche. Alule entièrement couverte de microtriches.

Pattes: p1 et p2 entièrement jaunes à pilosité concolore, avec l'extrémité des tarses légèrement bruni. Fémur 3 jaune ocre, orné d'un anneau nettement délimité, brun foncé à noir dans sa moitié distale. La longueur de cet anneau atteint environ 1/5 à 1/4 de la longueur du femur. Le genou est jaune. Tibia 3 jaune ocre, la partie centrale avec un anneau noir qui mesure près de 2/5 de la longueur du tibia. Les 4 derniers tarsomères de ta3 brunis, la partie basale de couleur jaunâtre (fig. 16). La pilosité de p3 est jaune partout. Toutes les hanches noires, les trochanters de la même couleur que la base des femurs.

Abdomen (fig.1): T1 entièrement noir brillant; T2 noir avec deux taches jaunes latérales largement séparées au milieu et ne débordant pas la marge du tergite. Les taches sont situées dans la moitié postérieure de T2. T3 avec deux taches jaunes rectangulaires plus longues que larges, bordant la marge antérieure du tergite et occupant 2/3 de sa longueur. T4 avec un dessin jaune similaire mais les deux taches sont plus rapprochées et atteignent la moitié de la longueur de T4. Les taches de T3 et T4 passent sur la marge latérale dans leur moitié antérieure et sont échancrées vers l'arrière. T5 noir avec deux petites taches jaunes à l'extrémité du bord antérieur. Hypopyge noir brillant à pilosité brun clair. Pilosité de l'abdomen composée en majeure partie de cils clairs assez courts, semi couchés. Ventre noirâtre avec indication plus ou moins nette des dessins jaunes des tergites.

FEMELLE

Tête: front noir brillant pourvu en son milieu de deux taches triangulaires de pruinosité grise; la base de ces triangles jouxte le bord oculaire et les sommets sont étroitement séparés au centre du front. Une bande pruineuse identique couvre l'avant du front, le long des yeux pour rejoindre, au niveau des antennes, celle de la face. Pilosité du front brun clair. Triangle ocellaire et vertex noir brillant. Face noire entièrement couverte de pruinosité grise, sauf le calus frontal qui est brillant ainsi que l'épistome. Pilosité de la face blanchâtre.

Thorax, aile, pattes: comme chez le ♂. Membrane de l'aile teintée de jaune, plus intense que chez le ♂.

Abdomen (fig. 7): noir, avec des dessins jaune orange. Premier tergite noir, brillant. T2 décoré de deux petites taches plus ou moins circulaires, situées au milieu du tergite et assez écartées l'une de l'autre. T3 et T4 pourvus de deux taches à peu près rectangulaires jouxtant la marge antérieure du tergite mais échancrées sur le côté extérieur. L'écartement des deux macules atteint environ 1/5 de la largeur du tergite. T5 muni de deux taches allongées dans le sens de la largeur, situées le long du bord antérieur, avec le bord arrière arrondi. Les taches sur T3 et T5 atteignent le milieu du tergite, tandis que celles de T4 n'occupent que 2/5 de la longueur. Pilosité de l'abdomen, brun clair, en grande partie couchée, avec des cils blancs, dressés sur T2 et le long du bord de l'abdomen.

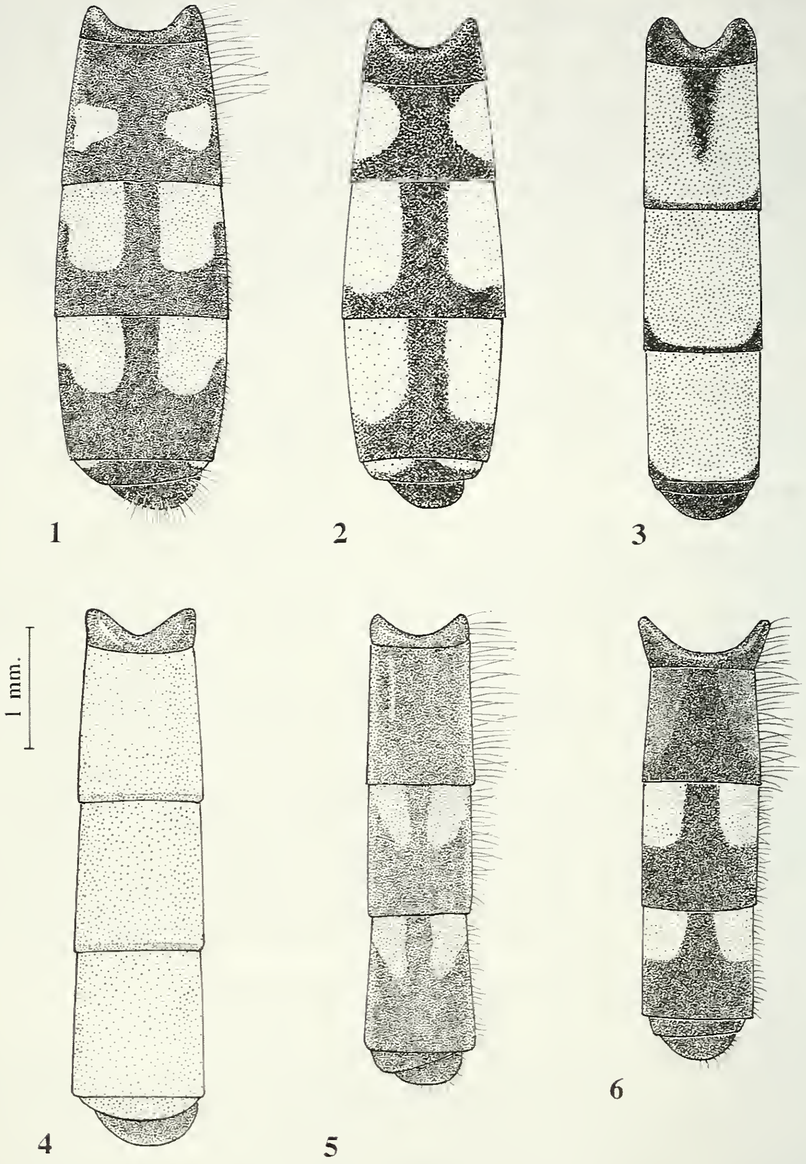
L: ♂ 5,9 - 7,3 mm; ♀ 6,5 - 8,0 mm; L_{aile}: ♂ 4,77 - 6,16 mm; ♀ 5,31 - 7,32 mm.

VARIABILITÉ

Bezzi (1915: 21) avait déjà fait remarquer que *M. annulipes* est une espèce très variable, notamment en ce qui concerne la coloration des pattes et la conformation des taches abdominales. Cette observation est pleinement confirmée par l'examen du matériel à notre disposition. Les principales modifications constatées sont résumées ci-après:

(1) Front: chez la ♀ les taches latérales de pruinosité peuvent se réduire à deux petites marques le long de la marge oculaire, laissant libre entre elles près des 2/3 de la largeur du front; chez d'autres spécimens elles se rejoignent au centre pour former une bande pruineuse transversale.

(2) Aile: la couverture en microtriches des cellules basales est variable. Chez certains individus, les parties dépourvues de microtriches ont une surface réduite ou sont même absentes;



Figs 1-6

Abdomen de *Melanostoma* spp. ♂♂: 1. *annulipes*; 2. *bituberculatum*; 3. *diffusum* (paratype); 4. *ochraceum* (holotype); 5. *satyriphilum*; 6. *sylvarum* (paratype).

(3) Pattes: les anneaux noirs de p3 varient en étendue et en intensité chromatique. Ainsi, Bezzi (1915: 21) signala que les pattes postérieures peuvent être presque entièrement noires. Parmi le matériel que nous avons étudié, l'anneau de f3 varie en longueur entre 1/6 et près de 1/3 de la longueur totale; l'extrémité distale des marques sombres sur f3 et t3 est souvent peu nette. Exceptionnellement, les t1 sont pourvus d'un anneau brunâtre en leur milieu. Le degré de noircissement des derniers tarsomères des trois paires de pattes est plus ou moins intense, nuancé de brun clair à noir.

(4) Abdomen: les dessins jaunes des tergites sont souvent réduits de façon à n'occuper que 1/4 à 1/3 de la longueur des tergites. Chez d'autres exemplaires ils sont, au contraire, plus développés et peuvent atteindre les 3/4 des tergites. En règle générale les macules des tergites sont plus étendues chez le ♂; sur T2, les taches jaunes sont parfois réduites à deux points chez la ♀ ou sont même absentes. Bezzi (1915: 21) nota déjà que T2 est souvent dépourvu de macules claires.

RÉPARTITION

Espèce paraissant commune partout où elle a été signalée. Elle est connue de la plus grande partie de la région afrotropicale mais semble absente des contrées méridionales du continent africain. Décrite de l'île de la Réunion, l'espèce est connue de longue date de différents endroits de la région malgache. Citée pour la première fois de la Grande Ile par Bigot (1859: 437), sans indication de localité, elle y fut retrouvée près d'un siècle plus tard à Fanovana (Madagascar Est) où une série importante de spécimens fut récoltée (Hull, 1941: 310). Par la suite, van Doesburg (1957: 104) mentionna 1♂ et 3♀♀ de Perinet, à mi-chemin, environ, entre Antananarivo et la côte est. Aux Seychelles, *M. annulipes* est connue de Silhouette et de Mahé (Lamb, 1922: 413) tandis que Bezzi & Lamb (1925: 552) la rapportent de Rodriguez. Enfin, outre l'île de la Grande Comore, De Meyer *et al.* (1990: 567) signalent la présence de l'espèce à Mohéli et à Anjouan dans l'archipel des Comores. On trouvera une carte de répartition de *M. annulipes* dans Dirickx (1998: 158, carte 33).

Melanostoma bituberculatum Loew, 1858 Figs 2, 8, 21, 27

MATÉRIEL EXAMINÉ

Madagascar Est: Oriental Forest, Fanovana Distr., I-V.1937 (*C. Lamberton*), 10 ♂♂, 20 ♀♀ (ANSP); Rogez, forêt Analandraraka, VI.1937 (*A. Seyrig*), 1♂ (MRAC).

Madagascar Centre: Morarano-Chrome, I.1992 (*A. Pauly*), 1♂ (MRAC); 30 km S. d'Ambositra, 28.VIII.1928 (*A. Seyrig*), 1♂, 1♀; SW. d'Ambositra, 20.X.1928 *A. Seyrig*), 2♀♀ (MNHN).

Maurice: forêt de Macchabé, 19.III.1981 (*L. Matile*), 1♀ (MNHN).

Matériel supplémentaire examiné:

RDC: 20♂♂, 28♀♀ (IRSNB); 7♂♂, 1♀ (MRAC); Burundi: 8♂♂, 8♀♀; Rwanda: 1♂, 1♀; Kenya: 1♂ (IRSNB).

MÂLE

Tête: front noir luisant avec une pruinosité blanchâtre très étroite le long des marges oculaires. Pilosité du front assez longue, brun foncé à noir. Triangle ocellaire noir brillant à pilosité brune dirigée vers l'avant. Face noire brillante, couverte d'une pruinosité gris jaunâtre, peu dense, couvrant toute la face à l'exception du tubercule facial et du bord de l'épistome. Calus facial formé de deux petits tubercules très rapprochés, un peu étirés dans le sens de la hauteur, l'étroit sillon séparant les deux tubercules est pruineux comme la face. Arista pratiquement nue, quelques cils peu visibles près de la base. Elle est brun clair, devenant brun foncé à noir vers l'apex.

Thorax: mesonotum noir brillant à reflets souvent vert métallisé et à pilosité claire, brun clair ou grisâtre, dressée, moyennement longue. Même pilosité claire sur les pleures, un peu plus longue. Scutellum comme le mesonotum, également couvert de pilosité gris brun.

Aile: hyaline, assez fortement teintée de brun clair sur toute sa surface, stigma peu marqué. Toute l'aile couverte de microtriches. Haltère jaune, souvent légèrement brunie. Cuilleron jaune clair, la partie alaire et la partie thoracique étant de même taille.

Pattes: p1 et p2 jaunes, les extrémités des tarses étant très légèrement brunis chez certains specimens. Fémur de p3 jaune plus ou moins bruni, t3 jaune avec, au milieu, un large anneau central brunâtre. Tarsomères 4 et 5 nettement obscurcis, contrastant avec les articles précédants qui sont jaunes. Pilosité des pattes jaune avec toutefois une rangée de cils noirs très courts sur t3.

Abdomen (fig. 2): noir, à dessins jaune orange. T1 noir brillant comme le thorax et le scutellum. T2-T4 mats, sans reflets métalliques, pourvus de grandes taches jaune orange. Les macules de T2 occupent les 3/4 de la longueur du segment; elles sont latérales et les bords internes sont arrondis. Sur T3 et T4 les taches sont approximativement rectangulaires, contiguës au bord antérieur et légèrement arrondies à l'apex. Elles débordent la marge latérale des tergites. T5 avec deux petites taches transversales, arrondies vers l'arrière et étroitement séparées au milieu. Pilosité de T2 blanche, dressée, sauf à l'extrémité apicale où les poils sont noirs, couchés. T3 orné d'une pilosité blanche, dressée, sur les 3/4 antérieurs des parties jaunes, ailleurs noire, couchée. Sur T4, les cils blancs sont limités à la base extérieure. Hypopyge noir brillant à pilosité claire, mêlée de quelques poils noirs. Ventre noir avec les dessins des tergites visibles. Pilosité du ventre blanche sur T2 et T3 et la moitié de T4, noire couchée au-delà.

FEMELLE

Tête: front noir brillant avec deux taches de pruinosité grisâtre, triangulaires, situées au milieu du front le long de la marge oculaire. Les deux triangles laissent libre, au milieu, un espace égal à environ 1/3 de la largeur du front. Pilosité du front brune, celle de la face blanche, assez courte.

Thorax, aile et pattes: comme chez le ♂.

Abdomen (fig. 8): noir à dessins jaune orange. Les taches claires sur T2 sont situées au milieu du segment, passant sur le bord latéral et laissant libre entre elles 1/5 de la largeur du tergite. T3 et T4 avec des dessins jouxtant le bord antérieur, de forme approximativement rectangulaire mais fortement échancrées sur le bord latéral. Les macules atteignent les 2/3 de la longueur des tergites. T5 avec deux taches semicirculaires étroitement séparées au milieu et occupant près des 4/5 du tergite. T6 montre deux petites taches jaunes latérales à sa base. La pilosité de l'abdomen est identique à celle du ♂.

L: ♂ 6,3 - 7,6 mm; ♀ 7,0 - 8,4 mm; L_{aile}: ♂ 5,07 - 6,35 mm; ♀ 5,86 - 7,16 mm.

VARIABILITÉ

Cette espèce est, dans l'ensemble, moins variable que la précédente. On peut cependant relever plusieurs caractères qui diffèrent légèrement:

(1) Tête: les taches de pruinosité du front de la ♀ s'étendent plus ou moins loin vers le centre: chez certains specimens les pointes des triangles sont très rapprochées ou se touchent. Par opposition, on rencontre des ♀♀ ayant des taches peu développées, laissant plus des 2/3 de la largeur du front libre entre elles. L'étendue des parties brunies du troisième article antennaire est variable: elles occupent normalement le bord dorsal et la moitié apicale mais il y a une nette tendance à leur effacement et plusieurs exemplaires ont le troisième article presque entièrement jaune.

(2) Aile: chez plusieurs ♀♀, les cellules basales ainsi que la cellule costale sont dépourvues de microtriches dans leurs parties inférieure et basale.

(3) Pattes: la pilosité des pattes est généralement jaune partout mais chez certains exemplaires des deux sexes t3 porte des cils noirs.

(4) Abdomen: chez le ♂, les macules de T4 peuvent se rejoindre pour former une large bande jaune continue sur tout le tergite; T5 est aussi orné parfois d'un liseré le long de la marge antérieure. L'espace noir qui sépare les taches tergales est variable.

RÉPARTITION

Décrite de l'Afrique du Sud, l'espèce est largement distribuée en Afrique centrale et orientale, de l'Ethiopie jusqu'à la Province du Cap. En RDC, la grande majorité des captures proviennent des provinces orientales (Kivu, Shaba). Les localités situées le plus à l'ouest sont Eala et Mbaza-Ngungu [=Thysville] d'où nous avons vu 3♂♂ et 3♀♀ (IRSNB). La première citation de Madagascar, sans autre précision, est celle de Bezzi (1920: 134). L'espèce a été identifiée sur l'île de la Grande Comore par De Meyer *et al.* (1990: 567). Voir aussi la carte de répartition dans Dirickx (1998: 158, carte 34).

Melanostoma diffusum Hull, 1941 Figs 3, 9, 22, 28

MATÉRIEL EXAMINÉ

Madagascar Est: Oriental Forest, Fanovana entre Tamatave [=Toamasina] et Tananarive [=Antananarivo], I-V.1937 (*C. Lamberton*) 11 ♂♂, 6 ♀♀, tous paratypes (ANSP); Perinet, 08.X.1958 (*F.Keiser*), 2♂♂ (NHMB).

Madagascar Centre: Vohiparara, 15.IX.1958, 4♂♂, 3♀♀; Ambalamanakana, 18.I.1958, 1♂; Manjakatompo, 23.IV.1958, 9♂♂, 1♀; Ambohitantely, 10.VI.1958, 1♂ (*F.Keiser*) (NHMB); Rogez, VII.1937 (*A. Seyrig*), 3♂♂, 2♀♀ (MRAC).

MÂLE

Tête: front noir brillant couvert de pruinosité grisâtre le long des marges oculaires et à pilosité noire, assez longue vers le sommet; l'espace sus-antennaire légèrement renflé est nu. Triangle ocellaire noir brillant à pilosité concolore dirigée vers l'avant. Face noir brillant entièrement couverte de pruinosité grise, à l'exception du calus facial et du bord de l'épistome. Arista pubescente, les cils ayant un peu moins que le diamètre de l'arista qui est unicolore, brun foncé et épaissie dans sa moitié basale.

Thorax: mesonotum noir brillant, à pilosité dressée brun clair. Pleures noires, couvertes de pruinosité grise à poils brun clair. Scutellum comme le mesonotum avec quelques soies plus longues le long du bord postérieur et muni d'une faible dépression préapicale transversale.

Aile: hyaline, teintée de brun clair. Stigma très peu marqué, à peine plus foncé que la teinte générale. Toute l'aile est couverte de microtriches. Haltère jaune orange et cuilleron jaune clair, à frange blanchâtre très longue.

Pattes: p1 entièrement jaunes, à pilosité concolore; p2 jaunes, à pilosité jaune, mélangée de courts poils noirs, couchés, sur le tibia et tous les articles du tarse. Les articles terminaux de ta1 et ta2 sont légèrement brunis. Aux pattes postérieures, f3 et t3 sont jaunes, t3 avec un large anneau foncé, parfois presque noir, sur le milieu. Pilosité de f3 jaune, celle de t3 et de ta3 en majeure partie noire. Hanches de p1 et p2 brun clair à brun moyen, pattes postérieures à hanches brun foncé ou noir, légèrement luisantes. Les tarsomères apicaux de ta3 nettement brunis, parfois aussi le basitarse.

Abdomen (fig. 3): T1 noir brillant. T2 presque totalement jaune orange, ne laissant apparaître en noir qu'une étroite ligne médiane dont le développement est variable. T3 également orné d'une ligne médiane brun foncé, se limitant parfois à un trait près de la marge antérieure. T4 entièrement jaune orange. T2-T4 ont le bord postérieur étroitement brun foncé et montrent de petits triangles foncés sur les coins postérieurs, taches qui se prolongent le long de la marge latérale jusqu'au milieu des tergites. T5 entièrement jaune orange avec le bord postérieur parfois très étroitement noirci. Hypopyge noir brillant à reflets métalliques et garni de pilosité noire. Ventre entièrement jaune à pilosité claire, semi-couchée. La pilosité des tergites est en majeure partie noire, couchée, le 1/3 basal des parties claires de T2 et T3 portant des cils jaunâtres dressés.

FEMELLE

Tête: front noir brillant, à reflets vert métallique au dessus des antennes et à reflets cuivrés sur le vertex. Deux taches triangulaires de pruinosité grise le long des yeux, au milieu du front. La distance séparant les sommets de ces taches correspond à 1/3 de la largeur du front. Pilosité du front brun foncé à noire sur la partie supérieure, devenant plus claire sur l'espace supra-antennaire. Triangle ocellaire noir brillant. Face noir brillant avec deux larges bandes de pruinosité grise le long des yeux et sur la dépression sous-antennaire; le calus facial et le bord de l'épistome sont noirs brillants. Pilosité de la face blanchâtre. Arista courtement pubescente, la longueur des cils étant légèrement inférieure au diamètre de l'arista; cette dernière est brun foncé, épaissie dans la moitié basale.

Thorax, aile et pattes: comme chez le ♂.

Abdomen (fig. 9): noir, à dessins jaune orange très étendus. T1 entièrement noir brillant, T2 avec deux taches latérales jaunes allongées, séparées au milieu par un espace égal au quart de la largeur du tergite; ces taches sont contiguës à la marge antérieure de T2 et occupent les 4/5 de sa longueur. T3 et T4 avec un dessin analogue mais la distance qui sépare les macules n'est plus qu'une étroite bande noire tout comme la marge postérieure. La largeur de l'espace central qui sépare les taches claires des tergites est variable: chez certains exemplaires elle est réduite à un nuage brun ou noirâtre et les bords intérieurs des macules deviennent diffus. T5 est jaune orange sur les 3/4 de sa longueur, bordé à l'arrière par un bande de couleur brune.

L: ♂ 6,0 - 7,5 mm; ♀ 6,3 - 7,3 mm; L_{aile}: ♂ 5,38 - 6,59 mm; ♀ 5,76 - 6,53 mm.

VARIABILITÉ

(1) Pattes: parmi le matériel examiné, quelques spécimens ont une ébauche d'anneau plus foncé, étroit, sur le milieu de t2. Un seul exemplaire est doté, dans la partie centrale de f3, d'un manchon brun. Il y a par ailleurs plusieurs insectes où l'anneau noir de t3 est faiblement développé ou fait défaut.

(2) Abdomen: comme l'avait déjà fait observer Keiser (1971: 223), le dessin de plusieurs ♂♂ s'écarte du modèle habituel. Ces spécimens ont une ligne centrale noire plus ou moins large sur T2-T4 et les triangles des angles postérieurs sont nettement marqués. Dans le cas extrême, ce schéma rappelle celui de la ♀.

RÉPARTITION

Connue jusqu'à présent uniquement de Madagascar Est où elle a été signalée aussi de Rogez (van Doesburg, 1957: 104) et de Madagascar Centre.

Melanostoma incurvum sp. n. ♀ Figs 10, 17

MATÉRIEL EXAMINÉ

Holotype ♀: Madagascar Est, Soanierana-Ivongo, 07.XI.1957 (*F. Keiser*), déposé au NHMB.

DIAGNOSE

Espèce dont l'allure générale rappelle *M. annulipes* avec laquelle elle partage le dessin de p3 et de l'abdomen. Elle s'en distingue toutefois nettement par la courbure de t3 et par la pilosité foncée du front. Nous avons hésité à décrire cette espèce, proche de *M. annulipes* et basée sur un unique exemplaire ♀. Les deux caractères distinctifs ci-dessus nous semblent toutefois exclure la présomption d'un individu aberrant se rapportant à une espèce connue. Chez tous les taxons examinés, le tibia 3 est droit, sans aucune trace de cambrure. A l'exception de Speiser (1910: 115) qui, dans la description de *M. alticola* note en passant que t3 est "ein klein wenig gebogen", nous n'avons trouvé aucune allusion dans la littérature à une quelconque courbure des tibias chez *Melanostoma*. La parfaite symétrie des deux pattes postérieures semble par ailleurs écarter la possibilité d'une malformation accidentelle. La pilosité du front constitue un deuxième élément en faveur du bien-fondé du nouveau taxon: tous les spécimens ♀♀ de *M. annulipes* étudiés présentent un front garni de cils brun clair. Enfin, il faut souligner que la longueur de *M. incurvum* est de 5,2 mm, alors que la dimension moyenne relevée sur une série de 20 ♀♀ de *M. annulipes* est de 6,24 ± 0,194 mm (α= 0,05) (min 5,31 mm - max 7,32 mm). De façon similaire, la largeur de la tête n'est que de 1,76 mm contre une moyenne (n= 20) de 1,90 mm (1,74 - 2,05 mm) chez *M. annulipes*. La nouvelle espèce est donc vraisemblablement plus petite que sa congénère.

DESCRIPTION

Tête: front noir brillant à reflets bleutés, avec deux grandes taches triangulaires de pruinosité grise au milieu du front. Ces taches laissent environ 1/6 de la largeur du front libre au centre. Pilosité brun noir sur le front, plus claire vers l'espace sus-antennaire. Vertex noir brillant à reflets bleutés sans aucune indication de pruinosité, à pilosité brune. Face noire comme le front mais couverte de pruinosité grise laissant libre seulement le calus facial et la partie supérieure de l'épistome. La face est presque entièrement plate, le calus facial étant à peine marqué. Occiput noir à pruinosité gris blanchâtre, dense, munie d'une rangée de cils clairs devenant bruns vers la partie supérieure. Antennes: 1er et 2ème articles jaune orange, le troisième article jaune avec le bord supérieur brun foncé sur environ 1/3 de la hauteur, ainsi que l'extrémité brunie. Arista jaune clair, brunie vers l'apex et pratiquement nue.

Thorax: mesonotum noir, luisant, couvert de pilosité brun clair, les bords latéraux munis d'une légère pruinosité grise. Le calus huméral est noir, légèrement saupoudré de pruinosité grise; calus postalaire teinté de brun rougeâtre. Pleures noires couvertes de pruinosité grise, dense, et à pilosité jaune, plus longue que sur le mesonotum. Scutellum noir brillant comme le mesonotum, à pilosité brun clair.

Aile: vitreuse, à peine teintée de brun sur sa surface, couverte de microtriches sauf à la base de la première et de la deuxième cellule basale. Haltère et cuilleron jaune clair.

Pattes: hanches postérieures noires. La totalité de p1 et p2 jaune à pilosité concolore partout. Les derniers tarsomères de p1 et de p2 sont légèrement brunis. A la patte postérieure, f3 est jaune avec un anneau subapical brun foncé, laissant libre le genou qui est jaune tandis que t3 est fortement courbé, jaune avec un anneau brun median à extrémités plus ou moins vagues. Enfin, ta3 jaune, les trois derniers tarsomères fortement brunis (fig. 17). Pilosité de p3 jaune, mélangée de poils noirs sur f3 et t3 concentrés sur les parties foncées.

Abdomen (fig. 10): T1 noir brillant, T2-T6 brun foncé faiblement luisants ornés de dessins jaunes. T2 avec deux macules arrondies situées juste au-delà de la moitié du tergite, et écartées de la marge latérale. T3 est orné de taches plus ou moins rectangulaires, laissant libre en elles environ 1/3 de la largeur et occupant les 2/3 de la longueur du tergite. Ces taches sont contigües au bord antérieur et s'étranglent fortement vers l'arrière. T4 avec deux macules similaires n'atteignant que la mi-longueur. T5 porte deux taches claires transversales, étroitement séparées au milieu et couvrant près de la moitié du tergite. Sur T6, enfin, le dessin jaune se limite à un modeste liseré bordant la marge antérieure. Les taches jaunes de T3-T5 débordent la marge latérale. Pilosité de l'abdomen courte, blanche à jaune clair, dressée sur les parties claires, et noire, couchée partout ailleurs. Ventre noir avec les dessins clairs des tergites visibles en dessous.

L: ♀ 6,3 mm; L_{aile}: ♀ 5,2 mm.

RÉPARTITION

Connue seulement par le type.

DERIVATIO NOMINIS

Allusion à la courbure du tibia postérieur.

Melanostoma keiseri sp. n. ♀ Fig. 11

MATÉRIEL EXAMINÉ

Holotype: ♀, Madagascar Centre: Vohiparara, 12.IX.1958 (*F. Keiser*). Paratypes: Ambalamanakana, 18.I.1958, 1♀; Manjakatompo, 23.IV.1958, 1♀ (*F. Keiser*). La série type est déposée au NHMB.

DIAGNOSE

Espèce à pattes entièrement jaune-orange et à grandes taches rectangulaires sur T3 et T4, isolées de la marge. Elle se distingue des autres *Melanostoma* afrotropicales par le dessin de T5 qui est jaune à l'exception d'une étroite marge postérieure noire. L'abdomen rappelle celui de *M. satyriphilum* mais les macules sont en général plus claires et à contours plus nets. La longueur de l'aile est aussi inférieure à celle de cette espèce (voir table 2).

DESCRIPTION

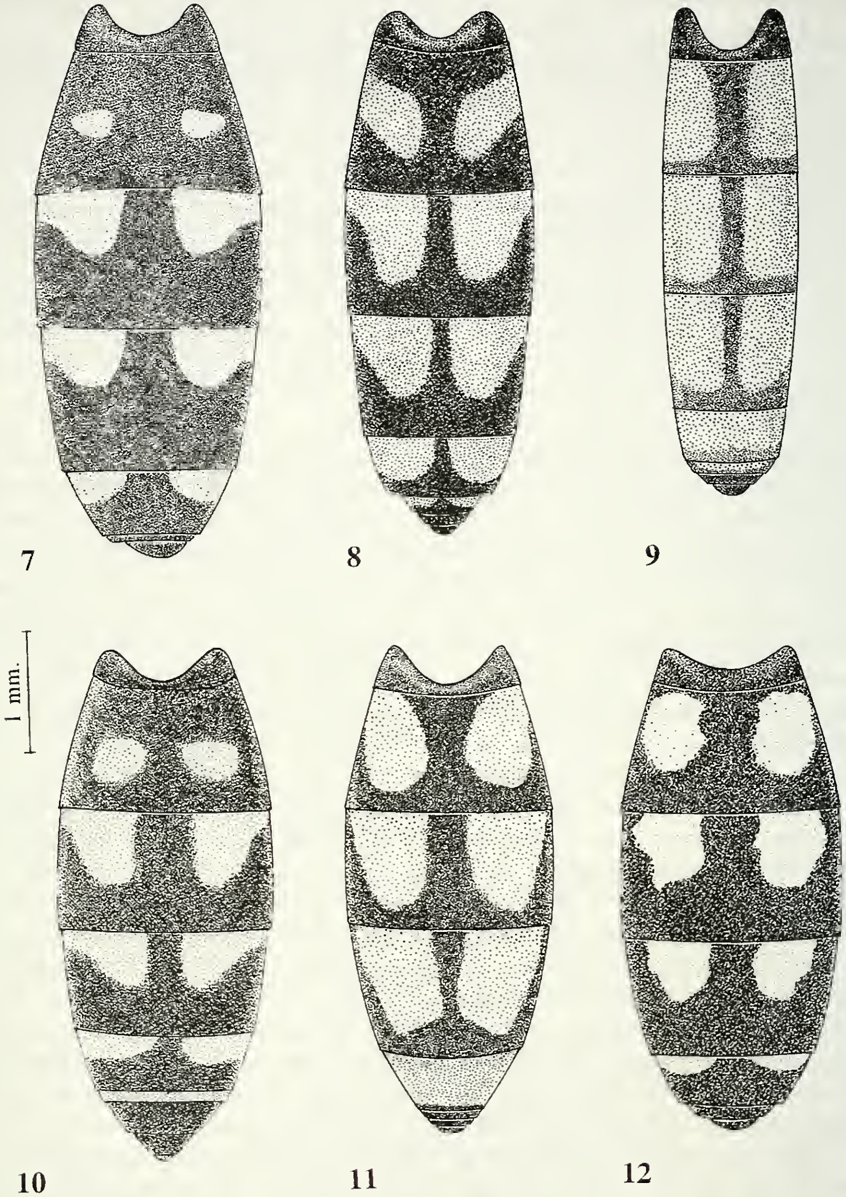
Tête: front noir luisant avec deux petites taches triangulaires de pruinosité grisâtre situées le long de la marge oculaire, à 1/3 de la hauteur. Chez un spécimen ces taches sont plus importantes et couvrent près des 2/3 de la largeur du front. Pilosité du front noire. Vertex noir, le triangle ocellaire couvert d'une pruinosité brune très légère; pilosité noire, devenant brune vers l'occiput. Face noire, avec une pruinosité grise, à reflets jaunâtres, plus dense le long des yeux et laissant libre le calus facial ainsi que le bord de l'épistome. Antenne: premier et deuxième articles jaune orange; troisième article jaune orange, noirci dans le tiers supérieur et la partie apicale. Arista brune, étroitement plus claire à sa base, nettement pubescente (x32). La pilosité de la face est blanche, nettement plus courte que celle du front.

Thorax: noir brillant avec des reflets verdâtres, à pilosité brune assez courte, plus longue vers l'arrière. Scutellum comme le mesonotum, à pilosité brune plus longue. Pas de soies différenciées au bord du scutellum. Ce dernier est marqué par quelques rides transversales irrégulières. Pleures noires, couvertes de pruinosité grisâtre assez dense. Pilosité claire, pas très longue. Calus postalaire noir brillant.

Aile: vitreuse, légèrement rembrunie, à nervures brunes. Aile entièrement recouverte de microtriches, y compris les cellules basales et l'alula. Le stigma peu marqué, brun très clair. Cuilleron blanc, petit; haltère jaune.

Pattes: toutes les pattes jaunes, légèrement orangées, sauf les hanches qui sont noires. Les derniers articles des tarses légèrement brunis, un peu plus fortement aux pattes postérieures. Pilosité des pattes blanche à jaune clair; sur p3 des cils noirs sont mélangés à la pilosité claire à l'extrémité de f3, sur t3 et le tarse.

Abdomen (fig. 11): premier tergite noir, avec une pruinosité peu dense sur les bords latéraux antérieurs. T2-T4 noirs, faiblement luisants, à dessin jaune orange à contours généralement nets. Ce dessin est constitué de taches rectangulaires allongées à bord postérieur arrondi qui occupent environ 4/5 de la longueur. Elles sont largement séparées au milieu. Les macules de T2 passent étroitement sur la marge à leur extrémité antérieure, tandis que celles de T3 et T4 sont éloignées des bords extérieurs. T5 est entièrement jaune orange, à l'exception d'un étroit liseré postérieur noir. Chez l'exemplaire de Manjakatompo, les taches de l'abdomen ne sont pas délimitées



Figs 7-12

Abdomen de *Melanostoma* spp. ♀♀: 7. *annulipes*; 8. *bituberculatum*; 9. *diffusum* (paratype); 10. *incurvum* (holotype); 11. *keiseri* (holotype); 12. *matilei* (holotype).

nettement mais présentent des bords diffus. Pilosité de l'abdomen en majorité noire, couchée, sauf sur les parties basales des taches claires où elle est blanche, dressée. Sur T5, la pilosité est partout noire, couchée. Ventre orange uni, à pilosité blanche semi-dressée.

L: ♀ 6,4 - 6,9 mm; L_{aile} : ♀ 5,0 - 6,2 mm.

RÉPARTITION

Connue seulement de trois localités de Madagascar Centre.

DERIVATIO NOMINIS

Espèce dédiée à la mémoire de F. Keiser qui a apporté une contribution majeure à la connaissance des Syrphides de Madagascar.

Melanostoma matilei sp. n. ♀ Fig. 12

MATÉRIEL EXAMINÉ

Holotype: ♀ Grande Comore, Kartala, Convalescence, 1680 m, 20-21.XI.1973 (*L. Matile*). Paratype: Grande Comore, Kartala, Convalescence, 1640-1680 m, 21.XI.1973, 1♀ (*L. Matile*), déposés au MNHN.

DIAGNOSE

Espèce faisant partie des formes à antennes complètement noires, au nombre de quatre sur le continent africain. Elle se distingue nettement de ces dernières, qui ont toutes les pattes et/ou l'abdomen noir, par les dessins jaunes des tergites et des fémurs. Abdomen à taches claires plus ou moins arrondies, isolées sur T2, contiguës à la marge postérieure sur T3-T4.

DESCRIPTION

Tête: front noir brillant à pilosité brune. Deux petites taches pruineuses, grises, latérales et situées au milieu du front, macules qui sont prolongées le long des marges oculaires et atteignent la face. Face noire ternie par une pruinosité assez dense sur les côtés, plus éparse autour du calus facial qui est noir brillant ainsi que le bord de l'épistome. Antennes brunes, le troisième article noirâtre, relativement peu allongé. Arista brun foncé, faiblement pubescente (x80).

Thorax: humerus noir à pruinosité grise. Mesonotum noir moyennement luisant avec deux bandes transversales pruineuses, plus ternes, l'une sur l'avant et l'autre occupant le 1/4 arrière. Pilosité brune avec quelques cils noirs. Scutellum comme le mesonotum, garni de quelques macrochètes sur la marge postérieure. Pleures complètement noires à faible pruinosité grise sur tous les sclérites; pilosité brun clair. Calus post-alaire noir à villosité brun clair.

Aile: translucide, non rembrunie, à nervures brunes. La couverture en microtriches est complète, mais à la base de la deuxième cellule basale elle est clairsemée. Haltère jaune clair, cuilleron blanc jaunâtre à longue frange blanche.

Pattes: p1 et p2 en majeure partie jaunes sauf les hanches qui sont noirâtres. Le milieu de t1 et t2 porte un anneau sombre, pas très large et faiblement marqué. Les derniers tarsomères de ta1 et, dans une moindre mesure, de ta2 sont légèrement brunis. La pilosité de p1 et p2 est jaune mêlée de cils noirs, plus nombreux sur la face dorsale. La base de f3 jaune sur 1/8-1/6 de la longueur pour devenir brun au-delà, nuancé de rougeâtre; t3 noir à l'exception du tiers basal qui est jaune, tout comme le genou. Le dessus de ta3 est entièrement noir, garni de cils concolores tandis que le dessous est de couleur ocre à pilosité jaune avec des reflets dorés. La hanche de p3 noire.

Abdomen (fig. 12): T1 brun, peu luisant. T2-T4 bruns, semi-mats, ornés de larges taches jaune ocre, accolées à la marge antérieure et occupant près de 2/3 de la longueur des tergites. Ces macules sont écartées des bords latéraux et laissent libre entre elles un espace égal à environ 1/4 de la largeur de l'abdomen. T5 brun-noir avec deux taches jaunes transversales atteignant presque la moitié de la longueur et passant la marge. Extrémité de l'abdomen brune. La pilosité de l'abdomen se compose de cils jaunes dressés assez longs sur T2 et se prolonge au delà par une couverture mêlée de poils clairs et noirs, couchés. Ventre orange à villosité semi-érigée, blanche mélangée de poils noirs.

L: ♀ 6,8; 6,9 mm; L_{aile}: ♀ 6,60; 6,77 mm.

RÉPARTITION

Connu seulement de l'île de la Grande Comore.

DERIVATIO NOMINIS

Espèce dédiée à la mémoire de Loïc Matile, récemment disparu.

Melanostoma ochraceum sp. n. ♂ Figs 4, 18, 23, 29

MATÉRIEL EXAMINÉ

Holotype: ♂, Madagascar Est, Perinet, 08.X.1958 (*F. Keiser*), déposé au NHMB.

DIAGNOSE

Espèce voisine de *M. diffusum* dont elle se différencie par l'abdomen entièrement jaune-orange et par le dessin de f3 qui porte un large anneau noir dans sa partie centrale. La pilosité de l'hypopyge, noire chez *M. diffusum* est brun clair chez *M. ochraceum.*

DESCRIPTION

Tête: front noir, couvert de pruinosité grisâtre au sommet, à l'angle des yeux et plus ou moins étroitement le long des bords oculaires. Pilosité brune. Face noire luisante, couverte de pruinosité grise sauf sur le calus facial et étroitement sur le bord de l'épistome. Face garnie d'une pilosité éparse, dressée, blanchâtre. Triangle ocellaire noir couvert de pruinosité grise avec une pilosité brune, dirigée vers l'avant. Antennes: 1er article brun foncé, 2ème article brun clair, le troisième article jaune orange, bruni sur la moitié supérieure et sur la moitié apicale où il est noirâtre. Ariste brun foncé avec une pubescence assez courte, visible seulement à fort grossissement (x80).

Thorax: mesonotum noir brillant à reflets métalliques, y compris l'humerus et le calus post-alaire. Pilosité brun clair composée de poils assez courts mélangés de cils plus longs. Pleures noirs comme le mesonotum, couverts d'une pruinosité grisâtre peu dense. Pilosité des pleures assez courte, brun clair. Scutellum comme le thorax, muni à sa marge postérieure de 2 ou 3 paires de soies plus longues, claires.

Aile: hyaline, teintée de brun clair et entiérement couverte de microtriches, à l'exception d'un petit espace à la base de la 2ème cellule basale. Stigma trés peu marqué, à peine plus sombre que la teinte générale de l'aile. Haltère jaune orange et cuilleron jaune blanchâtre.

Pattes: hanches médianes et postérieures brun foncé, légèrement luisantes, p1 et p2 entièrement jaunes à pilosité jaune clair. Pattes postérieures jaunes, f3 et t3 munis d'un large anneau brun foncé en leur milieu (fig. 18). Pilosité de f3 en majeure partie jaune blanchâtre, noire vers l'apex, celle de t3 et ta3 composée de cils plus courts, couchés, noirâtres.

Abdomen (fig. 4): T1 noir à reflets cuivrés. T2 à T4 jaune orange bordés etroitement de brun foncé le long du bord postérieur de T2 et T3. T5 entièrement jaune orange. Les marges latérales des tergites 2, 3 et 4 sont très étroitement bordées de brun. Pilosité de l'abdomen blanche, dressée sur T2 et T3, où elle est plus courte, et T4 où elle atteint environ la moitié de la longueur du tergite. Tous ces tergites portent également des poils noirs, courts, couchés qui occupent une bande centrale égale à environ la moitié de la largeur sur T2 et qui s'élargissent fortement sur T3 et T4 pour couvrir tout l'apex de T4. Hypopyge brun foncé, brillant, couvert d'une pilosité brun clair. Ventre entièrement jaune orange à pilosité blanche, dressée, longue sur T2 et T3, beaucoup plus courte et couchée sur T4.

L: ♂ 7,0 mm; L_{aile}: ♂ 5,6 mm.

RÉPARTITION

Connue seulement de la localité type.

DERIVATIO NOMINIS

Allusion à la teinte dominante de l'abdomen.

Melanostoma perinetense sp. n. ♀ Fig. 13

MATÉRIEL EXAMINÉ

Holotype: ♀, Madagascar Est, Perinet, 29.IX.1958 (*F. Keiser*). Paratypes: Perinet, même données que l'holotype, 1♀; Madagascar Centre, Manjakatompo, 04.I.1958, 1♀; Madagascar Nord, Montagne d'Ambre, 21.V.1958, 1♀ (*F. Keiser*). Tous ces insectes sont déposés au NHMB.

DIAGNOSE

Front sans traces de pruinosité. Abdomen presque complètement noir; T2 brun-noir sans taches, T3 et T4 avec des macules rougeâtres peu visibles et à bords flous. Caractérisé par l'alule très étroite: rapport longueur/largeur >3,5. L'aspect mélanisant de l'abdomen rappelle celui de *M. alticola* Speiser, 1910 mais tous les autres caractères, tant structurels que chromatiques, indiquent qu'il s'agit d'un taxon bien distinct.

DESCRIPTION

Tête: front noir brillant à reflets bleutés, couvert de villosité brun foncé sur le triangle ocellaire et la partie supérieure, plus claire vers l'avant. Le front est entièrement dépourvu de pruinosité. Face noire saupoudrée d'un givré gris-blanc léger au milieu mais dense le long des marges oculaires où il peut remonter jusqu'au niveau de la lunule. Calus facial bien développé, étiré transversalement, noir brillant. Pilosité de la face blanche, clairsemée. Gènes noirs couverts d'un faible satiné blanc. Antennes jaunes, troisième article avec le dessin noir habituel qui, chez cette espèce, occupe la moitié supérieure et plus de la moitié apicale. Arista pubescente, la longueur des cils égale au diamètre du flagelle.

Thorax: mesonotum noir brillant avec une bande tranversale présuturale faiblement pruineuse; une bande similaire peut s'observer aussi sur le tiers postérieur ainsi qu'à la base du scutellum. Pilosité brun clair. Scutellum comme le mesonotum, portant deux macrochètes sur la marge postérieure. Calus postalaire brun-roux à longue pilosité claire. Les pleures sont noirs, la pruinosité recouvrant les sclérites étant très fine et éparse.

Aile: légèrement rembrunie, couverte de microtriches sauf sur le 1/3 basal de la deuxième cellule basale et le 1/4 basal de la cellule anale. Alule caractéristique par sa forme allongée, rectangulaire et très étroite. Le rapport longueur/largeur est supérieur à 3,5 chez tous les spécimens étudiés (de 3,7x à 4,2x). Haltère orange, le capitule légèrement assombri. Cuilleron blanc sale à courte frange concolore.

Pattes: hanches de p1 et de p2 jaunâtres, parfois avec quelques reflets noirs, ainsi que les trochanters de p1-p3. Les f1 et f2 jaune-ocre à pilosité concolore; f3 jaune à la base, surtout sur la face supérieure, brun noir partout sur la partie distale. Tibias de p1 et p2 jaunes à anneau noir bien délimité, situé au milieu et couvrant 1/6-1/5 de la longueur; t3 brun, nuancé ou non de rouge, noir à son extrémité apicale. Les premiers articles de ta1 et ta2 sont jaune-ocre mais les tarsomères apicaux brunis, tout comme ta3 qui est brun fonçé à noir sur toute la longueur. Pilosité des pattes en majeure partie jaune ou brunâtre mélangée cependant de cils noirs, en particulier sur les tibias et les tarses.

Abdomen (fig. 13): T1 noir brillant comme le mesonotum; T2-T6 brun-noir mats à légèrement lustrés, offrant un contraste frappant avec le thorax. En vue rasante, l'abdomen paraît voilé de blanc. Les tergites T3-T5 portent, en général, de vagues indications de plages rougeâtres aux contours flous et sans forme reconnaissable. A faible agrandissement, ces ébauches de dessins s'estompent et l'abdomen semble être tout noir. La pilosité de T2 se compose de longueus soies jaunes érigées sur les côtés et le long de la marge latérale et de cils noirs, courts, couchés, au centre. Sur T3-T6, la villosité comporte un mélange de cils clairs et noirs, tous courts et en majorité couchés. Le ventre est orange avec des taches ou des marbrures noires sur un ou plusieurs sternites.

L: ♀ 5,8 - 7,2 mm; L_{aile}: ♀ 5,39 - 6,33 mm.

VARIABILITÉ

La série type ne comprend que 4 spécimens, ce qui ne permet pas d'apprécier toute l'étendue de l'intervalle de variation de l'espèce. L'examen attentif des exemplaires disponibles suggère cependant les remarques suivantes:

(1) Tête: la teinte brun foncé de la pilosité du front n'est pas toujours limitée au vertex et au triangle ocellaire mais peut atteindre, vers l'avant, l'espace sus-antennaire.

(2) Aile: chez deux spécimens, la cellule anale est entièrement couverte de microtriches.

(3) Pattes: l'intensité et le contraste de la coloration varient: les anneaux foncés sur t1 et t2 peuvent s'effacer et devenir peu visibles tandis que la teinte de p3 se situe entre le brun et le noir.

RÉPARTITION

A l'heure actuelle, connue seulement de trois localités situées à Madagascar Est, Centre et Nord.

DERIVATIO NOMINIS

Référence à la localité d'où provient l'holotype.

Melanostoma satyriphilum Hull, 1941 Figs 5, 14, 24, 30

MATÉRIEL EXAMINÉ

Madagascar Est: holotype ♂ n° 6576, Oriental Forest, Fanovana Distr., I-V.1937 (*C. Lamberton*) (ANSP); Perinet, 06-12.V.1968 (*K.M. Guichard*), 2♂♂ (BMNH); ibid. 24 & 29.IX.1958, 2♂♂; 02.X.1958, 1♂; 24.X.1957, 1♀; Ranomafana, 26.VII.1958, 1♂ (*F. Keiser*) (NHMB); Distr. Sambava, RN 12, Marojejy, col central 1700m (*P. Soga*), 1♀ (NHMB); Fenerive, 05-10.VIII.1975 (*A.M. Coyle*), 1♀ (BMNH); Rogež, forêt Analandranaka, VI.1937 (*A. Seyrig*), 5♂♂ (MRAC).

Madagascar Centre: Manjakatompo, 04.I.1958, 9♂♂, 8♀♀; 23.IV.1958, 1♂, 4♀♀; Ambalamanakana, 18-19.I.1958, 1♂, 3♀♀; La Mandraka, 04.IV.1958, 1♂, 2♀♀; 04.VI.1958, 1♂; Manankazo, 07.VI.1958, 1♂; Antsirabe, 13.I.1958, 1♂; Vohiparara, 12.IX.1958, 1♀; Ambohitantely, 11.VI.1958, 1♀ (*F. Keiser*); Andranotobaka, 1400m, Ambatolampy, III-IV.1957 (*P. Griveaud*), 1♂, 1♀ (NHMB); La Mandraka, II.1954 (*A. Seyrig*) (MRAC).

Madagascar Nord: Montagne d'Ambre, 26.V.1958, 1♂, 1♀; Joffreville, 10.V.1958 (*F. Keiser*), 1♀ ; Montagne d'Ambre, Les Roussettes, 1100m, II.1959 (*P. Soga*), 1♂ (NHMB).

Grande Comore: XI.1954 (*J. Millot*), 1♀ (NHMB); La Grille (Guiri), 850-900m, 16.XI.1973; 10.I.1974 (*L. Matile*), 2♀♀ (MNHN).

MÂLE

Tête: front garni de pruinosité grise, à reflets cuivrés dans sa moitié supérieure. Cette pruinosité se prolonge étroitement le long de la marge oculaire et rejoint celle de la face. Pilosité du front brun foncé à noire. Triangle ocellaire noir couvert de pruinosité grisâtre et portant une pilosité noire. Pilosité de la face assez courte, éparse, brun clair. Arista nettement pubescente, brun foncée et épaissie dans la moitié basale où elle est plus claire.

Thorax: pilosité du mesonotum brun clair, composé de deux types de poils: des cils longs, dressés, mélangés de poils de moitié de leur longueur, semi-couchés. Scutellum noir, à reflets brunâtres et plus ou moins translucide chez les individus immatures. Humerus et calus post-alaire teintés de brun, parfois jaunâtres, translucides. Pilosité du scutellum plus longue que celle du mesonotum, brun clair, avec 4 à 6 longues soies le long de la marge postérieure. Pleures à reflets légèrement brunâtres, surtout à leur partie supérieure et à pilosité brun clair, pas très longue.

Aile: translucide, brunie uniformément, en général couverte partout de microtriches. Haltère jaune orange et cuilleron jaune clair à longue frange dorée.

Pattes: hanches toutes jaunes, celles de p1 parfois brunies et celles de p3 souvent à reflets métalliques sur la face antérieure. La totalité de p1 et de p2 jaune orange, y compris les trochanters à l'exception d'une faible indication brunâtre occupant le tiers central des tibias. Les derniers articles de ta1 légèrement brunis. Pilosité de p1 et p2 jaune partout à l'exception de quelques soies noires très courtes sur les tarses. Pattes postérieures jaunes, f3 légèrement bruni dans sa moitié apicale ainsi que t3 qui porte un anneau couvrant les 2/3 apicaux mais laisse l'apex étroitement jaune. Tous les tarsomères de p3 sont brunis sur toute leur longueur. La pilosité de p3 est dans l'ensemble jaune, mélangée de quelques poils noirs.

Abdomen (fig. 5): T1 brun noir tout comme T2 qui est sans taches claires. T3 de la même couleur de fond mais portant deux macules le long du bord antérieur qui occupent moins de la moitié de la longueur et n'atteignent qu'étroitement les marges latérales. Les contours de ces taches sont flous. T4 comme le précédent mais les taches sont délimitées plus nettement et elles bordent la marge latérale sur plus de la moitié de leur longueur. T5 et l'hypopyge brun noir, ce dernier à pilosité noire. Pilosité de T2 dressée, jaune brun, longue sur les côtés. Sur T3 et T4, la pilosité claire est limitée aux taches claires, le reste étant couvert de poils noirs couchés. T2-T4 mats à faiblement luisants, à l'exception des marges latérales fortement brillantes, à reflets métalliques. Ventre en général noir mais chez certains exemplaires les dessins clairs des tergites se reproduisent sur les sternites. Pilosité blanchâtre éparse, longue, dressée sur le sternite 2, plus courte, couchée et noire sur les sternites 3 et 4.

FEMELLE

Tête: les deux taches de pruinosité grise du front occupent 1/3 de la hauteur et sont séparées en leur milieu par une étroite bande brillante noire. Pilosité du front brunâtre. Le calus facial est légèrement allongé transversalement. Bord de l'épistome étroitement noir brillant. Pilosité de la face blanche, fine, dressée et assez éparse. Arista pubescente, brun foncé avec la base épaissie, brun clair.

Thorax, aile et pattes: comme chez le ♂.

Abdomen (fig. 14): T1 noir avec des reflets brun orange vers les bords latéraux antérieurs. T2 noir avec une paire de taches brun orange obscurs à bords très diffus. Ces taches passent sur la marge aux coins antérieurs. T3 et T4 munis de macules jaune orange, plus claires que celles de T2, à bords en général plus nets. T5 est orné de deux taches jaune orange allongées, transversales, séparées au milieu mais atteignant les bords du tergite. Pilosité de l'abdomen claire, dressée sur les taches claires, noire, couchée ailleurs; la pilosité claire est limitée au tiers ou à la moitié basale des macules des tergites 3 et 4. Ventre jaune, les sternites 2 et 3 noircis. Pilosité du ventre blanchâtre sur les sternites 2 et 3, noire couchée sur la partie postérieure.

L: ♂ 6,1 - 8,1 mm; ♀ 5,9 - 7,8 mm; L_{aile}: ♂ 6,08 - 7,53 mm; ♀ 6,15 - 8,11 mm.

VARIABILITÉ

L'examen d'une série relativement importante de spécimens a permis de mettre en évidence les principaux caractères qui sont sujet à variation. Les plus importants sont énumérés ci-dessous. On trouvera aussi une analyse comparative de quelques paramètres morphométriques du complexe *M. satyriphilum/sylvarum* dans la suite de cette note.

(1) Tête: chez la ♀, les taches de pruinosité grise du front ont un développement plus ou moins important: en général elles sont grandes, triangulaires avec la pointe dirigée vers le centre, laissant libre une étroite bande brillante. Cependant, chez plusieurs exemplaires les taches se touchent pratiquement et leur dessin devient trapézoïdal. Une réduction des taches s'observe également mais semble plus rare. Chez les deux sexes, le troisième article antennaire est allongé, la longueur (face intérieure) en général plus de 1,3x la largeur (voir *M. sylvarum*).

(2) Pattes: le dessin de p1 et p2 est variable: la plupart des spécimens examinés n'ont pas d'anneaux plus foncés sur t1 et t2, tandis que d'autres peuvent montrer un développement bien marqué de ces anneaux. Sur p3, les tibias et les tarses sont nettement foncés, principalement à la partie supérieure. Il peut parfois être délicat d'apprécier la teinte des hanches, en particulier chez les exemplaires pas encore complètement colorés: les reflets métalliques sur la face antérieure paraissent alors noirâtres.

(3) Abdomen: il arrive que les taches claires de T2 soient évanescentes ou fassent exceptionnellement défaut chez la ♀. Les dessins jaune orange de T3 et T4 occupent en général environ la moitié de la longueur mais ils peuvent couvrir près de 3/4 des tergites. Les macules sur T3 peuvent être évanescentes chez le ♂. Chez certains individus le ventre est entièrement jaune.

RÉPARTITION

Connu seulement de Madagascar et des Comores. Toutes les localités connues jusqu'à présent figurent sous "matériel examiné".

Melanostoma sylvarum Hull, 1941 Figs 6, 15, 19, 25, 31

MATÉRIEL EXAMINÉ

Madagascar Est: Oriental Forest, Fanovava Distr., I-V.1937 (*C. Lamberton*) 11♂♂, 12♀♀ (tous paratypes) (ANSP); Perinet, 500m, 06-12.V.1968 (*K.M. Guichard*), 3♀♀; 12.X.1970 (coll. *P. Hammond*), 2♀♀ (BMNH); ibid., 23-24.X.1957, 7♂♂, 1♀; 01.XII.1957, 1♂, 2♀♀; 08-12.IV.1958, 5♀♀; 20-30.IX.1958, 2♂♂, 5♀♀; Moramanga, 09.X.1958, 1♂; Ranomafana, 26-27.VII.1958, 4♂♂, 9♀♀; Ifanadiana, 22.VIII.1958, 1♂, 1♀ (*F. Keiser*); Distr. Sambava, RN 12, Marojejy ouest, 1600 m (*P. Soga*), 1♀ (NHMB).

Madagascar Centre: Manjakatompo, XII.1951 (*Benoist*), 2♂♂ (MRAC); ibid., 02-04.I.1958, 39♂♂, 23♀♀; 23.IV.1958, 4♂♂; 9♀♀; Tananarive, 07-15.VII.1958, 7♂♂, 9♀♀; 06.IX.1958, 1♂; 15-19.X.1958, 2♂♂; Manankazo, 07.VI.1958, 1♂, 1♀; La Mandraka, 04.IV.1958, 3♂♂,12♀♀; Ambalamanakana, 18.I.1958, 4♂♂, 2♀♀; Belazoa, 13.1958, 1♂; Ivato,17.I.1958, 2♂♂, 1♀; Vohiparara, 12-13.IX.1958, 4♂♂, 4♀♀; Ampefy, chute de la Lily, 29.III.1958, 1♂; Ambohitantely, 09-11.VI.1958, 1♂, 4♀♀; Ambohimanga, 21.IV.1958, 1♀; Antsirabe, 13.I.1958, 1♀ (*F. Keiser*); Ankazomivady, 1640 m, Ambositra, 25.VII.1957, 1♂, 3♀♀; Andronotobaka, 1400 m, Ambatolampy, IV.1957, 2♀♀ (*P. Griveaud*) (NHMB); Andringitra sud, Andrianony, cirque Manrarivolo, 26.X-03.XI.1970 (*Mission CNRS*), 3♂♂, 1♀; Imerina, forêt d'Andrangoloaka, 1897 (*A. Grandidier*), 1♂; route d'Andriamena, forêt d'Andranobe, 1250 m (*A. Peyrieras*), 1♀; Mont Tsaratanana, forêt de mousses, 1500 m, X.1949 (*R. Paulian*), 1♀ (MNHN).

Madagascar Nord: Analamerana, 80 m, I.1959 (*R. Andria*), 1♂, 1♀ (NHMB).

MÂLE

Tête: front garni d'une une faible pruinosité dans l'angle supérieur et le long des marges oculaires. Sa pilosité est brun foncé, tout comme celle du triangle ocellaire où elle est clairsemée. Pruinosité de la face peu dense le long des yeux, sur la dépression sous-antennaire et au-dessus de l'épistome. Pilosité de la face blanchâtre, plutôt courte et peu dense. Arista brune, épaissie dans sa moitié basale où elle est très faiblement ciliée, les cils atteignant à peine le diamètre de l'arista. Vus sous certains angles d'éclairage, le front et la face ont des reflets métalliques.

Thorax: mesonotum à pilosité brun clair virant au roux sur les côtés. Pleures avec une légère pruinosité grisâtre par endroits, couverts d'une pilosité brun clair pas très dense. Scutellum comme le mesonotum mais la pilosité est plus claire.

Aile: légèrement rembrunie sur toute sa surface, à nervures brun foncé, couverte de microtriches sauf à la base de la deuxième cellule basale et de la cellule anale. Le stigma n'est pas marqué.

Pattes: toutes les hanches noires, les trochanters brun clair. La moitié basale de f1 et f2 noire. Au-delà ils sont jaune orange ainsi qu'à la base. Les t1 et t2, jaune orange, portent un étroit anneau brun foncé au milieu ou juste au-delà. Les tarses sont jaunes, plus ou moins brunis sur les derniers tarsomères. La base de f3 est jaune orange sur environ 1/6 de la longueur ainsi qu'à l'apex, le genou étant étroitement jaune. Entre les deux extrémités claires, f3 est teinté de brun foncé ou de noir. Il en va de même de t3 dont le dessin montre une base jaune de 1/3 à 1/4 de la longueur suivie d'un large anneau presque noir, l'apex étant ètroitement jaune. Les tarsomères de p3 sont tous nettement brunis (fig. 19). Pilosité des pattes en majorité jaune, mélangée de cils noirs.

Abdomen (fig. 6): T1 noir brillant avec des reflets métalliques. T2 entièrement brun foncé avec deux taches latérales bleutées, visibles seulement en vue par l'arrière, atteignant les 3/4 de la longueur du tergite et occupant chacune environ 1/3 de la largeur. T3 et T4 brun noir faiblement luisants, garnis de deux taches latérales jaunes orange jouxtant le bord antérieur. Ces macules atteignent ou débordent les marges latérales, surtout sur T4, et occupent près de la moitié de la longueur du tergite. Hypopyge noir brillant à reflets bleutés, contrastant avec la teinte mate brun noir de T2 à T4 et à pilosité noire. L'abdomen est couvert d'une pilosité blanchâtre, assez fine, dressée, sur T2 et T3 ainsi que de cils courts, noirs sur le milieu de T2, sur T3 et T4.

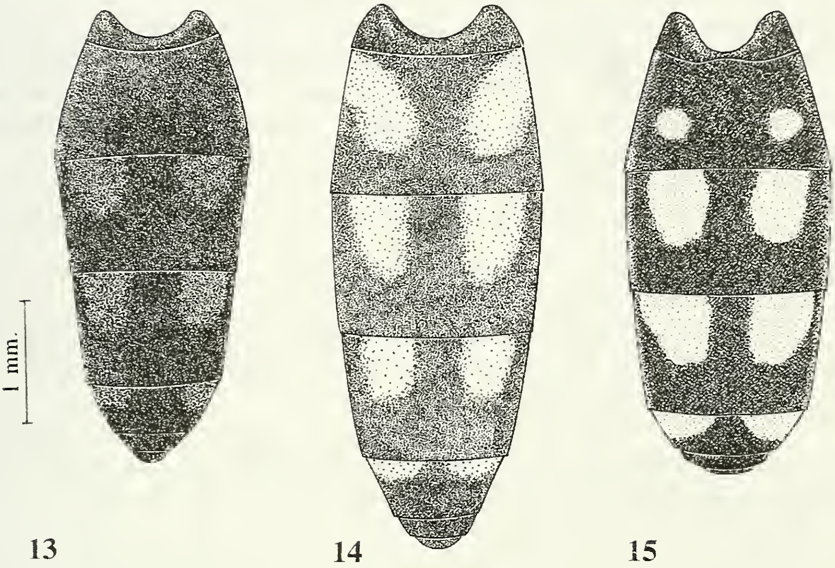
FEMELLE

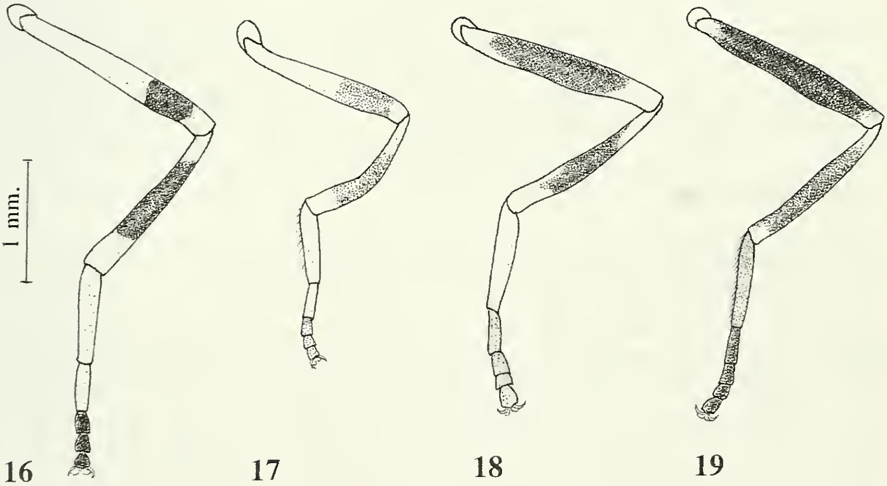
Tête: front orné de deux larges taches triangulaires de pruinosité blanchâtre, situées à mi-chemin entre la lunule et le vertex; l'espace séparant les deux pointes des triangles occupe en général moins de la moitié de la largeur du front. Pilosité du front brun foncé.

Thorax et aile: comme chez le ♂.

Pattes: p1 et p2 entièrement jaune brunâtre avec quelquefois un étroit anneau plus foncé sur les tibias, principalement sur t1. De même, ta1 et ta2 sont souvent légèrement brunis. Le quart basal de f3 est brun clair, la partie apicale devenant nettement brune ou noirâtre mais la transition est diffuse. L'ornementation de t3 est similaire à celle de f3 mais la coloration est en général plus affirmée. Les tarses de p3 sont brun foncé ou noirs.

Abdomen (fig. 15): T1 noir brillant; T2 brun noir orné de deux petites macules à contour plus ou moins circulaire, éloignées des marges latérales et situées à égale





FIGS 13-19

13-15: Abdomen de *Melanostoma* spp. ♀♀: 13. *perinetense* (holotype); 14. *satyriphilum*; 15. *sylvarum*. 16-19: Patte postérieure gauche (p3) de *Melanostoma* spp.: 16. *annulipes* ♂; 17. *incurvum* ♀ (holotype); 18. *ochraceum* ♂ (holotype); 19. *sylvarum* ♂.

distance des bords antérieur et postérieur du tergite. T3 et T4 portant chacun une tache jaune orange jouxtant le bord antérieur et atteignant le milieu des tergites. Ces taches, à contours vagues, sont en général séparées de la marge latérale mais peuvent la déborder à leur base. T5 avec deux demi-lunes jaunes le long du bord antérieur, séparées en leur milieu et passant largement sur la marge latérale. Ventre jaune marqué de noir sur la partie médiane.

L: ♂ 5,5 - 6,5mm; ♀ 5,4 - 6,5mm; L_{aile}: ♂ 4,70 - 6,03mm; ♀ 5,23 - 6,69 mm.

VARIABILITÉ

Comme chez la plupart des espèces dont une série relativement importante de spécimens a pu être étudiée, des variations ont été relevées:

(1) Tête: troisième article antennaire peu allongé, la longueur (face intérieure) pas plus de 1,2x la largeur. On comparera la forme de cet article à celle de *M. satyriphilum*.

(2) Pattes: la base claire de f3 peut se réduire à un étroit anneau ce qui fait paraître le fémur complètement noirci. Sur f1 et f2, la partie foncée peut aussi occuper près de 3/4 de la longueur. La démarcation entre les parties claires et foncées des pattes n'est jamais nette mais se fait graduellement.

(3) Abdomen: chez la ♀, les marques jaunes sur T2 peuvent être très petites ou évanescentes, à contours flous.

RÉPARTITION

Espèce apparemment endémique de Madagascar et de l'archipel des Comores. Les stations citées sous "Matériel examiné" couvrent la totalité des localités malgaches d'où le taxon est connu. Il avait été mentionné déjà de Manjakatompo par van Doesburg (1957: 104). Plus récemment, De Meyer *et al.* (1990: 568) ont signalé la présence de l'espèce sur la Grande Comore.

Melanostoma sp.

MATÉRIEL EXAMINÉ

La Réunion, Rampe de la Grande Montée, 1300m, 09.XII.1973 (*L. Matile*) 1♀; La Réunion, Cilaos, 1350m, 27.XII.1973 (*L. Matile*) 1♀ (MNHN).

Les collections du MNHN contiennent deux femelles provenant de l'île de la Réunion, dont l'habitus rappelle beaucoup *M. scalare* (Fabricius). Cette dernière espèce, connue surtout des régions paléarctique et orientale, a été citée de plusieurs pays d'Afrique tropicale (Dirickx, 1998: 78) mais elle n'est pas encore connue de la région malgache. La ressemblance constatée entre les spécimens de la Réunion et une série de *M. scalare* d'Europe centrale n'est cependant pas parfaite. Quelques différences discrètes séparent les deux échantillons étudiés.

Le dessin général de l'abdomen est semblable à deux détails près: (1) chez *M.* sp. les macules sur T2 sont plus petites que parmi la majorité des exemplaires de *M. scalare*; (2) les parties antérieures des taches jaunes sur T3 et T4 ne passent pas ou à peine sur la marge latérale de l'abdomen chez les ♀♀ de la Réunion, tandis qu'elles occupent jusqu'à 1/6 du bord des tergites chez *M. scalare*. Les taches sur T5 montrent le même dessin chez les deux formes.

Les ailes de *M.* sp. sont entièrement couvertes de microtriches. Chez *M. scalare*, près de la moitié de la deuxième cellule basale ainsi qu'une partie de la cellule anale sont normalement dépourvues de microtriches. Ce caractère est néanmoins variable et l'on rencontre des spécimens dont les cellules en question sont presque totalement couvertes de microtriches.

Les pattes sont toutes jaunes chez *M.* sp. avec un anneau assez large, faiblement bruni, au milieu de t3. Les deux derniers tarsomères de p3 sont très foncés, presque noirs. Cette conformation s'écarte quelque peu de celle que l'on peut observer chez *M. scalare*: p1 et p2 sont jaunes avec les derniers tarsomères légèrement brunis. Certains exemplaires ont un anneau central plus ou moins visible sur t3, accompagné parfois par un étroit anneau subapical sur f3 rappellant le dessin de p3 chez *M. annulipes*. Les tarses de p3 sont entièrement brunis, y compris le basitarse.

Enfin, les deux spécimens de l'île de la Réunion sont de taille inférieure à *M. scalare* d'Europe. En effet, la longueur totale n'est que de 6,5 mm et 6,6 mm alors que celle de *M. scalare* dépasse en général 7 mm.

Bien que les deux insectes étudiés soient certainement apparentés à *M. scalare*, nous hésitons à les réunir sous le même vocable spécifique. Un matériel plus abondant, et particulièrement la récolte de ♂♂, permettra sans doute de décider si les dissimilitudes constatées sont de nature intra-spécifique ou si, au contraire, il s'agit d'un taxon non encore décrit.

DISCUSSION

STATUT DE *M. GYMNOCERA* BIGOT, 1891

L'identité des *Melanostoma* signalés jusqu'à présent de Madagascar et des îles voisines ne pose pas de problèmes particuliers. La clé dichotomique proposée dans cette note, éventuellement complétée par les descriptions des taxons, devrait permettre la détermination de la plupart des exemplaires provenant de la région malgache.

Le statut d'une seule espèce est cependant incertain: la description originale de *M. gymnocera* et les quelques références ultérieures à ce taxon sont peu explicites et parfois contradictoires. Suivant en cela la pratique coutumière de son temps, Bigot (1891: 371) donna de sa nouvelle espèce une description passe-partout, sans aucun détail comparatif avec les *Melanostoma* déjà connues. Seule la ♀ de *M. gymnocera* est décrite et d'après son auteur, la série originale se composait de 3 spécimens.

Une dizaine d'années plus tard, Ricardo (1903: 369) suggéra que trois mâles capturés sur l'île de Sokotra pourraient correspondre au sexe masculin encore inconnu de l'espèce de Bigot. Elle ajoute cependant que le dessin de l'abdomen se différencie nettement de la description originale de *M. gymnocera*, T2 ayant deux macules et T3 et T4 étant presque entièrement jaunes. On notera que Ricardo mentionne à tort l'Abyssinie comme patrie du taxon alors que la série type provenait du territoire d'Assinie, en Côte d'Ivoire.

Dans le Catalogus Dipterorum, Kertesz (1910: 81) inclut *M. gymnocera* comme espèce à part entière avec la référence à Ricardo rappelée ci-dessus. Cet avis n'est pas partagé par Speiser (1910: 117) qui la met en synonymie avec *M. annulipes*, suivi peu après par Bezzi (1912: 403). Quelques années plus tard ce dernier (Bezzi, 1915: 3) révise cependant ce jugement et il considère désormais le taxon comme une "variété" de *M. annulipes*. Plus loin (loc. cit.: 21), il rapproche cette variété de *mauritianum* Bigot (1884), autre forme de *annulipes*, et y rattache 3 ♀♀ de Obuasi (Ghana).

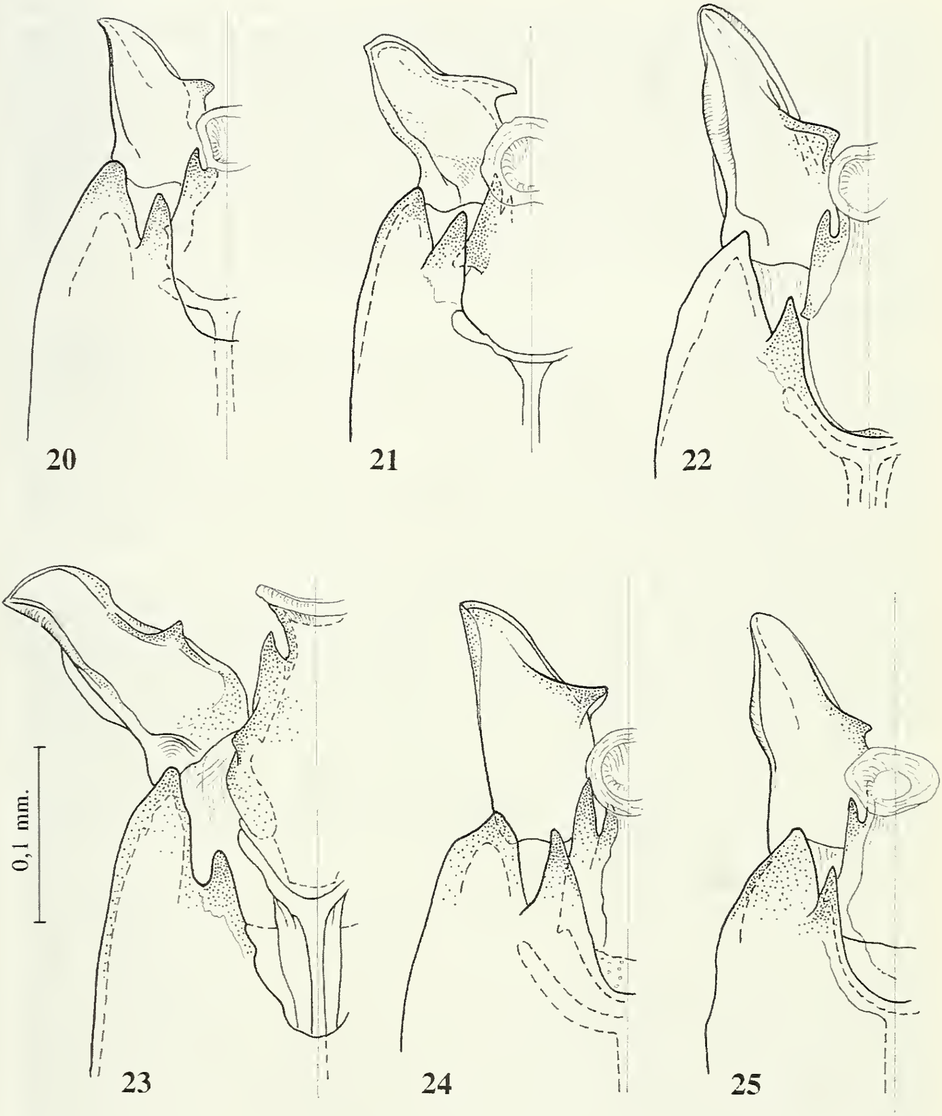
Plus tard, Curran (1938: 17) reconnaît trois exemplaires mâles de *M. gymnocera* récoltés au NE de la RDC. Il confirme que le deuxième tergite abdominal ne porte pas de taches claires et il fait un rapprochement avec l'espèce *infuscatum* qui lui ressemblerait superficiellement. On trouvera encore deux mentions de l'espèce dans les publications de Hull (1964: 443) et de De Meyer *et al.* (1990: 568) qui signalent sa présence respectivement en Afrique australe (Afrique du Sud, Zimbabwe) et dans l'archipel des Comores. Ces contributions de nature essentiellement faunistique ne comportent aucun commentaire relatif aux caractères distinctifs du taxon en question.

En reportant les citations rappelées ci-dessus sur une carte de la région afrotropicale, on constate qu'elles se rapportent à des localités disséminées dans tout le continent (Dirickx, 1998: 195, carte 35).

Les imprécisions et contradictions apparentes relevées ci-dessus nous ont incité à tenter de clarifier, si possible, le statut de *M. gymnocera*. Grâce à l'obligeance des conservateurs en charge des collections entomologiques du BMNH, du AMNH et du MZUL, nous avons été en mesure d'examiner une partie des insectes mentionnés par Bezzi (1915), Curran (1938) et Hull (1964). S'y ajoute un exemplaire ♀ déterminée par van Doesburg en 1954 comme *M. gymnocerum* [sic!] (non publié) qui se trouve dans les collections du MRAC où nous l'avons étudié. Jusqu'à présent il n'a malheureusement pas été possible de retrouver au MNHN les exemplaires cités par De Meyer *et al.* (1990).

Quelques conclusions se dégagent du rapide survol de la littérature et de l'examen des spécimens à notre disposition. En se basant sur la description de Bigot (1891: 371), *M. gymnocera* présente un facies voisin, sinon identique à l'espèce très répandue *M. annulipes* dont elle se distingue par l'absence de taches claires sur T2. Cette similitude de l'habitus et la constatation que, souvent, les macules de T2 sont très réduites ou font défaut chez *M. annulipes*, a vraisemblablement conduit Bezzi (1915: 3) a accorder à l'espèce de Bigot le statut de "variété" de cette dernière. Parmi les auteurs ayant reconnu le présence de *M. gymnocera* dans leur matériel, seuls Bezzi et van Doesburg attribuent ce nom à des insectes correspondant à la diagnose originale. Les spécimens déterminés par Ricardo, Curran et Hull appartiennent apparemment à d'autres taxons.

Grâce à l'obligeance du Dr A. C. Pont, nous avons pu étudier la série type de *M. gymnocera* déposée au Oxford University Museum of Natural History. Elle comprend un ♂ sans tête et 2 ♀♀ étiquettés "Assinie, Afrique oc.". Les trois spécimens présentent le dessin caractéristique de *M. annulipes* sur p3. L'anneau noir de f3 est étroit chez le ♂ et le contraste des parties sombres moins marqué chez l'une des ♀♀ mais le dessin général reste typique, de même que celui de t3. Chez les 2 ♀♀, T2 est entièrement noir, tandis que chez le ♂ il est orné de deux macules jaunes.



FIGS 20-25

Genitalia ♂♂ de *Melanostoma* spp., extrémité distale de l'hypandrium (vue ventrale): 20. *annulipes*; 21. *bituberculatum*; 22. *diffusum*; 23. *ochraceum* (holotype); 24. *satyriphilum*; 25. *sylvarum*.

placées au delà du milieu. T3-T5 sont en tous points similaires au modèle de *M. annulipes*. Nous avons mesuré, sur les trois syntypes, les quelques paramètres biométriques utilisés aussi pour le couple *M. sylvarum/satyriphilum*. Comparés aux valeurs statistiques obtenues avec un échantillon de *M. annulipes* (n=20), le ♂ et les deux ♀♀ de Bigot se rangent parfaitement dans la fourchette propre à cette espèce.

L'examen des trois syntypes montre ainsi que leur traits morphologiques essentiels ne diffèrent pas de ceux de *M. annulipes*, compte tenu de la variabilité reconnue à cette dernière. Nous rétablissons par conséquent la synonymie de *M. gymnocera* avec *M. annulipes*, identité déjà suggérée par Speiser (1910: 117).

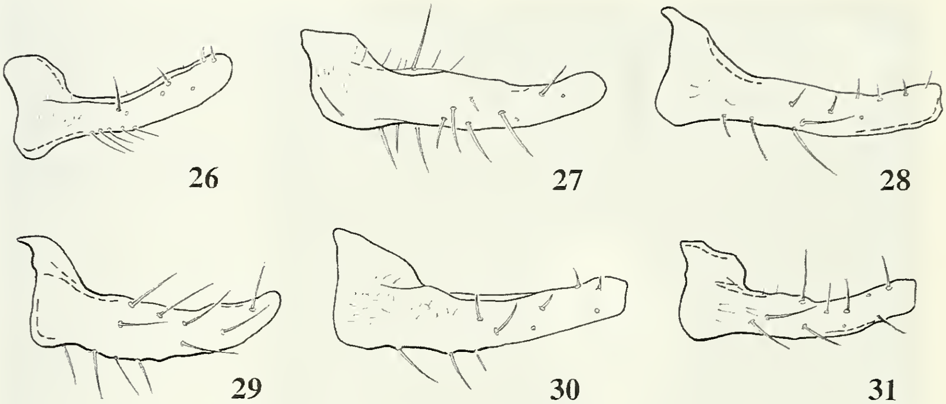
GENITALIA DES ♂♂

Les genitalia mâles de *Melanostoma* sont remarquablement homogènes à travers l'aire de repartition du genre. Ceux des deux espèces européennes examinées (*M. mellinum* et *M. scalare*) sont, à quelques détails près, tout à fait semblables aux structures arborées par les taxons malgaches et probablement afrotropicaux. Les Melanostomatini sont caractérisés, en ce qui concerne l'appareil copulateur du ♂, par un édéage simple, non segmenté, généralement plus ou moins dilaté à la base. Nous passerons succintement en revue les principaux constituants de l'armure génitale ♂ et nous tenterons d'en évaluer l'importance diagnostique.

L'épandrium et les cerques ne présentent pas de modifications particulières. En vue latérale, l'épandrium est assez court: sa longueur n'atteint pas plus de 7/10 de celle de l'hypandrium et sa face a un contour trapézoïdal. Les cerques sont similaires chez toutes les espèces étudiées. La plaque subépandriale est toujours présente: elle est articulée latéralement avec la base des surstyles et jouxte l'apex des cerques. La partie centrale est faiblement sclérifiée mais le pourtour est renforcé, principalement vers l'arrière où ressortent deux zones tranversales lancéolées. Ces plages sont bien marquées chez tous les taxons pour lesquels nous disposions de mâles, sauf chez *M. ochraceum* où elles sont très étroites.

Les surstyles sont allongés horizontalement et portent un lobe basodorsal. Leur face externe est couverte de soies relativement longues, disposées de façon irrégulière, sauf sur la partie basale qui est garnie d'une pilosité plus fine et courte. Sur la face interne, ils portent une couverture de spinules plus dense dans la partie apicale. La structure et la forme générale des surstyles est similaire chez les différents taxons mais on peut néanmoins reconnaître de discrètes divergences de nature spécifique, notamment dans leur longueur ainsi que dans le contour du lobe basodorsal. On se reportera à ce propos aux illustrations des surstyles (Figs 26-31).

L'hypandrium et ses organes associés affichent, pour leur part, une grande constance dans leur conformation générale. Chez toutes les espèces étudiées, les diverses structures sont symétriques. La partie ventrale de l'hypandrium est assez fortement sclérifiée sur toute sa longueur. A son extrémité apicale elle est échancrée, chacun des côtés de la découpure portant deux dents, une dent latérale et une dent médiane. La distance qui sépare ces denticules, mesurée suivant l'axe longitudinal de l'hypandrium, semble avoir une certaine valeur taxonomique. Chez *M. diffusum* et *M. ochraceum*, la dent latérale dépasse nettement la dent médiane tandis que chez



FIGS 26-31

Genitalia ♂♂ de *Melanostoma* spp., surstyles (vue latérale): 26. *annulipes*; 27. *bituberculatum*; 28. *diffusum*; 29. *ochraceum* (holotype); 30. *satyriphilum*; 31. *sylvarum*.

M. satyriphilum et *M. tuberculatum*, les deux avancées arrivent à peu près au même niveau. La face dorsale de l'hypandrium est ouverte sur près de sa moitié basale, permettant le passage du phallapodème et de l'apodème éjaculateur. A l'arrière, un large pont fortement sclérifié, précédé d'une surface membraneuse, relie les parois latérales et constitue ainsi, avec la partie ventrale correspondante, un anneau chitineux complet.

Les postgonites sont des appendices dont la structure est complexe. Ils sont constitués essentiellement d'une enveloppe hémicylindrique ou en forme de spathe munie d'arêtes et de dents diversement situées. Nous donnons une représentation en vue ventrale de ces éléments anatomiques pour toutes les espèces examinées (figs 20-25). On notera par exemple de subtiles différences dans le développement de la dent chez *M. sylvarum* et *M. satyriphilum*.

L'édéage est simple, tubulé et, en vue ventrale, épouse la forme d'une amphore. L'extrémité membraneuse du phallotrème est dirigée postéro-ventralement. Les parois latérales de l'édéage sont fortement sclérifiées et portent de chaque coté une cuspide caractéristique. Comme le montrent les illustrations, l'extrémité du phallapodème est normalement située au niveau de l'échancrure ventrale de l'hypandrium. Le sclérite est cependant mobile et peut pousser l'édéage vers l'arrière, vraisemblablement pour faciliter ou rendre possible la copulation. Nous avons rencontré cette situation chez l'unique ♂ de *M. ochraceum* (Fig. 23). L'apodème éjaculateur et les organes associés ne présentent pas de caractères distinctifs.

La figure 32 illustre la structure externe des postgonites et de l'extrémité distale de l'édéage vue au microscope électronique à balayage. Sur l'image ventrale, on aperçoit aussi les deux dents à l'apex de l'hypandrium.

De ce bref aperçu descriptif de l'appareil copulateur ♂, il ressort que son intérêt pour la reconnaissance des divers taxons malgaches est plutôt réduit. Les

FIG. 32

Postgonites et phallotrème de *Melanostoma sylvarum* ♂, vues dorsale, oblique et ventrale (de gauche à droite) au M.E.B.

sclérites qui participent à l'armure génitale ne varient pratiquement pas, ni dans leur forme propre, ni dans leur organisation d'ensemble. Nous avons cru utile, toutefois, de détailler la morphologie des genitalia ♂ des *Melanostoma* de la Grande Ile pour deux raisons: (1) il n'existe pas, à notre connaissance, de descriptions et/ou d'illustrations des sclérites génitaux dans la littérature, et (2) nous espérons que la documentation rassemblée dans cette note contribuera utilement à une révision future de toutes les espèces afrotropicales du genre.

BIOMÉTRIE DU COMPLEXE *SYLVARUM-SATYRIPHILUM*

Les caractères distinctifs entre *M. satyriphilum* et *M. sylvarum* retenus dans la clé d'identification se rapportent à la coloration des hanches, au dessin de p3 et à la configuration de T2. En consultant les descriptions et les illustrations, on notera qu'il y a également des dissemblances subtiles du troisième article de l'antenne, des dessins de T3 et T4 et des genitalia des mâles. Enfin, la pubescence de l'arista est très réduite chez *M. sylvarum* tandis qu'elle est nettement visible chez *M. satyriphilum*. Les deux taxons présentent toutefois une plage de variation étendue pour la plupart des attributs rappelés ci-dessus. Il s'en suit que la distinction entre les espèces voisines *M. sylvarum* et *M. satyriphilum* pose parfois des problèmes. En particulier, les spécimens au stade ténéral, n'ayant pas encore pris leurs couleurs définitives, sont délicats à identifier d'après les seuls caractères chromatiques. La comparaison de nombreux individus des deux taxons a suggéré qu'il existe des différences dans les dimensions de certaines caractéristiques de l'habitus. Une série relativement importante d'exemplaires de *M. sylvarum* et *M. satyriphilum*, tant mâles que femelles, étant disponible, cette condition favorable nous a incité à examiner de plus près certains aspects de la biométrie de ces taxons. Nous avons donc conduit une analyse statistique de quatre paramètres morphométriques chez les deux espèces en question. Les variables considérées sont: (1) la longueur totale; (2) la longueur de l'aile; (3) le rapport I_{front} entre la largeur du front (l_{front}) au niveau de l'ocelle avant et la largeur de la tête ($l_{tête}$) chez la ♀; (4) la longueur du tergite II. Pour les variables (1), (2) et (4) les résultats seront donnés séparément pour les ♂♂ et les ♀♀ et exprimés en mm. La variable (3) est un quotient sans dimensions.

Statistiques descriptives. Les échantillons ont été choisis en fonction des séries de spécimens disponibles. Pour *M. satyriphilum* la quasi totalité du matériel a été pris en considération tandis que pour *M. sylvarum*, nous avons prélevé au hasard un échantillon compris entre 20 et 30 spécimens. Pour la mesure de la longueur totale, il n'a été fait usage que des exemplaires ne présentant pas de distorsions ou autres déformations de l'abdomen, fréquentes chez les insectes en collection. Pour chacun des paramètres morphométriques, les descripteurs statistiques suivants ont été calculés:

(1) $\mu \pm IC_{95}$: moyenne arithmétique de l'échantillon assorti de l'écart type (en mm) correspondant à un intervalle de confiance de 95%;

(2) min, max : valeurs minimale et maximale (en mm) du descripteur considéré dans l'échantillon. La différence entre ces mesures représente donc l'étendue de la série statistique en question;

TABLE 1 - Statistiques descriptives de la longueur totale (mm)

	$\mu \pm IC_{95}$	min	max	n	V
M. sylvarum ♂	6,0 ± 0,06	5,5	6,5	25	4,99
M. sylvarum ♀	6,1 ± 0,06	5,4	6,5	25	5,25
M. satyriphilum ♂	7,1 ± 0,14	6,1	8,1	15	7,48
M. satyriphilum ♀	7,0 ± 0,15	5,9	7,8	12	7,43

TABLE 2 - Statistiques descriptives de la longueur de l'aile (mm)

	$\mu \pm IC_{95}$	min	max	n	V
M. sylvarum ♂	5,43 ± 0,107	4,70	6,03	30	5,28
M. sylvarum ♀	5,97 ± 0,147	5,23	6,69	30	6,58
M. satyriphilum ♂	6,69 ± 0,223	6,08	7,53	20	7,14
M. satyriphilum ♀	7,17 ± 0,272	6,15	8,11	20	8,11

TABLE 3 - Statistiques descriptives du front chez la ♀ : $I_{front} = l_{front} / l_{tête}$

	$\mu \pm IC_{95}$	min	max	n	V
M. sylvarum	0,22 ± 0,002	0,21	0,25	20	4,51
M. satyriphilum	0,20 ± 0,002	0,19	0,22	20	4,36

TABLE 4 - Statistiques descriptives de la longueur du tergite II (mm)

	$\mu \pm IC_{95}$	min	max	n	V
M. sylvarum ♂	1,13 ± 0,030	1,03	1,23	20	5,69
M. sylvarum ♀	0,94 ± 0,029	0,86	1,06	20	6,50
M. satyriphilum ♂	1,32 ± 0,046	1,14	1,47	20	7,39
M. satyriphilum ♀	1,10 ± 0,038	0,95	1,34	20	7,30

(3) n : effectif de l'échantillon;

(4) V : coefficient de variation. La valeur calculée a été multipliée par 100 pour faciliter la lecture des résultats.

Les valeurs observées et calculées pour chacun des quatre paramètres biométriques retenus sont résumées dans les tables 1 à 4. Une lecture superficielle des résultats montre que la longueur totale et celle de l'aile ainsi que la longueur du tergite II chez *M. satyriphilum* sont supérieures aux dimensions correspondantes de *M. sylvarum*. On notera par ailleurs que pour ces mêmes caractères, la variabilité de *M. satyriphilum* est plus importante que celle de *M. sylvarum*. En se reportant aux chiffres relatifs à l'indice du front de la ♀, on constate que *M. satyriphilum* a un front proportionnellement plus étroit que *M. sylvarum*.

Tests statistiques. Ayant reconnu que les quelques facteurs statistiques examinés démontrent que des écarts morphométriques existent entre les deux espèces considérées, nous avons voulu savoir si les différences constatées étaient significatives. Un test F préalable a montré que les diverses variances associées aux échantillons de *sylvarum/satyriphilum* ne peuvent pas être considérées comme égales. Nous avons donc eu recours à l'approximation de Cochrane pour le test t. Pour chacun des caractères morphologiques mesurés, un test t bilatéral a permis de comparer les moyennes. Le résultat de ces tests d'homogénéité indique clairement que l'hypothèse $H_0(\mu_1=\mu_2)$ est à rejeter dans tous les cas ($\alpha< 0{,}01$). La différence entre les deux espèces est donc significative pour les quatre paramètres morphométriques retenus. Ces résultats permettent de conclure que les caractères en question peuvent être utilisés pour préciser l'attribution spécifique des exemplaires problématiques, en complément des marques distinctives de la clé dichotomique et des descriptions.

NOTE COMPLÉMENTAIRE

Ce n'est que lorsque la rédaction de ces notes était achevée et le manuscrit remis à la rédaction, que nous avons eu connaissance de deux publications de C. F. Kassebeer (2000a, 2000b). Dans la première de ces notes, cet auteur cite *M. bituberculatum* Loew comme une espèce largement distribuée dans l'île de la Réunion, sur la base d'un matériel comprenant 26 ♂♂ et 88 ♀♀. Il précise en outre que ce nom recouvre un complexe d'au moins trois espèces jumelles qui sera clarifié dans une publication en préparation. Peu après paraît la description de *M. subbituberculatum* Kassebeer (2000b: 176) dont l'aire de répartition comprend entre autres la région malgache et à laquelle sont transférés tous les exemplaires de la Réunion.

Le nouveau taxon, *M. subbituberculatum* Kassebeer est fondé sur une série de distinctions parfois subtiles par rapport à son homologue: (1) stature inférieure; (2) pruinosité de la tête et des pleures plus réduite; (3) rapport longueur front/contact yeux (♂) plus grand; (4) pilosité du front noire (brun clair chez *M. bituberculatum*); (5) taches claires des tergites plus rapprochées au milieu. Tous ces traits sont, d'après l'auteur, très variables tout comme chez *M. bituberculatum* et la distinction entre les deux formes est "nur graduell". Deux caractères sont cependant qualifiés de sûrs chez les ♂♂: il s'agit de la longueur relative de la coalescence des yeux par rapport à celle du front et de la présence d'une petite découpe au bord apicoventral des postgonites. L'holotype ♂ de *M. subbituberculatum* est originaire de la Côte d'Ivoire tandis que l'importante série des paratypes rassemble des insectes de la même provenance ainsi que de la RDC, les Comores, Madagascar et la Réunion.

Les descriptions des ♂♂ précisent que le rapport longueur du front/contact des yeux est voisin de 1,5 chez *M. subbituberculatum* alors qu'il atteint seulement 1,0 chez *M. bituberculatum*, ce qui permettrait une distinction nette des deux taxons. Eu égard à la grande variabilité intraspécifique de la plupart des *Melanostoma*, on peut regretter que l'auteur, qui disposait de séries importantes, n'ait pas complété ses diagnoses par une analyse morphométrique. Cette remarque vaut aussi pour l'évaluation des dimensions du corps et de l'aile.

La répartition de *M. subbituberculatum*, telle qu'elle est actuellement connue, est disjointe: elle couvre d'une part la Côte d'Ivoire où 5 ♂♂ et 38 ♀♀ ont été récoltés, et d'autre part l'est de la RDC (provinces du Haut-Zaïre et du Kivu), enfin la région malgache. Kassebeer (2000b: 178) résume cette aire comme englobant l'Afrique tropicale occidentale et les forêts subtropicales madécasses. Il n'est pas tout à fait clair où l'auteur situe les spécimens originaires des régions orientales de la RDC qui sont proches de Kibondo (Tanzanie) où 1 ♂ et 1 ♀ sont identifiés comme *M. bituberculatum*, connu aussi du Kenya voisin. La découverte d'un représentant du groupe de *M. bituberculatum* en Afrique occidentale est très intéressante: elle étend l'aire de répartition connue de plus de 22° vers l'ouest. Dans ses conclusions, Kassebeer indique que des recherches seront entreprises pour tenter de clarifier la disjonction constatée entre les populations.

Signalons enfin ce qui paraît être une erreur matérielle dans la figure 2 de l'article de notre collègue: le trait indiquant l'échelle représente vraisemblablement 0,05 mm (et non 0,1 mm).

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In order to facilitate publication and avoid delays authors should follow the *Instructions to Authors* and refer to a current number of R.S.Z. for acceptable style and format. Manuscripts not conforming with these directives are liable to be returned to the authors. Papers may be written in French, German, Italian and English. Authors should aim to communicate ideas and information clearly and concisely. Authors not writing in their native language should pay particular attention to the linguistic quality of the text.

Manuscripts must be typed, or printed (high quality printing, if possible by a laser-printer), on one side only and double-spaced, on A4 (210 x 297 mm) or equivalent paper and all pages should be numbered. All margins must be at least 25 mm wide. Authors must submit one original and two copies, including tables and figures, in final fully corrected form, and are expected to retain another copy.

We encourage authors to submit the text on a diskette (3,5", Macintosh or IBM compatible, with "Microsoft Word" or similar programmes). The text should be in roman (standard) type face throughout, including headings, except genus and species names which should be formatted in italics (or underlined with pencil); bold, small capitals, large capitals and other type faces should not be used. Footnotes and cross-references by page should be avoided.

Papers should conform to the following general layout:

Title page. A concise but informative full title plus a running title of not more than 40 letters and spaces, name(s) in full and surname(s) of author(s), and full address(es).

Abstract. The abstract is in English, composed of the title and a short text of up to 200 words. It should summarise the contents and conclusions of the paper. The abstract is followed by less than 10 key-words, separated by hyphens, which are suitable for indexing.

Introduction. A short introduction to the background and the reasons for the work.

Materials and methods. Sufficient experimental details must be given to enable other workers to repeat the work. The full binominal name should be given for all organisms. The International Code of Zoological Nomenclature must be strictly followed. Cite the authors of species on their first mention.

Results. These should be concise and should not include methods or discussion. Text, tables and figures should not duplicate the same information. New taxa must be distinguished from related taxa. The abbreviations gen. n., sp. n., syn. n. and comb. n. should be used to distinguish all new taxa, synonymies or combinations. Primary types must be deposited in a museum or similar institution. In taxonomic papers the species heading should be followed by synonyms, material examined and distribution, description and comments. All material examined should be listed in similar, compact and easily intelligible format; the information should be in the same language as the text. Sex symbols should be used rather than "male" and "female".

Discussion. This should not be excessive and should not repeat results nor contain new information, but should emphasize the significance and relevance of the results reported.

References. The *Harvard System* must be used for the citation of references in the text, e.g. White & Green (1995) or (White & Green, 1995). For references with three and more authors the form Brown *et al.* should be used. Authors' names should not be written in capitals. The list of references must include all publications cited in the text but only these. References must be listed in alphabetical order of authors, and both the title and name of the journal must be given in full in the following style (italics can be formatted by the author):

Penard, E. 1888. Recherches sur le *Ceratium macroceros. Thèse, Genève*, 43 pp.
Penard, E. 1889. Etudes sur quelques Héliozoaires d'eau douce. *Archives de Biologie* 9: 1-61.
Mertens, R. & Wermuth, H. 1960. Die Amphibien und Reptilien Europas. *Kramer, Frankfurt am Main*, XI + 264 pp.
Handley, C. O. Jr 1966. Checklist of the mammals of Panama (pp. 753-795). *In:* Wenzel R. L. & Tipton, V. J. (eds). Ectoparasites of Panama. *Field Museum of Natural History, Chicago*, XII + 861 pp.

References should not be interspaced and, in the case of several papers by the same author, the name has to be repeated for each reference.

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Legends to figures. These should be typed in numerical order on a separate sheet.

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