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Description of a new African genus and a new tribe of Speleketorinae (Psocodea: 'Psocoptera': Prionoglarididae)

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Description of a new African genus and a new tribe of Speleketorinae (Psocodea: 'Psocoptera': Prionoglarididae). - Prionoglaridids are probably the most basal family of extant psocids and may be considered as living fossils. The genus *Afrotrogla* gen. n. is described for three new species from southern Africa, two of them only known from caves: *A. oryx* sp. n. (South Africa, in cave, type species), *A. maraisi* sp. n. (Namibia) and *A. fabella* sp. n. (Namibia, in cave). The male of the second African genus of the subfamily, *Sensitibilla* Lienhard, is described for the first time and two new species of *Sensitibilla* are described, one of them only known from a cave: *S. brandbergensis* sp. n. (Namibia) and *S. roessingensis* sp. n. (Namibia, in cave). Some structures of the type species *S. strinatii* Lienhard are also illustrated. A comparison of these two genera with the third known genus of the subfamily, the North American *Speleketor* Gurney, shows that the African genera are characterized by some striking synapomorphies in male and female genitalia. Thus a subdivision of the subfamily Speleketorinae in two tribes is proposed: Speleketorini for *Speleketor* and Sensitibillini trib. n. for *Sensitibilla* and *Afrotrogla*. Among other features, Sensitibillini are characterized by the presence of a trichobothrium on the hindtarsus. Tarsal trichobothria are not known elsewhere in insects. Male and female terminalia of *Speleketor irwini* Mockford are also illustrated.

Keywords: Trogiomorpha - new species - cave fauna - living fossils - trichobothria - Namibia - South Africa - North America.

INTRODUCTION

Within the order Psocodea (*sensu* Yoshizawa & Johnson, 2006) the 'Psocoptera' family Prionoglarididae forms one of the most basal clades of the basal suborder Trogiomorpha and has recently been classified in an infraorder of its own, the Prionoglaridetae (see Yoshizawa *et al.*, 2006). The family has been subdivided into two subfamilies by Lienhard (2004), Prionoglaridinae and Speleketorinae. Each of the subfamilies has been shown to be monophyletic by both morphological and molecular analyses (Lienhard, 2004; Yoshizawa *et al.*, 2006). The nominate subfamily contains the Palaearctic genus *Prionoglaris* Enderlein (3 species, see Lienhard & Smithers,

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2002) and the Oriental genus *Siamoglaris* Lienhard (monotypic, see Lienhard, 2004); the subfamily Speleketorinae contains the Nearctic genus *Speleketor* Gurney (3 species, see Lienhard & Smithers, 2002) and the Aethiopian genus *Sensitibilla* Lienhard (up to now monotypic, see Lienhard, 2000). Most of the few known prionoglaridid species live in caves or similar habitats and are considered as very rare.

The family is characterized among extant members of the Psocoptera by its unique and absolutely diagnostic forewing venation, in particular by the well-developed and strongly arched basal section of Sc, joining R1 near base of pterostigma, and by the presence of a long cross-vein between base of pterostigma and distal section of Rs. However, very similar wing venations have been observed in several of the oldest known fossil Trogiomorpha, recently described from Cretaceous amber and assigned to different families (see Baz & Ortuño, 2000, 2001; Perrichot *et al.*, 2003; Azar & Nel, 2004). Therefore the characters of wing morphology have to be considered as symplesiomorphic in extant Prionoglarididae for which the term "living fossils" may be appropriate. Thus, Yoshizawa *et al.* (2006) have tentatively postulated that they are Pangaean relicts, in view of their extremely disjunct distribution, their cavernicolous biology and in agreement with the results of the most recent phylogenetic and palaeontological analyses of Psocodea.

Contrary to the monophyly of the subfamilies, the monophyly of the family Prionoglarididae was only weakly supported by the available molecular data (Yoshizawa *et al.*, 2006) and its morphological definition is only based on the tentative autapomorphy of the phallosome structure and the possibly autapomorphic simplification or reduction of the lacinia in adults (Mockford, 1984; Lienhard, 2004). However, the latter may also be interpreted as an adaptive homoplasy related to the particular biology of these generally cavernicolous psocids.

In this paper five new African species of the subfamily Speleketorinae, belonging to the genus *Sensitibilla* and to a new genus, *Afrotrogla* gen. n., are described on the basis of material from Namibia and South Africa deposited in the National Museum of Namibia, Windhoek. This material allows the description of the formerly unknown male of *Sensitibilla* and of both sexes of the new genus, enabling us for the first time to compare also male genital structures between the African and American members of the subfamily. The African genera have some striking synapomorphies in male and female genitalia rendering these structures completely different from the genitalia of *Speleketor*. This fundamental difference in genital morphology, together with some other characters, justifies the establishment of a new tribe, Sensitibillini trib. n., for the African genera. The remaining genus of the subfamily, the North American *Speleketor*, constitutes the nominate tribe Speleketorini.

From this study of new African material the presence of tibial and tarsal trichobothria in these psocids, as described for *Sensitibilla strinatii* Lienhard (see Lienhard, 2000), can be confirmed. The first SEM micrographs of such trichobothria, which are unique in Psocoptera, are presented together with a brief discussion on leg trichobothria in insects.

The following abbreviations are used in the descriptions: BL = body length (in alcohol); F = hindfemur (length); f1, f2, etc. = antennal flagellomeres (length); FW = forewing (length); HW = hindwing (length); IO/D= shortest distance between

compound eyes divided by anteroposterior diameter of compound eye in dorsal view of head; P1-P4 = articles of maxillary palp; T = hindtibia (length); t1, t2, t3 = tarsomeres of hindtarsus (length, measured from condyle to condyle). Abbreviations of wing veins and cells are used according to Yoshizawa (2005). – The material examined has been deposited in the following institutions: MHNG Muséum d'histoire naturelle, Geneva, Switzerland; NMN National Museum of Namibia, Windhoek.

TAXONOMIC TREATMENT

Key to the tribes and genera of Speleketorinae and to the species of Sensitibillini

Note. A key to the subfamilies of Prionoglarididae (Prionoglaridinae and Speleketorinae) and to the genera of Prionoglaridinae (*Prionoglaris* Enderlein and *Siamoglaris* Lienhard) has been given by Lienhard (2004). For figures of *Speleketor* spp. see also Gurney (1943), Mockford (1984, 1993) and Lienhard (2000); for figures of *Sensitibilla strinatii* see also Lienhard (2000).

1 Hindwing with vein Rs 2-branched (Fig. 3i). Forefemur with a longitudinal row of articulated spines on anterior face. Some long and fine trichobothria present on femora and on some trochanters, no trichobothria on other segments of legs. P4 with 7 thin-walled conical sensilla, two of them situated in basal half (Fig. 3c). Female genitalia (Fig. 1c): Ovipositor consisting of a pair of very broad and simple external valvulae, peripherically setose, laterally articulated to clunium but not fused to subgenital plate ventrobasally (a reduced triangular and bare dorsal valvula is also present, completely covered by the external valvula); spermathecal duct short and relatively wide. Male genitalia (Fig. 2cd): Phallosome with a posterolateral pair of pore-bearing processes, sclerites of phallosome anteriorly closed, posteriorly open (**Speleketorini**) ..... *Speleketor* Gurney, 1943
Three Americal species known (keyed by Mockford, 1993). Type species: *S. flocki* Gurney.

1' Hindwing with vein Rs simple (Fig. 4b). Forefemur with only a longitudinal row of normal setae on anterior face. Some long and fine trichobothria (see Pl. 1) present on tibiae and hindtarsus, no trichobothria on other segments of legs. P4 with 2-5 thin-walled conical sensilla situated in apical half. Female genitalia (Figs 4g, 8c): Ovipositor consisting only of a pair of external valvulae, laterally articulated to clunium and ventrobasally fused to subgenital plate, each valvula bearing a distal process with a claw-like articulated spine at its tip; spermathecal duct long and thin. Male genitalia (Figs 5c, 9df): Phallosome lacking pore-bearing processes, sclerites of phallosome anteriorly open, posteriorly convergent or forming a closed aedeagal arch ..... (**Sensitibillini** trib. n.) 2

2(1') Hindwing with vein M 2-branched (Fig. 4b). P4 with 5 thin-walled conical sensilla (Fig. 3e). Female genitalia (Fig. 4g): Posterior part of subgenital plate sclerotized and clearly visible medially between ovi-

positor valvulae; spermapore situated near posterior end of a membranous sac bearing a complex scaffolding of sclerotized struts. Male genitalia (Fig. 5c): Phallosome with a narrow sclerite forming a simple aedeagal arch . . . . . (*Afrotrogla* gen. n.) 3

2' Hindwing with vein M simple (Fig. 9b). P4 with 2 thin-walled conical sensilla (Fig. 3g). Female genitalia (Fig. 8c): Posterior part of subgenital plate membranous and almost completely covered ventrally by the ovipositor valvulae; spermapore situated at the distal end of a small cap-like structure bearing a simple needle-like sclerite (the spermathecal duct running through the eye of the needle). Male genitalia (Fig. 9df): Phallosome with a pair of relatively broad sclerites, each bearing a narrow internal branch, these branches posteriorly convergent or fused to form a median aedeagal arch . . . . . (*Sensitibilla* Lienhard, 2000) 5

3(2) Head with striking dark brown colour pattern (Fig. 5a) . . *Afrotrogla oryx* sp. n.

3' Head pattern different or head uniformly medium brown 4

4(3') Head pattern as in Fig. 6a. Relatively small species: Body length and forewing length about 3 mm, hindtibia length 1.2 mm. Compound eyes relatively large: IO/D 2.6 . . . . . *Afrotrogla maraisi* sp. n.

4' Head uniformly medium brown. Large species: Body length and forewing length about 4 mm, hindtibia length 2.2 mm. Compound eyes relatively small: IO/D 3.4 . . . . . *Afrotrogla fabella* sp. n.

5(2') Male (unknown in *S. strinatii*) 6

5' Female (unknown in *S. roessingensis*) 7

6(5) Small species: Hindtibia length 1.0 mm. Abdomen white, lacking hypodermal pigmentation. Phallosome as in Fig. 9d . . . . . *Sensitibilla brandbergensis* sp. n.

6' Slightly larger species: Hindtibia length 1.3 mm. Abdomen with some brown hypodermal pigmentation. Phallosome as in Fig. 9f . . . . . *Sensitibilla roessingensis* sp. n.

7(5') Small species: Hindtibia length 1.0 mm. Abdomen white, lacking hypodermal pigmentation. Female genitalia (Fig. 8ac): Subgenital plate entirely membranous (except for sclerotized rims in zone of fusion with ovipositor valvulae), its posterior part triangular, with bluntly pointed apex; ovipositor valvula laterally articulated near anteroventral angle of clunium, anterior margin of clunium prolonged into a broad ventral fold on the valvula; distal process of ovipositor valvula with only one spine-like seta in apical half apart from the spine on its tip; sclerotized plate on spermathecal wall large (greatest width about 500 μm) . . . . . *Sensitibilla brandbergensis* sp. n.

7' Larger species: Hindtibia length 1.5 mm. Abdomen with some brown hypodermal pigmentation. Female genitalia: Anterior part of subgenital plate with a bilaterally symmetrical sclerified area connected to anteroventral angle of clunium; membranous posterior lobe of subgenital plate apically rounded; ovipositor valvula laterally articulated at posteroventral angle of clunium, anterior margin of clunium not

prolonged onto the valvula; distal process of ovipositor valvula with 3-4 spine-like setae in apical half apart from the spine on its tip; sclerotized plate on spermathecal wall much smaller (greatest width about 250 μm) ..... *Sensitibilla strinatii* Lienhard, 2000

SENSITIBILLINI trib. n.

DIAGNOSIS: Belonging to the subfamily Speleketorinae of the Prionoglarididae as defined by Lienhard (2004). Habitus similar to *Speleketor* (Fig. 1a). Hindwing (Figs 4b, 9b) with Rs simple and M 2-branched or simple. Forefemur lacking a longitudinal row of short articulated spines on anterior face. Pretarsal claws with distinct preapical tooth (Fig. 4d). Trichobothrial pattern on legs (see Lienhard, 2000: figs 17-21): Foretibia and midtibia with two external trichobothria in nymphs and adults; hindtibia with two such trichobothria in nymphs, usually the proximal one not differentiated in adults; hindtarsus with one trichobothrium on second article in nymphs and adults (Pl. 1); coxa, trochanter and femur of all legs and tarsus of foreleg and midleg lacking trichobothria in nymphs and adults. P2 with a subbasal sensory spur, P4 with 2-5 thin-walled conical sensilla in apical half (Fig. 3e). Tines of lacinial tip well-developed in nymphs (Fig. 5f), strongly reduced in adults (Fig. 4ef). Forewing with a row of acuminate denticles on distal section of vein Sc delimiting the pterostigma basally (see Lienhard, 2000: Fig. 2). Paraprocts in both sexes dorsally with a group of several relatively short trichobothria inserted in simple pit-like sockets, and with one normal seta between them (Fig. 5d). Female genitalia (Fig. 4g, 8c): Ovipositor consisting only of a pair of external valvulae, laterally articulated to clunium and ventrobasally fused to subgenital plate, each valvula bearing a distal process with a claw-like articulated spine at its tip; spermathecal duct long and thin. Male genitalia (Figs 7bc, 9df): Phallosome lacking pore-bearing processes, sclerites of phallosome anteriorly open, posteriorly convergent or forming a closed aedeagal arch.

TYPE GENUS: *Sensitibilla* Lienhard.

ADDITIONAL GENUS: *Afrotrogla* gen. n.

DISCUSSION: The particular trichobothrial pattern on legs, especially the presence of a tarsal trichobothrium, is probably an autapomorpy of this tribe (see also General Discussion, below). An even more impressive autapomorphy is the very particular structure of external ovipositor valvulae and subgenital plate, basally fused to form a functional unit, which is unknown elsewhere in Psocoptera. Two additional autapomorphies of this tribe are the presence of a row of acuminate denticles on the distal section of Sc on the forewing (no such denticles in *Speleketor* and the Prionoglaridinae) and the reduction of the Rs branching in the hindwing (Rs bifurcate in all other Prionoglarididae, see Fig. 3hi), while M initially remains 2-branched in the hindwing (simple in *Sensitibilla*), with M1 and M2 originating separately from Rs-M fusion, as in *Speleketor* (Fig. 3i), or from M stem and Rs-M fusion, respectively (M bifurcate in Prionoglaridinae, Fig. 3h). The absence of the pair of posterolateral pore-bearing processes of the phallosome can also be interpreted as an autapomorphy of this tribe. Such processes are present in *Speleketor* and the Prionoglaridinae (see Lienhard, 2004). They have been considered as homologous with the pore-bearing external para-

meres of other Psocoptera by Mockford (1984). If this homology is correct, then these processes belong to the groundplan of the trogiomorphan phallosome and their presence in *Speleketor* and the Prionoglaridinae is a symplesiomorphy.

Afrotrogla gen. n.

DIAGNOSIS: Habitus very similar to *Sensitibilla* and *Speleketor* (see Fig. 1a and Gurney, 1943: fig. 3). General morphology of female and nymph as described for *Sensitibilla* (see Lienhard, 2000), with the following differences. P4 with 5 thin-walled conical sensilla in apical half (Fig. 3def). Hindwing (Fig. 4b) with Rs simple and M 2-branched (M1 and M2 originating separately from Rs-M fusion or from M stem and Rs-M fusion, respectively). Third article of hindtarsus in females preapically with a dorsal pair of long and slender curved hairs (Fig. 4d); the corresponding hairs much shorter in males and on foretarsus and midtarsus of both sexes (cf. Fig. 5e). Females with some long backwards-directed sternal setae near midline at about basal one third of abdomen (Fig. 4c, 6g); these setae absent in males. Ventral half of female paraproct with numerous short setae (Fig. 6b), lacking the circular field of long dense pilosity present in *Sensitibilla* (cf. Lienhard, 2000: Fig. 29). Female genitalia (Fig. 4g): Posterior part of subgenital plate sclerotized and clearly visible medially between ovipositor valvulae; spermapore situated near posterior end of a membranous sac bearing a complex scaffolding of sclerotized struts; spermathecal duct long and thin; spermatheca thin-walled, its wall with small pores and, near origin of duct, with some sclerotized wrinkles (Figs 4g, 6c). General morphology of male as in female (for exceptions, see above). Male terminalia: Epiproct and paraproct simple (Fig. 7d), or epiproct with prominent ventral lobe (Fig. 5d); hyandrium simple (Fig. 5b); phallosome with a narrow sclerite forming a simple aedeagal arch (Fig. 7bc).

TYPE SPECIES: *Afrotrogla oryx* sp. n.

ETYMOLOGY: The name is feminine in gender and refers to the African distribution of the genus and to the cave dwelling habits of its type species (from Greek "trogle" = hole, cave).

DISCUSSION: See General Discussion, below.

Afrotrogla oryx sp. n. Figs 4, 5

TYPE MATERIAL: NMN, holotype ♀ (4 microscopical slides), South Africa, Richtersveld, Wondergat (in cave), SE 2816 Bd, 24.IX.1994, leg. E. Marais. – NMN, paratypes: 1♂ allotype (1 microscopical slide, rest in alcohol) and 1 nymph (2 microscopical slides), same data as for holotype.

DESCRIPTION: *Male and female*: See diagnosis of tribe and genus, with the following additions. Head yellowish, with striking cuticular colour pattern (Fig. 5a) consisting of a dark brown postclypeus and a broad, dark brown transversal band running from gena over frons and parts of vertex; labrum medium brown; compound eyes black; antenna brown. Prothorax yellowish, except for dark brown pronotum. Forelegs entirely yellowish to light brown, midlegs and hindlegs ditto, but with dark brown coxae. Pterothorax entirely dark brown. Wings transparent (pterostigma very slightly opaque), veins brown. Abdomen dorsally and laterally with much dark brown

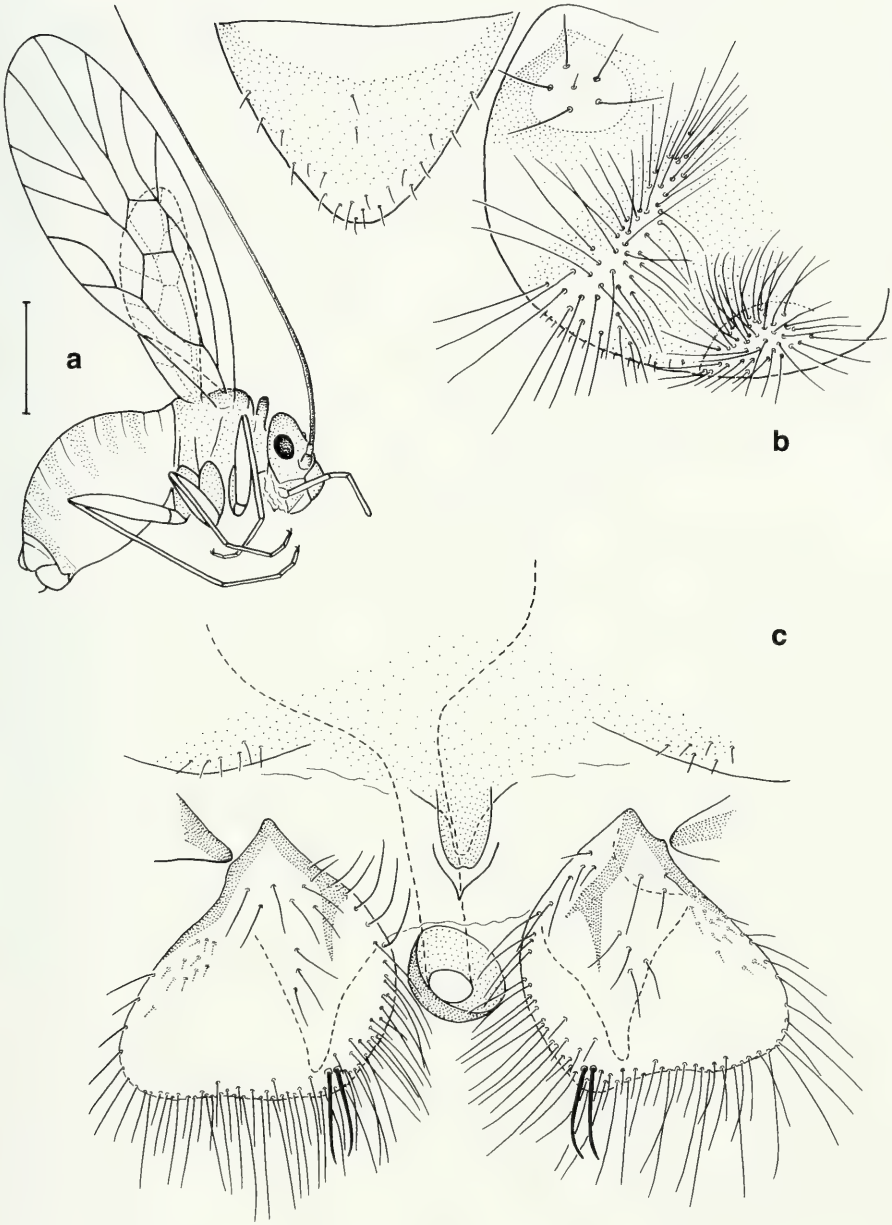

FIG. 1

Speleketor irwini Mockford, female from Palm Springs, California: (a) Habitus, lateral view, left appendages not figured, scale 1 mm. (b) Epiproct and right paraproct. (c) Genitalia, ventral view: Ovipositor valvulae with their articulation to clunium, subgenital plate, spermapore, spermathecal duct and beginning of spermathecal sac (dorsal valvulae and spermatheca represented by interrupted lines).

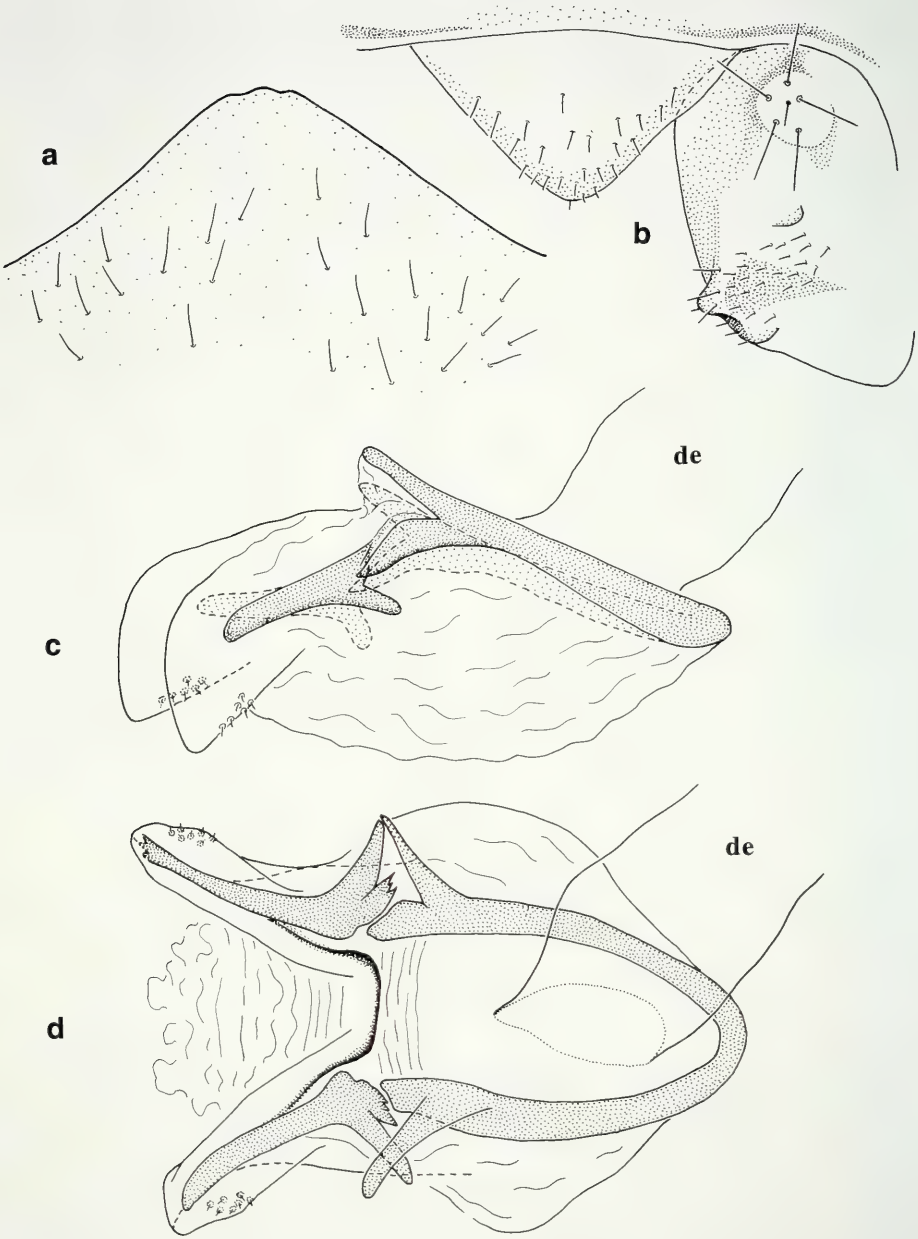

FIG. 2

Speleketor irwini Mockford, male from Palm Springs, California: (a) Hypandrium. (b) Epiproct and right paraproct. (c) Phallosome, lateral view, de = ductus ejaculatorius. (d) Ditto, dorsal view.

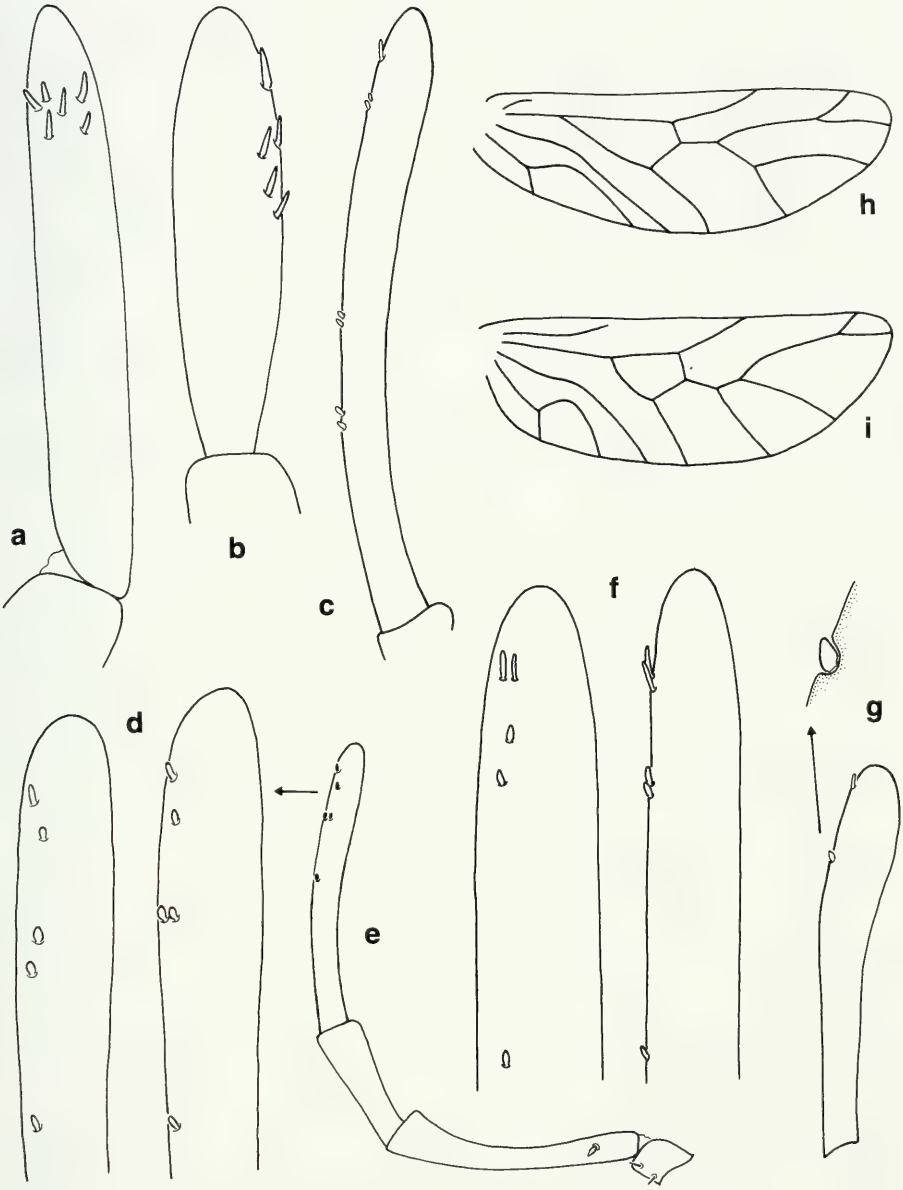

FIG. 3

Thin-walled conical sensilla of P4, other pilosity not figured (a-g): (a) *Prionoglaris stygia* Enderlein, female from type locality. (b) *Siamoglaris zebrina* Lienhard, male holotype. (c) *Speleketor flocki* Gurney, female paratype. (d) *Afrotrogla maraisi* sp. n., female holotype, apical half of both P4. (e) Ditto, left maxillary palp, spine-like sensillum of P2 also figured. (f) *Afrotrogla fabella* sp. n., male holotype, apical half of both P4. (g) *Sensitibilla roessingensis* sp. n., male holotype, with detail of proximal sensillum. – Hindwing (h-i): (h) *Prionoglaris stygia* Enderlein, female from type locality. (i) *Speleketor flocki* Gurney, female paratype.

hypodermal pigment, pattern not clearly defined (examined after 11 years in alcohol), but essentially consisting of two broad transversal bands; terminalia brown.

Head capsule with a slightly concave semicircular groove between lateral ocelli, passing by the bifurcation point of the epicranial suture; frontal suture weakly developed; ocelli arranged in a flat triangle (Fig. 5a); compound eyes small, approximately of same size in both sexes (IO/D: ♀ 2.8, ♂ 2.9). Antenna thin and apparently very long (extrapolated from lengths of basal flagellomeres, see measurements; all antennae damaged in the material available), the basal three flagellomeres together about equal to body length (the very similar values for the antennae of the holotype, both broken after f4, show that probably no asymmetrical regenerative length growth occurred, see remark in Lienhard, 2004: 870). Mouthparts generally as described for *Sensitibilla strinatii* by Lienhard (2000). All maxillary palps broken in the material available. Lacinia with reduced apical tines, outer part of its tip usually slightly indented (Fig. 4ef). Venation of forewing typical for the family (Fig. 4a). Hindwing: R1 always present; M1 originating from Rs-M fusion (Fig. 4b) or from M stem, slightly basally to Rs-M fusion; M2 originating from Rs-M fusion. Spine-like setae on tibiae and tarsi with more or less rounded tips. Pearman-organ of hindcoxa not differentiated, only a mirror-like membranous area present basally on inner side of hindcoxa, both midcoxae with a distinctly prominent hyaline tubercle on inner side. Third article of hindtarsus of female subapically with a pair of slender dorsal hairs, slightly curved ventrally and longer than length of claw (Fig. 4d). These specialized hairs not differentiated in male, there the corresponding setae shorter than the claw (cf. Fig. 5e). Proximal trichobothrium of hindtibia usually not differentiated in adults, corresponding to the general pattern of leg trichobothria in Sensitibillini, but this trichobothrium on one hindtibia of the allotype male also well-developed. Female with two tufts of long backwards-directed sternal setae medially at about basal one third of abdomen, very close to midline and practically fused to one single tuft (Fig. 4c). No such sternal setae in male.

Female terminalia (Fig. 4g): Epiproct and paraproct simple (cf. Fig. 6b). Ovipositor valvula with a long and almost straight distal process bearing a short claw-like apical spine and numerous short stout hairs, most of them situated on dorsal side of process; basal part of valvula with a transversal row of subapical dorsal setae and one long ventral seta on each side of base of distal process; basal part of valvula externally articulated at posteroventral angle of clunium, its internal margin curved and well-sclerotized, running parallel to hind margin of subgenital plate, posterointernal angles of valvulae almost touching each other medially. Posterior part of subgenital plate well-sclerotized but otherwise simple and bare, its anterior margin concave and anterolaterally prolonged into a long sclerotized rim fused to inner base of the corresponding ovipositor valvula; anterior part of subgenital plate a weakly sclerotized, almost circular plate bearing some sparse setae; transition zone between posterior and anterior parts of subgenital plate membranous; sclerotized anterior margin of posterior part with a group of about a dozen small hairs situated on the slightly hollow median zone of this margin (thus their insertion points not visible in ventral view), no porus present between these hairs. Spermapore situated near posterior end of an elongate membranous sac (interrupted line in Fig. 4g), with a small circular sclerite, in situ

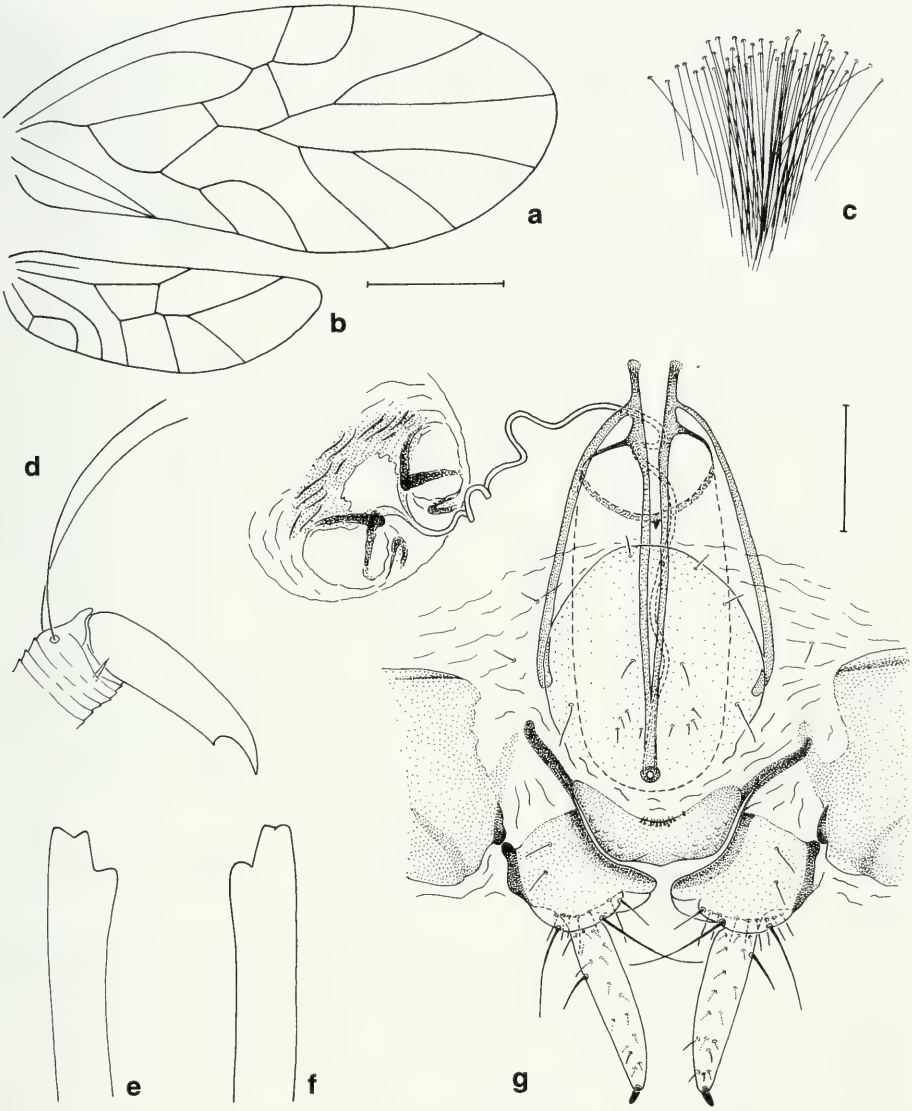

FIG. 4

Afrotrogla oryx sp. n., female holotype: (a) Forewing, scale 1 mm. (b) Hindwing, same scale. (c) Tuft of long backwards-directed sternal setae medially at about basal one third of abdomen. (d) Apex of third article of hindtarsus, with dorsal pair of long curved hairs, only one claw illustrated. (e) Lacinial tip, left. (f) Ditto, right. (g) Genitalia, ventral view, scale 0.2 mm: Ovipositor valvulae with ventrolateral parts of clunium, subgenital plate and, observed in situ through ventral membranes, spermapore and spermathecal duct with accessory structures and sclerotized wrinkles on spermathecal wall.

clearly visible through membranous zone just anteriorly to concave margin of posterior part of subgenital plate. Spermathecal duct long and thin, somewhat spirally curled, its posterior half situated in the above mentioned membranous sac, the latter equipped

with a complex scaffolding of sclerotized struts. The median paired struts situated ventrally on the sac, originating as a simple rod at the spermapore and, towards their anterior ends, successively bifurcating into a circular strut forming the anterior border of the sac, and into a pair of long lateral struts. The latter backwards-directed, slightly curved and with free posterior ends (probably movable, cf. Figs 4g and 6d). Spermathecal wall, near origin of duct, with some bilaterally symmetrical, sclerotized wrinkles. One spermatophore (sperm packet) clearly visible in the spermatheca of the holotype, simple, slightly pear shaped, but much more elongate than the spermatophores of *Sensitibilla strinatii* illustrated by Lienhard (2000: fig. 25).

Male terminalia: Epiproct simple, paraproct with a ventrally prominent posterior lobe (Fig. 5d). Hypandrium (Fig. 5b) with a characteristic sclerotized pattern. Phallosome developed as a membranous sac (cf. Fig. 7c), dorsally with a relatively long but simple, arched and posteriorly truncate aedeagal sclerite (Fig. 5c).

Nymph: One nymph (probably male) examined, late instar (see Discussion, below). See diagnosis of tribe and genus, with the following additions. Body colour entirely yellowish white (adult head pattern not yet recognizable), except for dark pigment in compound eyes and ocellar dots, and two large brown transversal bands on abdominal tergites. General morphology as desribed for the nymph of *Sensitibilla strinatii* by Lienhard (2000). Both maxillary palps broken. Lacinia with three well-developed apical tines (Fig. 5f) (one lacinia damaged). Terminal article of hindtarsus subapically without a pair of long curved hairs (Fig. 5e) (see Discussion, below).

MEASUREMENTS: *Female holotype*. BL = 3.1 mm; FW = 4.0 mm; HW = 1.9 mm; F = 1030 μm; T = 1750 μm; t1= 630 μm; t2 = 140 μm; t3 = 175 μm; flagellomeres (left/right): f1 = 900/870 μm; f2 = 1040/960 μm; f3 = 1220/1200 μm. – *Male allotype*. BL = 3.6 mm; FW = 3.7 mm; HW = 1.8 mm; F = 1020 μm; T = 1750 μm; t1= 610 μm; t2 = 140 μm; t3 = 165 μm.

ETYMOLOGY: The specific epithet is a noun in apposition alluding to the South African Oryx antelope (*Oryx gazella gazella*) which has a somewhat similar dark brown colour pattern on its head.

DISCUSSION: The type locality of *Afrotrogla oryx*, the Wondergat cave, is located in the arid northwestern corner of South Africa, north of Springbok and close to the Namibian border, quite far away from the type localities of the other known species of Sensitibillini in western, central or northeastern Namibia. This is the only species of the genus of which both sexes are known. Males of *A. oryx* and *A. fabella* are very similar in their phallosome morphology, but these species can easily be distinguished by paraproct shape, body size and especially by the colour pattern of the head. The very complex morphology of female genitalia allows a more detailed comparison of *A. oryx* with *A. maraisi*, the latter only known from the female holotype collected in central Namibia (Windhoek). The striking differences in the structure of the subgenital plate indicate that these species are only distantly related (see Discussion of *A. maraisi)*.

The absence of the dorsal pair of long curved preapical hairs in the male, present on female hindtarsus, corresponds to the situation observed in the nymph. Therefore the latter is believed to be a male nymph, because it seems likely that these specialized hairs are present in female nymphs, rather than being generally absent in nymphs and restricted to adult females.

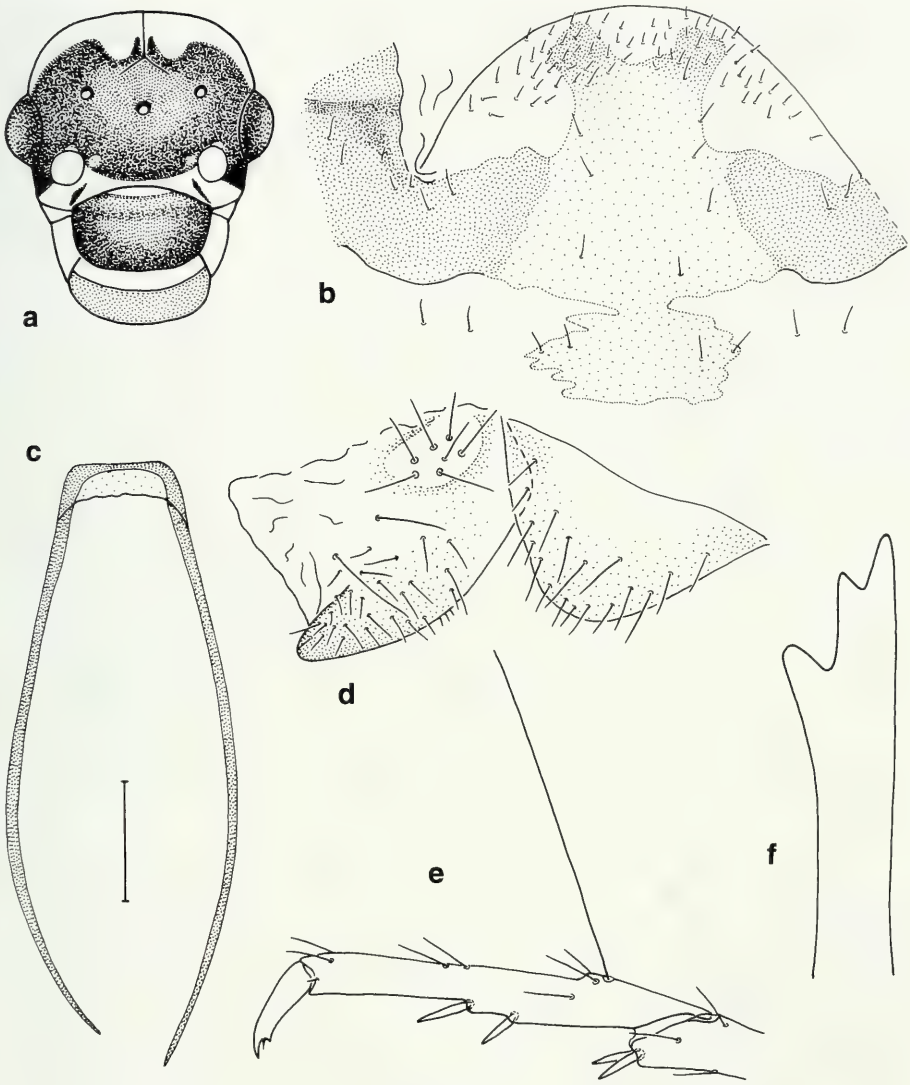

FIG. 5

Afrotrogla oryx sp. n., male allotype (a-d): (a) Head, frontal view. (b) Hypandrium, with left attachment to clunium. (c) Sclerite of phallosome, scale 0.2 mm. (d) Epiproct and left paraproct. – *Afrotrogla oryx* sp. n., nymph (e-f): (e) Hindtarsus, t2 with trichobothrium and apical part of t1, only one claw illustrated. (f) Lacinial tip.

Afrotrogla maraisi sp. n. Figs 3de, 6

TYPE MATERIAL: NMN, holotype ♀ (3 microscopical slides, rest in alcohol), Namibia, Windhoek, 10.X.1995, leg. E. Marais.

DESCRIPTION: *Female* (male unknown): See diagnosis of tribe and genus, with the following additions. Head generally light brown, the following areas with reddish

brown hypodermal pigment (Fig. 6a): Gena and base of mandible; a triangular arrow-like patch dorsally between lateral ocellus and compound eye pointing towards anterior end of vertical suture; a small longitudinal patch near anterior end of vertical suture. Compound eyes black, antenna and maxillary palp light brown. Prothorax light brown, pterothorax medium brown, legs yellowish to light brown. Wings transparent (pterostigma very slightly opaque), veins medium brown. Abdomen yellowish, with much dark brown hypodermal pigment, pattern not clearly defined (examined after 10 years in alcohol), but apparently consisting of some segmental patches and transversal bands; terminalia light to medium brown.

Shape of head capsule (Fig. 6a) similar to that of *A. oryx*, frontal suture reduced, ocelli arranged in a flat triangle (Fig. 6a), compound eyes small (IO/D 2.6). Antenna thin and distinctly longer than forewing. One antenna of the holotype apparently complete (i. e. last flagellomere slightly tapering to a regularly rounded tip, bearing a conspicuous terminal sensillum), 11-segmented, the other one broken after f4 (the considerably higher values for lengths of f1 to f3 for the latter may indicate some regenerative length growth, see remark in Lienhard, 2004: 870). Mouthparts generally as described for *Sensitibilla strinatii* by Lienhard (2000). Maxillary palp long and slender, P4 with five thin-walled conical sensilla in apical half, their arrangement somewhat variable (Fig. 3de). Lacinia and wing venation very similar to that of *A. oryx*. Hindwing: R1 present, M1 and M2 originating separately from Rs-M fusion. Spine-like setae on tibiae and tarsi with more or less rounded tips. Pearman-organ of hindcoxa not differentiated, only a mirror-like membranous area present basally on inner side of hindcoxa, both midcoxae with a distinctly prominent hyaline tubercle on inner side. Trichobothrial pattern on legs typical for Sensitibillini. The dorsal pair of long curved hairs subapically on third article of hindtarsus well-differentiated, longer than claw. Two well-separated tufts of long backwards-directed sternal setae present near midline at about basal one third of abdomen (Fig. 6g).

Female terminalia: Epiproct and paraproct simple (Fig. 6b). Ovipositor valvula (Fig. 6e) with a long, relatively broad and slightly curved distal process bearing a short claw-like apical spine and numerous spine-like setae, most of them situated on dorsal side of the process and three on its external margin; basal part of valvula with a transversal row of subapical dorsal setae and one long ventral seta on each side of base of distal process; basal part of valvula externally articulated at posteroventral angle of clunium, its internal margin only slightly curved and not sclerotized in apical part, running parallel to lateral hindmargin of subgenital plate, but the two valvulae not touching each other medially. Posterior part of subgenital plate (Fig. 6e) well-sclerotized and bearing a few short hairs, laterobasally fused to inner base of valvulae but not prolonged into a long sclerotized rim; anterior part of subgenital plate membranous except for a narrow sclerotized longitudinal area just anteriorly to the middle of the convex anterior margin of its posterior part. This margin laterally prolonged into a pair of short curved stylets, ventrally prominent and backwards-directed, the right stylet bearing a short fine hair on its rounded tip, the left one bare. Sclerotized part of subgenital plate perforated by a conspicuous porus in the middle of its anterior margin, between the bulged bases of the stylets; this porus opening to a sclerotized, digitiform, backwards-directed invagination of the subgenital plate (interrupted line in Fig. 6f);

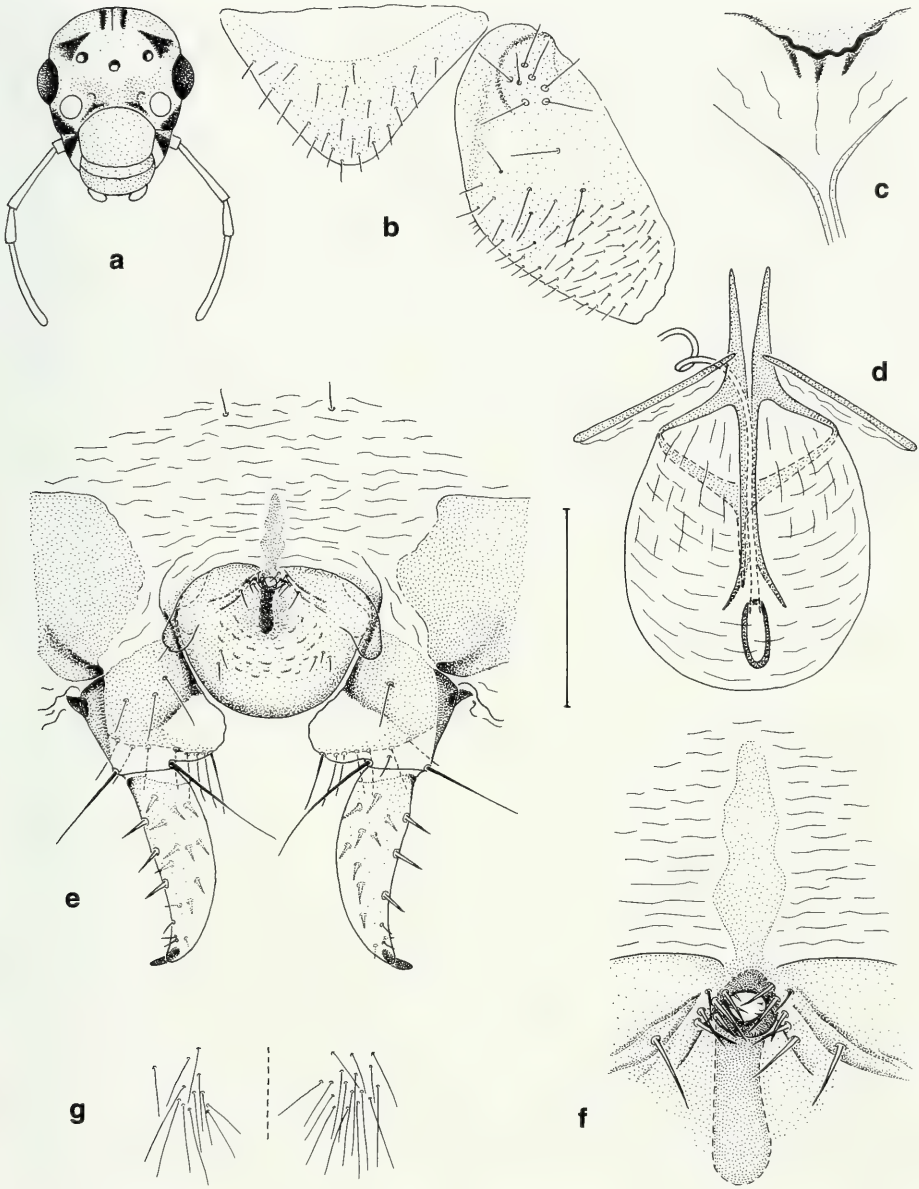

FIG. 6

Afrotrogla maraisi sp. n., female holotype: (a) Head, frontal view. (b) Epiproct and right paraproct. (c) Origin of spermathecal duct and sclerotized wrinkle on spermathecal wall. (d) Spermapore and posterior part of spermathecal duct, with accessory structures, ventral view, scale 0.2 mm. (e) Subgenital plate, ovipositor valvulae and ventrolateral parts of clunium, ventral view, same scale as Fig. 6d. (f) Detail of anteromedian porus on subgenital plate, compare with Fig. 6e. (g) Pair of tufts of long backwards-directed sternal setae at about basal one third of abdomen, middle of sternite shown by an interrupted line.

porus surrounded by heavy sclerotization and laterally flanked by some short stout setae (Fig. 6f), some very fine hyaline hairs (length 3-10 μm) also visible inside the lumen of the porus (only observable at high magnification). Spermapore with a longitudinally oval annular sclerite (Fig. 6d), in situ situated just dorsally of the digitiform invagination of the subgenital plate, near the posterior end of a rounded membranous sac; spermathecal duct of about the same relative length as in *A. oryx* (see Fig. 4g), somewhat spirally curled, its posterior part situated in the above mentioned membranous sac, the latter equipped with a complex scaffolding of sclerotized struts showing the same elements as in *A. oryx* (cf. Figs 6d and 4g). Median paired ventral struts bifurcate posteriorly and not in contact with spermapore sclerite, circular strut (interrupted line in Fig. 6d) dorsomedially prolonged by a backwards directed process (NB. Only a small rudiment of such a process visible in *A. oryx*, see Fig. 4g), lateral struts straight, only slightly backwards-directed, probably movable. Spermathecal wall, near origin of duct, with a slightly undulated sclerotized wrinkle (Fig. 6c). Several spermatophores (sperm packets) visible inside the spermatheca of the holotype, pear-shaped, very similar to the spermatophores of *Sensitibilla strinatii* illustrated by Lienhard (2000: fig. 25).

MEASUREMENTS: *Female holotype*. BL = 2.9 mm; FW = 3.0 mm; HW = 1.6 mm; F = 730 μm; T = 1230 μm; t1= 430 μm; t2 = 113 μm; t3 = 145 μm; flagellomeres (left/right): f1 = 650/740 μm; f2 = 660/800 μm; f3 = 610/750 μm (left antenna complete, 11-segmented, total length 3.9 mm).

ETYMOLOGY: The species is dedicated to Dr Eugene Marais, curator of the entomological collections of the National Museum Namibia and collector of all currently known specimens of the genus *Afrotrogla*.

DISCUSSION: The type of *Afrotrogla maraisi* was collected in Windhoek (central Namibia), but unfortunately no further information on its habitat is available (collecting by trap?). The species can easily be distinguished from *A. oryx* by its head pattern and by the structure of its genitalia: Different shape and pilosity of ovipositor valvula; different shapes of spermapore sclerite, of membranous sac around posterior part of spermathecal duct and of its accessory sclerites; strikingly different structure of subgenital plate. The presence, on the subgenital plate of *A. maraisi*, of a basal porus with a digitiform invagination and a pair of lateral stylets (compared with the simple subgenital plate of *A. oryx*), indicates that these species are only distantly related to each other and could even belong to different genera. At present their generic separation would of course be premature in view of the poorly known species diversity in Sensitibillini. For some remarks on functional morphology see General Discussion (below).

It seems highly unlikely that *A. fabella* (male described below, female unknown) could be the unknown male of *A. maraisi*. As shown by *A. oryx* and by *Sensitibilla brandbergensis*, there exists no significant sexual dimorphism concerning general body size, wing length, IO/D index or colouration of head in Sensitibillini. *A. maraisi* (female) and *A. fabella* (male) clearly differ in all these characters (see key, above).

Afrotrogla fabella sp. n. Figs 3f, 7

TYPE MATERIAL: NMN, holotype ♂ (4 microscopical slides), Namibia, Grootfontein District, Märchenhöhle (in cave), SE 1917 Cb, 30.VIII.1990, leg. E. Marais.

DESCRIPTION: *Male* (female unknown): See diagnosis of tribe and genus, with the following additions. Head uniformly medium brown, no hypodermal pigment pattern visible (examined after 15 years in alcohol, but abdominal hypodermal pigment perfectly preserved). Compound eyes black, antenna medium brown, maxillary palp light brown. Prothorax light brown, pterothorax dorsally dark brown, legs light to medium brown. Wings transparent (pterostigma very slightly opaque), veins dark brown. Abdomen yellowish, with characteristic dark brown hypodermal pigment pattern, especially well-developed dorsally in posterior two thirds of abdomen (Fig. 7a), terminalia dark brown.

Head capsule slightly concave between lateral ocelli, frontal suture weakly developed, ocelli arranged in a flat triangle, almost in a line. Compound eyes very small (IO/D 3.4). Antenna thin and apparently very long (extrapolated from lengths of basal flagellomeres, see measurements; both antennae damaged in the holotype, one of them broken after f3, the other after f6), the basal three flagellomeres together about equal to body length (the very similar values for both antennae of the holotype show that probably no asymmetrical regenerative length growth occurred, see remark in Lienhard, 2004: 870). Mouthparts generally as described for *Sensitibilla strinatii* by Lienhard (2000). Maxillary palp long and slender, P4 with five thin-walled conical sensilla in apical half, their arrangement somewhat variable (Fig. 3f). Lacinia and wing venation very similar to that of *A. oryx*. Hindwing: R1 present, M1 and M2 originating separately from Rs-M fusion. Spine-like setae on tibiae and tarsi with more or less rounded tips. Pearman-organ of hindcoxa not differentiated, only a mirror-like membranous area present basally on inner side of hindcoxa, both midcoxae with a distinctly prominent hyaline tubercle on inner side. Trichobothrial pattern on legs typical for Sensitibillini. Third article of hindtarsus broken on both hindlegs. Abdominal sternites with transversal rows of few short hairs, no tuft(s) of long sternal setae present in basal half of abdomen.

Male terminalia: Epiproct simple, paraproct with some sclerotized wrinkles near group of trichobothria, without prominent posteroventral lobe (Fig. 7d). Hypandrium simple, similar in shape to that of *A. oryx*, but entirely brown (cuticular pigmentation) except for narrow hyaline hindmargin. Phallosome a membranous sac (Fig. 7c), dorsally with a simple, arched and posteriorly rounded aedeagal sclerite (Fig. 7b) (NB. The extent of the anterior opening of the aedeagal arch depends on the degree of squashing of the slide-mounted phallosome).

MEASUREMENTS: *Male holotype*. BL = 4.2 mm; FW = 4.1 mm; HW = 2.2 mm; F = 1250 μm; T = 2220 μm; t1 = 850 μm; t2 = 165 μm; t3 broken on both hindlegs; flagellomeres (left/right): f1 = 1420/1370 μm; f2 = 1530/1410 μm; f3 = 1510/1420 μm.

ETYMOLOGY: The specific epithet refers to the type locality, a cave with the German name Märchenhöhle ("fairy-tale cave"); it is a noun in apposition (from Latin "fabella" = Märchen, fairy-tale).

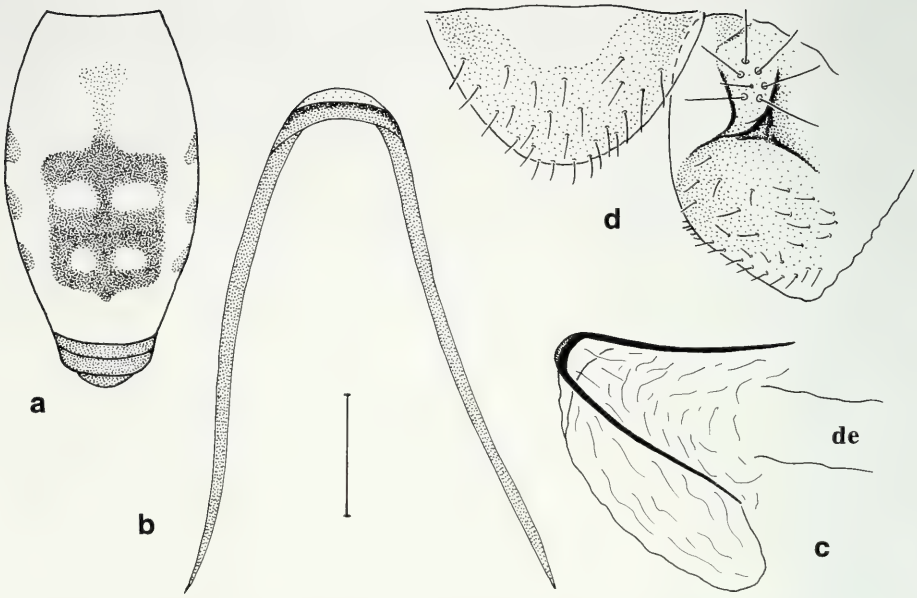

FIG. 7

Afrotrogla fabella sp. n., male holotype: (a) Colour pattern of abdomen, dorsal view. (b) Sclerite of phallosome, scale 0.2 mm. (c) Phallosome, with membranous parts asymmetrically deformed by slide mounting, dorsal view, de = ductus ejaculatorius. (d) Epiproct and right paraproct.

DISCUSSION: The type locality of *Afrotrogla fabella* is situated in northeastern Namibia (19°32'S 17°14'E), far away from Windhoek and the South African Wondergat cave, from where the two other species of the genus are known. For distinction from these species see the corresponding discussions and the key (above).

Sensitibilla Lienhard
Lienhard, 2000: 872.

DIAGNOSIS: See Lienhard (2000) with the following additions. Hindwing with veins Rs and M simple, R1 usually present, rarely absent (see Fig. 9b and Lienhard, 2000: Figs 3, 4). No long curved dorsal hairs subapically on third article of hindtarsus (Fig. 8b). P4 with 2 thin-walled conical sensilla in apical half (Fig. 3g). Both sexes without particularly long backwards-directed sternal setae near midline in basal half of abdomen. Female genitalia (Fig. 8c): Spermapore situated at the posterior end of a small cap-like structure, bearing a simple needle-like accessory sclerite (the spermathecal duct running through the eye of the needle). General morphology of male as in female. Male terminalia: Epiproct and paraproct simple (Fig. 9e); hypandrium simple (Fig. 9c); phallosome lacking pore-bearing processes, with a pair of anteriorly divergent and relatively broad sclerites, each bearing a narrow posterointernal branch, these branches convergent (Fig. 9f) or fused to form a median aedeagal arch (Fig. 9d).

TYPE SPECIES: *Sensitibilla strinatii* Lienhard.

DISCUSSION: See General Discussion, below.

Sensitibilla strinatii Lienhard Plate 1

Lienhard, 2000: 874.

MATERIAL EXAMINED: MHNG, ♀ holotype, 2♀ and 7 nymphs paratypes, Namibia, Arnhem Cave (124 km SE of Windhoek), in cave, 21.X.1999, leg. P. Strinati.

DESCRIPTION: *Female* (male unknown). See original genus and species description, key (above) and extended generic diagnosis (above).

DISCUSSION: See Discussion of *S. brandbergensis* and *S. roessingensis* (below).

Sensitibilla brandbergensis sp. n. Figs 8, 9a-d

TYPE MATERIAL: NMN, holotype ♂ (2 microscopical slides), Namibia, Brandberg, Wasserfallfläche, 1980m, 21°13.5'S 14°31.1'E, 10-12.XI.1998, Malaise trap, river bed, leg. A. H. Kirk-Spriggs. – NMN, paratypes: 1♀ (1 microscopical slide, rest in alcohol), Namibia, Brandberg, Wasserfallfläche, 1960m, 21°10.77'S 14°32.87'E, 7-10.IV.1999, Malaise trap, well-vegetated valley below waterfall, bushy Karoo-Namib shrubland (NA99-M05), leg. S. van Noort & S. G. Compton. 1♀ (alcohol), Namibia, Brandberg, Messum Valley, 700m, 21°13.29'S 14°30.98'E, 5-17.IV.1999, Malaise trap, bushy Karoo-Namib shrubland (NA99-M12), leg. S. van Noort & S. G. Compton. – MHNG, paratypes: ♀ allotype (2 microscopical slides), Namibia, Brandberg, plateau, 1960m, 21°10'50"S 14°32'50"E, 19-21.10.1998, yellow pan trap, leg. R. Butlin & J. Altringham. 1♀ (2 microscopical slides), Namibia, Brandberg, Hungorob Valley, 1180m, 21°11.40'S 14°31.69'E, 5-16.IV.1999, Malaise trap, bushy Karoo-Namib shrubland (NA99-M10), leg. S. van Noort & S. G. Compton.

DESCRIPTION: *Male and female*: See diagnosis of tribe and genus, with the following additions. General colouration yellowish white to very light brown. Compound eyes black. Wings transparent, veins light brown. Abdomen lacking hypodermal pigment (examined after 6-7 years in alcohol); terminalia yellowish to very light brown.

General morphology as described for *S. strinatii* (see Lienhard, 2000). Head capsule slightly concave between lateral ocelli, compound eyes small (IO/D: ♂ 3.0, ♀ 2.6-2.9). Antenna thin and apparently very long (extrapolated from lengths of basal flagellomeres, see measurements; all antennae damaged in the material available), the basal three flagellomeres together somewhat shorter than body length (very similar values for the antennae of the allotype, broken after f6 and f4, show that probably no asymmetrical regenerative length growth occurred, see remark in Lienhard, 2004: 870). P4 with two simple, thin-walled conical sensilla in apical half. Wing venation as in Fig. 9ab, R1 present in hindwing. Spine-like setae on tibiae and tarsi with distinctly rounded tips. Pearman-organ of hindcoxa not differentiated, both midcoxae with a distinctly prominent hyaline tubercle on inner side. Trichobothrial pattern on legs typical for Sensitibillini.

Female terminalia (Fig. 8ac): Epiproct and paraproct as in *S. strinatii* (Lienhard, 2000: Fig. 29), the circular field of dense and long pilosity on paraproct well-developed. Subgenital plate entirely membranous, except for sclerotized rims in zone of fusion with ovipositor valvulae; posterior part of subgenital plate triangular, with subacute apex, almost completely covered by basal parts of ovipositor valvulae, the latter touching each other medially. Ovipositor valvula laterally articulated near anteroventral angle of clunium, ventromedially fused with subgenital plate in a sclerotized rim; anterior margin of clunium prolonged into a broad membranous ventral fold

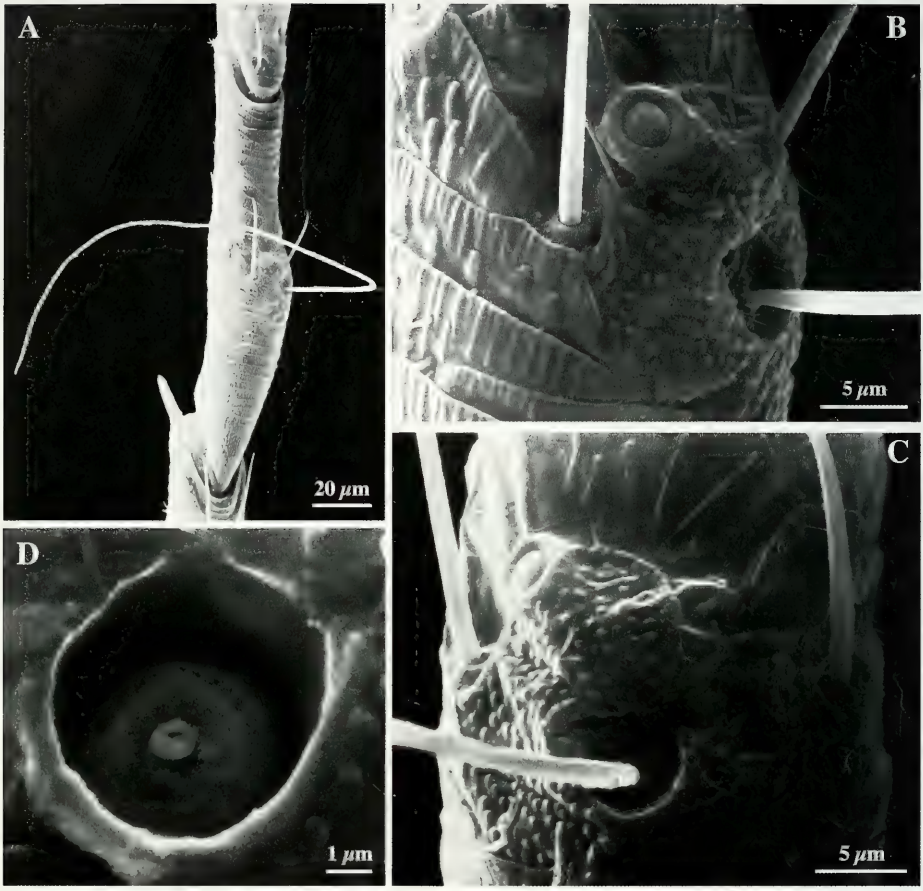

PLATE 1

Sensitibilla strinatii Lienhard, female paratype, hindleg. (A) Second article of hindtarsus with trichobothrium situated dorsally on slightly thickened central zone (dorsolateral view, base of article near bottom of photo); the trichobothrium is actually an erect filiform hair (cf. Fig. 5e), its artificially curved appearance on the photo results from the treatment of the leg for SEM examination. (B) Base of trichobothrium of hindtarsus with adjacent setae and campaniform sensillum, same view as A. (C) Ditto, dorsal view. (D) Socket of tibial trichobothrium, sensillum broken but insertion point visible. SEM micrographs made by J. Wuest (MHNG).

on the valvula. Distal process of ovipositor valvula slightly curved, with a long claw-like apical spine, one external spine-like seta in distal half and several such setae in basal half, two or three of them on ventral side of the process. Basal part of valvula with a transversal row of subapical dorsal setae and some ventral setae, a particularly long one near rounded posterointernal margin. Spermapore situated in a small membranous posteriorly rounded cap, spermathecal duct running through the eye of a simple needle-like acessory sclerite, duct relatively long but not distinctly spirally curled. Spermathecal wall, near origin of duct, with a large kidney-shaped, weakly

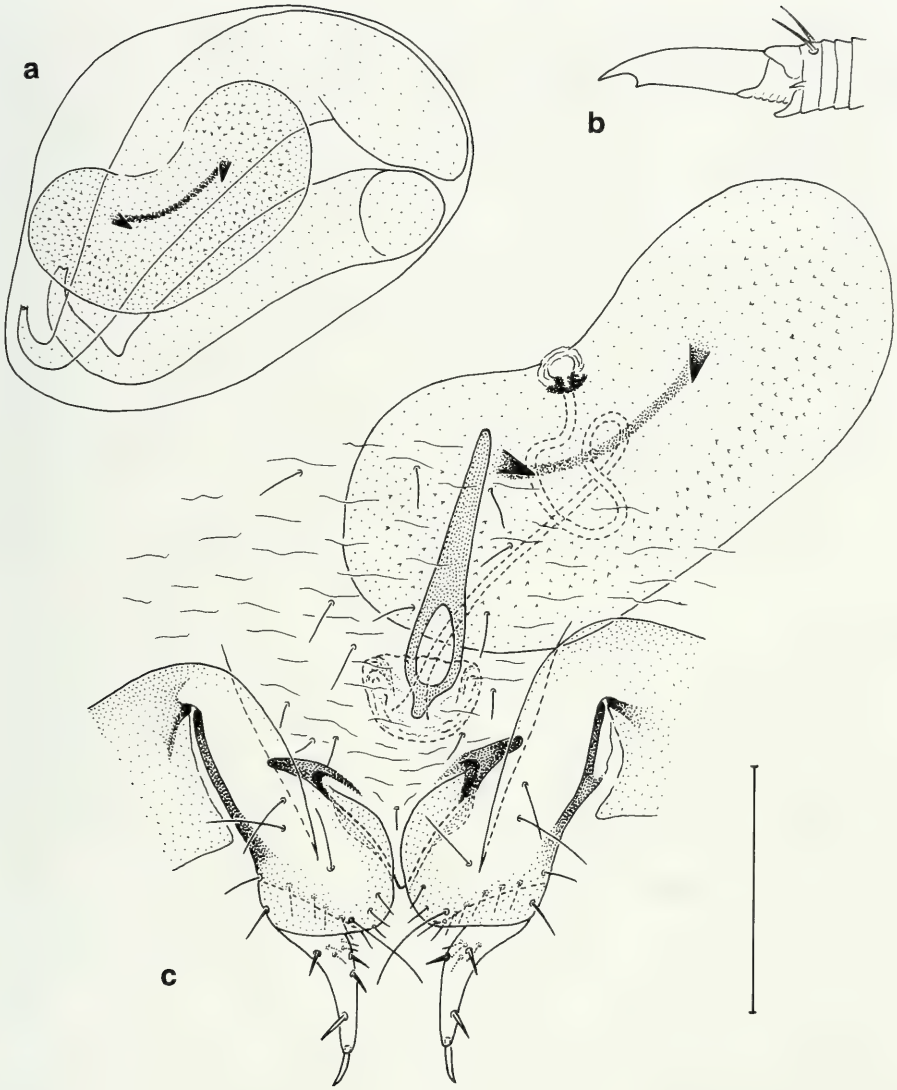

FIG. 8

Sensitibilla brandbergensis sp. n., female: (a) Spermatheca containing two spermatophores, with kidney-shaped sclerotized area of spermathecal wall, spermathecal duct not illustrated. (b) Apex of third article of hindtarsus, only one claw illustrated. (c) Genitalia, ventral view, scale 0.2 mm: Ovipositor valvulae with ventrolateral parts of clunium, subgenital plate and, observed in situ through ventral membranes, spermapore and spermathecal duct with accessory structures and kidney-shaped sclerotized area of spermathecal wall (compare with Fig. 8a).

sclerotized plate (its greatest width about 500 μm) sparsely covered by very fine denticles and bearing a pair of heavily sclerotized teeth directed to the lumen of the spermatheca and connected to each other by a narrow somewhat sclerotized band (in

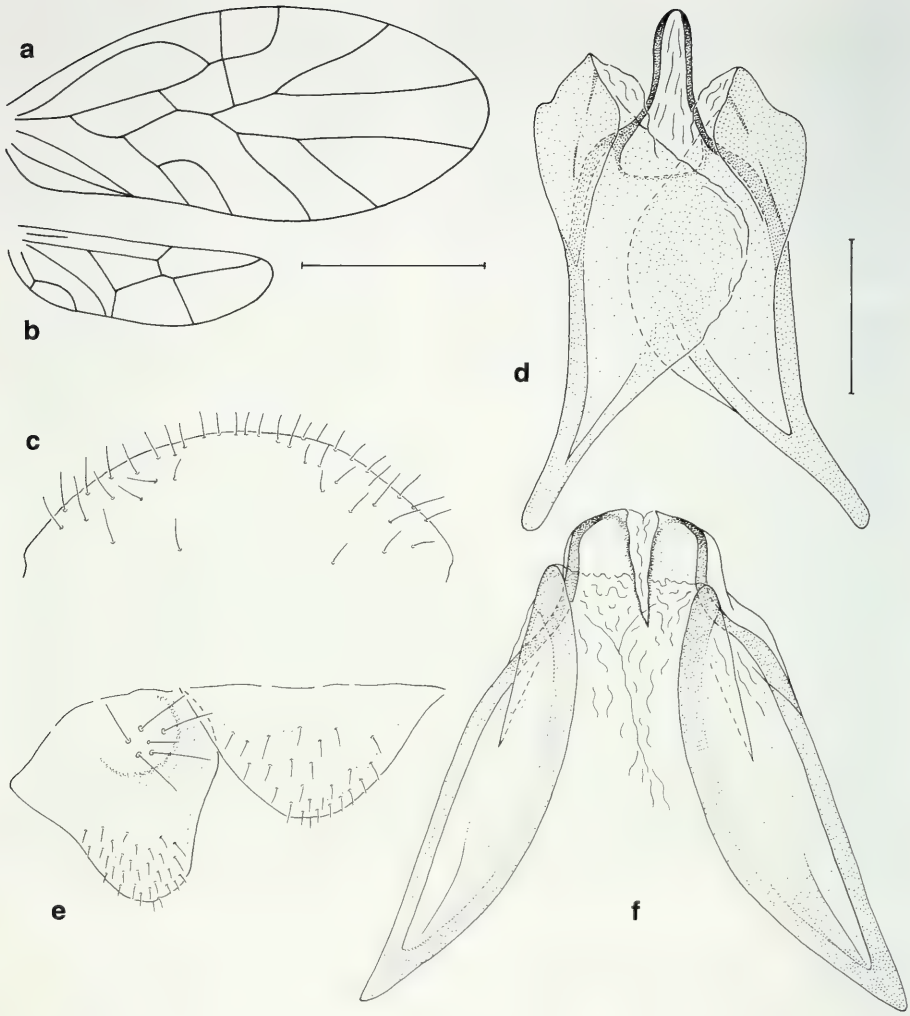

FIG. 9

Sensitibilla brandbergensis sp. n., male holotype (a-d): (a) Forewing, scale 1 mm. (b) Hindwing, same scale. (c) Hypandrium. (d) Phallosome, ventral view, scale 0.2 mm. – *Sensitibilla roessingensis* sp. n., male holotype (e-f): (e) Epiproct and left paraproct. (f) Phallosome, ventral view, same scale as Fig. 9d.

one paratype female one of these teeth not developed). Spermatophores elongately pear-shaped (Fig. 8a).

Male terminalia: Epiproct and paraproct simple (cf. Fig. 9e). Hypandrium simple and almost colourless (Fig. 9c). Phallosome (Fig. 9d) with a pair of foliaceous sclerites, anteriorly divergent, much enlarged in middle, posteriorly each with a well-developed lateral lobe and a narrow internal branch; these branches medially fused and forming a narrow aedeagal arch.

MEASUREMENTS: *Male holotype*. BL = 1.4 mm (strongly shrunk); FW = 2.6 mm; HW = 1.4 mm; F = 600 μm; T = 1000 μm; t1 = 350 μm; t2 = 100 μm; t3 = 125 μm. – *Female allotype*. BL = 2.3 mm (somewhat expanded); FW = 2.7 mm; HW = 1.5 mm; F = 630 μm; T = 1040 μm; t1 = 350 μm; t2 = 105 μm; t3 = 125 μm; flagellomeres (left/right): f1 = 490/480 μm; f2 = 510/535 μm; f3 = 525/550 μm.

ETYMOLOGY: The specific epithet refers to the type locality, Brandberg, the highest mountain massif of Namibia.

DISCUSSION: *S. brandbergensis* is easy to distinguish from *S. strinatii* and *S. roessingensis* by its smaller size, by the almost complete absence of any pigmentation and, above all, by the very characteristic genitalia of both sexes (see also key, above). The type locality of *S. brandbergensis*, the Brandberg massif, is situated in western Namibia, north of the town Swakopmund. *S. brandbergensis* has not been collected in caves, as were most of the other Sensitibillini treated in this study, but in semi-desertic shrubland, in Malaise traps and once in a yellow pan trap. Nothing is known on its biology and it is not unlikely that these minute insects live in soil crevices, from where they regularly come out during the night. The almost complete absence of any pigmentation also points towards such an edaphico-nocturnal mode of life, which is not fundamentally different from life in caves.

Sensitibilla roessingensis sp. n. Figs 3g, 9ef

TYPE MATERIAL: NMN, holotype ♂ (3 microscopical slides), Namibia, Swakopmund District, Rössing Wes Cave (in cave), SE 2214 Db, 10.VIII.1995, leg. E. Marais.

DESCRIPTION: *Male* (female unknown): See diagnosis of tribe and genus, with the following additions. General colouration yellowish to light brown. Compound eyes black. Wings transparent, veins light brown. Abdomen with some brown hypodermal pigment, pattern not clearly visible (examined after 10 years in alcohol), but essentially consisting of some segmental transverse bands; terminalia yellowish to light brown.

General morphology as described for *S. strinatii* (see Lienhard, 2000). Compound eyes small (IO/D 2.9). Antennae broken after f1 and f2. P4 with two simple thin-walled conical sensilla in apical half (Fig. 3g). Both forewings damaged, R1 present in both hindwings. Hindwing relatively long (1.3x greatest width of forewing). Spine-like setae on tibiae and tarsi with distinctly rounded tips. Pearman-organ of hind-coxa not differentiated, both midcoxae with a distinctly prominent hyaline tubercle on inner side. Trichobothrial pattern on legs typical for Sensitibillini.

Male terminalia: Epiproct and paraproct simple (Fig. 9e). Hyandrium simple and almost colourless (cf. Fig. 9c). Phallosome (Fig. 9f) with a pair of somewhat spindle-shaped sclerites, anteriorly divergent, posteriorly each with a weakly developed rounded lobe and a narrow internal branch; these branches curved towards midline of phallosome apex but not fused into a continuous aedeagal arch, medioapical lobe of phallosome deeply notched.

MEASUREMENTS: *Male holotype*. BL = 2.2 mm; HW = 1.6 mm; F = 720 μm; T = 1260 μm; t1 = 470 μm; t2 = 125 μm; t3 = 150 μm; flagellomeres (left/right): f1 = 540/530 μm; f2 = – /540 μm.

ETYMOLOGY: The specific epithet refers to the type locality, Rössing Wes Cave.

DISCUSSION: The type locality of *Sensitibilla roessingensis* is situated in western Namibia, on the Namib Desert plains, about 30 km from the town of Swakopmund. It seems rather unlikely that *S. roessingensis* could be the unknown male of *S. strinatii,* described from Arnhem Cave in central Namibia. The specific diversity observed in Sensitibillini suggests that these isolated and widely separated populations belong to different species, even if they are closely related in view of their general morphology. *S. roessingensis* is apparently slightly smaller than *S. strinatii* (T = 1.5 mm in the latter) but has relatively long hindwings (in *S. strinatii* hindwing length only very slightly exceeding greatest width of forewing). The forewing length of these species could not be compared, because both forewings are damaged in the holotype of *S. roessingensis*. In the holotype of *S. strinatii* the proximal P4 sensillum is slightly lobate (Lienhard, 2000: Fig. 8), in the holotype of *S. roessingensis* it is simple (detail in Fig. 3g), but this difference is of doubtful taxonomic value. An additional argument not to assign tentatively the male from Rössing cave to *S. strinatii* is the fact that the latter is the type species of the genus. The definition of the genus could become problematic due to such an unclear concept of the type species.

GENERAL DISCUSSION

PHYLOGENETICS

Due to the symplesiomorphic presence of an archaic wing venation, the extant Prionoglarididae may be considered as "living fossils" (see Introduction). However, the different clades of this family are characterized by striking autapomorphies and surprising specializations unknown elsewhere in Psocoptera. Characters of Prionoglaridinae have been treated by Lienhard (1988, 1998, 2004). In the following some characters of Speleketorinae are discussed with regard to the phylogeny of this subfamily.

The presence of trichobothria on legs, unique in Psocoptera (see also below), has been considered as an important synapomorphy of Speleketorinae (see Lienhard, 2000, 2004), but it may also be interpreted as an adaptive homoplasy related to the particular biology of these generally cavernicolous psocids. However, the monophyly of Speleketorinae is also supported by molecular data (see Yoshizawa *et al.*, 2006) and by the slight but almost identical extent of metamorphosis of their mouthparts, in particular the lacinia, during adult moult (see Lienhard, 2004). Therefore the presence of leg trichobothria is here also considered as an autapomorphy of this subfamily. Each tribe is characterized by a particular arrangement of trichobothria on the leg segments (see key above and Lienhard, 2000: figs 17-24). Most elements of the characteristic trichobothrial pattern in adults are already present in nymphs (at least in later instars, first instars not examined) so that these can easily be assigned to a tribe, in spite of the very similar habitus of all prionoglaridid nymphs. It is difficult to decide what kind of trichobothrial pattern should be considered as plesiomorphic within the subfamily. The presence of a tarsal trichobothrium in Sensitibillini, unique in insects (see below), may be an indication that the Sensitibillini pattern has to be considered as apomorphic compared to the Speleketorini pattern. However, each pattern could be an autapo-

morphy of the respective tribe with regard to an unknown initial pattern of their common ancestor. It is interesting to see that in both clades, Speleketorini and Sensitibillini, 2-3 trichobothria per leg are generally present; in Sensitibillini they have "migrated" to the distal segments (tibiae and hindtarsus), whereas in Speleketorini they can be found on the more proximal segments (trochanters and femora). In bugs (Hemiptera: Heteroptera), where leg trichobothria have almost certainly evolved several times independently, they are present on coxae, trochanters and femora (Schuh, 1975) (occasionally trichobothria-like setae also occur on tibiae in some semiaquatic bugs, see Moller Andersen, 1982). According to Schuh (1975) the Heteroptera, like the Arachnida, seem to be disposed to the multiple evolution of these structures, whereas leg trichobothria are unknown elsewhere in insects. The example of the Speleketorinae shows that leg trichobothria have also evolved in some basal Psocodea, the sister-group of the Condylognatha (i.e. Thysanoptera and Hemiptera) within the Paraneoptera (see Yoshizawa & Saigusa, 2001). See also discussion on Funcional Morphology (below).

The Speleketorinae (or perhaps the Prionoglarididae in general) could also be characterized by a reduced number of antennal segments. The normal trogiomorphan antenna has more than 20 segments (i. e. scapus, pedicellus and at least 18 flagellomeres); however, a slightly reduced number (19 segments) has been mentioned by Yoshizawa *et al.* (2006) for an undescribed species of Psyllipsocidae. In Prionoglarididae the antennae are always very thin and long and therefore broken in most of the material available. I am not aware of any published number of antennal segments of a complete antenna in *Prionoglaris*, and I could not find any complete antenna in the material of this genus at my disposal (MHNG). In *Siamoglaris* the antenna is more than 10-segmented (Lienhard, 2004: 870) but the exact number of segments remains unknown. Mockford (1984: 170) observed three complete antennae with a variable number of segments (7, 10, 15) in *Speleketor*. Lienhard (2000: 874) reported one complete 13-segmented antenna in a female of *Sensitibilla strinatii* (i.e. last flagellomere slightly tapering to a regularly rounded tip, bearing a conspicuous terminal sensillum). In *Afrotrogla maraisi* one complete antenna with 11 segments has been mentioned in the above description. Maybe the reduced and apparently variable number of antennal segments could also constitute an autapomorphy of the subfamily Speleketorinae, or even of the whole family Prionoglarididae. However, more flagellomere counts of undoubtedly complete antennae are needed to confirm the taxonomic value of this character.

The Sensitibillini are characterized by the synapomorphic structure of their female ovipositor, i. e. external valvulae with a strong distal process and ventrobasally fused to subgenital plate to form a functional unit (see also below). The genus *Speleketor* has relatively plesiomorphic female genitalia, as described by Yoshizawa *et al.* (2006) for Trogiomorpha. However, this genus is characterized by the autapomorphic structure of the phallosome, having its basal sclerites anteriorly fused (phallosome anteriorly open in Sensitibillini, as usual in the suborder Trogiomorpha), and by the autapomorphic presence of a row of small spines on anterior face of the forefemur. Another possible autapomorphy of the Sensitibillini is the absence of the pore-bearing processes of the phallosome, which probably belong to the groundplan of the Trogiomorpha (see Discussion under Sensitibillini above, where two additional wing characters of minor importance are also discussed).

Within Sensitibillini, the genus *Afrotrogla* is characterized by highly complex structures associated with the spermapore and by an extremely simplified phallosome (see also below). In addition, females of this genus have a dorsal pair of long curved hairs subapically on the third article of the hindtarsus and some long backwards-directed sternal setae near the midline in the basal half of the abdomen. All of these characters are probably autapomorphies of *Afrotrogla*.

The genus *Sensitibilla* is characterized by the particularly tight basal fusion of the ovipositor valvulae with the subgenital plate, so that the posterior part of the latter becomes entirely membranous, being completely covered by the valvulae. Two other autapomorphies of this genus are the absence of M2 in the hindwing and the reduction of the number of thin-walled conical sensilla on P4 (2 in *Sensitibilla* vs 5-7 in other prionoglaridids, see Fig. 3).

The high species diversity of Sensitibillini (i. e. six species, each from a different locality, all collected by non-specialists) in the relatively sparse material known from southern Africa indicates that these psocids are probably highly diversified in this region, especially in caves, but possibly also outside caves (see collecting data of *Sensitibilla brandbergensis*). I am sure that further sampling in southern Africa, and especially in Namibia, will significantly increase our knowledge of this interesting group of Psocoptera.

Functional morphology

Genitalia: The possible biological significance (digging organ?) of the particular ovipositor valvulae and of their partial fusion with the subgenital plate was briefly discussed by Lienhard (2000) for *Sensitibilla*. The fusion, unique in Psocoptera, is also present but less developed in *Afrotrogla*. The conspicuous porus (probably a glandular opening) on the subgenital plate of *Afrotrogla maraisi* is also a highly specialized structure. Its function is unknown, but it possibly forms a functional unit with the pair of lateral stylets present on the subgenital plate of this species (see Fig. 6ef). The porus opens into a digitiform invagination of the subgenital plate and is surrounded by a series of stout setae. Some very fine hyaline hairs (length 3-10 μm) could also be observed in the lumen of the porus. This pilosity has probably a protective function against intrusion of dust etc. into the porus. Structures similar to this porus and to the stylets have never been observed in Psocoptera. They may play a role in oviposition by producing a protective secretion and distributing it on the surface of newly laid eggs. However, the absence of the porus and of the stylets in *Afrotrogla oryx* and in *Sensitibilla* shows that these structures are not essential parts of the functional unit "ovipositor valvulae – subgenital plate", present in all Sensitibillini. The unusual tuft(s) of long sternal setae basally on the abdomen of females of *Afrotrogla* and the pair of long curved subapical hairs on their hindtarsus (both absent in males) probably also play a role in reproductive biology.

The membranous vesicle associated with the spermapore and its complex accessory structures, present in females of *Afrotrogla*, are also unique in Psocoptera. These structures are counterbalanced by an extreme simplification of phallosome sclerites in this genus. In *A. oryx* the phallosome sclerite and the accessory structures to spermapore are of very similar width (cf. scales to Figs 4g and 5c). It seems likely

that the otherwise relatively complex trogiomorphan phallosome structures are here functionally replaced by the complex female structures associated with the spermapore. According to Klier (1956) the pincer-like pair of parameres in male Trogiomorpha clasps the evaginated spermapore (opening of spermathecal duct) of females during the long-lasting copulation (often more than two hours) and is responsible for the close grip of male and female genitalia during sperm transmission. In *Afrotrogla* this role may have been transferred, at least partially, to the complex set of sclerites present near the opening of the spermathecal duct in females, in view of the reduction of the phallosome sclerites to a simple and rigid aedeagal arch. In this context it is interesting to note that in *Sensitibilla* the much more complex phallosome, bearing a pair of movable sclerites, is paralleled by a very simple spermapore sclerite.

Trichobothria on legs: These trichobothria are very fine, but relatively rigid, long and erect filiform hairs inserted in special sockets. They have briefly been discussed by Lienhard (2000), who mentioned that they are probably vibroreceptors sensitive to air currents and low frequency air vibrations (sound) and may be interpreted as adaptations to cave life. Some SEM micrographs are here presented for the first time (Pl. 1); they show the shape of the deep pit-like trichobothrial socket and the differences between the latter and the socket of a normal tactile hair. The particular trichobothrial pattern of Sensitibillini has been described in the diagnosis of the tribe. The presence of a trichobothrium on the second article of the hindtarsus (Pl. 1ABC) in nymphs and adults of all Sensitibillini is of some general interest, because tarsal trichobothria seem to be unknown elsewhere in insects (Schuh, 1975 and Schuh *in litt.*). Trichobothria are known from different body parts in insects, but on legs they have only been found in some Heteroptera families: In Miridae, Gerridae and Veliidae trichobothria regularly occur on coxae, trochanters and femora (Schuh, 1975), but never on tarsi (occasionally trichobothria-like setae are seen on tibiae in some semi-aquatic Heteroptera, see Moller Andersen, 1982).

The trichobothrium on the second article of the hindtarsus of Sensitibillini is situated dorsally on the thickened central part of the article, in a zone of granular cuticle, and it is always accompanied by a campaniform sensillum (Pl. 1BC). Such an auxiliary sensillum could not be observed near the tibial trichobothria. Similar campaniform sensilla, which are sensitive to slight deformations in the cuticle, have for instance been observed near cercal trichobothria of the cricket *Gryllus bimaculatus* (see Barth, 1986: fig. 11e). No histological examination of these tarsal trichobothria was made, but the central thickening of the second article of the hindtarsus (Pl. 1A) indicates that the neurological equipment of this specialized sensillum is particularly space consuming. All tarsal articles without trichobothria, of all pairs of legs, are of normal cylindrical shape in Sensitibillini, as is the case in *Speleketor* and in Prionoglaridinae.

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A review of the catfish genus *Hara*, with the description of four new species (Siluriformes: Erethistidae)

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A review of the catfish genus *Hara*, with the description of four new species (Siluriformes: Erethistidae). - Species of the erethistid catfish genus *Hara* are reviewed in this study. Eight species are recognized: *Hara filamentosa*, *H. hara*, *H. horai*, *H. jerdoni*, *H. longissima*, *H. mesembrina*, *H. minuscula*, and *H. spinulus*, of which the latter four are described as new herein. *Erethistes maesotensis* is a junior synonym of *Hara filamentosa*, and *H. saharsai* and *H. serrata* junior synonyms of *H. hara*. A neotype is designated for *H. filamentosa* Blyth, 1860 and a lectotype is designated for *Hara horai* Misra, 1976.

Keywords: Sisoroidea - Bangladesh - India - Myanmar - Thailand.

INTRODUCTION

The Erethistidae are a small family of sisoroid catfishes inhabiting hillstreams in the subhimalayan region and western Indochina. The erethistid catfish genus *Hara* consists of small to medium sized catfishes with a brown cryptic coloration and heavily tuberculate skin. Species of *Hara* are diagnosed from other members of the family in having an anteroventral flange on the ventral surface of the complex centrum and the parapophysis of the fifth vertebra with a vertical lamina (de Pinna, 1996). The genus has been recorded from the Ganges-Brahmaputra river drainages eastwards to the Salween River drainage in western Thailand (Hora, 1950; Kottelat, 1989; Ukkatawewat & Vidthayanon, 1998).

Recently, the authors obtained material from southern Thailand that considerably extends the southernmost extent of the distribution of *Hara*. Our attempts to identify this material prompted us to investigate the identities of specimens collected from India, Myanmar and Thailand. The following study presents the results of this investigation, which reviews the species of *Hara*. We report here eight species of *Hara*, of which four are described as new.

We received Thomson & Page's (2006) list of generic and species names in the families Erethistidae and Sisoridae after the present work was completed. A compila-

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tion of such a nature would make sense as the completion of a revision of the various genera and species (but not before). Thomson & Page treat *Hara* as a junior synonym of *Erethistes*. In the discussion below, we mention the results of a phylogenetic analysis based on both morphological and molecular data that make it premature to formally synonymise these genera. This is discussed in greater detail in HHN's doctoral dissertation (Ng, 2006). Thomson & Page's list of species and synonymies of *Hara* are apparently compilations, and do not affect our conclusions below (based on our studies of a considerable number of specimens).

MATERIALS AND METHODS

Measurements were made point to point with dial callipers and data recorded to 0.1 mm. 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 and counts were made following Ng & Kottelat (1998) with the following addition: the length of the posterior process on coracoid is measured from the anterior edge of the coracoid where the process is situated to the posterior tip of the process.

Fin rays were counted under a binocular dissecting microscope using transmitted light. Vertebrae were counted from radiographs obtained with a Hewlett Packard Faxitron 43855B cabinet x-ray machine. Vertebral counts and terminology follow those of Roberts (1994). Material for this study is deposited in the following collections: Natural History Museum, London (BMNH), California Academy of Sciences, San Francisco (CAS), collection of the second author, Cornol (CMK), Muséum d'histoire naturelle Genève (MHNG), Naturhistoriska Riksmuseet, Stockholm (NRM), Museum of Zoology, University of Michigan, Ann Arbor (UMMZ), and the Zoological Reference Collection of the Raffles Museum of Biodiversity Research, Singapore (ZRC).

RESULTS

Hara filamentosa Blyth, 1860 Fig. 1

Hara filamentosa Blyth, 1860: 152 (type locality: Tenasserim)
Erethistes conta (non Hamilton): Vinciguerra, 1890: 250.
Erethistes maesotensis Kottelat, 1983: 71, Fig. 1 (type locality: Mae Nam Moei, 5 km west of Mae Sot, Thailand)

MATERIAL EXAMINED: CMK 11961 (2), 48.9-53.1 mm SL; CMK 14689 (9), 42.1-44.4 mm SL; Thailand: Tak province, Mae Nam Moei at Ban Wa Le. CMK 12175 (2), 44.6-47.0 mm SL; ZRC 42223 (1), 46.3 mm SL; Thailand: Tak province, stream at km 57 on road from Mae Sot to Wa Le (5 km before Wa Rei). ZRC 41269 (1), 44.3 mm SL; Thailand: Tak province, Mae Nam Moei at 16°17'47.1"N 98°42'44.9"E. MHNG 2150.5 (1 paratype of *Erethistes maesotensis*), 19.7 mm SL; Thailand: Tak province, Mae Nam Moei, 5 km W of Mae Sot. ZRC 50647 (1), 43.1 mm SL; Thailand: Tak province, Mae Nam Moei at Mae Sot (border with Myanmar), 16°41'13.2"N 98°30'54.0"E. CMK 14640 (11), 32.1-48.6 mm SL; MHNG 2680.076 (3), 40.2-48.1 mm SL; CMK 15102 (17), 20.6-30.1 mm SL; MHNG 2680.075 (5), 24.1-27.2 mm SL; Thailand: Tak province, Huai Mae Lamao, about 2 km N of road 105 on road from Ban Mae Lamao to Ban Mae Ramat. CMK 5529 (1), 48.3 mm SL; Thailand: Tak province, Huai Mae Lamao at Ban Mae Lamao. UMMZ 197583 (1), 47.4 mm SL; Thailand: Tak province, Mae

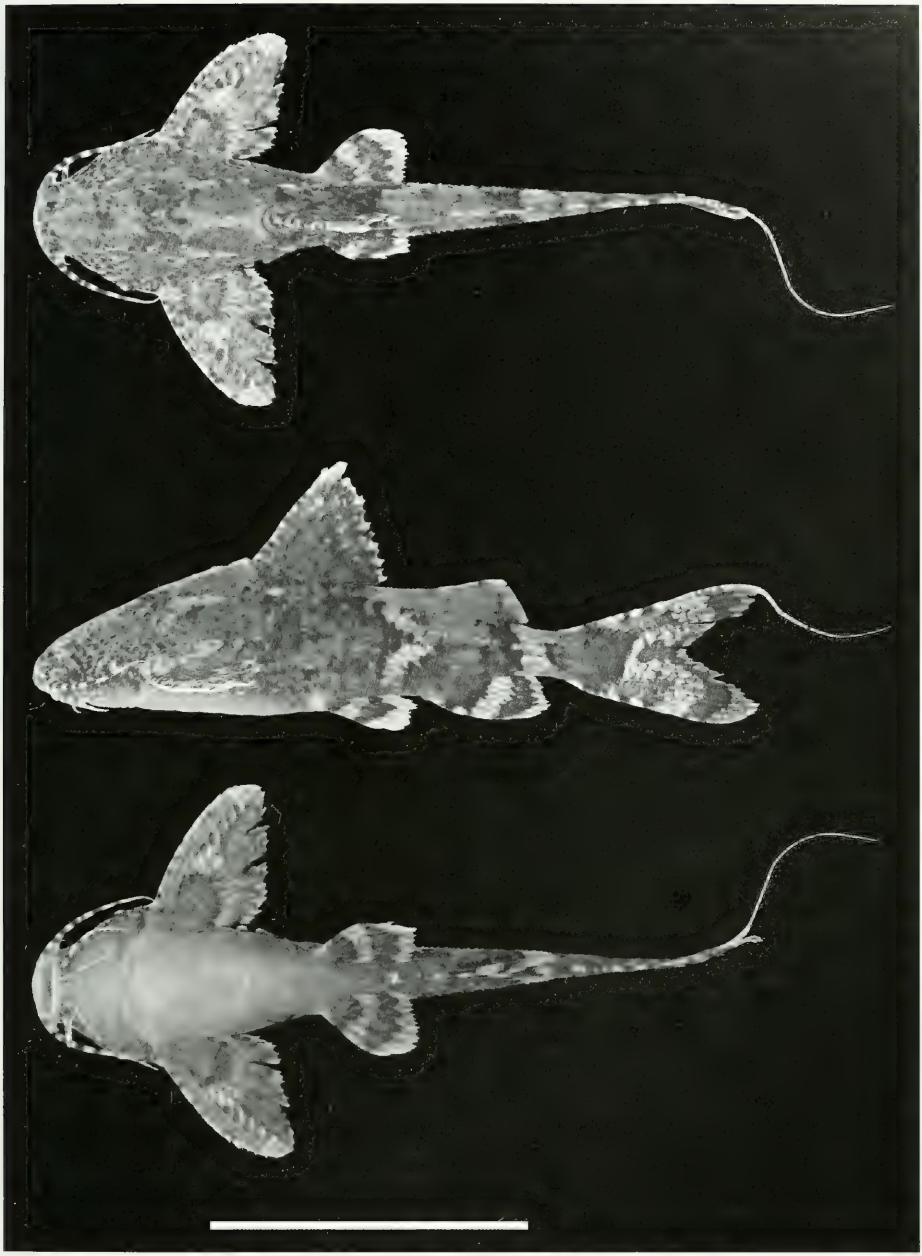


FIG. 1
Hara filamentosa, neotype, MHNG 2687.038, 43.7 mm SL; Myanmar: Megathat Chaung. Scale bar: 25 mm.

Lamao, tributary of Salween River. CMK 14769 (1), 55.2 mm SL; Thailand: Mae Hong Son province, Huai Hai, about 5 km from Mae Hong Son to Pai road, on road turning off north at km 44. CMK 16186 (5), 41.4-52.4 mm SL; CMK 17951 (2), 44.8-62.7 mm SL; Thailand: Mae Hong Song province, Salween River at Mae Sam Leap. CMK 16198 (1), 45.3 mm SL; Thailand: Mae Hong Son province, Nam Mae Kong Ka, 4-8 km upstrean of confluence with Salween River. CMK 16227 (1), 46.9 mm SL; Thailand: Mae Hong Son province, Salween River about 1 km upstream of Ban Mae Sam Leap. BMNH 1893.2.16.12-14 (3), 49.4-59.1 mm SL. – Myanmar: Meetan (=Mitan Chaung, a rivulet flowing S from the summit of Mulayet Taung, 16°11'N 98°32'E, in the Salween basin). MHNG 2687.038, neotype, 43.7 mm SL; CMK 17786 (4), 46.8-59.7 mm SL; CMK 17951 (2), 45.1-61.2 mm SL; Myanmar: Kayin state, Ataran River drainage, stream "Chon Son" between Kyondaw and Phadaw, about 20 km NW of Payathouzu (at border with Thailand), 15°25'N 98°15'E. UMMZ 243692 (6), 46.4-50.0 mm SL; Myanmar: from aquarium trade. UMMZ 245962 (1), 53.7 mm SL; Myanmar: Bago division, Pyu township, Pyu stream (tributary of Sittang River) ca. 229 km from Yangon, 18°29'N 96°26'E. UMMZ 245964 (9), 56.7-67.1 mm SL; Myanmar: Kayin state, hillstreams in Ataran River drainage in the vicinity of Payathonzu.

Diagnosis: *Hara filamentosa* can be distinguished from congeners (except *H. mesembrina* and *H. longissima*) in sometimes having (vs. always lacking) a filamentous extension to the first principal ray of the upper caudal-fin lobe; it is also distinguished from all congeners except *H. hara* and *H. longissima* in having a short posterior process on coracoid (reaching to midway of distance between bases of pectoral spine and first pelvic-fin ray vs. two thirds or beyond; length 19.9-22.8% SL vs. 23.5-38.3). It differs from *H. longissima* in having a shorter (length 14.9-17.8% SL vs. 18.8-21.3) and deeper (depth 6.1-7.2% SL vs. 5.0-6.1) caudal peduncle (depth 2.1-2.9 times in its length for *H. filamentosa* vs. 3.1-3.9 times in *H. longissima*) and deeper body (depth 13.9-19.2% SL vs. 12.5-14.5). *Hara filamentosa* can be further distinguished from *H. hara* in having a longer adipose-fin base (15.7-21.7% SL vs. 11.8-15.6), deeper caudal peduncle (depth 6.1-7.2% SL vs. 5.0-5.8) and lacking (vs. presence) of serrations on the anterior edge of the dorsal spine, from *H. horai* in having a deeper caudal peduncle (depth 6.1-7.2% SL vs. 5.2-6.2) and a shorter adipose-fin base (length 15.7-21.7% SL vs. 10.0-13.7) and head (length 26.5-29.1% SL vs. 30.3-34.2), from *H. jerdoni* in having a shorter pectoral spine (length 23.3-29.9% SL vs. 42.2-51.7), more soft pectoral-fin rays (total number of soft fin rays modally 7 vs. 5), more vertebrae (31–34 vs. 27-29), the supraoccipital spine not reaching (vs. reaching) the anterior nuchal plate and a deeply forked (vs. emarginate) caudal fin. It differs from *H. mesembrina* in having a shorter caudal peduncle (length 14.9-17.8% SL vs. 17.2-18.9), from *H. minuscula* in having more soft pectoral-fin rays (total number of soft fin rays modally 7 vs. 5) and the supraoccipital spine not reaching (vs. reaching) the anterior nuchal plate, and from *H. spinulus* in having a longer dorsal spine (length 20.4-27.6% SL vs. 14.7-19.8), adipose-fin base (length 15.7-21.7% SL vs. 12.9-16.1) and caudal peduncle (length 14.9-17.8 % SL vs. 11.8-15.0).

Description: Morphometric data in Table 1. Head and body moderately compressed. Dorsal profile curved from tip of snout to level of nares, then evenly sloping to origin of dorsal fin; evenly sloping ventrally to origin of adipose fin and gently concave from origin of adipose fin to end of caudal peduncle. Ventral profile flat to pelvic-fin base; sloping gently dorsally to end of anal-fin base and gently concave from end of anal-fin base to end of caudal peduncle. Anus and urogenital openings

TABLE 1. Morphometric data for *Hara filamentosa* (n=25: 43.7-67.1 mm SL).

	Range	Mean±SD
%SL		
Predorsal length	42.1-46.7	44.3±1.44
Preanal length	69.1-72.9	70.4±1.14
Prepelvic length	49.0-52.3	51.0±1.04
Prepectoral length	21.3-27.8	24.0±1.66
Length of dorsal fin base	17.2-20.7	18.9±1.16
Dorsal spine length	20.4-27.6	23.6±2.48
Anal fin length	13.0-17.2	14.8±1.10
Pelvic fin length	16.0-19.6	17.2±1.20
Pectoral fin length	25.6-32.4	28.8±2.16
Pectoral spine length	23.3-29.9	27.0±1.99
Caudal fin length	20.9-30.3	26.7±2.80
Length of adipose fin base	15.7-21.7	18.7±1.99
Dorsal to adipose distance	5.1-11.0	7.2±1.96
Post-adipose distance	14.1-18.3	16.5±1.50
Caudal peduncle length	14.9-17.8	16.7±0.88
Caudal peduncle depth	6.1-7.2	6.8±0.37
Body depth at anus	13.9-19.2	16.9±1.65
Head length	26.5-29.1	28.0±0.91
Head width	21.0-27.0	24.7±1.75
Head depth	19.1-24.3	21.5±1.54
Length of posterior process on coracoid	19.9-22.8	21.3±1.04
%HL		
Snout length	50.0-60.7	54.9±3.60
Interorbital distance	32.2-41.4	37.3±3.04
Eye diameter	12.5-15.5	13.7±1.21
Nasal barbel length	12.6-22.1	17.0±3.59
Maxillary barbel length	57.5-94.4	85.0±10.66
Inner mandibular barbel length	31.0-45.4	38.1±4.47
Outer mandibular barbel length	37.4-61.3	52.5±8.00

located at vertical through posterior three quarters of adpressed pelvic fin. Skin tuberculate, tubercles distributed evenly throughout head and body. Lateral line complete and midlateral. Vertebrae 14+17=31 (1), 14+18=32 (2), 15+17=32 (2), 14+19=33 (1), 15+18=33 (5), 16+17=33 (4), 15+19=34 (2) or 16+18=34 (7).

Snout narrow; profile dorsally rounded when viewed laterally and acutely triangular when viewed from above. Snout with pronounced steepening of curvature anteriorly at level of posterior nares when viewed laterally. Anterior and posterior nares large and separated by flap of skin comprising base of nasal barbel. Gill openings narrow, extending from immediately ventral to posttemporal to immediately lateral to point immediately ventral to base of pectoral spine. Bony elements of dorsal surface of head covered with thin, tuberculate skin and very prominent. Supraoccipital spine not reaching anterior nuchal plate. Weberian lamina well developed, approximately same length as supraoccipital spine and extending parallel to either side of spine. Eye ovoid, horizontal axis longest; located entirely in dorsal half of head, with faint dorsal ridge on frontal bone dorsal to eye. Orbit with free margin.

Barbels in four pairs. Maxillary barbel long and slender, extending to middle of pectoral-spine base. Nasal barbel short, subtended by flap of skin at base and extending to midway between posterior edge of posterior nares and anterior margin of orbit. Inner mandibular-barbel origin close to midline, extending to middle of distance between its base and that of pectoral spine. Outer mandibular barbel originating posterolateral of inner mandibular barbel, extending to about three quarters of distance between its base and that of pectoral spine.

Mouth inferior, premaxillary tooth band not exposed when mouth is closed. Upper lip with indistinct plicae. Oral teeth small and villiform, in irregular rows on all tooth-bearing surfaces. Premaxillary teeth in single crescentic band across midline. Palate edentulous. Dentary teeth in two narrow crescentic bands separated at midline.

Dorsal fin located above anterior third of body, with I,5,i (25) rays; dorso-posterior fin margin straight. Dorsal spine moderately long and gently curved; with smooth anterior margin and posterior margin with 4-7 serrae. Adipose fin with anterior margin straight and posterior margin angular. Caudal fin strongly forked, with i,7,7,i (1), i,7,8,i (23) or i,8,7,i (1) principal rays; upper lobe slightly longer than lower. First principal ray of upper caudal-fin lobe produced into a filament extending posteriorly for length of upper caudal lobe proper. Procurrent rays symmetrical and extending only slightly anterior to fin base. Anal-fin base approximately in line with adipose-fin base. Anal fin with convex margin anteriorly and straight margin posteriorly, with iii,6,i (3), iv,6 (2) iv,6,i (8), iii,7 (2), iii,7,i (5), v,6 (1), iv,7 (1) or iv,7,i (3) rays. Pelvic-fin origin anterior to vertical through posterior end of dorsal-fin base. Pelvic fin with pointed tip and straight posterior margin, with i,5 (25) rays; tip of adpressed fin just reaching anal-fin origin. Pectoral fin with I,5,i (3) or I,6,i (22) rays; fin margin gently convex posteriorly; anterior spine margin with 14–23 small distally directed serrations, posterior margin with 9-13 large medially directed serrations. Coracoid with well developed posterior processes, extending to midway between base of posteriormost pectoral-fin ray and pelvic-fin origin.

Colour: Head and body dark chestnut brown to light chocolate brown, with a mottling caused by numerous smaller, irregular darker brown patches. Belly and ventral surfaces of head light brown. Two thin, irregular light brown bars on body: first chevron-shaped and located between dorsal- and adipose-fin bases, second thicker than first and located on caudal peduncle. Dorsal fin dark mottled brown, except for thin hyaline distal margin. Pectoral fin dark brown, with thin hyaline distal margin and either a small ovoid hyaline spot or a crescentic median hyaline band on middle third of fin. Pelvic and anal fins hyaline, with dark brown bases and subdistal stripes. Adipose fin brown as in body, with lighter coloured distal margin. Caudal fin hyaline, with irregular W-shaped band subdistally and with small dark brown flecks randomly distributed throughout fin. Two small light brown patches present at bases of caudal-fin lobes in some individuals. Maxillary and mandibular barbels light brown, with dark brown annuli.

DISTRIBUTION. *Hara filamentosa* is known from the Ataran, Salween and Sittang river drainages (Fig. 2). In the Salween, it has been collected in the Salween proper and the Mae Nam Moei, in Tak and Mae Hong Son Provinces of Thailand.

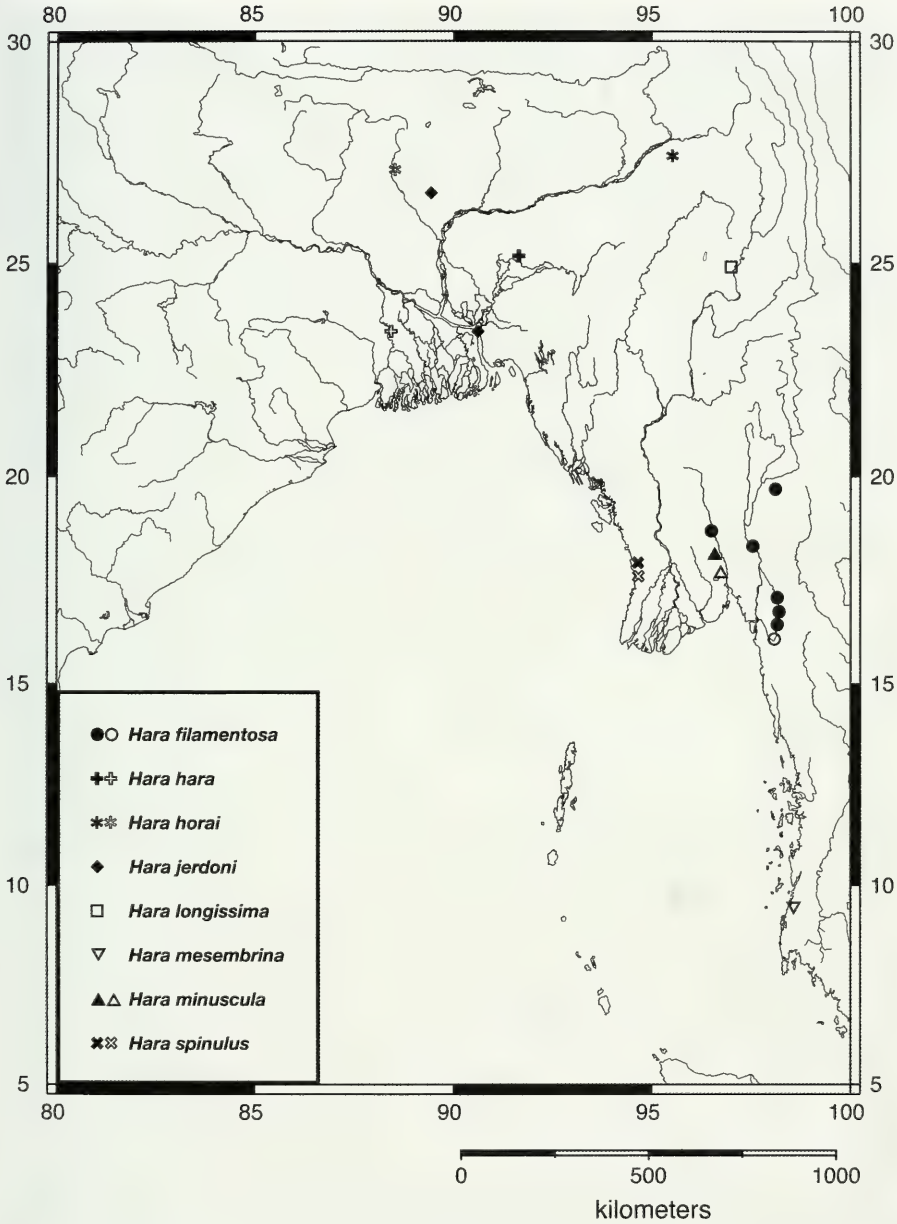


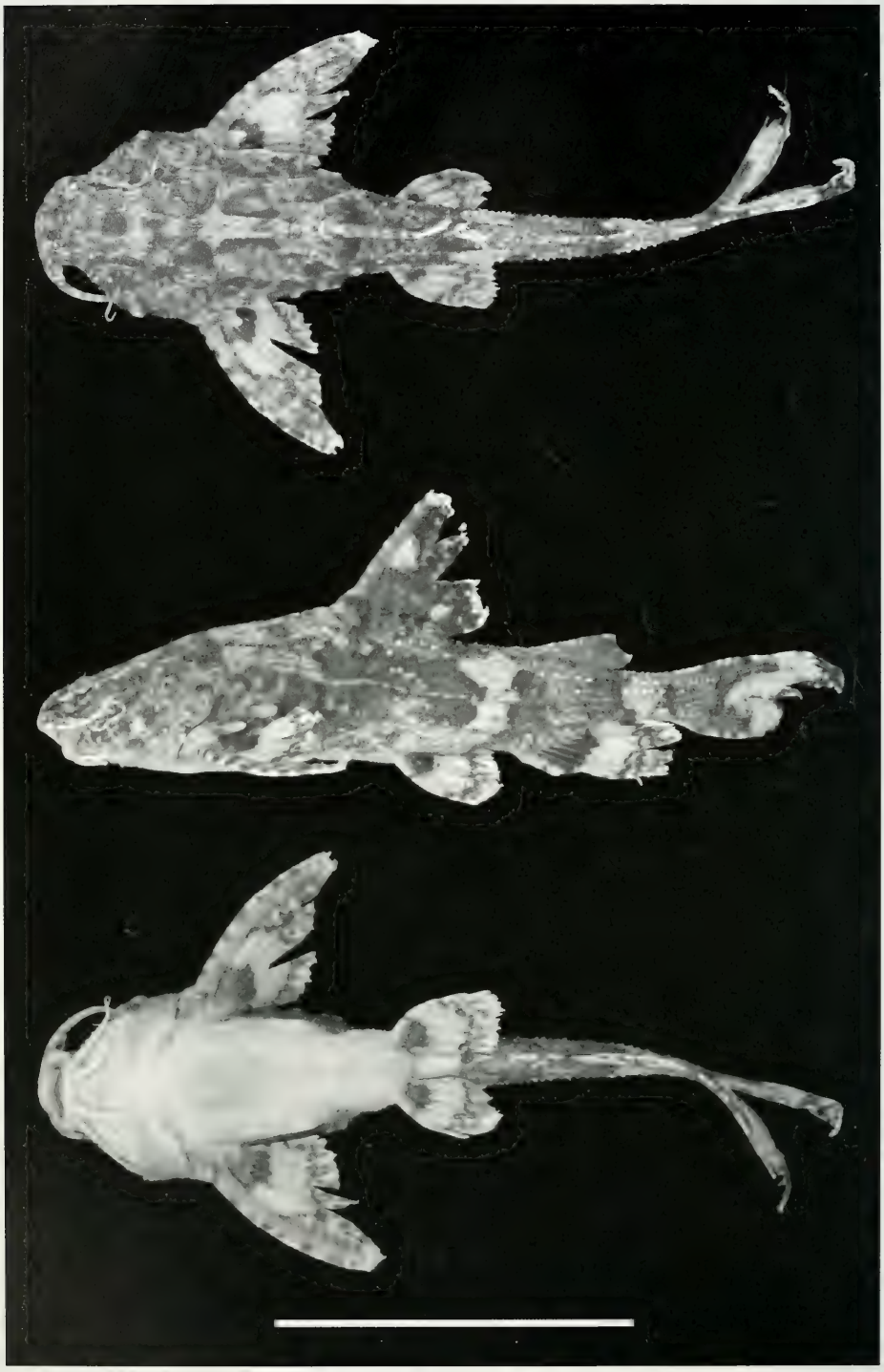
FIG. 2

Map showing collecting localities of *Hara* examined. Outlined symbols are type localities.

Hara hara (Hamilton 1822) Fig. 3

Pimelodus hara Hamilton, 1822: 190 (type locality: Nathpur, India)

Pimelodus asperus M'Clelland, 1844: 404, pl. 24 fig. 2 (type locality: Hooghly River S of Ranaghat)



Hara saharsai Datta Munshi & Srivastava, 1988: 265, fig. 5 (type locality: Kosi Belt, northern Bihar, India)

Hara serratus Vishwanath & Kosygin, 2000: 143, figs 2-5 (type locality: Jiri River at Jiribam, Manipur, India)

MATERIAL EXAMINED: UMMZ 244697 (neotype), 47.2 mm SL; India: W Bengal, Hooghly River S of Ranaghat. UMMZ 208748 (44), 33.0-50.0 mm SL; Bangladesh: Gowain River at Gowainghat.

DIAGNOSIS: *Hara hara* can be distinguished from congeners in possessing (vs. lacking) serrations on the anterior edge of the pectoral spine. It further differs from *H. filamentosa*, *H. mesembrina* and *H. longissima* in always lacking (vs. sometimes having) a filamentous extension to the first principal ray of the upper caudal-fin lobe; it is also distinguished from all congeners except *H. filamentosa* and *H. longissima* in having a short posterior process on coracoid (reaching to midway of distance between bases of pectoral spine and first pelvic-fin ray vs. two thirds or beyond; length 19.9-24.8% SL vs. 23.5-38.3). *Hara hara* further differs from *H. filamentosa* in having a shorter adipose-fin base (11.8-15.6% SL vs. 15.7-21.7) and slenderer caudal peduncle (depth 5.0-5.8% SL vs. 6.1-7.2), from *H. horai* in having a longer caudal fin (25.8-28.0% SL vs. 20.5-23.5), slenderer body (11.5-14.3% SL vs. 15.1-17.9) and a shorter head (length 27.2-30.9% SL vs. 30.3-34.2), from *H. jerdoni* in having a shorter pectoral spine (length 26.9-33.3% SL vs. 42.2-51.7), more soft pectoral-fin rays (total number of soft fin rays modally 7 vs. 5), more vertebrae (31-34 vs. 27-29), the supraoccipital spine not reaching (vs. reaching) the anterior nuchal plate, and a deeply forked (vs. emarginate) caudal fin. It further differs from *H. mesembrina* in having a slenderer caudal peduncle (depth 5.0-5.8% SL vs. 6.0-7.4), from *H. minuscula* in having a narrower head (width 22.4-24.3% SL vs. 24.5-27.2), more soft pectoral-fin rays (total number of soft fin rays modally 7 vs. 5) and the supraoccipital spine not reaching (vs. reaching) the anterior nuchal plate, and from *H. spinulus* in having a longer dorsal spine (22.7-27.4% SL vs. 14.7-19.8), narrower head (width 22.4-24.3% SL vs. 25.9-30.0) and slenderer caudal peduncle (depth 5.0-5.8% SL vs. 6.7-8.5).

DESCRIPTION: Morphometric data in Table 2. Exactly as in *Hara filamentosa*, except for the following. Vertebrae 14+18=32 (7), 15+17=32 (4), 14+19=33 (1), 15+18=33 (9) or 15+19=34 (3). Dorsal fin with I,5,i (24) rays. Dorsal spine moderately long and gently curved; with serrated anterior margin and posterior margin with 8-13 serrae. Caudal fin with i,7,6,i (24) principal rays. First principal ray of upper caudal-fin lobe not produced into a filament. Anal fin with iv,6,i (24) rays. Pelvic fin with i,5 (24) rays. Pectoral fin with I,6,i (24) rays; anterior spine margin with 17-24 small distally directed serrations, posterior margin with 12-17 large medially directed serrations. Coracoid with well developed posterior processes, extending to midway between base of posteriormost pectoral-fin ray and pelvic-fin origin.

Colour: Head and body chestnut brown or light brown, with a mottling caused by numerous smaller, irregular darker brown patches. Belly and ventral surfaces of head light brown. Two thin, irregular light brown bars on body: first chevron-shaped and located between dorsal- and adipose-fin bases, second thicker than first and located

FIG. 3

Hara hara, neotype, UMMZ 244697, 47.2 mm SL; India: Hooghly River at Ranaghat. Scale bar: 25 mm.

TABLE 2. Morphometric data for *Hara hara* (n=24: 33.0-50.0 mm SL).

	Range	Mean±SD
%SL		
Predorsal length	44.0-45.5	44.6±0.64
Preanal length	66.9-70.9	68.7±1.54
Prepelvic length	47.6-53.6	51.1±2.28
Prepectoral length	21.2-27.3	24.4±2.22
Length of dorsal fin base	16.7-21.0	18.6±1.60
Dorsal spine length	22.7-27.4	24.5±1.88
Anal fin length	14.6-16.8	15.6±0.82
Pelvic fin length	15.8-18.2	16.8±0.91
Pectoral fin length	30.0-36.2	32.5±2.40
Pectoral spine length	26.9-33.3	30.0±2.32
Caudal fin length	25.8-28.0	27.0±1.01
Length of adipose fin base	11.8-15.6	14.0±1.46
Dorsal to adipose distance	10.8-12.7	12.0±0.71
Post-adipose distance	15.7-18.6	17.2±1.27
Caudal peduncle length	14.6-19.4	17.7±1.85
Caudal peduncle depth	5.0-5.8	5.4±0.34
Body depth at anus	11.5-14.3	12.8±1.28
Head length	27.2-30.9	29.6±1.41
Head width	22.4-24.3	23.5±0.91
Head depth	18.6-20.1	19.3±0.61
Length of posterior process on coracoid	19.9-24.8	22.0±1.79
%HL		
Snout length	50.0-54.7	51.8±1.87
Interorbital distance	31.5-38.0	35.4±2.53
Eye diameter	9.4-10.9	10.1±0.65
Nasal barbel length	14.8-21.9	18.0±3.07
Maxillary barbel length	80.8-108.2	93.4±9.78
Inner mandibular barbel length	34.2-49.6	43.6±6.13
Outer mandibular barbel length	52.1-67.2	60.8±6.13

on caudal peduncle. Dorsal fin dark mottled brown, except for thin hyaline distal margin. Pectoral fin dark brown, with thin hyaline distal margin and either a small ovoid hyaline spot or a crescentic median hyaline band on middle third of fin. Pelvic and anal fins hyaline, with dark brown bases and subdistal stripes. Adipose fin brown as in body, with lighter coloured distal margin. Caudal fin hyaline, with irregular W-shaped band subdistally and with small dark brown flecks randomly distributed throughout fin. Two small light brown patches present at bases of caudal-fin lobes in some individuals. Maxillary and mandibular barbels light brown, with dark brown annuli.

DISTRIBUTION: *Hara hara* is known from the Brahmaputra and Ganges river drainages (Fig. 2).

Hara horai Misra, 1976 Fig. 4

Hara horai Misra, 1976: 245, Pl. 9 figs 1-3 (type locality: Terai and Duars, northern Bengal, India)

MATERIAL EXAMINED: ZSI FF955 (lectotype), 58.8 mm SL; India: West Bengal, Terai and Duars. UMMZ 245633 (2), 56.2-73.1 mm SL; ZRC 50578 (2), 41.8-62.7 mm SL; India: Assam,

Tinsukia, Dibru River at Guijan. ZRC 50576 (3), 44.8-50.4 mm SL; India: Assam, Guijan. ZRC 38914 (2), 83.4-85.4 mm SL; ZRC 41364 (1), 77.8 mm SL; India: Assam, from aquarium trade.

DIAGNOSIS: *Hara horai* can be distinguished from *H. filamentosa* in always lacking (vs. sometimes having) a filamentous extension to the first principal ray of the upper caudal-fin lobe and having a slenderer caudal peduncle (depth 5.2-6.2% SL vs. 6.1-7.2), shorter adipose-fin base (length 10.0-13.7% SL vs. 15.7-21.7), longer head (length 30.3-34.2% SL vs. 26.5-29.1) and posterior process on coracoid (reaching to two-thirds distance between bases of pectoral spine and first pelvic-fin ray vs. midway; length 23.5-26.2% SL vs. 19.9-22.8), from *H. hara* in having a shorter caudal fin (20.5-23.5% SL vs. 25.8-28.0), deeper body (15.1-17.9% SL vs. 11.5-14.3), and a longer head (length 30.3-34.2% SL vs. 27.2-30.9), and from *H. jerdoni* in having a shorter pectoral spine (length 28.0-33.4% SL vs. 42.2-51.7), more soft pectoral-fin rays (total number of soft fin rays modally 7 vs. 5), more vertebrae (31-34 vs. 27-29), the supraoccipital spine not reaching (vs. reaching) the anterior nuchal plate and a deeply forked (vs. emarginate) caudal fin. It differs from *H. longissima* in always lacking (vs. sometimes having) a filamentous extension to the first principal ray of the upper caudal-fin lobe and having a shorter adipose-fin base (length 10.0-13.7% SL vs. 13.3-16.5) and caudal peduncle (length 15.5-17.9% SL vs. 18.8-21.3), a deeper body (depth 15.1-17.9% SL vs. 12.5-14.5), a longer head (length 30.3-34.2% SL vs. 26.0-29.1) and a smaller eye (diameter 8.0-9.8% HL vs. 11.3-13.8), from *H. mesembrina* in always lacking (vs. sometimes having) a filamentous extension to the first principal ray of the upper caudal-fin lobe and having a shorter adipose-fin base (length 10.0-13.7% SL vs. 13.5-17.0), slenderer caudal peduncle (depth 5.2-6.2% SL vs. 6.0-7.4), longer head (length 30.3-34.2% SL vs. 22.1-27.3) and smaller eye (diameter 8.0-9.8% HL vs. 13.1-17.9), from *H. minuscula* in having a longer head (30.3-34.2% SL vs. 24.8-28.4), shorter posterior process on coracoid (reaching to two thirds of distance between bases of pectoral spine and first pelvic-fin ray vs. three quarters; length 23.5-26.2% SL vs. 29.5-32.9), more soft pectoral-fin rays (total number of soft fin rays modally 7 vs. 5) and the supraoccipital spine not reaching (vs. reaching) the anterior nuchal plate, and from *H. spinulus* in having a longer dorsal spine (length 21.0-28.4% SL vs. 14.7-19.8), shorter adipose-fin base (length 10.0-13.7% SL vs. 12.9-16.1), longer (length 15.5-17.9% SL vs. 11.8-15.0) and slenderer (depth 5.2-6.2% SL vs. 6.7-8.5) caudal peduncle, longer head (length 30.3-34.2% SL vs. 26.9-28.9) and smaller eye (diameter 8.0-9.8% SL vs. 11.2-14.4).

DESCRIPTION: Morphometric data in Table 3. Exactly as in *Hara filamentosa*, except for the following. Vertebrae 14+17=31 (1), 15+16=31 (1), 14+18=32 (6), 15+17=32 (1) or 14+19=33 (1). Dorsal fin with I,5,i (10) rays. Dorsal spine moderately long and gently curved; with smooth anterior margin and posterior margin with 8–11 serrae. Caudal fin with i,7,6,i (10) principal rays. First principal ray of upper caudal-fin lobe not produced into a filament. Anal fin with iv,6,i (10) rays. Pelvic fin with i,5 (10) rays. Pectoral fin with I,6,i (10) rays; anterior spine margin with 19–25 small distally directed serrations, posterior margin with 9-17 large medially directed serrations. Coracoid with well developed posterior processes, extending to two-thirds distance between base of posteriormost pectoral-fin ray and pelvic-fin origin.

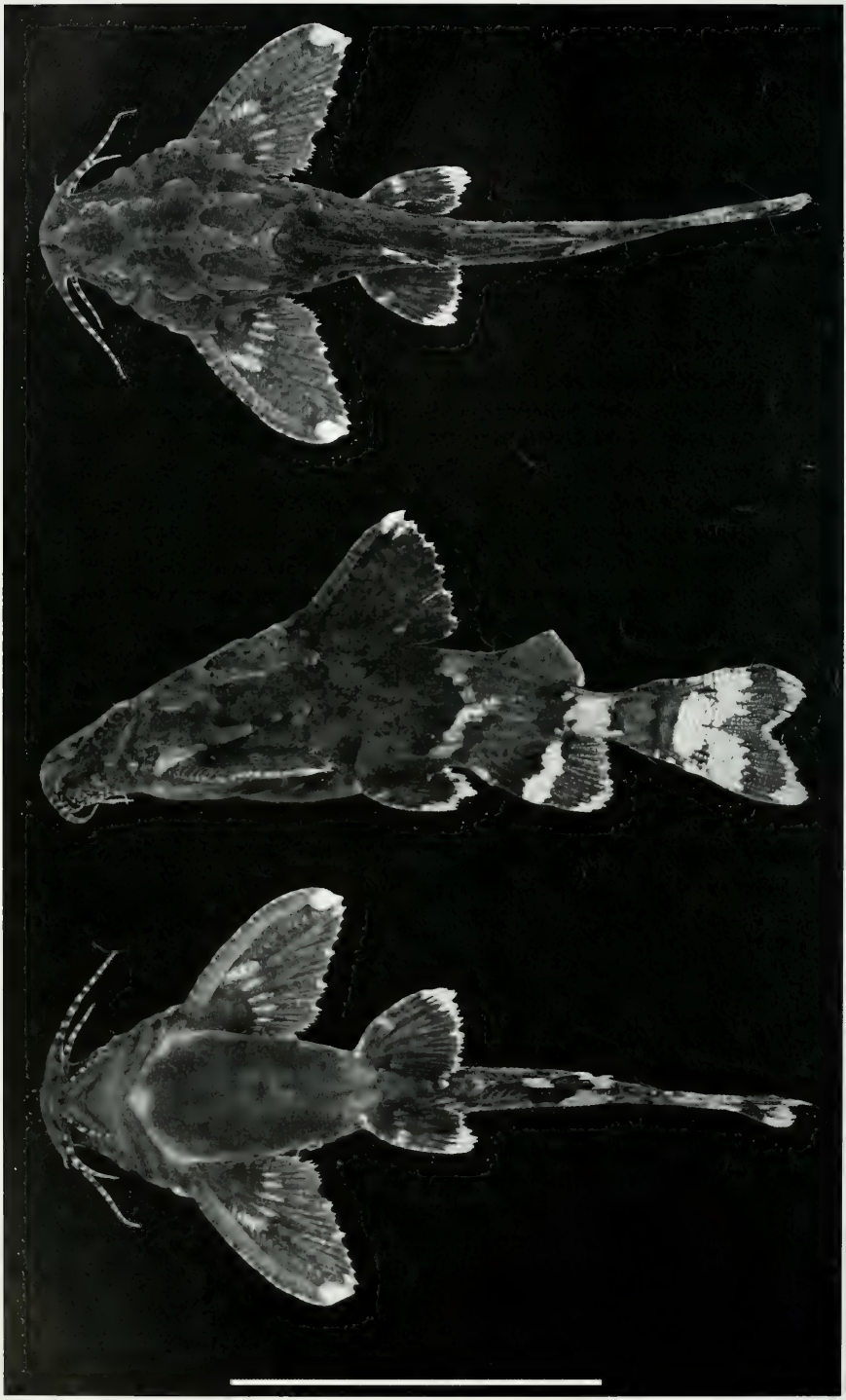


TABLE 3. Morphometric data for *Hara horai* (n=10: 41.8-85.4 mm SL).

	Range	Mean±SD
%SL		
Predorsal length	42.1-49.2	46.4±2.35
Preanal length	68.6-70.9	69.9±0.86
Prepelvic length	50.7-53.2	52.0±0.88
Prepectoral length	23.0-29.4	25.8±2.22
Length of dorsal fin base	19.1-23.3	21.0±1.82
Dorsal spine length	21.0-28.4	24.0±2.60
Anal fin length	11.2-17.7	14.6±2.25
Pelvic fin length	14.8-18.7	17.2±1.73
Pectoral fin length	30.9-36.5	32.6±3.01
Pectoral spine length	28.0-33.4	30.4±2.07
Caudal fin length	20.5-23.5	23.5±1.72
Length of adipose fin base	10.0-13.7	12.2±1.40
Dorsal to adipose distance	7.7-12.5	10.8±2.00
Post-adipose distance	14.0-16.7	15.6±1.08
Caudal peduncle length	15.5-17.9	16.6±0.89
Caudal peduncle depth	5.2-6.2	5.7±0.39
Body depth at anus	15.1-17.9	16.7±1.01
Head length	30.3-34.2	31.6±1.61
Head width	23.1-29.6	27.3±2.27
Head depth	19.6-21.9	21.1±0.83
Length of posterior process on coracoid	23.5-26.2	24.7±1.63
%HL		
Snout length	48.0-53.3	50.0±2.06
Interorbital distance	30.8-36.5	33.7±2.10
Eye diameter	8.0-9.8	8.8±0.82
Nasal barbel length	15.8-26.0	21.2±4.90
Maxillary barbel length	71.5-84.6	76.2±5.08
Inner mandibular barbel length	32.4-40.0	36.9±3.37
Outer mandibular barbel length	40.4-52.6	45.9±4.48

Colour: Head and body dark chestnut dark chocolate brown, without mottling. Belly and ventral surfaces of head light brown. Two thin, irregular light brown bars on body: first chevron-shaped and located between dorsal- and adipose-fin bases, second thicker than first and located on caudal peduncle. Dorsal fin dark brown, except for thin hyaline distal margin. Pectoral fin dark brown, with thin hyaline distal margin and either a small ovoid hyaline spot or a crescentic median hyaline band on middle third of fin. Pelvic and anal fins hyaline, with dark brown bases and subdistal stripes. Adipose fin brown as in body, with lighter coloured distal margin. Caudal fin hyaline, with irregular W-shaped band subdistally and with small dark brown flecks randomly distributed throughout fin. Maxillary and mandibular barbels light brown, with dark brown annuli.

DISTRIBUTION: *Hara horai* is known from the Brahmaputra River drainage (Fig. 2).

FIG. 4

Hara horai, ZRC 38914, 83.4 mm SL; India: Assam. Scale bar 50 mm.

Hara jerdoni Day, 1870 Fig. 5

Hara jerdoni Day, 1870: 39, Pl. 4 (type locality: Sylhet district, Bangladesh)

MATERIAL EXAMINED: UMMZ 208401 (12), 15.6–20.6 mm SL; Bangladesh: Dakatia River at Chandpur. UMMZ 244581 (1), 19.2 mm SL; India: West Bengal, Dolong River (a tributary of the Mansai River) in the vicinity of Shildanga, 26°23'13"N 89°14'31"E.

DIAGNOSIS: *Hara jerdoni* can be distinguished from all congeners in having a longer pectoral spine (length 42.2–51.7% SL vs. 23.3–34.7), fewer vertebrae (27-29 vs. 30-35) an emarginate (vs. deeply forked) caudal fin and a longer posterior process on coracoid (reaching to four fifths of distance between bases of pectoral spine and first pelvic-fin ray vs. three quarters or less; length 34.4-38.3% SL vs. 19.9-32.9). It further differs from all congeners except *H. minuscula* in having fewer soft pectoral-fin rays (total number of soft fin rays modally 5 vs. 6-7) and the supraoccipital spine reaching (vs. not reaching) the anterior nuchal plate. *Hara jerdoni* is also the smallest species of *Hara*, not reaching ca. 25 mm SL in maximum size (vs. ca. 30 mm SL in *H. minuscula* and 60 mm SL in other congeners; Table 4).

DESCRIPTION: Morphometric data in Table 5. Exactly as in *Hara filamentosa*, except for the following. Vertebrae 14+13=27 (1), 14+14=28 (3), 15+13=28 (6) or 15+14=29 (2). Supraoccipital spine reaching anterior nuchal plate. Dorsal fin with I,5,i (12) rays. Dorsal spine moderately long and gently curved; with smooth anterior margin and posterior margin with 4-5 serrae. Caudal fin emarginate, with i,5,5,i (12) principal rays; without filamentous extension to first principal ray of upper lobe. Anal fin with iii,5,i (11) or iii,6,i (1) rays. Pelvic fin with i,5 (12) rays. Pectoral fin with I,4,i (12) rays; anterior spine margin with 18-25 small distally directed serrations, posterior margin with 10-12 large medially directed serrations. Coracoid with well developed posterior process, extending to four-fifths distance between base of posteriormost pectoral-fin ray and pelvic-fin origin.

Colour: Head and body dark chestnut brown to light chocolate brown, with a mottling caused by numerous smaller, irregular darker brown patches. Belly and ventral surfaces of head light brown. Two thin, irregular light brown bars on body: first chevron-shaped and located between dorsal- and adipose-fin bases, second thicker than first and located on caudal peduncle. Dorsal fin dark mottled brown, except for thin hyaline distal margin. Pectoral fin dark brown, with thin hyaline distal margin and either a small ovoid hyaline spot or a crescentic median hyaline band on middle third of fin. Pelvic and anal fins hyaline, with dark brown bases and subdistal stripes. Adipose fin brown as in body, with lighter coloured distal margin. Caudal fin hyaline, with irregular W-shaped band subdistally and with small dark brown flecks randomly distributed throughout fin. Two small light brown patches present at bases of caudal-fin lobes in some individuals. Maxillary and mandibular barbels light brown, with dark brown annuli.

DISTRIBUTION: *Hara jerdoni* is known from the Brahmaputra River drainage (Fig. 2), and has also been recorded from the Ganges River drainage (Husain & Tilak, 1978).

FIG. 5

Hara jerdoni, UMMZ 208401, 19.2 mm SL; Bangladesh: Dakatia River. Scale bar: 10 mm.

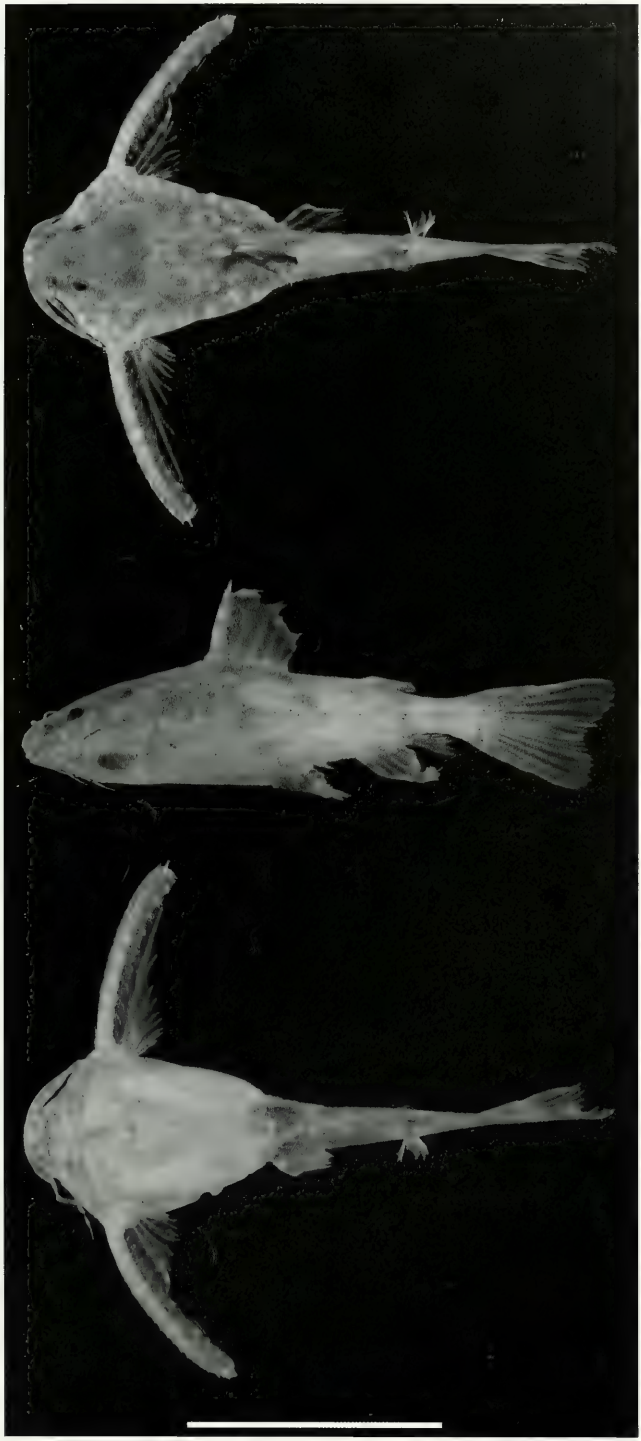


TABLE 4. Maximum known sizes of *Hara* species

Species	Maximum size (SL)
Hara filamentosa	67 mm
Hara hara	50 mm
Hara horai	85 mm
Hara jerdoni	21 mm
Hara longissima	55 mm
Hara mesembrina	55 mm
Hara minuscula	30 mm
Hara spinulus	50 mm

TABLE 5. Morphometric data for *Hara jerdoni* (n=11: 15.6-20.6 mm SL).

	Range	Mean±SD
%SL		
Predorsal length	38.5-43.3	41.5±2.62
Preanal length	67.3-70.3	68.9±1.51
Prepelvic length	53.1-54.3	53.8±0.64
Prepectoral length	18.0-19.7	18.6±0.93
Length of dorsal fin base	19.1-19.7	19.4±0.31
Dorsal spine length	19.1-21.4	19.9±1.30
Anal fin length	14.4-16.3	15.4±0.96
Pelvic fin length	14.4-15.5	14.8±0.59
Pectoral fin length	46.6-46.9	46.8±0.21
Pectoral spine length	42.2-51.7	48.0±4.69
Caudal fin length	24.5-27.9	26.6±1.81
Length of adipose fin base	9.9-12.9	11.0±1.68
Dorsal to adipose distance	10.8-12.0	11.4±0.60
Post-adipose distance	15.5-18.2	16.5±1.46
Caudal peduncle length	14.9-15.4	15.1±0.25
Caudal peduncle depth	4.7-5.3	5.1±0.32
Body depth at anus	15.5-16.1	15.8±0.31
Head length	27.6-29.4	28.6±0.93
Head width	25.5-31.3	28.2±2.92
Head depth	22.6-23.7	23.2±0.57
Length of posterior process on coracoid	34.4-38.3	36.4±1.40
%HL		
Snout length	41.6-47.2	44.2±2.81
Interorbital distance	37.7-41.6	39.9±2.00
Eye diameter	12.3-17.0	14.2±2.48
Nasal barbel length	16.7-28.1	21.2±6.05
Maxillary barbel length	52.8-105.3	77.7±26.35
Inner mandibular barbel length	37.7-51.7	46.2±7.45
Outer mandibular barbel length	47.2-84.2	66.0±18.51

Hara longissima sp. nov. Fig. 6

HOLOTYPE: UMMZ 245902, 51.2 mm SL; Myanmar: Kachin state, Myitkyina district, hillstreams approximately 2 hours by foot on road from Mogaung to Kamaing; Tin Win & Kyaw Zin, 1 August 2004.

PARATYPES: UMMZ 245945 (10), 49.0-55.3 mm SL; data as for holotype.

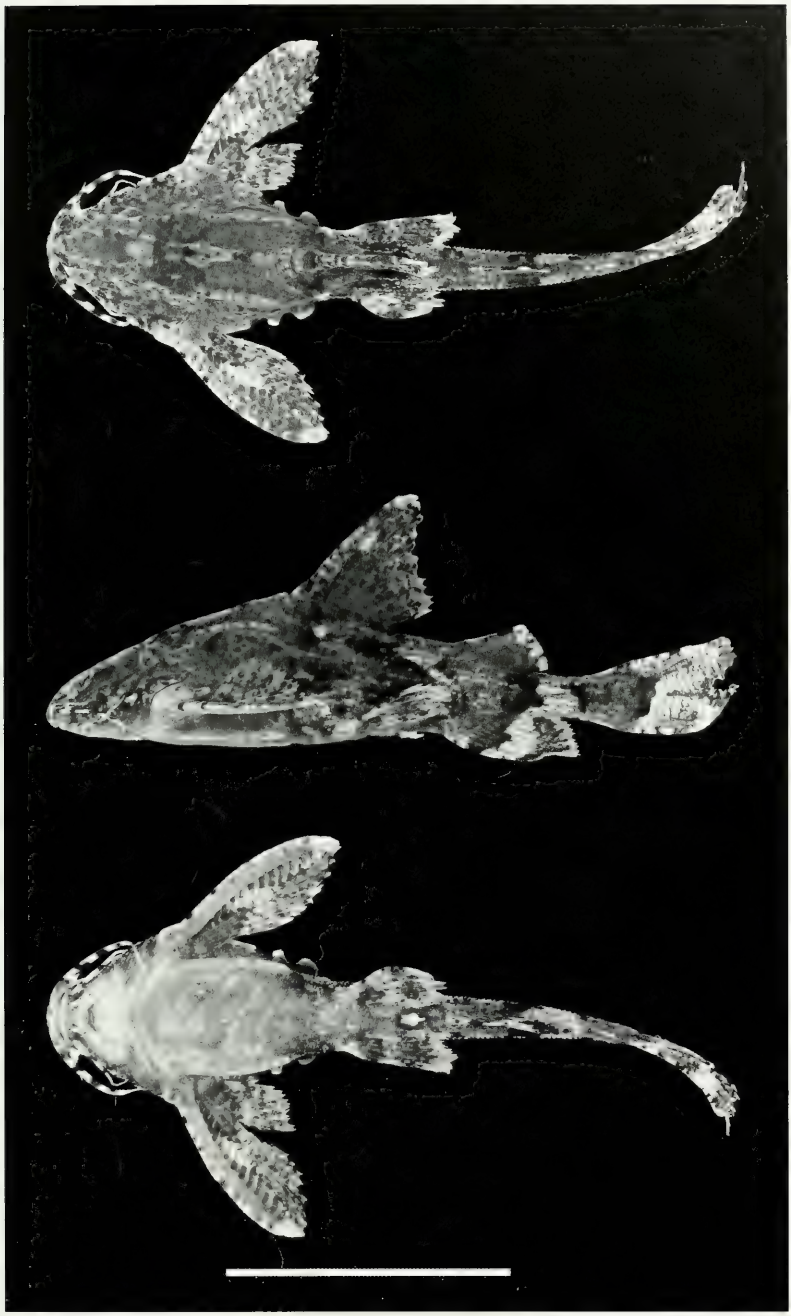


FIG. 6

Hara longissima, holotype, UMMZ 245902, 51.2 mm SL; Myanmar: hillstreams approximately 2 hours by foot on road from Mogaung to Kamaing. Scale bar: 25 mm.

DIAGNOSIS: *Hara longissima* can be distinguished from all congeners in having a longer caudal peduncle (18.8-21.3% SL vs. 11.7-19.4) and from congeners except *H. filamentosa* and *H. mesembrina* in having (vs. lacking) a filamentous extension of the first principal ray of the upper caudal-fin lobe. It further differs from *H. filamentosa* in having a slenderer (depth 5.0-6.1% SL vs. 6.1-7.2) caudal peduncle and body (depth 12.5-14.5% SL vs. 13.9-19.2), from *H. hara* in lacking (vs. having) serrations on the anterior edge of the dorsal spine, and from *H. horai* in having a longer adipose-fin base (length 13.3-16.5% SL vs. 10.0-13.7), a slenderer body (depth 12.5-14.5% SL vs. 15.1-17.9), a shorter head (length 26.0-29.1% SL vs. 30.3-34.2) and a larger eye (diameter 11.3-13.8% HL vs. 8.0-9.8). *Hara longissima* can be further distinguished from both *H. jerdoni* and *H. minuscula* in having a shorter posterior process on coracoid (reaching to midway of distance between bases of pectoral spine and first pelvic-fin ray vs. at least three quarters; its length 20.7-23.9% SL vs. 29.5-38.3), more soft pectoral-fin rays (total number of soft fin rays modally 7 vs. 5) and vertebrae (33-35 vs. 27-32), and the supraoccipital spine not reaching (vs. reaching) the anterior nuchal plate, and from *H. jerdoni* in having a shorter pectoral spine (length 25.9-31.8% SL vs. 42.2-51.7). It further differs from *H. mesembrina* in having a smaller eye (diameter 11.3-13.8% HL vs. 13.1-17.9) and shorter posterior process on coracoid (reaching to midway of distance between bases of pectoral spine and first pelvic-fin ray vs. two thirds; its length 20.7-23.9% SL vs. 23.6-27.0), and from *H. spinulus* in having a longer dorsal spine (length 22.6-26.7% SL vs. 14.7-19.8), slenderer body (depth 12.5-14.5% SL vs. 17.2-20.9), narrower head (width 23.7-25.2% SL vs. 25.9-30.0), shorter posterior process on coracoid (reaching to midway of distance between bases of pectoral spine and first pelvic-fin ray vs. two thirds; length 20.7-23.9% SL vs. 24.9-28.0) and more vertebrae (33-35 vs. 30-32).

DESCRIPTION: Morphometric data in Table 6. Exactly as in *Hara filamentosa*, except for the following. Vertebrae 15+18=33 (2), 16+17=33 (1), 15+19=34 (2), 16+18=34 (3) or 16+19=35 (3). Dorsal fin with I,5,i (11) rays. Dorsal spine moderately long and gently curved; with smooth anterior margin and posterior margin with 6-8 serrae. Caudal fin with i,7,6,i (11) principal rays. First principal ray of upper caudal-fin lobe produced into a filament extending posteriorly for half length of upper caudal lobe proper. Anal fin with iv,6,i (10) or v,6,i (1) rays. Pelvic fin with i,5 (11) rays. Pectoral fin with I,6,i (11) rays; anterior spine margin with 18-19 small distally directed serrations, posterior margin with 13-14 large medially directed serrations. Coracoid with well developed posterior processes, extending to midway between base of posteriormost pectoral-fin ray and pelvic-fin origin.

Colour: Head and body light chocolate brown, with a mottling caused by numerous smaller, irregular darker brown patches. Belly and ventral surfaces of head light brown. Two thin, irregular light brown bars on body: first chevron-shaped and located between dorsal- and adipose-fin bases, second thicker than first and located on caudal peduncle. Dorsal fin dark mottled brown, except for thin hyaline distal margin. Pectoral fin dark brown, with thin hyaline distal margin and either a small ovoid hyaline spot or a crescentic median hyaline band on middle third of fin. Pelvic and anal fins hyaline, with dark brown bases and subdistal stripes. Adipose fin brown as in body,

TABLE 6. Morphometric data for *Hara longissima* (n=11: 49.0-55.3 mm SL).

	Holotype	Range	Mean±SD
%SL			
Predorsal length	46.1	42.7-46.5	44.8±1.52
Preanal length	67.8	63.2-69.4	68.1±1.73
Prepelvic length	50.4	48.1-51.2	49.6±0.96
Prepectoral length	23.0	20.1-24.9	22.1±1.29
Length of dorsal fin base	19.3	16.5-19.9	17.7±1.09
Dorsal spine length	25.8	22.6-26.7	24.7±1.37
Anal fin length	14.5	12.6-15.6	14.0±1.00
Pelvic fin length	16.6	16.4-21.8	17.9±1.67
Pectoral fin length	32.0	28.0-33.5	31.4±1.80
Pectoral spine length	29.5	25.9-31.8	29.2±1.80
Caudal fin length	20.7	18.8-27.4	23.6±2.72
Length of adipose fin base	15.4	13.3-16.5	14.8±0.93
Dorsal to adipose distance	11.1	9.0-12.5	10.9±1.28
Post-adipose distance	16.8	15.7-18.8	17.4±1.02
Caudal peduncle length	19.9	18.8-21.3	19.9±0.85
Caudal peduncle depth	5.9	5.0-6.1	5.7±0.38
Body depth at anus	13.7	12.5-14.5	13.4±0.60
Head length	28.3	26.0-29.1	27.9±0.89
Head width	25.2	23.7-25.2	24.6±0.47
Head depth	21.9	19.7-22.0	20.7±0.89
Length of posterior process on coracoid	22.9	20.7-23.9	22.3±0.97
%HL			
Snout length	53.1	48.4-60.3	54.9±3.52
Interorbital distance	36.6	32.9-38.3	36.0±1.34
Eye diameter	13.8	11.3-13.8	12.8±0.74
Nasal barbel length	24.8	13.8-30.7	21.0±5.56
Maxillary barbel length	84.1	77.4-99.3	90.5±7.37
Inner mandibular barbel length	41.4	40.7-50.3	44.5±3.10
Outer mandibular barbel length	57.9	53.5-72.3	59.8±6.04

with lighter coloured distal margin. Caudal fin hyaline, with irregular W-shaped band subdistally and with small dark brown flecks randomly distributed throughout fin. Two small light brown patches present at bases of caudal-fin lobes in some individuals. Maxillary and mandibular barbels light brown, with dark brown annuli.

DISTRIBUTION: *Hara longissima* is known from the Irrawaddy River drainage in northern Myanmar (Fig. 2).

ETYMOLOGY: The name comes from the Latin *longissimus*, meaning longest, and refers to the relatively long caudal peduncle of this species. An adjective.

Hara mesembrina sp. nov. Fig. 7

HOLOTYPE: UMMZ 245903, 47.3 mm SL; Thailand: Ranong province, Baan Na district, hillstreams flowing from Langkatuek, Klong Naka; K. Udomritthiruj, April 2005.

PARATYPES: UMMZ 245602 (9), 31.4-55.3 mm SL; UMMZ 245963 (6), 42.4-55.8 mm SL; data as for holotype. CMK 12204 (3), 34.7-40.2 mm SL; Thailand: Ranong, stream N of Khura Bhuri, 100 km S of Ranong, 9°17'48"N 98°23'50"E; K. Kubota, March 1996.

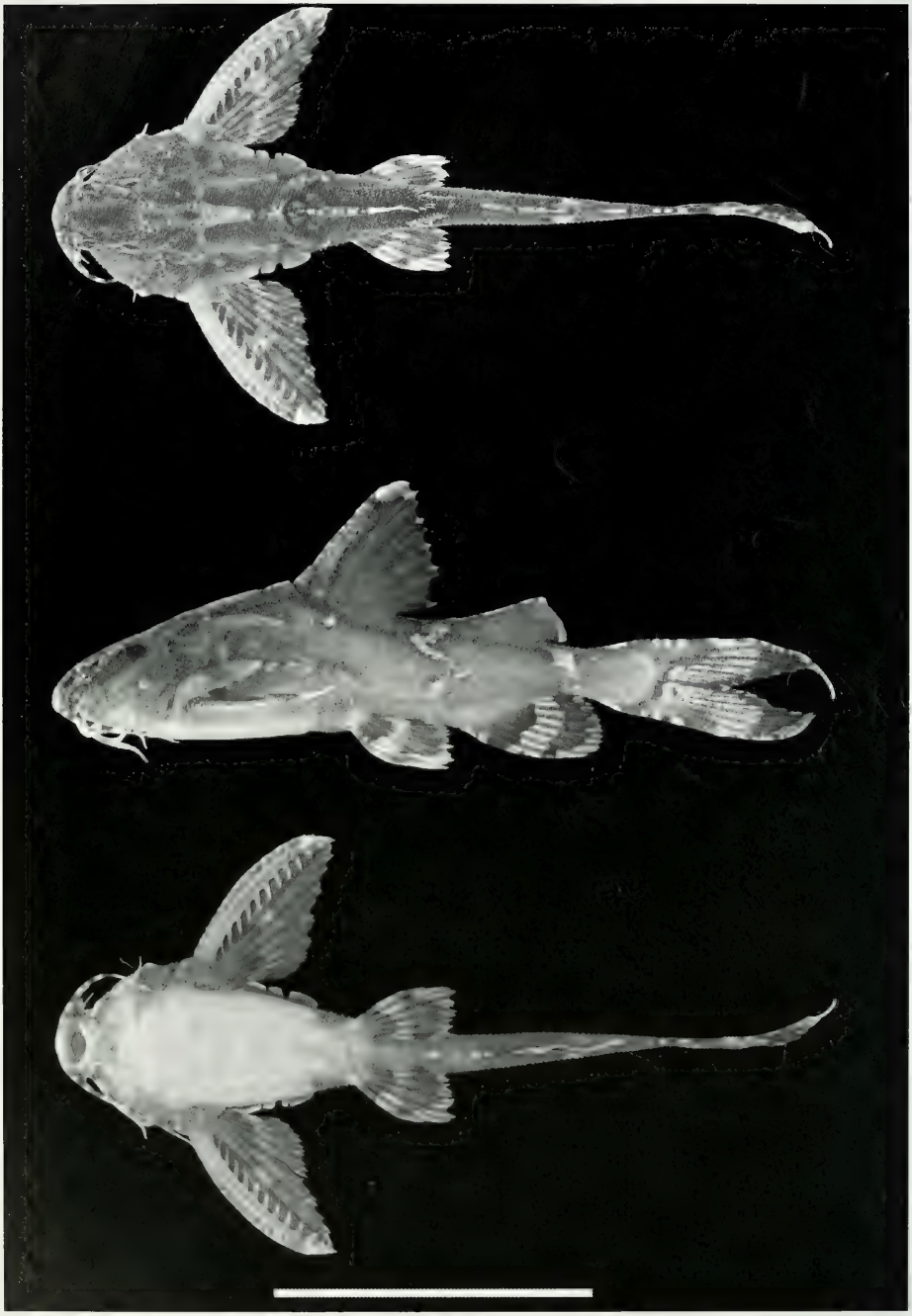


FIG. 7

Hara mesembrina, holotype, UMMZ 245903, 47.3 mm SL; Thailand: hillstreams flowing from Langkatuek. Scale bar: 25 mm.

DIAGNOSIS: *Hara mesembrina* can be distinguished from congeners except *H. filamentosa* and *H. longissima* in having (vs. lacking) a filamentous extension to the first principal ray of the upper caudal-fin lobe. It differs from *H. filamentosa* in having a longer posterior process on coracoid (reaching to two thirds of distance between bases of pectoral spine and first pelvic-fin ray vs. midway; length 23.6-27.0% SL vs. 19.9-22.8) and a longer caudal peduncle (length 17.2-18.9% SL vs. 14.9-17.8), and from *H. longissima* in having a shorter caudal peduncle (length 17.2-18.9% SL vs. 18.8-21.3), larger eye (diameter 13.1-17.9% HL vs. 11.3-13.8) and longer posterior process on coracoid (reaching to two thirds of distance between bases of pectoral spine and first pelvic-fin ray vs. midway; length 23.6-27.0% SL vs. 20.7-23.9). *Hara mesembrina* can be further distinguished from *H. hara* in having a deeper caudal peduncle (depth 6.0-7.4% SL vs. 5.0-5.8) and longer posterior process on coracoid (reaching to two thirds of distance between bases of pectoral spine and first pelvic-fin ray vs. midway; length 23.6-27.0% SL vs. 19.9-24.8), from *H. horai* in having a deeper caudal peduncle (depth 6.0-7.4% SL vs. 5.2-6.2), shorter head (length 22.1-27.3% SL vs. 30.3-34.2), longer adipose-fin base (length 13.5-17.0% SL vs. 10.0-13.7) and larger eye (diameter 13.1-17.9% HL vs. 8.0-9.8), and from both *H. jerdoni* and *H. minuscula* in having a shorter posterior process on coracoid (length 23.6-27.0% SL vs. 29.5-38.3), more soft pectoral-fin rays (total number of soft fin rays modally 6 vs. 5) and vertebrae (32-35 vs. 27-32) and the supraoccipital spine not reaching (vs. reaching) the anterior nuchal plate. It further differs from *H. jerdoni* in having a shorter pectoral spine (length 26.4-30.1% SL vs. 42.2-51.7), and from *H. spinulus* in having a longer dorsal spine (length 20.2-25.7% SL vs. 14.7-19.8) and caudal peduncle (length 17.2-18.9% SL vs. 11.8-15.0) and slenderer body (depth 13.1-16.7% SL vs. 17.2-20.9).

DESCRIPTION: Morphometric data in Table 7. Exactly as in *Hara filamentosa*, except for the following. Vertebrae 16+16=32 (1), 14+19=33 (1), 15+18=33 (7), 16+17=33 (2), 15+19=34 (3), 16+18=34 (4) or 16+19=35 (1). Dorsal fin with I,5,i (19) rays. Dorsal spine moderately long and gently curved; with smooth anterior margin and posterior margin with 4-9 serrae. Caudal fin with i,7,7,i (19) principal rays. First principal ray of upper caudal-fin lobe produced into a filament extending posteriorly for half length of upper caudal lobe proper. Anal fin with iii,6,i (5), iv,6 (3), iv,6,i (6), iii,7,i (2), iv,7 (2) or iv,7,i (1) rays. Pelvic fin with i,5 (19) rays. Pectoral fin with I,6,i (19) rays; anterior spine margin with 10-20 small distally directed serrations, posterior margin with 8-13 large medially directed serrations. Coracoid with well developed posterior process, extending to two thirds distance between base of posteriormost pectoral-fin ray and pelvic-fin origin.

Colour: Head and body chestnut brown to light chocolate brown, with a mottling caused by numerous smaller, irregular darker brown patches. Belly and ventral surfaces of head light brown. Two thin, irregular light brown bars on body: first chevron-shaped and located between dorsal- and adipose-fin bases, second thicker than first and located on caudal peduncle. Dorsal fin dark mottled brown, except for thin hyaline distal margin. Pectoral fin dark brown, with thin hyaline distal margin and either a small ovoid hyaline spot or a crescentic median hyaline band on middle third of fin. Pelvic and anal fins hyaline, with dark brown bases and subdistal stripes.

TABLE 7. Morphometric data for *Hara mesembrina* (n=19: 31.4-55.8 mm SL).

	Holotype	Range	Mean±SD
%SL			
Predorsal length	44.8	42.0-46.5	44.0±1.32
Preanal length	68.8	64.8-69.3	67.3±1.56
Prepelvic length	50.6	46.4-53.4	49.3±2.20
Prepectoral length	24.5	19.4-25.0	22.8±1.79
Length of dorsal fin base	19	17.4-20.2	18.6±0.99
Dorsal spine length	25.7	20.2-25.7	22.5±1.53
Anal fin length	15.3	14.0-17.2	15.3±1.19
Pelvic fin length	18.8	15.2-19.7	17.8±1.43
Pectoral fin length	32.6	28.4-33.3	31.1±1.56
Pectoral spine length	29.9	26.4-30.1	28.2±1.25
Caudal fin length	27.0	21.0-28.6	25.7±2.10
Length of adipose fin base	15.7	13.5-17.0	15.0±1.10
Dorsal to adipose distance	7.3	7.1-12.4	9.5±1.80
Post-adipose distance	16.7	15.0-19.3	16.8±1.32
Caudal peduncle length	18.8	17.2-18.9	18.3±0.56
Caudal peduncle depth	6.3	6.0-7.4	6.6±0.48
Body depth at anus	14.4	13.1-16.7	14.8±1.08
Head length	27.8	25.8-29.5	27.8±0.87
Head width	25.3	22.1-27.3	24.3±1.67
Head depth	20.7	18.7-23.5	21.6±1.41
Length of posterior process on coracoid	23.8	23.6-27.0	25.2±1.19
%HL			
Snout length	50.4	39.6-59.6	50.7±5.74
Interorbital distance	35.3	32.5-36.4	34.3±1.25
Eye diameter	13.5	13.1-17.9	14.6±1.48
Nasal barbel length	19.5	8.8-27.2	17.2±5.03
Maxillary barbel length	88.7	76.3-99.3	85.0±7.08
Inner mandibular barbel length	41.4	22.9-45.4	40.9±6.29
Outer mandibular barbel length	48.9	42.9-61.5	52.8±5.40

Adipose fin brown as in body, with lighter coloured distal margin. Caudal fin hyaline, with irregular W-shaped band subdistally and with small dark brown flecks randomly distributed throughout fin. Two small light brown patches present at bases of caudal-fin lobes in some individuals. Maxillary and mandibular barbels light brown, with dark brown annuli.

DISTRIBUTION: *Hara mesembrina* is known from the small rivers draining the southern extremity of the Tenasserim Range (in the Isthmus of Kra in southern Thailand) that debouch into the Andaman Sea (Fig. 2).

ETYMOLOGY: The name comes from the Greek μεσημβρινοζ (mesembrinos), meaning southern, referring to the distribution of this species, which is the southernmost of all *Hara* species. An adjective.

Hara minuscula sp. nov. Fig. 8

HOLOTYPE: CAS 223734, 28.4 mm SL; Myanmar: Bago, Dayame Chaung, 1.6 km N of Daik-U; T. R. Roberts, 9 March 1985.

PARATYPES: CAS 61339 (45), 25.8-30.0 mm SL; data as for holotype. NRM 39883 (23), 25.0-31.0 mm SL; Myanmar: Bago, roadside stream about 64 km on road from Taungoo to

Nyaunglaybin, 18°19'5"N 96°30'7"E; F. Fang & A. Roos, 19 March 1997. UMMZ 245671 (1), 30.2 mm SL; Myanmar: from aquarium trade, collector and date unknown. ZRC 43576 (8), 23.3-29.3 mm SL; Myanmar: Bago; H. H. Tan, 28 February 1999.

DIAGNOSIS: *Hara minuscula* can be distinguished from congeners except *H. jerdoni* in having a longer posterior process on coracoid (reaching to three quarters of distance between bases of pectoral spine and first pelvic-fin ray vs. two thirds or less; length 29.5-32.9% SL vs. 19.9-28.0), fewer soft pectoral-fin rays (total number of soft fin rays modally 5 vs. 6-7) and the supraoccipital spine reaching (vs. not reaching) the anterior nuchal plate. It can be distinguished from *H. jerdoni* in having a shorter pectoral spine (length 28.6-34.7% SL vs. 42.2-51.7) and posterior process on coracoid (length 29.5-32.9% SL vs. 34.4-38.3) and more vertebrae (30-32 vs. 27-29). *Hara minuscula* can be further distinguished from *H. filamentosa* in having fewer vertebrae (30-32 vs 31-34), a longer pectoral spine (length 28.6-34.7% SL vs. 23.3-29.9) and always lacking (vs. sometimes with) a filamentous extension of the first principal ray of the upper caudal-fin lobe, from *H. hara* in having a wider head (width 24.5-27.2% SL vs. 22.4-24.3) and lacking (vs. having) serrations on the anterior edge of the pectoral spine, and from *H. horai* in having a shorter head (length 24.8-28.4% SL vs. 30.3-34.2). It further differs from *H. longissima* in having a shorter caudal peduncle (length 11.7-14.5% SL vs. 18.8-21.3), deeper body (depth 16.0-18.0% SL vs. 12.5-14.5), fewer vertebrae (30-32 vs. 33-34) and lacking (vs. having) a filamentous extension of the first principal ray of the upper caudal-fin lobe, from *H. mesembrina* in having a shorter caudal peduncle (length 11.7-14.5% SL vs. 17.2-18.9), deeper body (depth 16.0-18.0% SL vs. 13.1-16.7) and lacking (vs. having) a filamentous extension of the first principal ray of the upper caudal-fin lobe, and from *H. spinulus* in having a slenderer caudal peduncle (depth 4.1-7.0% SL vs. 6.7-8.5). *Hara minuscula* is also the smallest species of Indochinese *Hara*, with a maximum recorded size of ca. 30 mm SL (vs. ca. 55-67 mm SL in other Indochinese congeners); compared to Indian congeners, only *H. jerdoni* is smaller (Table 4).

DESCRIPTION: Morphometric data in Table 8. Exactly as in *Hara filamentosa*, except for the following. Vertebrae 15+15=30 (10), 16+14=30 (1), 15+16=31 (16), 16+15=31 (7) or 16+16=32 (2). Supraoccipital spine reaching anterior nuchal plate. Dorsal fin with I,5,i (36) rays. Dorsal spine moderately long and gently curved; with smooth anterior margin and posterior margin with 5-6 serrae. Caudal fin with i,7,7,i (36) principal rays; without filamentous extension to first principal ray of upper lobe. Anal fin with iii,6,i (14), iv,5,i (9) or iv,6,i (13) rays. Pelvic fin with with i,5 (36) rays. Pectoral fin with I,4,i (17) or I,5 (19) rays; anterior spine margin with 13-17 small distally directed serrations, posterior margin with 9-11 large medially directed serrations. Coracoid with well developed posterior process, extending to three quarters distance between base of posteriormost pectoral-fin ray and pelvic-fin origin.

Colour: Head and body dark chestnut brown to light chocolate brown, with a mottling caused by numerous smaller, irregular darker brown patches. Belly and ventral surfaces of head light brown. Two thin, irregular light brown bars on body: first chevron-shaped and located between dorsal- and adipose-fin bases, second thicker than first and located on caudal peduncle. Dorsal fin dark mottled brown, except for thin hyaline distal margin. Pectoral fin dark brown, with thin hyaline distal margin and

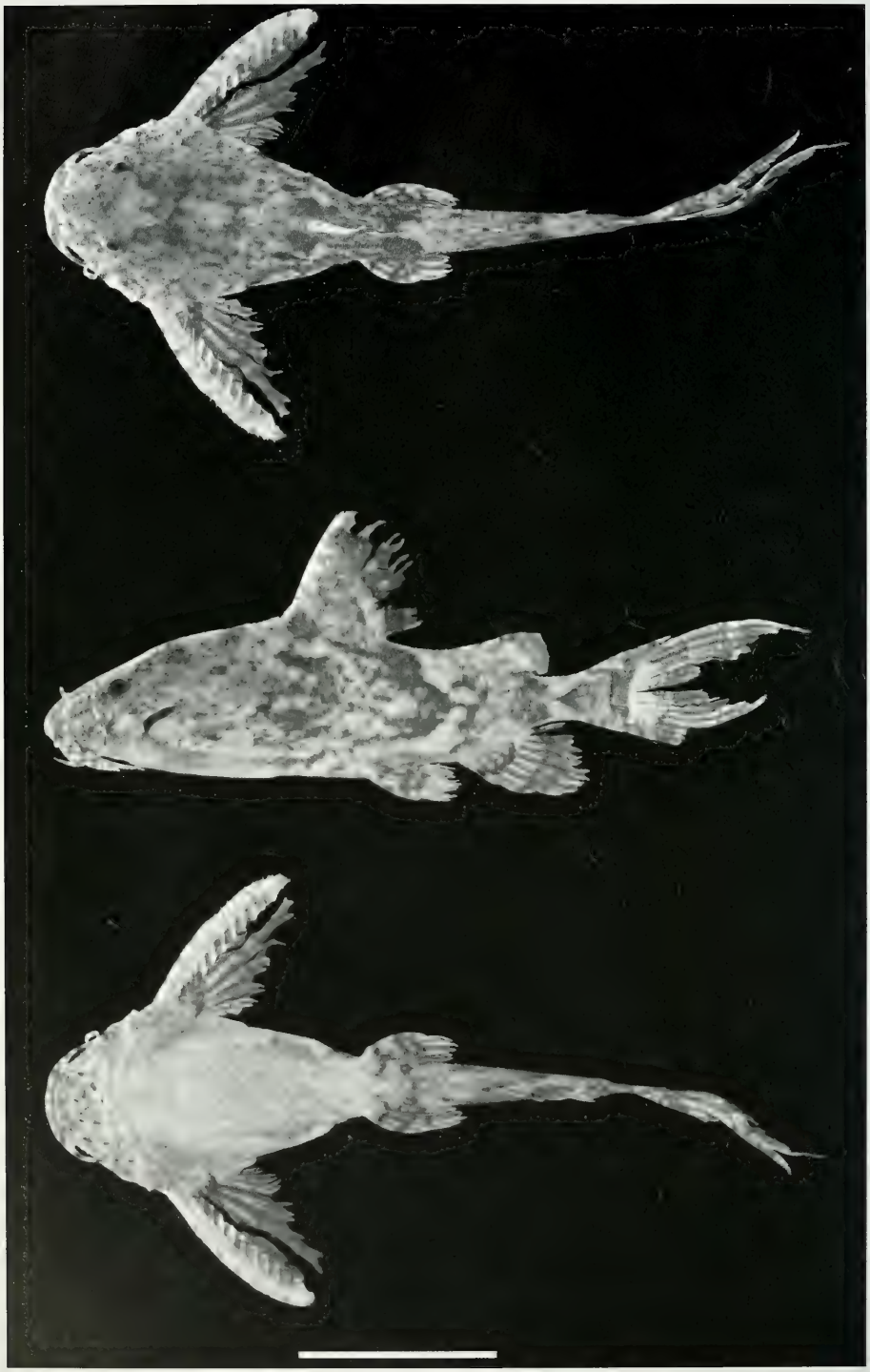


TABLE 8. Morphometric data for *Hara minuscula* (n=36: 25.8-31.0 mm SL).

	Holotype	Range	Mean±SD
%SL			
Predorsal length	44.9	42.9-46.7	44.7±1.26
Preanal length	71.6	68.8-75.1	72.3±1.74
Prepelvic length	56.1	52.2-56.1	54.2±1.30
Prepectoral length	20.0	17.9-22.2	20.4±1.32
Length of dorsal fin base	20.7	13.9-21.7	18.5±2.47
Dorsal spine length	20.0	18.7-22.9	21.2±1.29
Anal fin length	14.7	13.9-16.7	15.3±0.93
Pelvic fin length	17.5	13.8-19.7	17.4±1.63
Pectoral fin length	33.3	30.3-36.5	33.1±1.92
Pectoral spine length	32.6	28.6-34.7	31.3±1.68
Caudal fin length	34.7	27.0-35.9	32.2±2.87
Length of adipose fin base	15.4	12.9-18.4	15.5±1.48
Dorsal to adipose distance	8.4	8.4-11.6	9.7±1.07
Post-adipose distance	15.1	12.3-16.2	14.3±0.99
Caudal peduncle length	13.7	11.7-14.5	13.5±0.83
Caudal peduncle depth	6.7	4.1-7.0	5.5±0.92
Body depth at anus	16.5	16.0-18.0	17.0±0.66
Head length	28.1	24.8-28.4	26.8±1.02
Head width	26.3	24.5-27.2	25.6±0.79
Head depth	24.6	22.6-26.8	24.1±1.24
Length of posterior process on coracoid	32.6	29.5-32.9	31.3±1.13
%HL			
Snout length	50.0	45.5-54.5	50.9±2.40
Interorbital distance	41.3	37.0-42.9	40.0±1.80
Eye diameter	13.8	10.7-15.6	12.9±1.42
Nasal barbel length	21.3	17.3-32.5	22.8±4.71
Maxillary barbel length	92.5	74.0-100.0	86.5±7.38
Inner mandibular barbel length	47.5	40.0-57.1	50.1±5.41
Outer mandibular barbel length	73.8	58.2-73.8	65.0±4.43

either a small ovoid hyaline spot or a crescentic median hyaline band on middle third of fin. Pelvic and anal fins hyaline, with dark brown bases and subdistal stripes. Adipose fin brown as in body, with lighter coloured distal margin. Caudal fin hyaline, with irregular W-shaped band subdistally and with small dark brown flecks randomly distributed throughout fin. Two small light brown patches present at bases of caudal-fin lobes in some individuals. Maxillary and mandibular barbels light brown, with dark brown annuli.

DISTRIBUTION: *Hara minuscula* is known from the Sittang river drainage (Fig. 2).

ETYMOLOGY: The name comes from the Latin *minusculus*, meaning rather small, referring to the small size of this species. An adjective.

FIG. 8

Hara minuscula, CAS 223734, holotype, 28.4 mm SL; Myanmar: Dayame Chaung. Scale bar: 10 mm.

Hara spinulus sp. nov. Fig. 9

HOLOTYPE: NRM 52556, 50.3 mm SL; Myanmar: Rakhine state, Baw Di Chaung at Baw Di bridge, 32 km from Gwa on road to Ngathaingchaung, 17°34'15"N 94°43'47"E; S. O. Kullander *et al.*, 18 March 1998.

PARATYPES: NRM 40750 (3), 34.7-48.5 mm SL; data as for holotype. UMMZ 246173 (1), 49.8 mm SL; Myanmar: Rakhine state, Thandwe Chaung; Than Kyaw Toe, November 2005.

DIAGNOSIS: *Hara spinulus* can be distinguished from congeners (except *H. minuscula*) in having a shorter dorsal spine (14.7-19.8% SL vs. 20.2-27.6). It can be further distinguished from *H. filamentosa* in having a shorter adipose-fin base (length 12.9-16.1% SL vs. 15.7-21.7) and caudal peduncle (length 11.8-15.0% SL vs. 14.9-17.8) and always lacking (vs. sometimes with) a filamentous extension of the first principal ray of the upper caudal-fin lobe, from *H. hara* in having a wider head (width 25.9-30.0% SL vs. 22.4-24.3), deeper caudal peduncle (depth 6.7-8.5% SL vs. 5.0-5.8) and lacking (vs. having) serrations on the anterior edge of the dorsal spine, and from *H. horai* in having a longer adipose-fin base (length 12.9-16.1% SL vs. 10.0-13.7), shorter (length 11.8-15.0% SL vs. 15.5-17.9) and deeper (depth 6.7-8.5% SL vs. 5.2-6.2) caudal peduncle, shorter head (length 26.9-28.9% SL vs. 30.3-34.2) and larger eye (diameter 11.2-14.4% SL vs. 8.0-9.8). *Hara spinulus* can be further distinguished from both *H. jerdoni* and *H. minuscula* in having a deeper caudal peduncle (depth 6.7-8.5% SL vs. 4.1-7.0), shorter posterior process on coracoid (reaching to two thirds of distance between bases of pectoral spine and first pelvic-fin ray vs. at least three quarters; length 24.9-28.0% SL vs. 29.5-38.3), more soft pectoral-fin rays (total number of soft fin rays modally 7 vs. 5) and the supraoccipital spine not reaching (vs. reaching) the anterior nuchal plate, from *H. jerdoni* in having a shorter pectoral spine (length 27.5-30.3% SL vs. 42.2-53.8) and caudal peduncle (length 11.8-15.0% SL vs. 15.1-18.4), more vertebrae (30-32 vs. 27-29), from *H. mesembrina* in having a shorter caudal peduncle (length 11.8-15.0% SL vs. 17.2-18.9), a deeper body (depth 17.2-20.9% SL vs. 13.1-16.7) and lacking (vs. having) a filamentous extension of the first principal ray of the upper caudal-fin lobe, and from *H. longissima* in having a deeper body (depth 17.2-20.9% SL vs. 12.5-14.5), wider head (width 25.9-30.0% SL vs. 23.7-25.2), longer posterior process on coracoid (reaching to two thirds of distance between bases of pectoral spine and first pelvic-fin ray vs. midway; length 24.9-28.0% SL vs. 20.7-23.9), fewer vertebrae (30-32 vs. 33-35) and lacking (vs. having) a filamentous extension of the first principal ray of the upper caudal-fin lobe.

DESCRIPTION: Morphometric data in Table 9. Exactly as in *Hara filamentosa*, except for the following. Vertebrae 15+15=30 (1), 15+16=31 (1), 15+17=32 (2) or 16+16=32 (1). Dorsal fin with I,5,i (1), I,6 (3) or I,6,i (1) rays. Dorsal spine moderately short and gently curved; with smooth anterior margin and posterior margin with 3-5 serrae. Caudal fin strongly forked, with i,7,7,i (2) or i,7,8,i (3) principal rays; without filamentous extension to first principal ray of upper lobe. Anal fin with iv,6,i (3), iv,7

FIG. 9

Hara spinulus, holotype, NRM 52556, 50.3 mm SL; Myanmar: Baw Di Chaung. Scale bar: 25 mm.

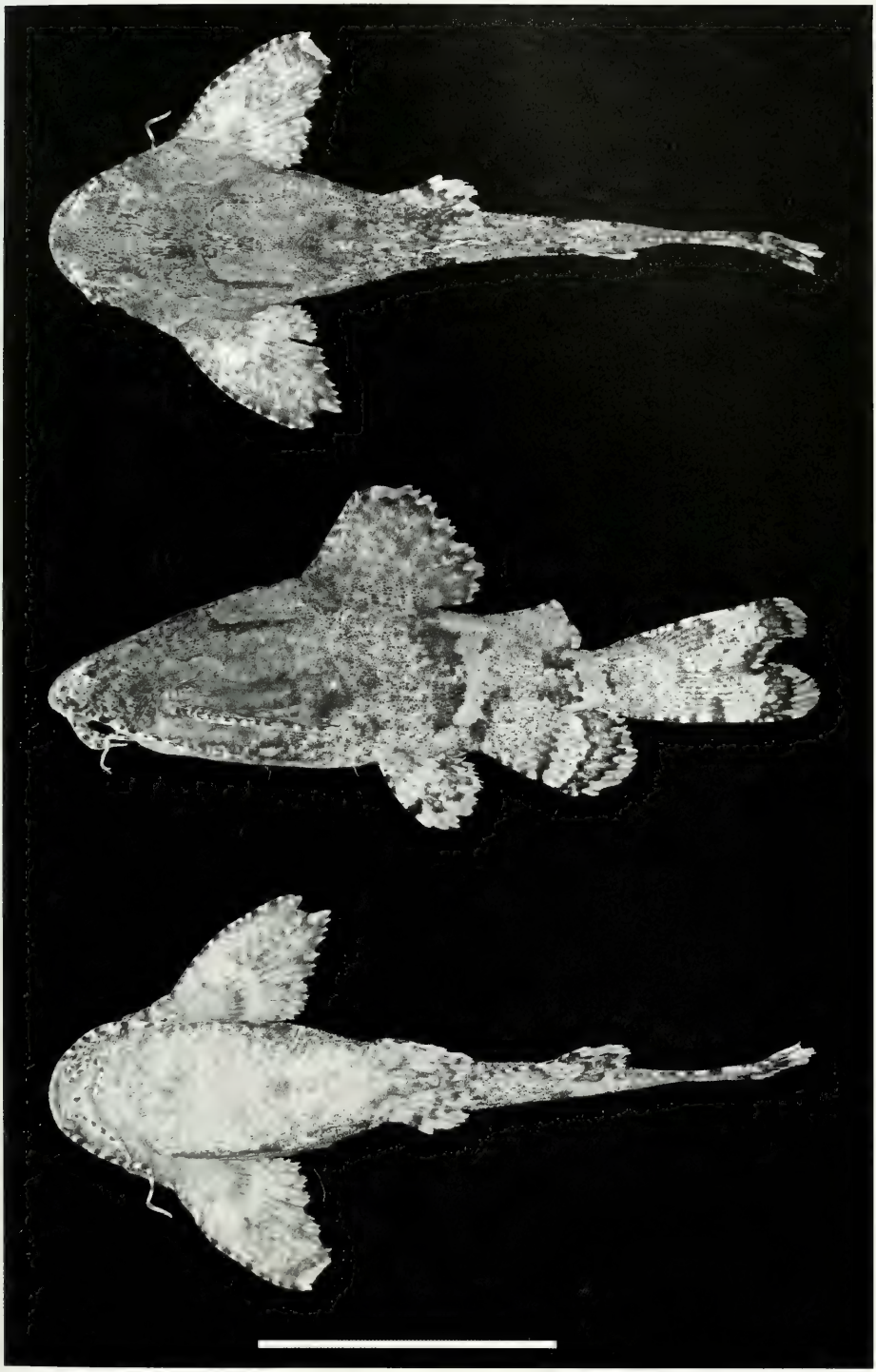


TABLE 9. Morphometric data for *Hara spinulus* (n=5: 34.7-50.3 mm SL).

	Holotype	Range	Mean±SD
%SL			
Predorsal length	41.3	39.4-45.8	43.6±3.01
Preanal length	71.4	68.6-71.8	70.4±1.36
Prepelvic length	52.7	52.0-55.3	53.2±1.26
Prepectoral length	21.9	21.4-23.7	22.5±1.07
Length of dorsal fin base	21.9	19.1-22.9	20.7±1.67
Dorsal spine length	18.5	14.7-19.8	17.4±2.18
Anal fin length	16.9	15.3-18.3	16.5±1.26
Pelvic fin length	17.5	15.8-18.1	16.9±0.96
Pectoral fin length	30.6	29.3-33.3	31.0±1.47
Pectoral spine length	29.2	27.5-30.3	29.0±1.00
Caudal fin length	26.4	24.5-26.8	25.9±0.90
Length of adipose fin base	13.5	12.9-16.1	14.5±1.42
Dorsal to adipose distance	8.3	7.8-11.3	9.3±1.58
Post-adipose distance	14.7	12.4-17.7	14.9±1.89
Caudal peduncle length	12.9	11.8-15.0	13.8±1.40
Caudal peduncle depth	8.5	6.7-8.5	7.4±0.66
Body depth at anus	20.9	17.2-20.9	18.5±1.51
Head length	28.8	26.9-28.9	28.2±0.80
Head width	29.0	25.9-30.0	28.6±1.69
Head depth	23.7	22.7-24.7	23.7±0.86
Length of posterior process on coracoid	27.6	24.9-28.0	26.5±1.31
%HL			
Snout length	50.3	47.4-52.9	50.4±2.04
Interorbital distance	33.6	33.6-37.3	35.7±1.71
Eye diameter	11.6	11.2-14.4	12.4±1.25
Nasal barbel length	32.9	22.1-32.9	27.1±4.14
Maxillary barbel length	85.6	72.5-104.5	91.3±13.01
Inner mandibular barbel length	52.7	43.1-53.7	49.0±4.40
Outer mandibular barbel length	61.6	56.9-68.7	61.3±4.49

(1) or iv,7,i (1) rays. Pelvic fin with i,5 (4) rays. Pectoral fin with I,6 (1) or I,6,i (4) rays; anterior spine margin with 11-18 small distally directed serrations, posterior margin with 7-11 large medially directed serrations. Coracoid with well developed posterior processes, extending to two thirds distance between base of posteriormost pectoral-fin ray and pelvic-fin origin.

Colour: Head and body terracotta to light chocolate brown, with a mottling caused by numerous smaller, irregular darker brown patches. Belly and ventral surfaces of head light brown. Two thin, irregular light brown bars on body: first located between dorsal- and adipose-fin bases, second thicker than first and located on caudal peduncle. Dorsal fin dark mottled brown, except for thin hyaline distal margin. Pectoral fin dark brown, with thin hyaline distal margin and either a small ovoid hyaline spot or a crescentic median hyaline band on middle third of fin. Pelvic and anal fins hyaline, with dark brown bases and subdistal stripes. Adipose fin brown as in body, with lighter coloured distal margin. Caudal fin hyaline, with irregular W-shaped band subdistally and with small dark brown flecks randomly distributed throughout fin. Two small light brown patches present at bases of caudal-fin lobes in some individuals. Maxillary and mandibular barbels light brown, with dark brown annuli.

DISTRIBUTION: *Hara spinulus* is known from the Baw Di Chaung drainage, which drains the western face of the Rakhine (Arakan) Yoma, in southwestern Myanmar (Fig. 2).

ETYMOLOGY: The name comes from the diminutive form of the Latin *spina*, meaning thorn, and refers to the short dorsal spine of this species. A noun in apposition.

KEY TO THE SPECIES OF *HARA*

1 Caudal fin emarginate; vertebrae 27-29 [Brahmaputra and Ganges river drainages] . . . . . *H. jerdoni*
Caudal fin deeply forked; vertebrae 30-35 2

2 Serrations on anterior edge of dorsal spine present [Ganges and Brahmaputra river drainages] . . . . . *H. hara*
Serrations on anterior edge of dorsal spine absent 3

3 Supraoccipital process reaching anterior nuchal plate; posterior process on coracoid extending three quarters distance between bases of pectoral spine and pelvic fins; total soft pectoral-fin rays modally 5 [Sittang River drainage] . . . . . *H. minuscula*
Supraoccipital process not reaching anterior nuchal plate; posterior process on coracoid extending two thirds or less distance between bases of pectoral spine and pelvic fins; total soft pectoral-fin rays modally 6-7 4

4 Length of adipose-fin base 10.0-13.7% SL; eye diameter 8.0-9.8% HL [Brahmaputra River drainage] . . . . . *H. horai*
Length of adipose-fin base 12.9-17.0% SL; eye diameter 11.2-17.9% HL . . . 5

5 Length of dorsal spine 14.7-19.8% SL; first principal ray on upper lobe of caudal fin not extended into filament [Baw Di Chaung drainage] . . . . . *H. spinulus*
Length of dorsal spine 20.2-27.6% SL; first principal ray on upper lobe of caudal fin usually extended into filament 6

6 Posterior process on coracoid reaching to two thirds distance between bases of pectoral spine and first pelvic-fin ray, its length 23.6-27.0% SL [rivers draining southern extremity of Tenasserim Range] . . . . *H. mesembrina*
Posterior process on coracoid reaching to midway of distance between bases of pectoral spine and first pelvic-fin ray, its length 19.9-23.9% SL 7

7 Caudal peduncle length 14.9-17.8% SL, depth 6.1-7.2% SL (depth 2.1-2.9 times in its length); body depth 13.9-19.2% SL [Ataran, Salween and Sittang river drainages] . . . . . *H. filamentosa*
Caudal peduncle length 18.8-21.3% SL, depth 5.0-6.1% SL (depth 3.1-3.9 times in its length); body depth 12.5-14.5% SL [Irrawaddy River drainage] . . . . . *H. longissima*

DISCUSSION

Although Thomson & Page (2006) consider *Erethistes* and *Hara* to be synonyms (the former being the senior name), a phylogenetic analysis of the Sisoridae using 190 morphological and 1371 molecular characters carried out as part of HHN's

doctoral dissertation (Ng, 2006) indicates that *Hara* (including *Erethistes*) is paraphyletic. The analysis of the concatenated dataset indicates that the species currently assigned to *Hara* can be divided into three clades: one consisting of *H. filamentosa* (the type species of *Hara*)+*H. mesembrina*, another consisting of *H. jerdoni*+*H. minuscula*, and another consisting of *Erethistes pusillus* and all other species of *Hara*. However, the three clades were not recovered in the analysis of the morphological dataset alone (most species of *Hara* were recovered in a polytomy with *Erethistoides* and *Ayarnangra*) and no morphological synapomorphies could be found to diagnose the three clades. The apparent paraphyly of *Hara* and the conflicting nature of the evidence are currently being further investigated and the complete results of the analysis will be published elsewhere. The synonymization of *Hara* with *Erethistes* by Thomson & Page (2006) does not truly reflect the phylogenetic relationships of this group of catfishes. Therefore, pending publication of the results of a fine-scale phylogenetic analysis of the group, we follow the sole current usage in the literature in recognizing *Erethistes* and *Hara* as distinct genera. We see no advantage in substituting one non-phylogenetic classification scheme with another.

The species-level taxonomy of *Hara* was confused, with only one attempt to review the genus (Hora, 1950). We consider only three valid species to occur on the Indian subcontinent: *H. hara* (Hamilton, 1822), *H. horai* Misra, 1976 and *H. jerdoni* Day, 1870. Both *H. saharsai* Datta Munshi & Srivastava, 1988 and *H. serrata* Vishwanath & Kosygin, 2000 are considered junior synonyms of *H. hara* because we could not find any significant differences in comparing the original descriptions and material we identified as *H. hara*. *Hara saharsai* (described from the Ganges River drainage in northern Bihar, which is within the recorded range for *H. hara*) is not adequately diagnosed from *H. hara* in the original description. The only difference is mentioned in the key to the species (Datta Munshi & Srivastava, 1988: 263), and states that *H. hara* has a pectoral spine shorter than head length, while *H. saharsai* has a pectoral spine longer than head length. Our examination of material indicates that the pectoral spine in *H. hara* is equal to, or very slightly longer than head length and because we could not find other characters to distinguish between the two species, we consider them to be conspecific. *Hara serrata* (described from the Jiri River, a tributary of the Barak River, itself a tributary of the Brahmaputra River, which is within the recorded range for *H. hara*) is diagnosed as a distinct species based on the serrated anterior edge of the dorsal spine, but our examination of *H. hara* shows that it also has the dorsal spine serrated anteriorly. No other characters could be found to distinguish *H. serrata* and *H. hara*, and we also consider the two conspecific here.

Hara filamentosa was originally described from the Tenasserim Provinces, which was a British administrative unit of colonial Burma (Myanmar) consisting of the coastal area east and south of the Irrawaddy Delta [not to be confused with the present administrative unit of Tanintharyi (Tenasserim), which constitutes only a fraction of the former Tenasserim Provinces]. The Tenasserim Provinces include the present-day states of Kayah, Kayin, Mon, Bago (partially) and possibly Tanintharyi in Myanmar (Fang & Kottelat, 1999). We have discussed the actual locality of the fishes described from "Tenasserim" by Blyth in an earlier work (Ng & Kottelat, 2001), and hypothesize that much of this material comes from either the Sittang River drainage or from the

drainages to the south of it. The original description does not state on how many specimens it is based and Blyth gives only one size (3 inches) which could mean either that he examined a single specimen (which would then be the holotype) or several for which only the size of the largest is given, a common practice of the time. Edward Blyth was the curator of the museum of the Asiatic Society of Bengal, and types of the fishes he described were initially deposited at the Society's museum; this material was subsequently transferred to the Indian Museum (now the Zoological Survey of India (Whitehead & Talwar, 1976).

Hora (1950) examined six specimens of *Hara* (ZSI 585) in the ZSI collected by Berdmore from "Tenasserim" (Major Hugh Berdmore [May 1812-30 May 1859] collected in Tenasserim the type series of several species described by Blyth). As the description of *H. filamentosa* appeared after Berdmore's death (apparently in U.K.) it seems that part (or all) of ZSI 585 could have been used in the original description of *H. filamentosa*. Hora (1950) reidentified five of the six specimens as *H. filamentosa* (which he considered conspecific with *H. hara*), and the remaining specimen as *Erethistes pusillus*. Other than the size of the specimen reidentified as *E. pusillus* (39.8 mm SL, which is smaller than the the size reported by Blyth; possibly the size of his largest specimens if he had more than one), no other indication of size was given by Hora (1950) for ZSI 585. Hora (1950: 201) commented that "it appears ... that Day's [1877: pl. 102 fig. 4] figures of *E. conta* ... were made from one of these specimens [ZSI 585]". Day (p. 453) commented that "Berdmore sent 5 or 6 specimens to the Calcutta Museum". This creates some doubts as to whether all of the specimens in ZSI 585 may indeed be the type(s) of *H. filamentosa*.

We note that the specimen out of ZSI 585 that Hora identified as *E. pusillus* is the only specimen of the species ever recorded from Myanmar and this casts doubts as to its identity or origin. *Erethistes pusillus* is otherwise known only from the Brahmaputra and Ganges river drainages. Since the drawing of the pectoral spine of this specimen in Hora (1950: fig. 1) is unmistakeably that of *E. pusillus*, this means that the material in ZSI 585 almost certainly was obtained from at least two different areas (southern Myanmar and somewhere in the Ganges or Brahmaputra river drainage). This has implications for the stability of nomenclature (see below).

The first author visited the ZSI twice, but was neither able to examine ZSI 585 nor successfully locate the type material of *H. filamentosa*. This type material is also not mentioned in the catalogue of fish types in that collection (Menon & Yazdani, 1968). The fish collections of the ZSI suffered extensive loss and damage as a result of a flood when the collection was temporarily housed in Benares during the Second World War (Chopra, 1947; Whitehead & Talwar, 1976), and the type(s) of *H. filamentosa* might have been lost at that time or is(are) mislabelled or misplaced. It is not known if Hora examined ZSI 585 before or after the war. There is no known other material that could possibly be types of *H. filamentosa*. Our studies indicate that several species of *Hara* with a filamentous extension of the dorsalmost principal caudal-fin ray occur in Myanmar and Thailand; only one is known from southern Myanmar (in the former "Tenasserim Provinces") to date, and we identify it as *H. filamentosa*. However, problems remain in objectively defining *H. filamentosa* with the uncertainties surrounding the type series, the number of types originally included, the possible type

status and apparent loss of ZSI 585, and the vague type locality. As two species are recorded by Hora in the potential type series, the status of the name can only be cleared by a lectotype or a neotype designation.

The designation of a neotype is needed to define the nominal taxon objectively. We designate MHNG 2687.038, 43.7 mm SL, from the Ataran drainage in Myanmar, as neotype of *H. filamentosa*, as diagnosed and described above. It agrees with Blyth's original description, with Day's drawing of a putative syntype, and it comes from within the area that can be considered as the original type locality.

Kottelat (1983) described *Erethistes maesotensis* from the Salween River drainage in western Thailand. The only difference between *Erethistes* and *Hara* is the direction of the serrations on the anterior edge of the pectoral spine (divergent in *Erethistes* and antrorse in *Hara*; Hora, 1950, de Pinna, 1996). The serrations in the pectoral spine of *E. maesotensis* (Kottelat, 1983: fig. 2b) are not truly divergent, but have a few that are retrorse or anteriorly directed, instead of all the serrations being antrorse as typically seen in other *Hara* species. This is a condition commonly seen in juvenile *Hara*, and as such, we attach no significance to its use as a diagnostic character. We were unable to find any significant differences between the material of *H. filamentosa* from the Salween River drainage in western Thailand (most collected at or very near the type locality of *E. maesotensis*) with the material we identify as *H. filamentosa* from Myanmar, although it should be noted that most of the Salween material we have examined (58 out of 65 specimens) lack the filamentous extension to the dorsalmost principal caudal-fin ray.

Of the other material from Myanmar reported as *H. hara* by Hora (1950), the material from Meetan [=Mitan Chaung] (ZSI F11049/1) is most likely *H. filamentosa*, while that from Indawgyi Lake (ZSI F10878/1) and Mandalay (ZSI 582) is most likely *H. longissima* (the probable identities of these three lots are surmised from the collection localities). The specimen reported from Bassein (ZSI 1453) is almost certainly *H. minuscula*, as this specimen was reported as having a proportionately longer pectoral spine (a relatively long pectoral spine is a diagnostic character of this species).

Because *H. filamentosa* and *H. minuscula* occur sympatrically in the Sittang river drainage, it is necessary to rule out the possibility that the smaller *H. minuscula* are not merely juvenile *H. filamentosa*. The most striking difference is the extent of the supraoccipital process; it reaches the anterior nuchal plate in *H. minuscula* while it does not reach it in *H. filamentosa*. We note that the contact between the supraoccipital process and the anterior nuchal plate is independent of ontogeny, as it remains constant for all *Hara* species (from India, Bangladesh, Thailand and Myanmar) of all size ranges we have examined (16-85 mm SL; see individual species account for explicit details of size ranges of each species).

The number of vertebrae also distinguishes the two species (Table 10). While the number of abdominal vertebrae does not really distinguish *Hara* species, *H. minuscula* differs from *H. filamentosa* by the number of caudal vertebrae (14-16, vs. 17-19) and the total number of vertebrae (30-32, vs. 31-34). *Hara minuscula* is distinguished from all other Indochinese *Hara* species in having most specimens (29 out of 36) with more abdominal vertebrae than caudal or equal number of both; caudal vertebrae outnumber abdominal vertebrae in only 7 specimens out of 36 examined (Table 10). In *H. filamentosa* there are 2 to 5 more caudal than abdominal vertebrae.

TABLE 10. Vertebrae count frequencies for *Hara*.

	abdominal			caudal							total									(caudal) - (abdominal)								
	14	15	16	13	14	15	16	17	18	19	27	28	29	30	31	32	33	34	35	-2	-1	0	+1	+2	+3	+4	+5	n
H. filamentosus	4	9	11	-		-	-	7	14	3					1	4	10	9	-	-	-	-	-	13	6	4	1	24
H. hara	8	16		-		-	-	4	16	4						11	10	3	-	-	-	-	-	4	9	10	1	24
H. horai	8	2		-		-	1	2	6	1					2	7	1		-	-	-	-	1	1	1	6	1	10
H. jerdoni	4	8		7	5	-	-				1	9	2			-				6	3	3	-	-	-	-	-	12
H. longissima	-	4	7	-		-	-	1	5	5		-	-			-	3	5	3	-	-	-	1	-	8	2	-	11
H. mesembrina	1	10	8	-	-	1	2	11	5	-	-					1	10	7	1	-	-	1	2	-	8	7	1	19
H. minuscula	-	26	10		1	17	18	-	-	-			11	23	2	-	-	-	-	1	16	12	7	-	-	-	-	36
H. spinulus	-	4	1	-		1	2	2	-	-				1	1	2	-	-	-	-	-	1	1	2	-	-	-	4

Hara minuscula possesses fewer soft pectoral fin rays (modally 5 vs. 6-7) than most congeners. This reduction also occurs only in *H. jerdoni*, another diminutive *Hara* species, and we treat this reduction as a pedomorphic character associated with miniaturization (see discussion in Weitzman & Vari, 1988).

The original description of *H. horai* Misra (1976: 245, pl. 9 fig. 1) does not include explicit information on type material and Tilak & Talwar (1976: 246) designated a neotype. This neotype designation is not valid because a neotype can only be designated if all primary types (holotype, lectotype, neotype or syntypes) are lost (ICZN art. 75.3). Tilak & Talwar assumed that there was a holotype and that it is lost. This is erroneous because Misra did not state that he had a single specimen. All specimens on which Misra's *H. horai* is based are syntypes. These syntypes include all specimens examined by Misra [if any] and the specimens of *H. hara* sensu Hora (1950: 200) explicitly listed by Misra as belonging to the present species, that is those collected by Shaw & Shebbeare in Terai and Duars; Hora (1950: 201) listed only ZSI F11390/1 [2]; so there are at least 2 syntypes and one of them is still extant (the one Tilak & Talwar designated as neotype). Therefore, the Code does not permit the designation of a neotype. This surviving syntype is designated here as lectotype of *H. horai*.

The length of the posterior process on coracoid is a useful diagnostic character for *Hara* species. Its use in diagnosing members of the Erethistidae is reported here for the first time, although it has previously been shown to be useful in diagnosing species of the Aspredinidae, another siluriform group with a prominent posterior process on the coracoid (Mees, 1989).

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Deroplatys indica, nouvelle espèce de l'Inde (Dictyoptera, Mantodea)

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***Deroplatys indica*, new species from India (Dictyoptera, Mantodea).** - A new species of *Deroplatys* is described after a single male from India, preserved in the Muséum d'Histoire naturelle de la ville de Genève.

Keywords: Dictyoptera - Mantodea - Mantidae - Deroplatyinae - *Deroplatys* - région orientale.

INTRODUCTION

Le genre *Deroplatys* Westwood, 1839, comprend dans l'état actuel des connaissances (Anisyutkin, 1998; Ehrmann, 2002) onze espèces répandues en Asie du Sud-Est depuis le Myanmar jusqu'à la Nouvelle-Guinée, de taille moyenne à grande, de coloration générale brune, bien ailées dans les deux sexes, qui se caractérisent surtout par des expansions foliacées latérales sur le pronotum, de forme différente suivant les espèces et les sexes dans chacune. La tête est sans grandes particularités avec les yeux latéralement arrondis, les pattes antérieures sont de proportions ordinaires pour des Mantes, avec un nombre d'épines moyen, tandis que les pattes médianes et postérieures ont les fémurs avec un lobe préapical plus ou moins développé, ainsi qu'une épine géniculaire.

Le spécimen étudié ici, qui fait partie de la collection du Muséum d'Histoire naturelle de la ville de Genève (MHNG), avait déjà été repéré par l'éminent spécialiste des Mantes Max Beier lors de son passage au Muséum en octobre 1973, et il s'était contenté de lui ajouter une étiquette imprimée à son nom avec la mention manuscrite «Deroplatys ♂ spec. vic. Saravaka Westw.». En effet son pronotum ressemble surtout à celui du type femelle de *D. sarawaca* Westwood, 1889, espèce décrite de Borneo, jamais citée d'autres régions et dont les mâles n'ont pas encore été signalés à ma connaissance. Mais les similitudes s'arrêtent là, le nouveau spécimen différant de *sarawaca* et aussi de toutes les autres espèces connues de *Deroplatys* par l'absence de lobes préapicaux aux fémurs médians et postérieurs, et par sa localisation en Inde, ce qui accroît notablement vers l'ouest l'aire de répartition du genre. De plus, la forme de son pronotum apparaît inhabituelle pour un mâle. Cependant, toutes ses autres particularités étant conformes à la diagnose de *Deroplatys*, l'espèce qu'il représente doit bien se situer dans ce genre.

Manuscrit accepté le 02.03.2007

DESCRIPTION

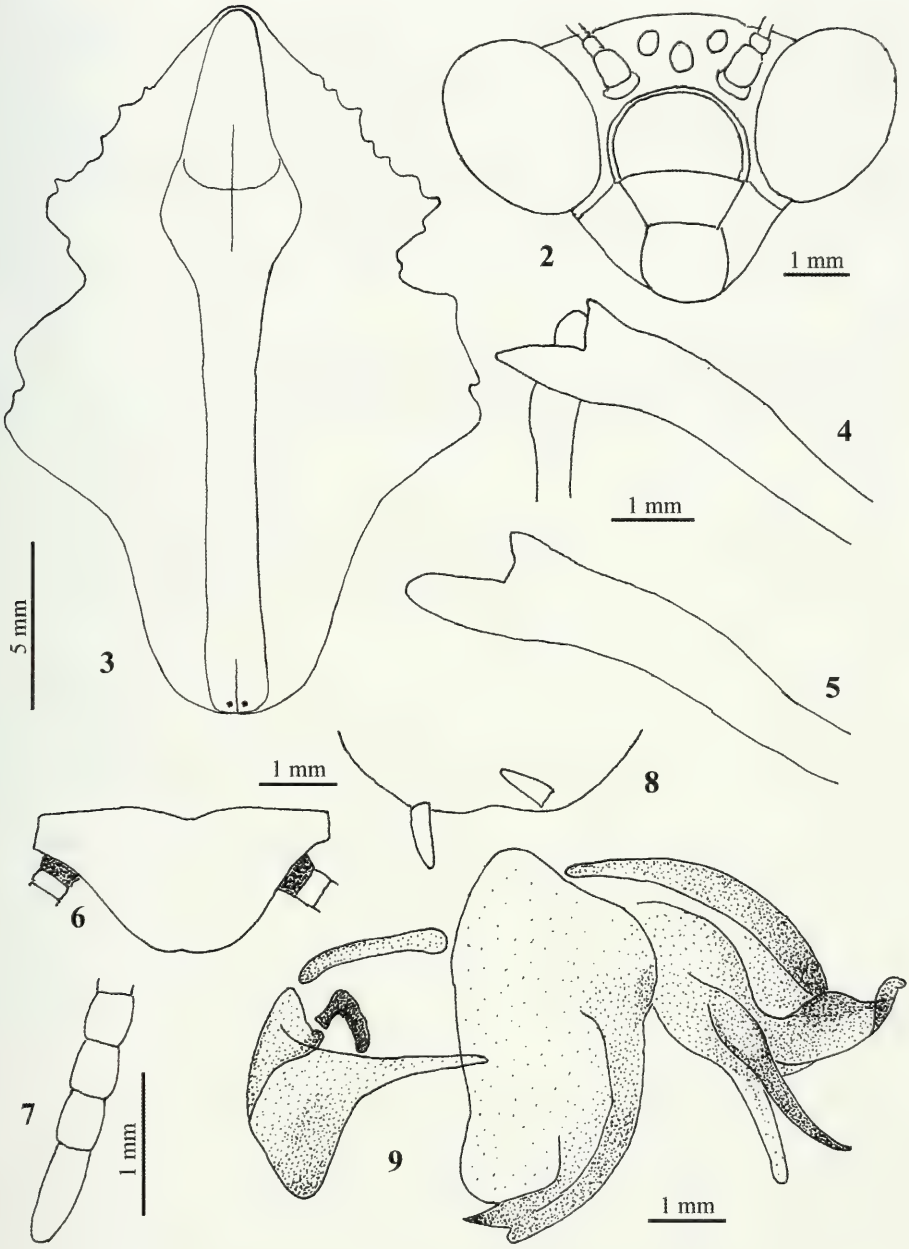
Deroplatys indica n. sp. Figs 1-9

HOLOTYPE ♂: India (Kerala), Cardamon Hills, Periyar, env. de l'hôtel Aranga, 959 m, 4.II.1972, leg. R. Mussard, C. Besuchet & I. Löbl, genitalia R. Roy n°4043, collection MHNG, seul spécimen connu.

Longueur du corps 60 mm, coloration générale brun sombre, organes du vol dépassant largement l'extrémité de l'abdomen (Fig. 1).

FIG. 1
Deroplatys indica n. sp., ♂ holotype, x 1,5.

Tête (Fig. 2) longue d'environ 5 mm et large de 6,5 mm, avec les yeux régulièrement arrondis très saillants et les ocelles bien développés. Vertex à peine bombé entre ses sillons latéraux. Antennes longues d'environ 30 mm avec les deux premiers articles brun clair, les suivants plus fins, progressivement plus sombres, courtement



FIGS 2-9

Deroplatys indica n. sp., ♂ holotype. (2) tête. (3) pronotum. (4) région apicale du fémur médian gauche et base du tibia en vue dorsale. (5) région apicale du fémur postérieur gauche en vue dorsale. (6) plaque suranale avec la base des cerques. (7) région apicale d'un cerque. (8) partie postérieure de la plaque sous-génitale avec les styles. (9) genitalia en vue ventrale.

ciliés. Ecusson frontal un peu plus large que haut, à bord supérieur arrondi, finement rebordé, de teinte relativement claire. Clypéus, labre et pièces buccales y compris les palpes brun sombre.

Pronotum (Fig. 3) long de 21 mm dont 15,5 mm pour la métazone et large de 14 mm, avec les bords foliacés formant deux élargissements successifs, le second plus grand et à bords moins denticulés. Prosternum assombri au niveau de l'insertion des hanches, sa métazone relativement claire avec une série d'une dizaine de doubles taches sombres, les dernières étant plus allongées.

Pattes antérieures conformées comme celles des autres espèces de *Deroplatys*. Hanches longues de 12,5 mm à face dorsale brune avec deux grandes taches beiges et à face ventrale d'un brun plus clair parsemée de petits granules beiges, les lobes apicaux étant brun-noir et se recouvrant partiellement; leur bord externe avec 6 ou 7 grandes épines aplaties à base brun sombre entre lesquelles des plus petites concolores. Fémurs longs de 15 mm, brun assez sombre avec des marbrures du côté dorsal, brun clair du côté ventral avec des parties brun sombre dont une grande tache au niveau des huit premières épines internes; 4 épines discoïdales très sombres, 4 épines externes, les deux premières étant plus sombres, et 14-15 épines internes, les quatre premières et ensuite seulement les plus grandes brun-noir. Tibias longs de 8 mm avec l'épine terminale, brun marbré, armés de 9-10 épines externes et 15 épines internes, les dernières plus sombres. Premier article des tarses long d'environ 4,5 mm, les suivants courts (les deux derniers ont été perdus).

Pattes médianes et postérieures grêles, d'un brun un peu marbré, sans lobes préapicaux aux fémurs (Figs 4 et 5) dont la région terminale est seulement arquée et un peu élargie, et se termine par des prolongements dorsal et ventral relativement longs, en pointe mousse pour les médians, longs de 13 mm, en arrondi plus large pour les postérieurs, longs de 15 mm; l'épine géniculaire est présente, mais très courte. Les tibias, longs de 12 mm pour les médians, de 16 mm pour les postérieurs, sont très minces. Le premier article des tarses est environ aussi long que les suivants réunis.

Elytres longs de 47 mm, brun sombre dans l'aire costale, large de 3,5 mm, et à l'avant de l'aire discoïdale, d'un brun plus clair ensuite avec toutefois l'apex plus foncé; stigma beige clair, très apparent. Ailes longues de 43 mm, brun clair puis sombre dans l'aire costale et l'avant de l'aire discoïdale, laquelle présente une éclaircie préapicale, brun sombre avec les nervures transverses soulignées de clair dans l'aire anale.

Abdomen d'un brun sombre presque uniforme, tergites avec de petits lobes latéraux. Plaque suranale (Fig. 6) brune, transverse avec le bord postérieur arrondi à peine échancré; cerques grêles, apparemment de 17 articles, le premier brun sombre, les suivants clairs, d'abord courts, puis plus longs, le dernier environ deux fois et demie plus long que large (Fig. 7). Plaque sous génitale très grande, un peu plus longue que large, d'un brun un peu marbré, portant des petits styles plus clairs (Fig. 8).

Genitalia (Fig. 9) avec l'hypophallus terminé par un prolongement double, en pointe et en lobe arrondi, beaucoup plus grand que chez *D. desiccata* Westwood, espèce type du genre; épiphallus droit sans particularités marquantes; titillateur plutôt court, renflé dans sa partie moyenne; phallus et pseudophallus très allongés, ce dernier en pointe courbe.

DISCUSSION

Cette nouvelle espèce est bien caractéristique par la forme de son pronotum et par l'absence de lobes préapicaux aux fémurs médians et postérieurs, lobes présents chez les autres espèces, petits chez les mâles, beaucoup plus grands chez les femelles; on ne peut donc la confondre avec aucune autre actuellement connue. Cette absence ne me semble pas suffisante à elle seule pour exclure l'espèce du genre *Deroplatys*, tous les autres caractères étant conformes à la diagnose du genre (Ehrmann, 2002). D'ailleurs il n'est pas impossible que la femelle inconnue soit pourvue de tels lobes plus ou moins réduits.

REMERCIEMENTS

Je remercie vivement les Dr Bernd Hauser et Peter Schwendinger, du MHNG, qui ont attiré mon attention sur ce remarquable spécimen et m'ont permis de le décrire.

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Further additions to the scorpion fauna of the Guayana region of South America[1]

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Further additions to the scorpion fauna of the Guayana region of South America. - This paper presents the results of a study of a new collection of South American scorpions now deposited in the Geneva Museum. The collection comprises two families, four genera and nine species. Among them is one new species, *Broteochactas danielleae* sp. n. (Chactidae), described here from Guyana and Brazil.

Keywords: Scorpiones - *Broteochactas* - new species - Guyana.

INTRODUCTION

Contributions to our knowledge of the scorpion fauna of the Neotropical region and to material deposited in the Natural History Museum of Geneva have been presented in previous studies (Lourenço, 1997, 2002a). As already mentioned in numerous publications, South America is probably one of the regions of the world best studied for its fauna of scorpions. Studies began in the first half of the 19th century and were for the first time compiled in a monograph by Mello-Leitão (1945). Since then other contributions have been published, notably by Maury (1979), González-Sponga (1996), Lourenço, (2002b,c) and Ojanguren Affilastro (2005). On account of the diversity and richness of the scorpion fauna of South America, the discovery and description of new species and even of new genera is by no means unusual (Lourenço, 2003, 2006; Lourenço *et al.*, 2004).

The present contribution, once again, is the result of a study of a more or less heterogeneous collection of scorpions now deposited in the Natural History Museum of Geneva. In addition to the description of a new species in the genus *Broteochactas* Pocock, a list of all the species studied here is given. This list is presented in an alphabetical order of families, genera and species. Species from the following countries have been included: Brazil, Guyana, Suriname and Venezuela. Most of the material examined was collected in the Guayana region, a floristic lowland province that has been delineated botanically (see Mori, 1991).

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METHODS

Illustrations and measurements were made using a Wild M5 stereo-microscope with a drawing tube and an ocular micrometer. Measurements follow those of Stahnke (1970) and are given in mm. Trichobothrial notations are those developed by Vachon (1974) and the morphological terminology mostly follows that of Vachon (1952) and Hjelle (1990).

TAXONOMY

Family Buthidae C.L. Koch, 1837

Genus *Tityus* C.L. Koch, 1836
Subgenus *Atreus* Gervais, 1843

Tityus cambridgei Pocock, 1897

MATERIAL: Suriname, between Moengo and Albina, 5-15/III/1987 (collected by local village people and received by J.-C. Lacroix), 2 males, 2 females.

DISTRIBUTION: Eastern Amazonia and Guayana, Brazil, French Guiana and Suriname.

Tityus discrepans (Karsch, 1879)

MATERIAL: Venezuela, Caracas IV/2005 (A. Borges leg.), 2 males, 2 females.

DISTRIBUTION: Trinidad, Venezuela.

Tityus falconensis González-Sponga, 1974

MATERIAL: Venezuela, Estado Falcón, II/2005 (E. Ythier leg.), 1 female.

DISTRIBUTION: Venezuela.

Tityus magnimanus Pocock, 1897

MATERIAL: Venezuela, Estado Mérida, X/1977 (P. Augusto leg.), 1 female.

DISTRIBUTION: Venezuela.

Family Chactidae Pocock, 1893

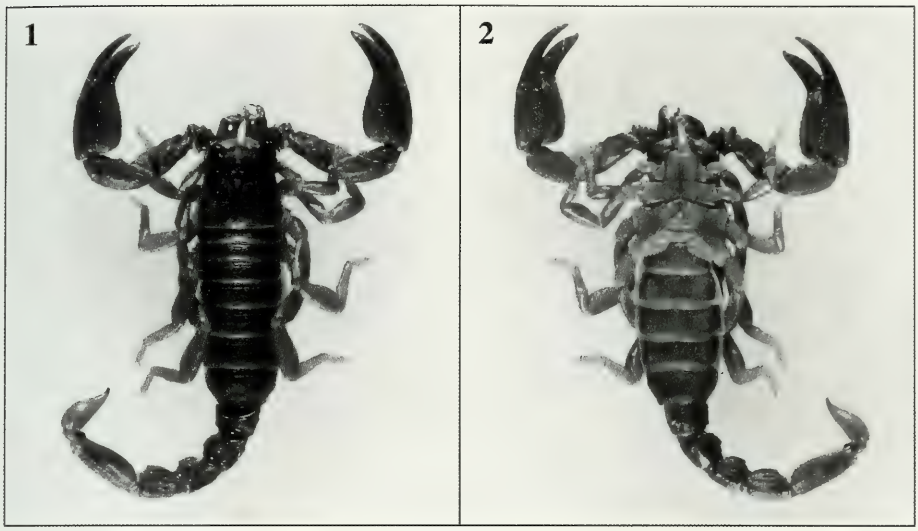
Genus *Broteochactas* Pocock, 1893

Broteochactas danielleae sp. n. Figs 1-12

MATERIAL: Guyana (on the border with Brazil), between Lethem and Conceição do Mau, 6/IV/1987 (collected by local people and received by J.-C. Lacroix): female holotype. Brazil, State of Pará, on the border with Guyana, X/1965 (F. Castro leg.); female paratype. Type material deposited in the Natural History Museum of Geneva (MHNG).

ETYMOLOGY: The species name is a patronym in honor of Dr Danielle Decrouez, director of the Natural History Museum of Geneva.

DIAGNOSIS: Small scorpions, 23 to 24 mm in total length. Coloration reddish yellow to reddish brown. Body and appendages weakly granulated or smooth, with minute punctation. Pectines with 7-8 teeth in females. Trichobothrial pattern of type C neobothriotaxic 'majorante'.

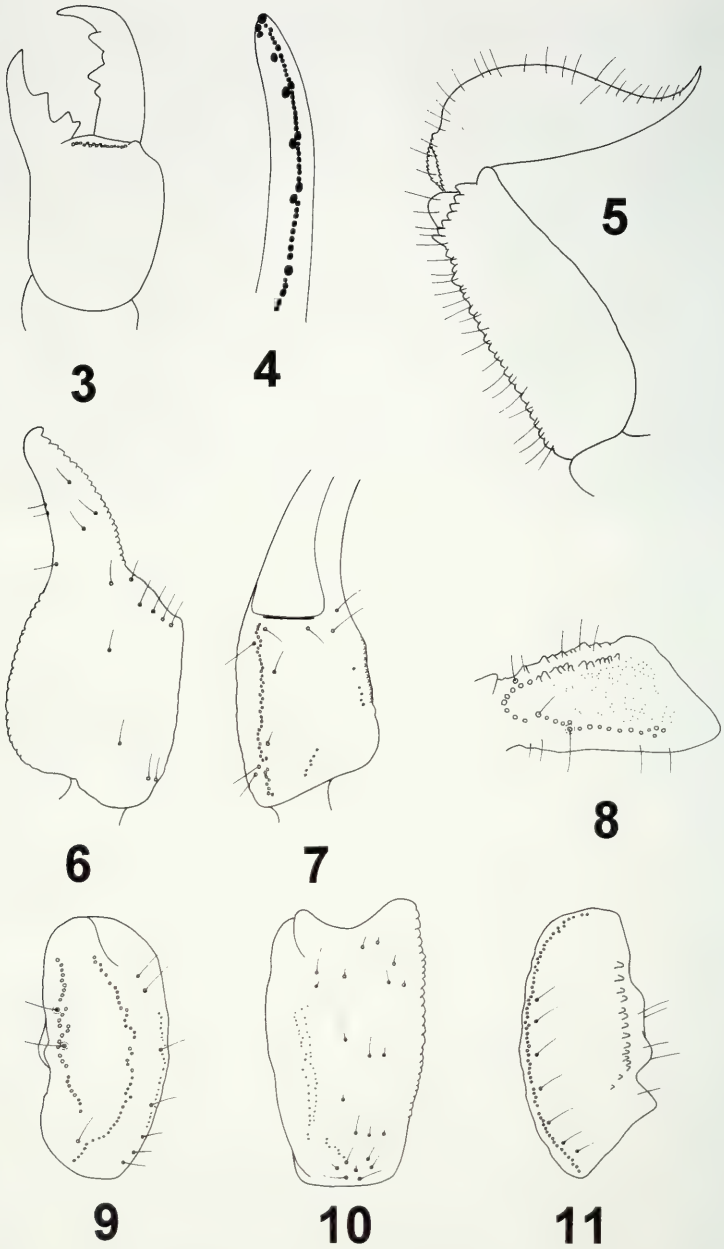


FIGS 1-2
Broteochactas danielleae sp. n. Female holotype, dorsal and ventral aspects.

Broteochactas danielleae sp. n. can be included in the 'Broteochactas' species group (Lourenço, 2002b). The new species can be distinguished from others in the genus *Broteochactas* and in particular from *Broteochactas santanai* Gonzalez-Sponga, 1978 which occurs in the nearby region of Estado Bolivar in Venezuela, and from *Broteochactas delicatus* (Karsch, 1879) which is distributed throughout the Guayana region, by the following features: (i) carapace, pedipalps and metasomal tegument exclusively punctuated (ii) overall size smaller (iii) larger number of pectinial teeth. Moreover, the new species is found in a savannah-like open vegetation habitat, the'Amazon terra firme savannahs' (Murça Pires & Prance, 1985), whereas the other two species are found in tropical forest.

DESCRIPTION: (based on female holotype and paratype). Coloration. Basically reddish yellow to reddish brown (Figs 1-2). Prosoma: carapace reddish brown. Tergites reddish brown, slightly paler than carapace, with two longitudinal yellowish strips. Metasomal segments reddish yellow, with darker zones over carinae; vesicle yellowish. Chelicerae reddish yellow, with diffuse variegated blackish spots; fingers uniformly deep reddish yellow. Pedipalps reddish; femur darker than patella and chela. Legs reddish yellow to yellow. Venter and sternites yellowish; pectines and genital operculum paler than sternites.

Morphology: Carapace lustrous and acarinate, with dense minute punctation; furrows shallow. Sternum pentagonal, wider than long. Tergites acarinate, with only minute granulations, almost smooth and shiny. Pectinal teeth count 7-7 (7-8), fulcra absent (Fig 2). Sternites smooth and shiny, VII acarinate. Metasomal segments IV and V longer than wide; metasomal tegument almost lustrous with only a few small granulations and a few punctuations; segment V with small spinoid granulations ventrally



FIGS 3-11

Broteochactas danielleae sp. n. Female holotype. (3) Chelicera, dorsal aspect. (4) Disposition of granules on the dentate margins of the pedipalpal chela movable finger. (5) Metasomal segment V and telson, lateral aspect. (6-11) Trichobothrial pattern. Chela, dorso-external and ventral aspects (6-7); femur, dorsal aspect (8); patella, dorsal, external and ventral aspects (9-11).

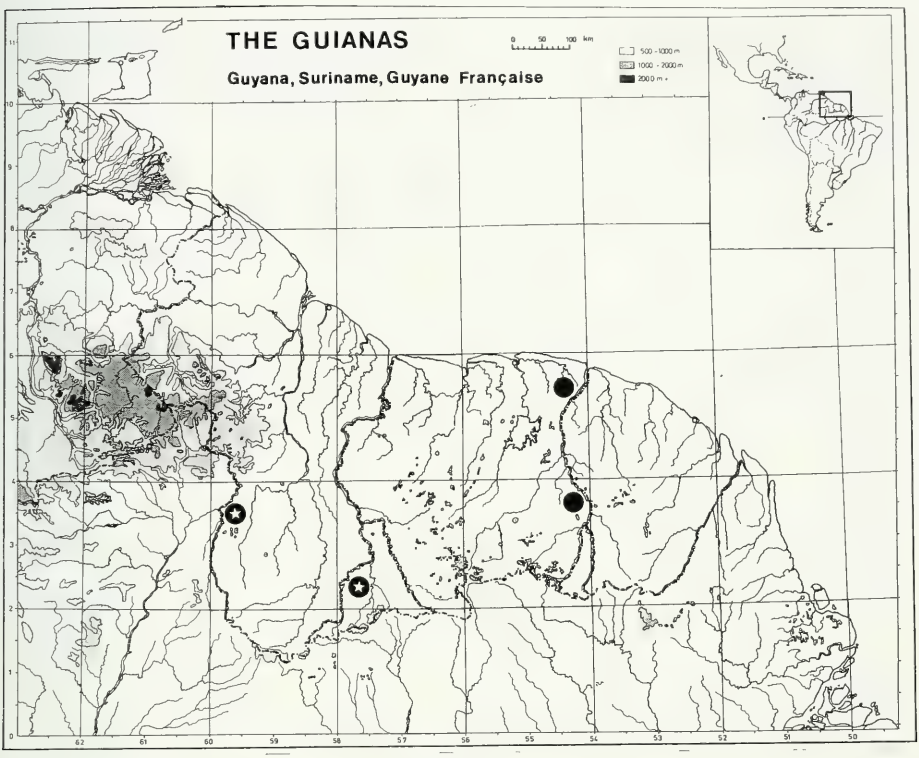


FIG. 12

Map of the Guianas region, comprising the Guayana floristic province. Are indicated the localities of *Broteochactas danielleae* sp. n., in Guyana and Brazil (black circle with white star), and the new localities in Suriname for *Tityus cambridgei*, *Broteochactas delicatus*, *Brotheas gervaisii*, *Brotheas granulatus* and *Hadrurochactas schaumii* (black circle).

(Fig 5). Carinae on segments I-V moderately developed; ventral carina absent from segments I and II, weakly marked on segments III-IV. Pedipalps: femur with dorsal internal, dorsal external and ventral internal carinae moderately marked; ventral external carina vestigial; dorsal and ventral aspects with minute granulations; internal aspect weakly granular. Patella with minute granulations; dorsal internal, ventral internal, ventral external and external carinae weak; other carinae vestigial. Chela with minute granulations; ventral and dorsal median carina moderately to strongly developed; other carinae weakly marked; internal aspect with a few moderate granules. Dentate margins on movable and fixed fingers with 6 rows of granules (Fig 4). Chelicerae with a dentition typical of the family Chactidae (Vachon, 1963), and with dense setation ventrally and internally (Fig 3). Trichobothriotaxy of type C (Figs 6-11); neobothriotaxic 'majorante' (Vachon, 1974).

Morphometric values of the female holotype: Total length excluding the vesicle, 24.1. Carapace: length, 4.2; anterior width, 2.8; posterior width, 4.7. Metasomal segments. I: length, 1.4; width, 2.5; II: length, 1.7; width, 2.1; III: length, 1.7; width,

1.9; IV: length, 2.1; width, 1.8; V: length, 3.8; width, 1.7; depth, 1.5. Vesicle: width, 1.5; depth, 1.1. Pedipalp: femur length, 2.9, width, 1.3; patella length, 3.5, width, 1.5; chela length, 6.8, width, 2.5, depth, 3.0; movable finger length, 3.8.

Broteochactas delicatus (Karsch, 1879)

MATERIAL: Suriname, between Moengo and Albina, 5-15/III/1987 (collected by local village people and received by J.-C. Lacroix), 9 males, 3 females.

DISTRIBUTION: Brazil, French Guiana, Guiana, Suriname, Venezuela (?).

Genus *Brotheas* C.L. Koch, 1837

Brotheas gervaisii Pocock, 1893

MATERIAL: Suriname, between Moengo and Albina, 5-15/III/1987 (collected by local village people and received by J.-C. Lacroix), 2 males.

DISTRIBUTION: Brazil, French Guiana, Suriname.

Brotheas granulatus Simon, 1877

MATERIAL: Suriname, between Moengo and Albina, 5-15/III/1987 (collected by local village people and received by J.-C. Lacroix), 1 male, 3 females.

DISTRIBUTION: Brazil, French Guiana, Suriname.

Genre *Hadrurochactas* Pocock, 1893

Hadrurochactas schaumii (Karsch, 1880)

MATERIAL: Suriname, north of Benzdorp, 18/25/III/1987 (collected by local village people and received by J.-C. Lacroix), 2 males, 2 females.

DISTRIBUTION: Brazil, French Guiana, Guiana, Suriname, Venezuela.

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Revue suisse de Zoologie 114 (3): 521-572; septembre 2007

Records of Pauropoda (Pauropodidae; Brachypauropodidae; Eurypauropodidae) from Singapore, Indonesia and Malaysia with the description of 18 new species (Pauropoda and Symphyla of the Geneva Museum XV)

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Records of Pauropoda (Pauropodidae; Brachypauropodidae; Eurypauropodidae) from Singapore, Indonesia and Malaysia with the description of 18 new species (Pauropoda and Symphyla of the Geneva Museum XV). - A collection of 104 Pauropoda (Myriapoda) from Southeast Asia was studied. Twenty-seven species were identified, 18 of them are new to science and are described here. These are: *Allopauropus serapiensis* sp. n., *A. cibodasensis* sp. n., *A. javanus* sp. n., *A. bidentulus* sp. n., *A. arcuatus* sp. n., *A. acuticaudis* sp. n., *A. prolongatus* sp. n., *A. divaricatus* sp. n., *A. bakoensis* sp .n., *A. crassus* sp. n., *A. curtus* sp. n., *A. quadrispinus* sp. n., *A. trapezoides* sp. n., *Scleropauropus singapuranus* sp. n., *Samarangopus trilix* sp. n., *S. tuberosus* sp. n., *S. interstinguus* sp. n., *S. sarawakensis* sp. n. Most species in this collection have not been found elsewhere, indicating a high degree of endemism. The wide range element is poor in species.

Keywords: Myriapoda - taxonomy - soil fauna - Southeast Asia - biogeography.

INTRODUCTION

In November and December 1987 an entomological expedition from the Natural History Museum, Geneva, visited Singapore, Indonesia (Java, Bali) and Malaysia (Sarawak). The members, Drs Bernd Hauser, Charles Lienhard and Pierre Strinati, collected 104 specimens of Pauropoda from litter and subsoil, mainly by means of automatical extraction and to a less degree manually. Twenty-seven species are present belonging to six genera in three families: Pauropodidae (*Allopauropus*, *Rabaudauropus* and *Scleropauropus*), Brachypauropodidae (*Brachypauropoides*) and Eurypauropodidae (*Samarangopus* and *Sphaeropauropus*). This material made it possible to report Pauropoda for the first time from Singapore, Bali and Sarawak. Two species are now known from Singapore (*Scleropauropus singapuranus* sp. n. and *Samarangopus tuberosus* sp. n.), one species from Bali (*Allopauropus quadrispinus* sp. n.) and 18 species from Sarawak, 13 of them new to science (*Allopauropus serapiensis* sp. n., *A. bidentulus* sp. n., *A. arcuatus* sp. n., *A. acuticaudis* sp. n., *A. prolongatus* sp. n., *A. divaricatus* sp. n., *A. bakoensis* sp. n., *A. curtus* sp. n., *A. crassatus* sp. n., *A. trapezoides* sp. n., *Samarangopus trilix* sp. n., *S. interstinguus* sp. n., *S. sarawakensis* sp. n.) and five species previously known from other countries (*Allopauropus man-*

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jakotompensis Remy, *A. proximus* Remy, *Rabaudauropus dispar* Scheller, *Brachypauropoides penanorum* Scheller, *Samarangopus longipenes* Scheller). Six additional species can be listed for the Javanese fauna (*Allopauropus mortensenii* (Hansen), *A. pulcher* (Remy), *A. pumilio* Remy, *A. javanus* sp. n., *A. cibodasensis* sp. n. and *Sphaeropauropus arcuatus* Scheller).

MATERIAL AND METHODS

Abbreviations: ad. …, subad. … and juv. … = an adult, a subadult or a juvenile specimen with the number of pairs of legs indicated. Descriptive terms are listed in Scheller, 1988.

Measurements: body length of holotype and range of body lengths of adult paratypes are given in mm in brackets. Other indications of absolute lengths are given in µm. When relative lengths are used the reference value is stated in the text.

Collecting has been made either by hand or by soil samples, the latter extracted in Berlese funnels at places indicated.

The material, preserved in alcohol, is deposited in the pauropod collection of the Department of Arthropods and Entomology I, Natural History Museum of Geneva, Switzerland.

In the section Systematics the collectors are given by surnames only.

PREVIOUS KNOWLEDGE

The Pauropoda fauna of the south-eastern Oriental region is poorly known by a few records only: Hansen (1902), a small collection of nine species from the island of Koh Chang in the Gulf of Siam; Silvestri (1930), two species from Java; Remy (1933), one species from central Vietnam; Attems (1938) and Scheller (2004), one and eight species respectively from Vietnam; Remy (1957d), six species from the Philippines, the Palau Islands and Guam; Scheller *et al.* (1994) and Scheller (2001), six and 14 species respectively from Sabah on northern Borneo and Scheller (1995), 11 species from north-western Thailand.

The picture of a poorly investigated Pauropoda fauna in this part of the world is strengthened by the almost complete lack of knowledge about the northern part of the Australian region. Only three publications deal with that region: Remy (1957b) and Scheller (1993), one and 22 species, respectively, from New Caledonia, and Scheller (1996) one species from Papua New Guinea.

With few exceptions the collections studied by the above authors are small, but taken together they indicate a most diversified fauna.

SYSTEMATICS

Order TETRAMEROCERATA

PAUROPODIDAE

Pauropodinae

Genus ***Allopauropus*** Silvestri, 1902

Subgenus ***Decapauropus*** Remy, 1957 (Remy, 1957a).

1. ***Alllopauropus (D.) proximus*** Remy

Allopauropus proximus Remy, 1948a: 572-573, fig. 4.

MATERIAL EXAMINED: Malaysia, Sarawak, Serian District, Penrissen Road, 12 mls from Kuching, "Semongok Wildlife Rehabilitation Centre, Nursery Centre of the Forest Department", soil sample from between buttresses of large trees (extraction at Kuching, Sarawak), alt. 50 m, 4 ad. 9(♀), 8.XII.1987 (loc. Sar-87/60, leg. Hauser); Bako National Park, Jalan Lintang, soil sample (extraction in Geneva) from between buttresses of *Austrobuxus nitidus* Miq. [= *Longetia malayana* (Benth.) P. & H.] (Euphorbiaceae), alt. 30 m, 2 ad. 9(♀), 2 juv. 6, 2 juv. 5, 11.XII.1987 (loc. Sar-87/76, leg. Hauser). - Alltogether 10 specimens.

GENERAL DISTRIBUTION: This species is widely and discontinuously distributed in the tropics and subtropics of the Americas, Africa and southern Asia. It is here reported for the first time from Sarawak.

2. ***Allopauropus (D.) mortensenii*** (Hansen)

Pauropus mortensenii Hansen, 1902: 382-385, pl. 5, figs 1a-c.

MATERIAL EXAMINED: Indonesia, Java, Bogor, Botanical Garden, soil sample from between buttresses of large trees near "Guest House" (extraction at Bogor), alt. ≈250 m, 2 ad. 9(♀), 24.XI.1987 (loc. Sar-87/8, leg. Hauser). – Altogether 2 specimens.

GENERAL DISTRIBUTION: This species is here reported for the first time from Java. It was described from the island of Koh Chang in the Gulf of Thailand (Hansen, 1902) and has later been reported also from Egypt (Remy, 1950), Réunion (s. n. *Allopauropus* cf. *mortensenii*, Remy, 1956e), Mauritius (s. n. *Allopauropus* cf. *mortensenii*, Remy, 1959), Sri Lanka (Remy, 1962; Scheller, 1970). There is also a doubtful record from Australia.

3. ***Allopauropus (D.) manjakotompensis*** Remy & Bello

Allopauropus manjakotompensis Remy & Bello, 1960: 86-88, fig. 8.

MATERIAL EXAMINED: Malaysia, Sarawak, Bako National Park, Jalan Tg. Sapi, soil sample from between buttresses of large trees (extraction in Geneva), alt. 10 m, 1 juv. 6, 2 juv. 5, 11.XII.1987 (loc. Sar-87/80, leg. Hauser). – Altogether 3 specimens.

GENERAL DISTRIBUTION: This species is previously known from two localities on Madagascar only (Remy & Bello, 1960).

4. ***Allopauropus (D.) pulcher*** Remy

Allopauropus pulcher Remy, 1956c: 445-446, figs 1-3.

MATERIAL EXAMINED: Indonesia, Java, Cibodas, Botanical Garden, alt. 1300 m, 1 ad. 9(♀), 25.XI.1987 (loc. Sar-87/18, leg. Hauser).

GENERAL DISTRIBUTION: This species is here reported for the first time from Java. It was previously known only from the type locality in South Africa and from a few places in the USA: Texas (Remy, 1956d) and Great Smoky Mountains National Park (Scheller & Bernard, 2005).

5. ***Allopauropus (D.) pumilio*** Remy

Allopauropus pumilio Remy, 1956e: 148-149, fig. 7.

MATERIAL EXAMINED: Indonesia, Java, Bogor, Botanical Garden, soil sample from between buttresses of large trees near the two lakes (extraction at Bogor), alt. 260 m, 2 ad. 9(♀), 24.XI.1987 (loc. Sar-87/11, leg. Hauser). – Altogether 2 specimens.

GENERAL DISTRIBUTION: The species is here reported for the first time from Java. It was known earlier from the type locality on La Réunion only.

6. ***Allopauropus (D.) serapiensis*** sp. n. Figs 1-11

TYPE MATERIAL: Holotype: ad. 9(♀), Malaysia, Sarawak, Gunung Serapi at road Kuching-Matang, soil sample in forest at the road to the television station (extraction at Kuching, Sarawak), alt. 670 m, 9.XII.1987 (LOC. Sar-87/64, leg. Hauser). Paratype: same data as for holotype, 1 ad. 9(♀).

OTHER MATERIAL: Malaysia, Sarawak, Bako National Park, Jalan Lintang, soil sample from between buttresses of *Austrobuxus nitidus* Miq. [= *Longetia malayana* (Benth.) P. & H.] (Euphorbiaceae) (extraction in Geneva), alt. 30 m, 4 ad. 9(2♂,2♀), 1 subad. 8(sex?), 2 juv. 6, 2 juv. 5, 11.XII.1987 (loc. Sar-87/76, leg. Hauser). – Altogether 11 specimens.

ETYMOLOGY: A latinized adjective of the name Serapi.

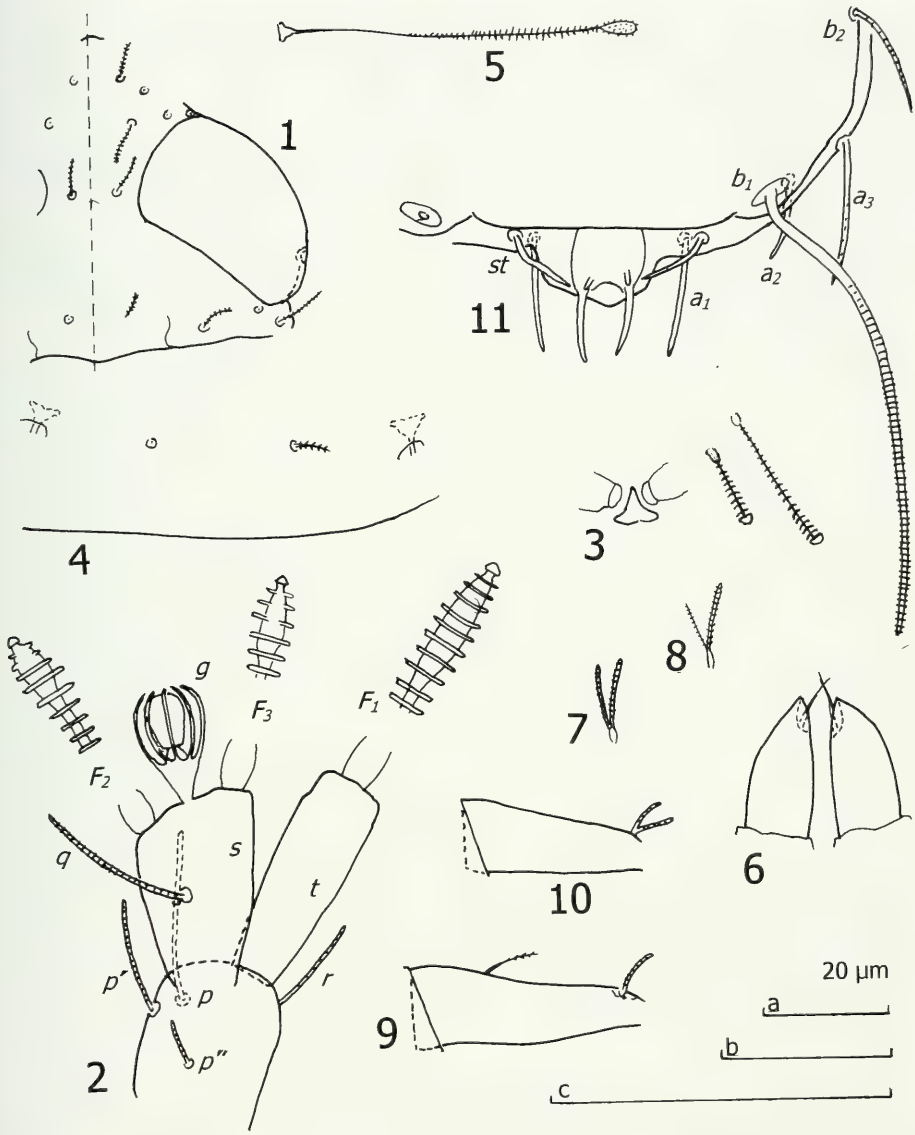
DIAGNOSIS: Several pygidial characters (shape of anal plate, setae of tergum and sternum, shape of posterior margin of tergum) indicate that *A. serapiensis* sp. n. is close to *A. (D.) absimilis* Scheller from southern Vietnam (Scheller, 2004). Good distinctive characters are the shape of the antennal globulus (proportionately long, with ovoid capsule in *A. serapiensis* sp. n.; short, with almost spherical capsule in *A. absimilis*), the proportions of the tergal antennal branch (5.3 times as long as its greatest diameter and 1.8 times as long as sternal branch in *A. serapiensis* sp. n.; 2.2-2.6 and 0.9-1.1 respectively in *A. absimilis*) and the shape of the tarsus of the last pair of legs (2.7-3.2 times as long as its greatest diameter in *A. serapiensis* sp. n., 4.5 in *A. absimilis*).

DESCRIPTION: *Length* = 0.41(-0.43) mm.

Head (Fig. 1): Most tergal setae lost, those present short, very thin, tapering, pointed, striate. Relative lengths of setae (holotype only), 1st row: a_1 = 10, a_2 = ?; 2nd row: a_1= 13, a_2 and a_3 = ?; 3rd row: a_1 = 10, a_2 = ?; 4th row: a_1 = a_2 = 10, a_3 = ?, a_4 = 12; lateral group: l_1 = ?, l_2 = 8, l_3 = 15. Ratio $a_1/a_1 - a_1$ in 1st and 2nd row 0.6, 3rd row 0.8, 4th row 0.7. Temporal organs large, at least twice longer than their shortest interdistance; small pistil in posterior part. Head cuticle glabrous.

Antennae (Fig. 2): Segment 4 with setae p, p', p'' and r; p''' not ascertained. Setae cylindrical, densely striate. Relative lengths of setae: p = 100, p' = (57-)60, p'' = (28-)30(-32), r = 60(-76). Tergal seta p about as long as tergal branch t. The latter somewhat fusiform, (2.2-)2.6 times as long as its greatest diameter and about as long as sternal branch s, this (1.5-)1.7 times as long as its greatest diameter and with its anterodistal corner distinctly truncate. Seta q cylindrical, blunt, densely striate, almost as long as (–1.3 times as long as) length of s. Relative lengths of flagella (basal segments included) and basal segments: F_1 = 100, bs_1 = (4-)5; F_2 = (24-)33(-37), bs_2 = 3(-4); F_3 = 70(-78), bs_3 = 5(-6). F_1 4.9(-5.8) times as long as t, F_2 and F_3 (1.6-)1.8(-2.0) and (3.5-)4.5 times as long as s, respectively. Distal calyces with small caps and distal part of flagella axes fusiformly widened. Globulus g 1.6(-1.8) times as long as wide and its width (0.9-)1.1 of greatest diameter of t; ≈8 bracts present. Antennae glabrous.

Trunk: Setae of collum segment (Fig. 3) simple, somewhat clavate, blunt, annulate. Sublateral seta (1.6-)1.9 times as long as submedian seta; sternite process narrow anteriorly and without apical incision; appendages barrel-shaped, caps with distinctly bent surface. Process and appendages glabrous.



FIGS 1-11

Allopauropus (D.) serapiensis sp. n., 1-5, 7-11, holotype, ad. 9(♀); 6, paratype, ad. 9(♂). (1) head, median and right part, tergal view; (2) left antenna, sternal view; (3) collum segment, median and left part, sternal view; (4) tergite VI, posterior part; (5) T_3; (6) genital papillae, anterior view; (7) seta on coxa of leg 9; (8) seta on trochanter of leg 9; (9) tarsus of leg 9; (10) tarsus of leg 8; (11) pygidium, tergal view. Scale a: Figs 1, 5; b: Figs 3-4, 6-10; c: Figs 2, 11.

Setae on tergites as submedian setae on head; 4+4 setae on tergite I, 6+6 on II-IV, 6+? on V and 4+2 on VI. Posterior setae on tergite VI (Fig. 4) 0.2(-0.3) of inter-distance and about 0.5 of length of pygidial setae a_1.

Bothriotricha (Fig. 5): Relative lengths: T_1 = 100, T_2 = ?(125), T_3 = (101-)114, T_4 = (108-)130, T_5 = (146-)182). All with straight and very thin axis. T_3 thickest and with apical ovoid swelling, 0.1 of length of bothriotrix. Pubescence very short except below end-swelling of T_3, the latter with very short, simple hairs.

Genital papillae (Fig. 6, paratype): 2.1 times as long as their greatest diameter, proximal half subcylindrical, distal half conical, with outer side strongly curved, glabrous; distal seta short, very thin, 0.4 of length of papilla.

Legs: Setae on coxa (Fig. 7) and trochanter (Fig. 8) of leg 9 short, furcate, branches thin, cylindrical, striate, secondary branch of seta on trochanter very thin. Corresponding setae on more anterior legs (including setae on coxa of leg 2 in male), simple, cylindrical, without rudiments of secondary branch. Tarsus of leg 9 (Fig. 9) tapering, (2.7-)3.1(-3.2) times as long as its greatest diameter. Setae striate-annulate, proximal seta short, thin, tapering, curved, $^1/_4$ of length of tarsus and very little longer than distal seta; the latter cylindrical, striate, blunt, almost as long as proximal seta. Cuticle of tarsus glabrous. Distal setae on tarsi of legs 1-8 furcate (Fig. 10), branches cylindrical, striate, blunt.

Pygidium (Fig. 11): *Tergum.* Posterior margin between *st* and above anal plate with a low triangular bulge protruding from a trapezoid base. Relative lengths of setae: a_1 = 10, a_2 = (7-)8, a_3 = (12-)13(-14), *st* = 7(-8). Setae a_1, a_2, and a_3 thin, cylindrical, somewhat curved inwards and converging, only a_3 with faint pubescence distally; *st* tapering, pointed, somewhat curved inwards and with a knee in proximal third. Distance $a_1 - a_1$ 1.3(-1.5) times as long as a_1, distance $a_1 - a_2$ as long as distance $a_1 - a_1$ and somewhat shorter than distance $a_2 - a_3$; distance *st* – *st* 2.2(-2.6) times as long as *st* and 1.2(-1.3) times as long as distance $a_1 - a_1$. Tergum glabrous.

Sternum. Posterior margin between b_1 straight. Relative lengths of setae (a_1=10): b_1 = 40(-46), b_2 = 10(-11). Setae tapering, striate, b_2 diverging, somewhat curved inwards. b_1 1.4(-1.5) times as long as interdistance; b_2 0.6 of distance $b_1 - b_2$.

Anal plate large, subquadrate, somewhat longer than broad, with convex lateral margins and broadly V-shaped posteromedian indentation. Each posterolateral corner with two appendages: one directed posteriorly, as long as plate, tapering, the other very short and protruding from sternal side. Long appendages somewhat curved inward, short ones straight, diverging. Plate and sternum glabrous.

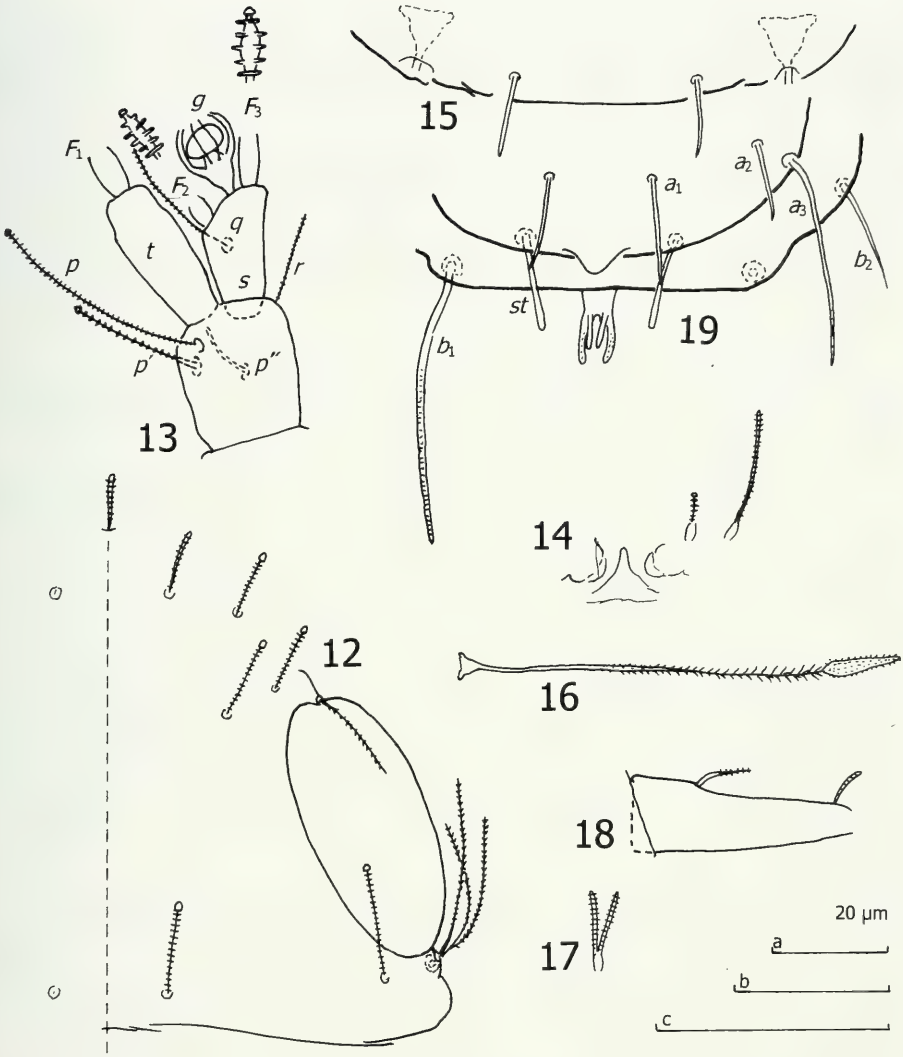
7. ***Allopauropus (D.) cibodasensis*** sp. n. Figs 12-19

TYPE MATERIAL: Holotype: ad. 9(♀), Indonesia, Java, Cibodas, Botanical Garden, alt. ≈1300 m, 25.XI.1987 (loc. Sar-87/18, leg. Hauser).

ETYMOLOGY: A latinized adjective that refers to the name Cibodas.

DIAGNOSIS: *A. (D.) cibodasensis* sp. n. seems to be a very close relative of *A. (D.) bedosae* Scheller from north-western Thailand (Scheller, 1995). They can be distinguished by the shape of the posterior part of the pygidial sternum (margin straight in *A. cibodasensis* sp. n., with broad indentation in *A. bedosae*) and by the shape of the anal plate (plate short with long appendages in *A. cibodasensis* sp. n., plate longer with short appendages, especially the sternal ones, in *A. bedosae*).

DESCRIPTION: *Length* = 0.51 mm.



FIGS 12-19

Allopauropus (D.) cibodasensis sp. n., holotype, ad. 9(♀). (12) head, median and right part, tergal view; (13) right antenna, sternal view; (14) collum segment, median and left part, sternal view; (15) tergite VI, posterior part; (16) T_3; (17) seta on trochanter of leg 9; (18) tarsus of leg 9; (19) pygidium, tergal view. Scale a: Fig. 16; b: Figs 14, 17-18; c: Figs 12, 13, 15, 19.

Head (Fig. 12): Some tergal setae lost, those present of medium length, somewhat clavate, with distinct endsegment, striate. a_3 in 2nd row tapering, pointed. Relative lengths of setae: 1st row: $a_1 = a_2 = 10$; 2nd row: $a_1 = 12$, $a_2 = 10$, $a_3 = 15$; 3rd row: a_1 and a_2 = ?; 4th row: $a_1 = 13$, a_2 = ?, $a_3 = 25$, a_4 = ?; lateral group: $l_1 = 27$, $l_2 = 20$, $l_3 = 22$. Ratio $a_1/a_1 - a_1$ in 1st row 0.6, in 2nd row 0.4 and 4th row 0.8. Temporal organs 0.8 of shortest interdistance. Head cuticle glabrous.

Antennae (Fig. 13): Segment 4 with setae p, p', p'' and r, p''' not ascertained. Setae cylindrical, annulate. Relative lengths of setae: $p = 100$, $p' = 70$, $p'' = 42$, $r = 53$. Tergal seta p 1.2 times as long as tergal branch t. The latter somewhat fusiform, widest near the middle, 2.4 times as long as its greatest diameter and as long as sternal branch s, this 1.7 times as long as its greatest diameter and with its anterodistal corner distinctly truncate. Seta q cylindrical, blunt, striate, 0.9 of length of s. Relative lengths of flagella (basal segments included) and basal segments: $F_1 = 100$, $bs_1 = 6$; $F_2 = 45$, $bs_2 = 3$; $F_3 = 81$, $bs_3 = 7$. F_1 5 times longer than t, F_2 and F_3 2.2 and 4.1 times as long as s, respectively. Distal calyces small, distal part of flagella axes fusiformly widened. Globulus g 1.1 times as long as wide and its width 0.9 of greatest diameter of t; 9 bracts present. Antennae glabrous.

Trunk: Setae of collum segment (Fig. 14) simple, somewhat clavate, blunt, annulate. Sublateral seta 3.4 times as long as submedian seta; sternite process small, narrow anteriorly and without apical incision; appendages directed inwards, small, indistinct. Process and appendages glabrous.

Setae on anterior tergites cylindrical, striate, more posteriorly growing glabrous, pointed; 4+4 setae on tergite I, 6+6 on II-V, and 4+2 on VI. Posterior setae on tergite VI (Fig. 15) 0.4 of interdistance and 0.9 of length of pygidial setae a_1.

Bothriotricha: Relative lengths: $T_1 = 100$, T_2 broken, $T_3 = 95$, $T_4 = 113$, $T_5 = 181$. All with straight, thin axis, T_3 (Fig. 16) thickest, with apical swelling, this almost 0.2 of length of bothriotrix and broadest near base. Pubescence short, longest below endswelling of T_3, the latter with very short erect hairs.

Legs: Setae on coxa of leg 9 not studied, seta on trochanter of that leg (Fig. 17) furcate, branches subsimilar, cylindrical, striate, blunt. Corresponding setae on more anterior legs simple, striate, blunt. Tarsus of leg 9 (Fig. 18) tapering, 2.7 times as long as its greatest diameter. Setae subequal in length, 0.3 of length of tarsus. Proximal seta tapering, pointed, with short pubescence distally; distal seta cylindrical, blunt, striate. Cuticle of tarsus glabrous.

Pygidium (Fig. 19): *Tergum*. Posterior margin evenly rounded but with small median triangular lobe between a_1 and st. Relative lengths of setae: $a_1 = 10$, $a_2 = 9$, $a_3 = 24$, $st = 14$. Setae a_1 and a_2 straight, somewhat diverging, glabrous, the former cylindrical, the latter tapering, a_3 curved inward, diverging, tapering, st straight, somewhat clavate and converging, glabrous. Distance $a_1 - a_1$ 1.2 times as long as a_1, distance $a_1 - a_2$ 3.2 times as long as distance $a_2 - a_3$; distance $st - st$ 1.2 times as long as st and 1.4 times as long as distance $a_1 - a_1$. Tergum glabrous.

Sternum. Posterior margin between b_1 straight. Relative lengths of setae ($a_1 = 10$): $b_1 = 33$, $b_2 = 13$. Setae b_1 cylindrical, faintly striate, b_2 somewhat diverging and curved inward, tapering, pointed. b_1 as long as interdistance; b_2 as long as distance $b_1 - b_2$.

Anal plate subquadrate, with concave lateral margins; distal part with 4 posteriorly directed cylindrical blunt appendages, tergal ones thickest, somewhat curved inward, those protruding from sternal side shorter and thinner, somewhat converging; tergal and sternal appendages 1.5 and 1.3 times as long as plate, respectively. Plate and sternum glabrous.

8. ***Allopauropus (D.) javanus*** sp. n. Figs 20-28

TYPE MATERIAL: Holotype: ad. 9(♀), Indonesia: Java, Cibodas, *Lithocarpus-Castanopsis* forest along gorge above the Botanical Garden, under rotten wood, alt. ≈1400 m, 25.XI.1987 (loc. Sar-87/17, leg. Lienhard).

ETYMOLOGY: A latinized adjective of the name Java.

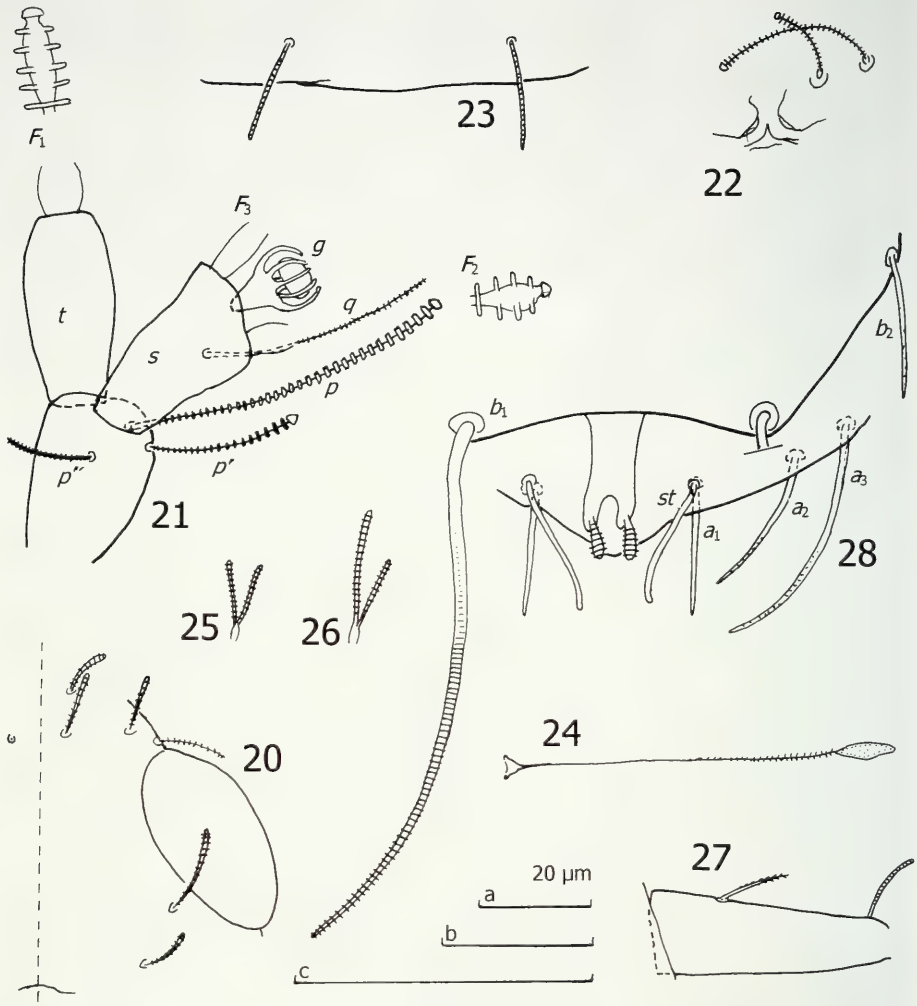
DIAGNOSIS: Among several similar species in the subgenus the new species can be identified by the following combination of characters: flattened base of capsule in antennal globulus, setae of collum segment somewhat claviform and with distinct endsegment, T_3 with distal endswelling with very short pubescence, anal plate with U-shaped posterior incision.

A. javanus sp. n. might be most closely related to two species known from Sri Lanka, *A. (D.) excavatus* Scheller and *A. (D.) baculatus* Scheller (Scheller, 1970), and to the Madagascan *A. (D.) delphini* Remy and *A. (D.) barroisi* Remy (Remy, 1956a). Good distinctive characters are: in relation to *A. excavatus* the proportions of the tergal antennal branch (as long as sternal branch in *A. javanus* sp. n., distinctly longer in *A. excavatus*) and the number of appendages of the anal plate (only two sternal ones in *A. javanus*, two sternal and two tergal ones in *A. excavatus*); in relation to *A. baculatus*, the shape of the pubescence of the bothriotricha (very short in *A. javanus* sp. n., long and with partly branched hairs in *A. baculatus*) and the shape of the T_3 (with distal swelling in *A. javanus* sp. n., no swelling in *A. baculatus*); in relation to *A. delphini*, the shape of the pubescence on the endswelling of the T_3 (endswelling almost glabrous in *A. javanus* sp. n., with long ramose hairs in *A. delphini*) and the shape of the posterior margin of the pygidial tergum (with triangular bulge in *A. javanus* sp. n., no bulge in *A. delphini*); in relation to *A. barroisi*: the shape of the *st* (long, cylindrical in *A. javanus* sp. n., short, clavate in *A. barroisi*). Among these four species the new species may be most close to *A. barroisi* because both have very similar anal plates and the submedian setae a_1 in the 4th row of the tergal setae on the head are lacking in both.

DESCRIPTION. *Length* = 0.46 mm.

Head (Fig. 20): Many tergal setae lost, those present short, somewhat clavate, striate. a_3 in 2nd row cylindrical. Relative lengths of setae (for holotype only), 1st row: $a_1 = a_2 = 10$; 2nd row: $a_1 = 11$, $a_2 = 10$, $a_3 = 13$; 3rd row: $a_1 = ?$, $a_2 = 14$; 4th row: a_1 not identified, $a_2 = 10$, a_3 and $a_4 = ?$; lateral group, not identified. Ratio $a_1/a_1 - a_1$ not studied. Temporal organs about as long as shortest interdistance. Head cuticle glabrous.

Antennae (Fig. 21): Segment 4 with setae p, p', p'' and r; p''' not ascertained. Setae p and p' somewhat clavate, annulate, p'' cylindrical, striate. Relative lengths of setae: $p = 100$, $p' = 53$, $p'' = 32$, $r = ?$. Tergal seta p 1.5 times as long as tergal branch t. The latter somewhat fusiform, widest near the middle, 1.6 times as long as its greatest diameter and 1.1 times as long as sternal branch s, this 1.7 times as long as its greatest diameter and with its anterodistal corner moderately truncate. Seta q cylindrical, blunt, densely striate, 1.3 times as long as length of s. Relative lengths of flagella (basal segments included) and basal segments: $F_1 = 100$, $bs_1 = 6$; $F_2 = 45$, $bs_2 = 5$; $F_3 = 90$, $bs_3 = 4$. F_1 4.5 times as long as t, F_2 and F_3 2.2 and 4.3 times as long as s, respectively. Distal calyces small, distal part of flagella axes fusiformly widened. Globulus g 1.2 times as long as wide and its width 0.6 of greatest diameter of t; ≈9 bracts present. Antennae glabrous.



FIGS 20-28

Allopauropus (D.) javanus sp. n., holotype, ad. 9(♀). (20) head, median and right part, tergal view; (21) right antenna, tergal view; (22) collum segment, median and left part, sternal view; (23) tergite VI, posteromedian part, tergal view; (24) T_3; (25) seta on coxa of leg 9; (26) seta on trochanter of leg 9; (27) tarsus of leg 9; (28) pygidium, posteromedian and left part, sternal view. Scale a: Fig. 24; b: Figs 20, 22, 25-27; c: Figs 21, 23, 28.

Trunk: Setae of collum segment (Fig. 22) simple, somewhat clavate, blunt, annulate. Sublateral seta 2.4 times as long as submedian seta; sternite process small, narrow anteriorly and without apical incision; appendages indistinct, caps thin. Process and appendages glabrous.

Setae on tergites cylindrical, blunt, striate; 4+4 setae on tergite I and 4+2 on VI. Posterior setae on tergite VI (Fig. 23) 0.6 of interdistance and 0.8 of length of pygidial setae a_1.

Bothriotricha: Relative lengths: T_1 = 100, T_2 = 107, T_3 = 101, T_4 = 123, T_5 = 179. All with straight and very thin axis. T_3 (Fig. 24) thickest, with apical ovoid swelling, this well 0.1 of length of bothriotrix. Pubescence very short except below endswelling of T_3, the latter almost glabrous.

Legs: Setae on coxa (Fig. 25) and trochanter (Fig. 26) of leg 9 furcate, branches cylindrical, striate, blunt; branches subequal in length on coxal seta, one of the branches distinctly longer than the other on trochanter. Corresponding setae on more anterior legs with somewhat clavate main branch and rudimentary secondary branch. Tarsus of leg 9 (Fig. 27) tapering, 2.8 times as long as its greatest diameter. Setae equal in length, 0.3 of length of tarsus. Proximal seta tapering, pointed, with short pubescent distally; distal seta cylindrical, blunt, very densely striate. Cuticle of tarsus glabrous.

Pygidium (Fig. 28): *Tergum*. Posterior margin between *st* and above anal plate with a triangular lobe. Relative lengths of setae: a_1 = 10, a_2 = *st* = 11, a_3 = 19. Setae a_1 straight, directed posteriorly, glabrous; a_2, and a_3 curved inward, converging, the former glabrous, the latter with very faint distal pubescence; *st* somewhat S-shaped, converging, tapering, glabrous. Distance $a_1 - a_1$ 1.2 times as long as a_1, distance $a_1 - a_2$ 0.6 of distance $a_1 - a_1$ and 1.8 times as long as distance $a_2 - a_3$; distance *st* – *st* 1.2 times as long as *st* and 1.1 times as long as distance $a_1 - a_1$. Tergum glabrous.

Sternum. Posterior margin between b_1 with broad, shallow, bow-shaped indentation. Relative lengths of setae (a_1 = 10): b_1 = 41, b_2 = 12. Setae tapering, striate, b_2 somewhat diverging and curved inwards. b_1 1.9 times as long as interdistance; b_2 0.7 of distance $b_1 - b_2$.

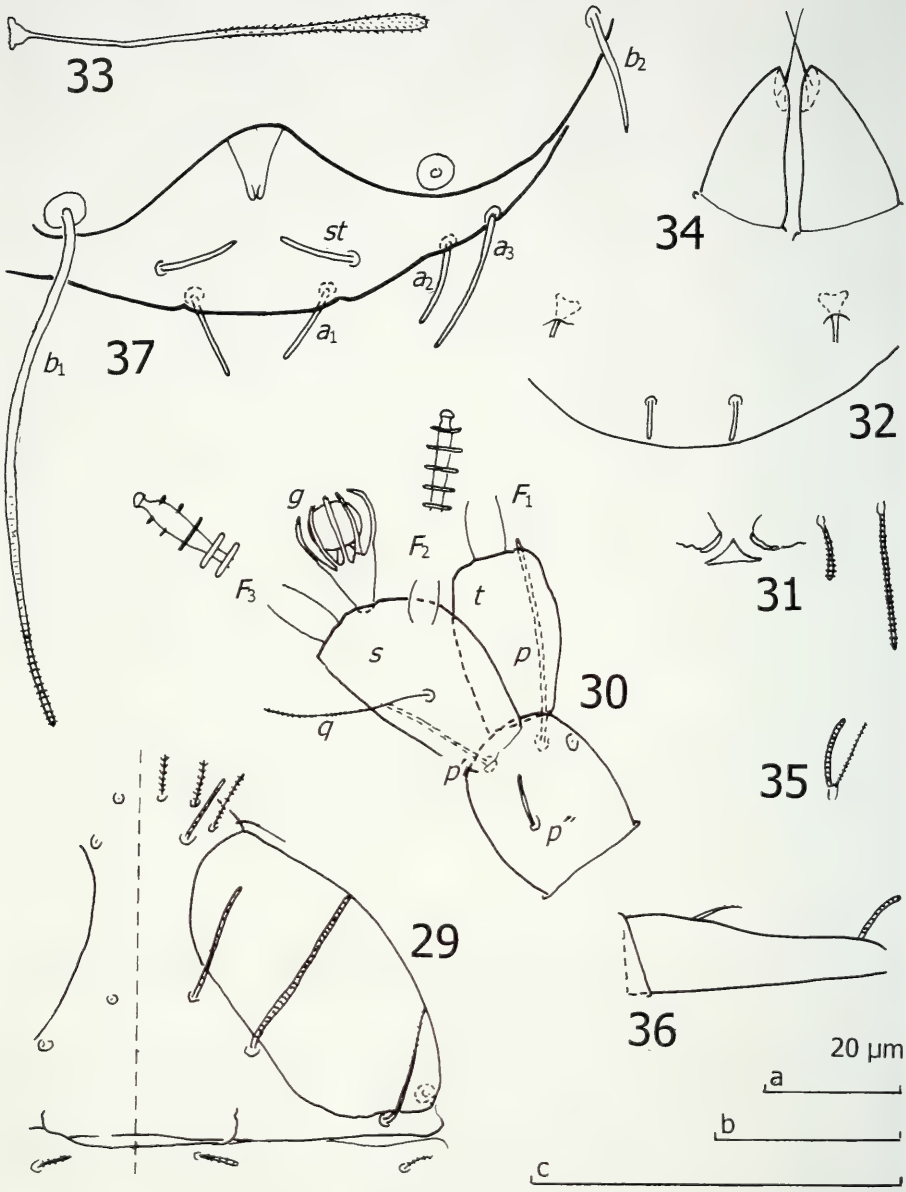
Anal plate 2.3 times as long as greatest breadth, lateral margins concave, distal part protruding into two rounded lobes separated by a U-shaped indentation, 0.3 of length of plate. Two clavate striate appendages originating from sternal sides of these lobes and projecting backwards-downwards; these appendages 0.4 of length of plate. Plate and sternum glabrous.

9. ***Allopauropus (D.) bidentulus*** sp. n. Figs 29-37

TYPE MATERIAL: Holotype: ad. 9(♂), Malaysia: Sarawak, Gunung Serapi at road Kuching-Matang, soil sample (extraction at Kuching) from forest at the road to the television station, alt. 670 m, 9.XII.1987 (loc. Sar-87/64, leg. Hauser). Paratypes: same data as for the holotype, 4 ad. 9(2♂, 2♀). – Altogether 5 specimens.

ETYMOLOGY: From the Latin bi = two and dens = tooth (referring to the distal part of the anal plate).

DIAGNOSIS: *A. (D.) bidentulus* sp. n is a close relative of *A. (D.) facetus* Remy from Nosy Be, Madagascar (Remy, 1956a). The two species are very alike regarding the general chaetotaxy of the pygidium and the shape of the anal plate. They are well distinguished by the shape of the following characters: antennal globulus *g* (1.5 times as long as its greatest diameter and its length 0.6-0.7 of length of *s* in *A. bidentulus* sp. n., longish, 2.2 times as long as greatest diameter and its length as long as *s* in *A. facetus*); base segments of the antennal flagella (about twice longer than wide in *A. bidentulus* sp. n., 5-6 times longer than wide in *A. facetus* Remy); pygidial setae a_1 (cylindrical and converging in *A. bidentulus* sp. n., somewhat lanceolate and diverging in *A. facetus*).



FIGS 29-37

Allopauropus (D.) bidentulus sp. n., holotype, ad. 9(♂). (29) head and anterior part of tergite I, median and right part, tergal view; (30) left antenna, sternal view; (31) collum segment, median and left part, sternal view; (32) tergite VI, posterior part; (33) T_3; (34) genital papillae, anterior view; (35) seta on coxa of leg 9; (36) tarsus of leg 9; (37) pygidium, median and left part, tergal view. Scale a: Fig. 33; b: Figs 29, 31-32, 34-36; c: Figs 30, 37.

DESCRIPTION: *Length* = (0.28-)0.35 mm.

Head (Fig. 29): Setae (holotype only) on anterior part of tergal side short, much longer on posterior part. Setae $a_1$and a_2 of 4th row not verified. Setae thin, striate. Relative lengths of setae: 1st row: $a_1 = a_2 = 10$; 2nd row: $a_1 = a_2 = a_3 = 14$; 3rd row: $a_1 = 26$, $a_2 = 36$; 4th row: $a_3 = 28$, $a_4 = ?$; lateral group setae not studied. Ratio $a_1/a_1 - a_1$ in 1st row 1.0, in 2nd row 0.7, in 3rd row 1.6. Temporal organs proportionally large, 3.1 times as long as their shortest interdistance. Small posterior aperture close to posterior margin of temporal organ. Head cuticle glabrous.

Antennae (Fig. 30): Segment 4 with setae p, p', p'' and r; p''' not ascertained. Setae cylindrical, annulate. Relative lengths of setae (holotype only): $p = 100$, $p' = ?$, $p'' = 27$, $r = 46$. Tergal seta p 1.2 times as long as tergal branch t. The latter somewhat fusiform, widest near the middle, 1.5 times as long as its greatest diameter and 0.8 of length of sternal branch s, this (1.4-)1.6 times as long as its greatest diameter and with its anterodistal corner distinctly truncate. Seta q thin, cylindrical, blunt, faintly striate, about as long as s. Relative lengths of flagella (basal segments included) and basal segments: $F_1 = 100$, $bs_1 = 5(-6)$; $F_2 = 33(-38)$, $bs_2 = 3$; $F_3 = 68(-76)$, $bs_3 = (6-)7$. F_1 (5.6-)6.7 times as long as t, F_2 and F_3 1.8(-1.9) and (3.5-)3.6 times as long as s, respectively. Distal calyces small, distal part of flagella axes somewhat widened in F_1 and F_3, not in F_2. Globulus g 1.4 times as long as wide and its width 0.8 of greatest diameter of t; 9 bracts present. Antennae glabrous.

Trunk: Setae of collum segment (Fig. 31) simple, cylindrical, blunt, striate. Sublateral seta 2.1(-2.2) times as long as submedian seta; sternite process small, narrow anteriorly and without apical incision; appendages small, indistinct. Both process and appendages glabrous.

Setae on anterior tergites cylindrical, striate, more posteriorly growing glabrous. 4+4 setae on tergite I, 4+2 on VI. Posterior setae on tergite VI (Fig. 32) 0.4 of interdistance and 0.8 of length of pygidial setae a_1.

Bothriotricha: Relative lengths (holotype only): $T_1 = 100$, $T_2 = 88$, $T_3 = 80$, $T_4 = 68$, $T_5 = 121$. All but T_3 with straight, very thin axis, T_3 (Fig. 33), with apical swelling, this 0.2 of length of bothriotrix. Pubescence short, on T_1, T_2, T_4 and T_5 extremely short, longest pubescence below endswelling of T_3, the latter with short almost erect hairs.

Genital papillae (Fig. 34): Short, conical with rounded outer sides, 1.8 times as long as their greatest diameter, glabrous; distal seta very thin, 0.5 of length of papilla.

Legs: Setae on coxa of leg 9 (Fig. 35) short, furcate, striate, branches subsimilar in length, seta on trochanter seems to be simple. Corresponding setae on more anterior legs simple, striate. Tarsus of leg 9 (Fig. 36) tapering, (3.1-)3.2 times as long as its greatest diameter. Proximal seta tapering, pointed, distal one cylindrical, blunt, striate, both 0.2 of length of tarsus. Cuticle of tarsus glabrous.

Pygidium (Fig. 37): *Tergum*. Posterior margin evenly rounded. Relative lengths of setae: $a_1 = 10$, $a_2 = 10(-11)$, $a_3 = (15-)16$, $st = 8$. Setae cylindrical, somewhat curved inward, blunt, glabrous, converging. Distance $a_1 - a_1$ 1.5(-1.6) times as long as a_1, distance $a_1 - a_2$ about 3 times longer than distance $a_2 - a_3$; distance $st - st$ (2.3-)2.6 times as long as st and (1.1-)1.3 times as long as distance $a_1 - a_1$. Tergum glabrous.

Sternum: Posterior margin between b_1 with deep, broadly V-shaped indentation. Relative lengths of setae ($a_1 = 10$): $b_1 = 56(-58)$, $b_2 = 14(-15)$. Seta b_1 cylindrical,

somewhat tapering, faintly striate distally, b_2 subcylindrical, tapering distally, glabrous, somewhat diverging. b_1 1.4 times as long as interdistance, b_2 0.6 of distance $b_1 - b_2$.

Anal plate broadest at base, longish, triangular, with straight sides and two appendages most distally; appendages very short, blunt, close to each other. Plate and sternum glabrous.

10. ***Allopauropus (D.) arcuatus*** sp. n. Figs 38-45

TYPE MATERIAL: Holotype: ad. 9(♀), Malaysia, Sarawak, Gunung Serapi at road Kuching-Matang, soil sample (extraction at Kuching) from forest at the road to the television station, alt. 670 m, 9.XII.1987 (loc. Sar-87/64, leg. Hauser).

ETYMOLOGY: From the Latin arcus = bow (referring to pygidial setae *st*).

DIAGNOSIS: Many species in the subgenus have similar anal plates but *A. (D.) arcuatus* sp. n. is distinguished by having also clavate bothriotricha T_3 and cylindrical *st* evenly curved inward like an arc of a circle. The setae a_1 of the 4th row of setae on the tergal side of the head have not been verified.

DESCRIPTION: *Length* = 0.32 mm.

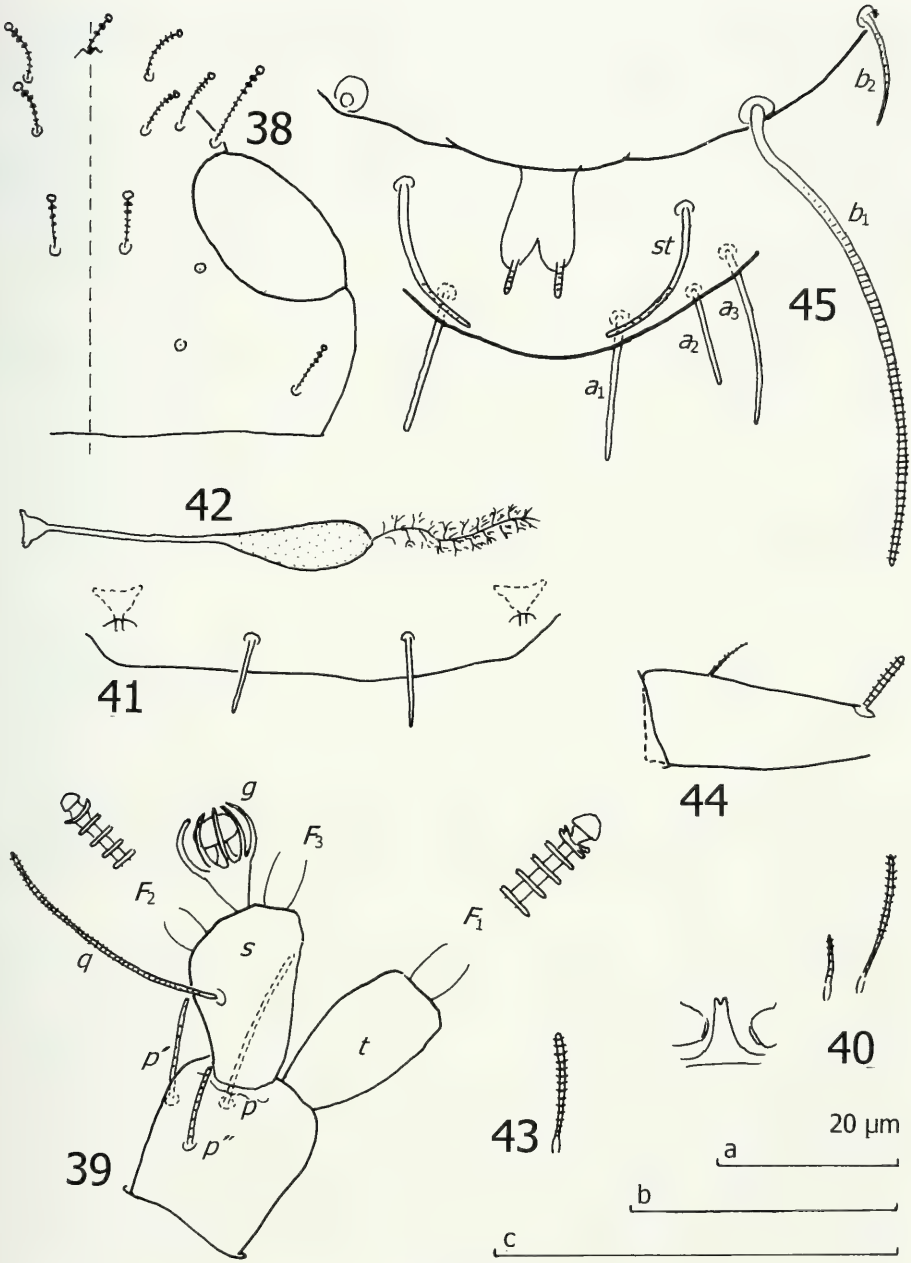
Head (Fig. 38): Tergal setae short, somewhat clavate, annulate, with distinct endsegment. Relative lengths of setae: 1st row: only one pair of setae verified l = 10; 2nd row: $a_1 = 9$, $a_2 = 11$, $a_3 = 15$; 3rd row: $a_1 = 9$, $a_2 = ?$; 4th row: a_1 not verified, $a_2 = ?$, $a_3 = 9$, $a_4 = ?$; lateral group of setae not studied. Ratio $a_1/a_1 - a_1$ in 2nd row 0.3, in 3rd row 0.8. Temporal organs proportionally small, as long as shortest interdistance. Head cuticle glabrous.

Antennae (Fig. 39): Segment 4 with at least setae p, p', and p'', r and p''' not ascertained. Setae thin, cylindrical, indistinctly striate. Relative lengths of setae: $p = 100$, $p' = 62$, $p'' = 55$. Tergal seta p as long as tergal branch t. The latter somewhat fusiform, widest outside the middle, 1.7 times as long as its greatest diameter and 0.9 of length of sternal branch s, this 1.7 times as long as its greatest diameter and with its anterodistal corner distinctly truncate. Seta q thin, cylindrical, blunt, densely striate, 1.5 times as long as s. Relative lengths of flagella (basal segments included) and basal segments: $F_1 = 100$, $bs_1 = 5$; $F_2 = 32$, $bs_2 = 4$; $F_3 = 84$, $bs_3 = 5$. F_1 6.3 times as long as t, F_2 and F_3 1.9 and 4.8 times as long as s, respectively. Distal calyces hemispherical, distal part of flagella axes not widened. Globulus g 1.3 times as long as wide and its width 0.8 of greatest diameter of t; ≈7 bracts present. Antennae glabrous.

Trunk: Setae of collum segment (Fig. 40) simple, cylindrical, tapering, striate. Sublateral seta 3 times longer than submedian seta; sternite process small, narrow, with small incision anteriorly; appendages small. Process and appendages glabrous.

Setae on anterior tergites cylindrical, striate, more posteriorly growing glabrous. 4+4 setae on tergite I, 4+2 on VI. Posterior setae on tergite VI (Fig. 41) 0.5 of interdistance and 0.8 of length of pygidial setae a_1.

Bothriotricha: T_1, T_2 and T_4 lost or broken. Lengths: $T_3 = 49$, $T_5 = 50$ µm. All but T_3 seems to be very thin, T_3 (Fig. 42) with proximal 1/3 of axis cylindrical, middle 1/3 forming a club-shaped swelling, distal 1/3 very thin; proximal part glabrous, middle part maybe with very short pubescence, distal part with long branched hairs arranged in whirls.



FIGS 38-45

Allopauropus (D.) arcuatus sp. n., holotype, ad. 9(♀). (38) head, median and right part, tergal view; (39) left antenna, sternal view; (40) collum segment, median and left part, sternal view; (41) tergite VI, posterior part; (42) T_3; (43) seta on coxa of leg 9; (44) tarsus of leg 9; (45) pygidium, median and left part, sternal view. Scale a: Figs 38, 40; b: Figs 41-43; c: Figs 39, 44, 45.

Legs: Setae on coxa (Fig. 43) and trochanter of leg 9 simple, cylindrical, blunt, striate. Corresponding setae on more anterior legs simple, striate, coxal seta somewhat thicker than seta on trochanter. Tarsus of leg 9 (Fig. 44) tapering, 2.4 times as long as its greatest diameter. Proximal seta tapering, pointed, distal one cylindrical, blunt, striate, the former 0.4 and the latter 0.7 of length of tarsus. Cuticle of tarsus glabrous.

Pygidium (Fig. 45): *Tergum*. Posterior margin evenly rounded. Relative lengths of setae: $a_1 = 10$, $a_2 = 7$, $a_3 = st = 13$. Setae cylindrical, blunt, almost glabrous; a_1 and a_2 straight, a_3 and *st* curved inward, *st* curved like an arch, a_2 and a_3 diverging, *st* converging. Distance $a_1 - a_1$ 1.3 times as long as a_1, distance $a_1 - a_2$ 1.3 times as long as distance $a_2 - a_3$; distance $st - st$ 1.6 times as long as *st* and distance $a_1 - a_1$. Tergum glabrous.

Sternum. Posterior margin between b_1 with low median bulge. Relative lengths of setae ($a_1 = 10$): $b_1 = 34$, $b_2 = 8$. Setae striate, b_1 subcylindrical, b_2 tapering, somewhat diverging. b_1 1.2 times as long as interdistance, b_2 0.8 of distance $b_1 - b_2$.

Anal plate 1.4 times as long as broad, broadest in distal third, with concave lateral margins; distal part protruding into two rounded somewhat diverging lobes; two cylindrical appendages originating from sternal sides of these lobes and projecting backward; these appendages 0.3 of length of plate, cylindrical, blunt, striate, somewhat diverging. Plate and sternum glabrous.

11. ***Allopauropus (D.) acuticaudis*** sp. n. Figs 46-52

TYPE MATERIAL: Holotype: subad. 8(♀), Malaysia, Sarawak, Bau, in the surroundings of the cave "Gua Puang" near Kampong Pelaman Sekiang, on steep slope of Gunung Jambusan, under bark, alt. 10-30 m, 4.XII.1987 (loc. Sar-87/52, leg. Lienhard).

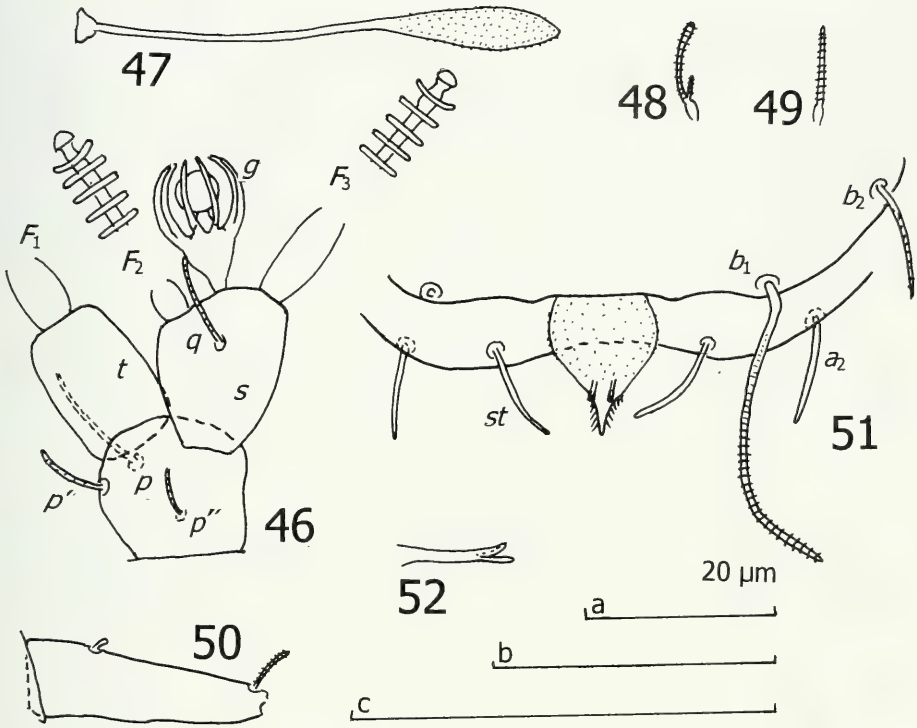
ETYMOLOGY: From the Latin acutus = pointed and cauda = tail.

DIAGNOSIS: The specimen is not in the best condition (many setae lost) but it is well defined by the peculiar shape of the anal plate in combination with the endswelling of the T_3 and the unusual shape of the proximal seta of the tarsus of the last pair of legs. *A. acuticaudis* sp. n. appears to be most closely related to two Madagascan species, *A. baudoti* Remy and *A. lienharti* Remy (Remy, 1956a). It can be distinguished from *A. lienharti* by the shape of the T_3 (thick, simple, with distal swelling in *A. acuticaudis* sp. n.; thin, branched in *A. lienharti*) and the shape of the distal seta on the tarsi of the last pair of legs (simple in *A. acuticaudis* sp. n.; furcate in *A. lienharti*). Good distinctive characters in relation to *A. baudoti* are the size ratio *q/s* (0.6 in *A. acuticaudis* sp. n.; 1.7 in *A. baudoti*), the shape of the T_3 (thick, simple, with distal swelling in *A. acuticaudis* sp. n.; thin, tapering in *A. baudoti*) and the shape of the proximal seta on the tarsi of the last pair of legs (very short, blunt, less than 0.1 of length of tarsus and about 0.3 of length of distal seta in *A. acuticaudis* sp. n.; 1/4 of length of tarsus and longer than distal seta in *A. baudoti*). The new species is also related to *A. (D.) digitiger* Remy (Remy, 1956a), but to a less degree.

DESCRIPTION: *Length* = 0.42 mm.

Head: Not available for study.

Antennae (Fig. 46): Segment 4 with at least setae p, p', and p'', r and p''' not ascertained. Setae thin, cylindrical, indistinctly striate. Relative lengths of setae: $p = 10$, $p' = 6$, $p'' = 4$. Tergal seta p 0.9 of length of tergal branch t. The latter cylindrical,



FIGS 46-52

Allopauropus (D.) acuticaudis sp. n., holotype, subad. 8(♀). (46) left antenna, sternal view; (47) T_3; (48) seta on coxa of leg 8; (49) seta on trochanter of leg 8; (50) tarsus of leg 8; (51) pygidium, median and left part, sternal view; (52) anal plate, lateral view. Scale a: Figs 48-49; b: Figs 47, 50-52; c: Fig. 46.

1.5 times as long as its greatest diameter and 0.9 of length of sternal branch *s*, this 1.3 times as long as its greatest diameter and with anterodistal corner distinctly truncate. Seta *q* proportionately short, thin, cylindrical, blunt, densely striate, 0.6 of length of *s*. Relative lengths of flagella (basal segments included) and basal segments: F_1 = 100, bs_1 = 9; F_2 = 36, bs_2 = 5; F_3 = 83, bs_3 = 13. F_1 5.3 times as long as *t*, F_2 and F_3 1.7 and 3.9 times as long as *s*, respectively. Distal calyces small, hemispherical, distal part of flagella axes not widened. Globulus *g* 1.4 times as long as wide and its width 0.9 of greatest diameter of *t*; ≈9 bracts present. Antennae glabrous.

Trunk: Collum segment and setae on tergites not available for study.

Bothriotricha: Only T_3 (Fig. 47) studied, the others broken. Length of T_3 = 35 µm, axis thick, with distal swelling, pubescence very short.

Legs: Setae on coxa of leg 8 (Fig. 48) short, furcate, striate, main branch somewhat clavate, striate, secondary branch much thinner and 0.3 of length of main branch; seta on trochanter (Fig. 49) simple, cylindrical, blunt, striate. All corresponding setae on more anterior legs simple, striate. Tarsus of leg 8 (Fig. 50) tapering, 3.3 times as long as its greatest diameter. Proximal seta very short, cylindrical, blunt, glabrous,

distal one cylindrical, blunt, striate; proximal seta less than 0.1 of length of tarsus and 0.3 of length of distal seta. Cuticle of tarsus glabrous.

Pygidium (Fig. 51): *Tergum*. Posterior margin with broad and shallow indentation between *st*. Lengths of setae: a_1 = ?, a_2 = 7, a_3 = ?, *st* = 8 µm. a_2 and *st* subcylindrical, blunt, glabrous, somewhat curved inward, converging. Distance *st* – *st* 2.1 times as long as *st*. Tergum glabrous.

Sternum. Posterior margin between b_1 almost straight, with one small bulge only at each side of anal plate. Lengths of setae: b_1 = 23, b_2 = 8 µm. Seta b_1 cylindrical, striate, b_2 tapering, faintly striate distally, somewhat curved inward. b_1 as long as interdistance, b_2 0.8 of distance $b_1 - b_2$.

Anal plate (Figs 51-52) broadest in proximal half, subcircular, with triangular posterior prolongation; this with one marginal row of hairs on each side and with two short appendages protruding backward from sternal side; appendages subparallell, cylindrical, blunt, glabrous. Plate with faint pubescence, sternum glabrous.

12. ***Allopauropus (D.) prolongatus*** sp. n. Figs 53-57

TYPE MATERIAL: Holotype: ad. 9(♀), Malaysia, Sarawak, Serian District, Penrissen Road, 12 mls from Kuching, "Semongok Wildlife Rehabilitation Centre, Nursery Centre of the Forest Department", soil sample (extraction at Kuching) from between buttresses of large trees, alt. 50 m, 8.XII.1987 (loc. Sar-87/60, leg. Hauser). Paratype: 1 ad. 9(♀), same data as holotype. – Altogether 2 specimens.

ETYMOLOGY: From the Latin pro- = in relation to, and longus = long (referring to the lengthened posterior part of pygidial tergum).

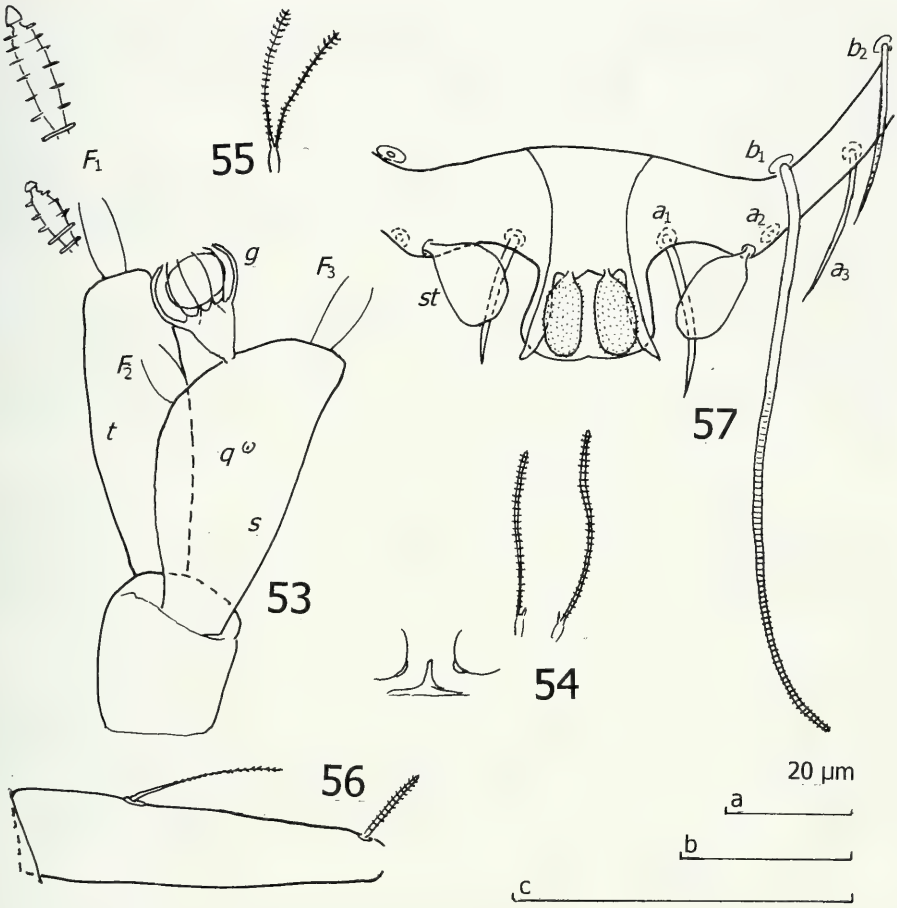
DIAGNOSIS: The type specimens are not in the best condition (many setae lost) but they are well defined by the shape of the anal plate (with balloon-like submedian appendages), the posterior part of the pygidial tergum (with a large posterior lobe) and the *st* (balloon-like). The general morphology of the anal plate is alike that in *A. (D.) ludovicae* Remy from Corsica (Remy, 1945) but otherwise they are not close to each other. At present the relationships of this species can not be established.

DESCRIPTION: *Length* = 0.75 mm.

Head: Head not available for study.

Antennae (Fig. 53): All setae lost. Tergal antennal branch elongate, somewhat fusiform, distal end obliquely truncate, 3.0 times longer than wide and as long as sternal branch *s*, this 2.2 times as long as its greatest diameter and with its anterodistal corner roundly truncate. Relative lengths of flagella (basal segments included) and basal segments (for holotype only): F_1 = 100, bs_1 = 8; F_2 = 53, bs_2 = 6; F_3 = ?, bs_3 = 8. F_1 3.1 times as long as *t*, F_2 1.7 times as long as *s*. Distal calyces of F_1 conical, those of F_2 small, hemispherical; distal part of flagella axes fusiformly widened. Globulus *g* 1.2 times as long as wide and its width 0.9 of greatest diameter of *t*; 13 bracts present. Antennae glabrous.

Trunk: Setae of collum segment (Fig. 54) furcate; main branch subcylindrical, blunt, striate, secondary branch rudimentary, pointed. Setae long, sublateral one 1.3 times as long as submedian seta; sternite process small, narrow anteriorly and without apical incision; appendages subglobular, caps very small. Process and appendages glabrous. Setae on tergites I-VI not studied.



FIGS 53-57

Allopauropus (D.) prolongatus sp. n., holotype, ad. 9(♀). (53) left antenna, sternal view; (54) collum segment, median and left part, sternal view; (55) seta on trochanter of leg 9; (56) tarsus of leg 9; (57) pygidium, median and left part, tergal view. Scale a: Figs 55-56; b: Fig. 54; c: Figs 53, 57.

Bothriotricha: Not available for study.

Legs: Setae on coxa and trochanter (Fig. 55) of leg 9 furcate, branches subequal in length, cylindrical, somewhat widened distally, striate, blunt. Corresponding setae on more anterior legs furcate, with rudimentary secondary branch. Tarsus of leg 9 (Fig. 56) tapering, 4.1 times as long as its greatest diameter. Proximal seta thin, tapering, pointed, with very short pubescent most distally, seta 0.4 of length of tarsus and 2.1 times as long as distal seta; the latter cylindrical, blunt, striate. Cuticle of tarsus glabrous.

Pygidium (Fig. 57): *Tergum*. Posterior margin between widely separated *st* with large broadly linguiform lobe above anal plate; between lobe and *st* a distinct but shallow indentation. Relative lengths of setae: $a_1 = a_3 = 10$, $a_2 = ?$, $st \approx 7$. Setae a_1 and

a_3 tapering, pointed, curved inward, glabrous, the former diverging, the latter converging, *st* balloon-shaped, converging, glabrous, at most twice longer than wide. Distance $a_1 - a_1$ 0.9 of length of a_1, distance $a_1 - a_2$ 0.8 of distance $a_1 - a_1$ and 0.9 of distance $a_2 - a_3$; distance *st* – *st* 2.8 times as long as *st* and 2.1 times as long as distance $a_1 - a_1$. Tergum glabrous.

Sternum. Posterior margin with shallow indentation between b_1. Relative lengths of setae (a_1 = 10): b_1 = 35, b_2 = 12. Setae tapering, striate distally, b_2 pointed, somewhat curved inward. b_1 1.5 times as long as interdistance; b_2 1.1 times as long as distance $b_1 - b_2$. Tergum glabrous.

Anal plate somewhat longer than broad, broadest at base, lateral margins concave, distal margin with shallow median indentation and 4 large appendages: two posterolateral, 0.8 of length of plate, somewhat diverging, pointed, outer margin almost straight, inner margin convex; and two submedian appendages, 0.7 of length of plate, protruding backward from posterior margin of sternal side of plate, these appendages very alike *st* but with very short pubescence. Plate and sternum glabrous.

13. ***Allopauropus (D.) divaricatus*** sp. n. Figs 58-66

TYPE MATERIAL: Holotype: ad. 9(♀), Malaysia, Sarawak, Bako National Park, Jalan Lintang, soil sample (extraction in Geneva) from between buttresses of *Austrobuxus nitidus* Miq. [= *Longetia malayana* (Benth.) P. & H.] (Euphorbiaceae), alt. 30 m, 11.XII.1987 (loc. Sar-87/76, leg. Hauser).

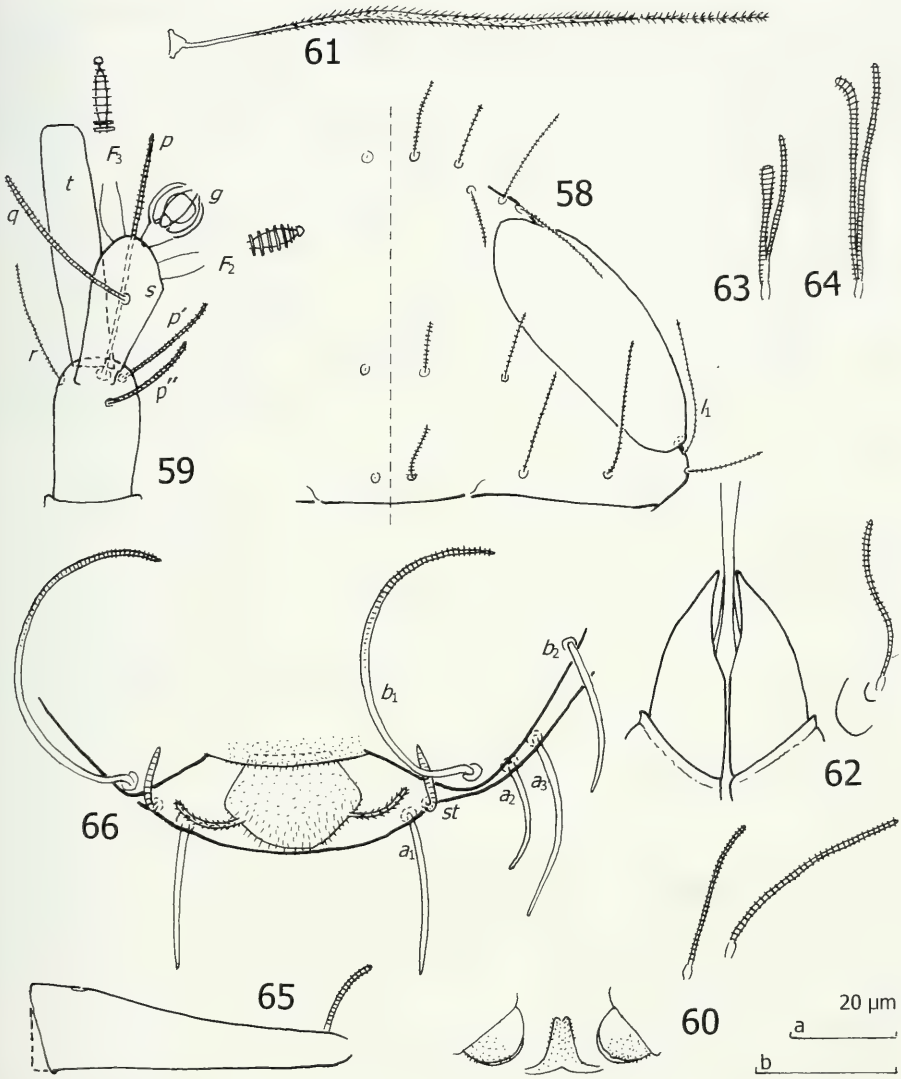
ETYMOLOGY: From the Latin divarico = stretch out (referring to the appendages of the anal plate).

DIAGNOSIS: *A. (D.) divaricatus* sp. n. is well delimited by several characters of the pygidium (see below: setae b_1 and *st*, anal plate), and also by the shape of the genital papillae and of the tarsus of the last pair of legs. These partly rare or unique characters, make it impossible to trace the relationships of this species at present.

DESCRIPTION: *Length* = 0.66 mm.

Head (Fig. 58): Setae on tergal side thin striate, of medium length, shortest on posteromedian part. Relative lengths of setae: 1st row: a_1 = 10, a_2 = 8; 2nd row: a_1 = 7, a_2 = 13, a_3 = 11; 3rd row: a_1 = 6, a_2 = 8; 4th row: a_1 = 6, a_2 = 13, a_3 = 17, a_4 = 9; lateral group setae: l_1 = 17, l_2 = 13, l_3 = 11. Ratio $a_1/a_1 - a_1$ in 1st row 1.8, in 2nd row 0.4, in 3rd row 0.8 and in 4th row 1.4. Temporal organs 1.8 times as long as their shortest interdistance. Small posterior aperture close to posterior margin of temporal organ. Head cuticle glabrous.

Antennae (Fig. 59): Segment 4 with setae *p*, *p´*, *p´´* and *r*; *p´´´* not ascertained. Setae subcylindrical, blunt, striate. Relative lengths of setae: *p* = 100, *p´* = 46, *p´´* = 43, *r* = 49. Tergal seta *p* 1.1 times as long as tergal branch *t*. The latter slender, cylindrical, 4.7 times as long as its greatest diameter and 1.5 times as long as sternal branch *s*, this 2.2 times as long as greatest diameter and with anterodistal corner distinctly truncate. Seta *q* as seta *p*, 1.2 times as long as *s*. Lengths of flagella (basal segments included) and basal segments: F_1 and bs_1 lost; F_2 = 52, bs_2 = 6; F_3 = 120, bs_3 = 8 µm. F_2 and F_3 2.4 and 5.6 times as long as *s*, respectively. Distal calyces small, distal part of flagella axes fusiformly widened on F_2, cylindrically widened on F_3. Globulus *g* 1.4 times as long as wide, its width 1.1 times as wide as greatest diameter of *t*; ≈9 bracts present. Antennae glabrous.



FIGS 58-66

Allopauropus (D.) divaricatus sp. n., holotype, ad. 9(♂). (58) head, median and right part, tergal view; (59) right antenna, sternal view; (60) collum segment, median and left part, sternal view; (61) T_3; (62) genital papillae and seta on coxa of leg 2, anterior view; (63) seta on coxa of leg 9; (64) seta on trochanter of leg 9; (65) tarsus of leg 9; (66) pygidium, median and left part, sternal view. Scale a: Figs 58, 61, 65; b: Figs 59-60, 62-64, 66.

Trunk: Setae of collum segment (Fig. 60) long, simple, blunt, striate. Sublateral seta 1.4 times as long as submedian seta; sternite process with anterior incision; appendages subglobular, caps very thin. Process and posterior halves of appendages with short pubescence.

Setae on anterior tergites similar to submedian setae on tergal side of head. 4+4 setae on tergite I, 6+6 on II-V, VI not available for study.

Bothriotricha: Relative lengths: T_1 = 100, T_2 = 120, T_3 = 115, T_4 = 123, T_5 = 170. All with straight simple axes, all but T_3 very thin with, extremely short pubescence most distally. T_3 (Fig. 61) with axis thickest in proximal 2/3, then growing very thin, pubescence strong, hairs simple, oblique.

Genital papillae (Fig. 62): 2.7 times as long as greatest diameter, conical, base obliquely trucate, distal part thin, strongly tapering, glabrous, distal seta proportionately long, 0.8 of length of papilla.

Legs: Setae on coxa (Fig. 63) and trochanter (Fig. 64) of leg 9 long, furcate, striate, main branch somewhat clavate, secondary branch cylindrical, branches subsimilar in length. Corresponding setae on more anterior legs simple, striate. Tarsus of leg 9 (Fig. 65) strongly tapering, 3.5 times as long as its greatest diameter. Proximal seta lost, distal one cylindrical, blunt, striate, 0.3 of length of tarsus. Cuticle of tarsus glabrous.

Pygidium (Fig. 66): *Tergum*. Posterior margin rounded, with broad rounded bulge between *st*. Relative lengths of setae: a_1 = 100, a_2 = 68, a_3 = 118, *st* ≈ 50. These setae tapering, a_1, a_2 and a_3 curved inward, a_1 and a_2 glabrous, a_3 with very short pubescence distally, *st* curved downward, striate. Distance $a_1 - a_1$ 1.4 times as long as a_1, distance $a_1 - a_2$ 3 times longer than distance $a_2 - a_3$; distance *st* – *st* 1.2 times as long as *st* and 1.2 times as long as distance $a_1 - a_1$. Tergum glabrous.

Sternum. Posterior margin between b_1 with broad median indentation. Relative lengths of setae (a_1 = 100): b_1 = 240, b_2 = 98. Seta b_1 curved downward-forward, somewhat tapering, distal half very densely striate, b_2 subcylindrical, tapering distally, striate, somewhat diverging. b_1 1.1 times as long as interdistance, b_2 as long as distance $b_1 - b_2$.

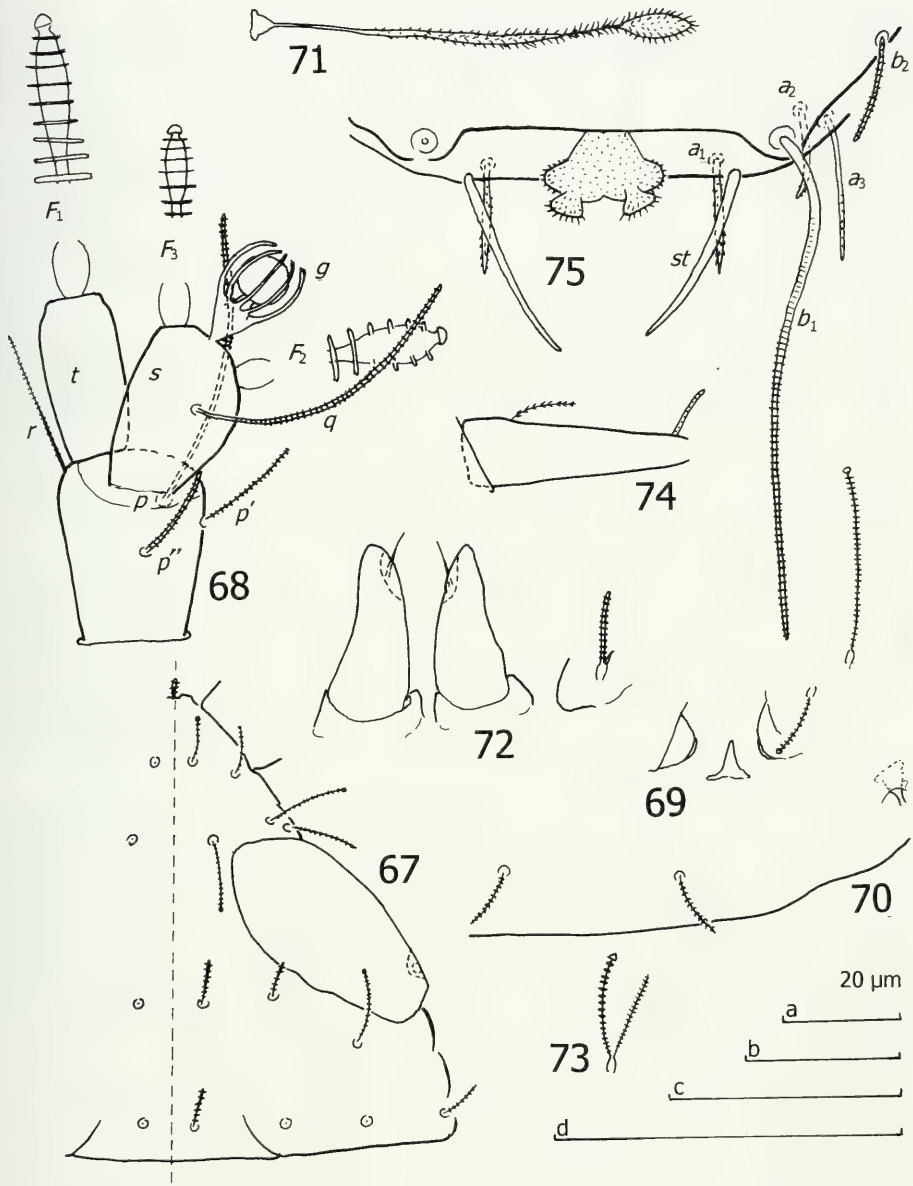
Anal plate large, 1.1 times as broad as long, narrowest anteriorly, with large lateral corners and rounded posterior margin; two widely separated, subcylindrical appendages protruding from posterosternal side of lateral corners, appendages strongly diverging, curved inward, appendages and posterior part of plate distinctly pubescent, lateral parts with shorter hairs. Posteromedian part of sternum pubescent.

14. ***Allopauropus (D.) bakoensis*** sp. n. Figs 67-75

TYPE MATERIAL: Holotype: ad. 9(♀), Malaysia, Sarawak, Bako National Park, Jalan Lintang, soil sample (extraction in Geneva) from between buttresses of *Austrobuxus nitidus* Miq. [= *Longetia malayana* (Benth.) P. & H.] (Euphorbiaceae), alt. 30 m, 11.XII.1987 (loc. Sar-87/76, leg. Hauser). Paratypes: Malaysia: Sarawak: Serian District, Penrissen Road, 12 mls from Kuching, "Semongok Wildlife Rehabilitation Centre, Nursery Centre of the Forest Department", soil sample (extraction at Kuching) from between buttresses of large trees, alt. 50 m, 2 ad. 9(♂,♀), 8.XII.1987 (loc. Sar-87/60, leg. Hauser). – Altogether 3 specimens.

ETYMOLOGY: A latinized adjective of the name Bako (referring Bako National Park).

DIAGNOSIS: An anal plate similar to that in *A. (D.) bakoensis* sp. n. has not been found in other species of the genus and is, together with the unusually long *st* and the T_3 with distal swelling, delimiting this species. Its relationships cannot be traced at present.



FIGS 67-75

Allopauropus (D.) bakoensis sp. n., holotype, ad. 9(♀). (67) head and anterior part of tergite I, right part, tergal view; (68) right antenna, sternal view; (69) collum segment, median and left part, sternal view; (70) tergite VI, posteromedian part and right posterior corner; (71) T_3; (72) genital papillae and seta on coxa of leg 2, anterior view; (73) seta on coxa of leg 9; (74) tarsus of leg 9; (75) pygidium, posteromedian and left part, sternal view. Scale a: Fig. 67; b: Figs 69, 71-74; c: Figs 70, 75; d: Fig. 68.

DESCRIPTION: *Length* = 0.51(-0.53) mm.

Head (Fig. 67): Tergal setae thin, striate. Relative lengths of setae (holotype only), 1st row: $a_1 = a_2 = 10$; 2nd row: $a_1 = a_3 = 15$, $a_2 = 19$; 3rd row: $a_1 = 10$, $a_2 = 8$; 4th row: $a_1 = 9$, a_2 and a_3 = ?, $a_4 = 10$; lateral group: $l_1 = 15$, $l_2 = 19$, l_3 = ?. Ratio $a_1/a_1 - a_1$ in 1st row 1.1, 2nd row 0.9, 3rd row 0.7, 4th row 0.8. Temporal organs twice longer than shortest interdistance; small pistil present in posterior part. Head cuticle glabrous.

Antennae (Fig. 68): Segment 4 with setae *p*, *p´*, *p´´* and *r*; *p´´´* not ascertained. Setae striate, *p*, *p´*, *p´´* cylindrical, blunt, *r* tapering. Relative lengths of setae: *p* = 100, *p´* = (35-)37, *p´´* = (30-)32(-33), *r* = (51-)53. Tergal seta *p* 1.9 times as long as tergal branch *t*. The latter fusiform, (1.8-)1.9 times as long as greatest diameter and 0.9 of length of sternal branch *s*, this twice longer than greatest diameter and with anterodistal corner distinctly truncate. Seta *q* long, cylindrical, striate, 1.8(-1.9) times as long as length of *s*. Relative lengths of flagella (basal segments included) and basal segments: $F_1 = 100$, bs_1 = (5-)6; F_2 = 39(-44), $bs_2 = 2$; F_3 = (82-)85, $bs_3 = 5$. F_1 (6.0-)6.1 times as long as *t*, F_2 and F_3 2.2(-2.4) and 4.7(-4.9) times as long as *s*, respectively. Distal calyces hemispherical and distal part of flagella axes fusiformly widened, strongest in F_2. Globulus *g* (1.4-)1.5 times as long as wide and its width (0.9-) as long as greatest diameter of *t*; ≈8 bracts present. Antennae glabrous.

Trunk: Setae of collum segment (Fig. 69) simple, cylindrical, blunt, annulate. Sublateral seta (2.7-)2.8 times as long as submedian seta; sternite process small, narrow anteriorly and without apical incision; appendages short, hemispherical, with small caps. Both process and appendages glabrous.

Setae on tergites short, thin, striate; 4+4 setae on tergite I, 6+6 on II-V, and 4+2 on VI. Posterior setae on tergite VI (Fig. 70) 0.4(-0.5) of interdistance and about 0.6(-0.7) of length of pygidial setae a_1.

Bothriotricha: Relative lengths (holotype only): $T_1 = 100$, $T_2 = 97$, $T_3 = 83$, $T_4 = 93$, $T_5 = 140$. All with straight, simple axes, all but T_3 very thin. Axis of T_3 (Fig. 71) thickest in the middle, subdistally thin and with distal swelling, this twice longer than wide and almost 0.2 of length of bothriotrix. Pubescence short, thin, almost vertically erect except on T_3; the latter with coarse hairs, oblique on axis, erect on endswelling.

Genital papillae (Fig. 72, of paratype): Proximal half subcylindrical, with concave outer side distally, 2.2 times as long as greatest diameter, glabrous; distal seta short, thin, 0.3 of length of papilla. Seta on coxa of leg 2 furcate, main branch cylindrical blunt striate, secondary branch rudimentary, pointed, glabrous.

Legs: Setae on coxa (Fig. 73) and trochanter of leg 9 furcate, branches thin, cylindrical, striate, secondary branch somewhat thinner than primary branch. Corresponding setae on more anterior legs with rudimentary secondary branch. Tarsus of leg 9 (Fig. 74) tapering, 3.3(-3.6) times as long as greatest diameter. Proximal seta somewhat curved, tapering, pointed, with distinct pubescence; distal seta almost straight, cylindrical, blunt, striate. Proximal seta (0.2-)0.3 of length of tarsus and as long as distal seta. Cuticle of tarsus glabrous.

Pygidium (Fig. 75): *Tergum*. Posterior margin between *st* straight. Relative lengths of setae: $a_1 = 10$, a_2 = (7-)8, a_3 = 13(-14), *st* = 17(-19). Setae a_1, a_2 and a_3, thin, cylindrical, tapering, directed posteriorly, a_1 also straight, with short pubescence, a_2 somewhat curved inward, a_3 somewhat curved inward and with faint pubescence

distally; *st* tapering, somewhat curved inward, converging, glabrous. Distance $a_1 - a_1$ 2.0(-2.1) times as long as a_1, distance $a_1 - a_2$ 0.3 of distance $a_1 - a_1$ and 3 times longer than distance $a_2 - a_3$; distance *st* – *st* 1.4(-1.5) times as long as *st* and 1.2(-1.3) times as long as distance $a_1 - a_1$. Tergum glabrous.

Sternum. Setae b_1 on small but distinct posterior lobes, margin between lobes straight. Relative lengths of setae (a_1 = 10): b_1 = (39-)44, b_2 = 10(-11). Setae striate, b_1 tapering, b_2 cylindrical, somewhat curved inwards. b_1 1.4(-1.5) times as long as interdistance; b_2 0.8 of distance $b_1 - b_2$.

Anal plate narrowest anteriorly, anterior part of lateral margins somewhat concave, distal part convex, forming lateral rounded lobes at broadest part; posterior margin with shallow median indentation; plate 1.8 times as broad as long. Two appendages, protruding posteriorly from hindmost part of sternal side; appendages 0.5 of the length of plate, thick, flattened distally, somewhat diverging. Plate with appendages distinctly pubescent, hairs longest on distal part of appendages; sternum glabrous.

15. ***Allopauropus (D.) crassatus*** sp. n. Figs 76-81

TYPE MATERIAL: Holotype: ad. 9(♀), Malaysia, Sarawak, Bau, near "Fairy Cave I", soil sample (extraction in Geneva) from between buttresses of large trees, alt. 20 m, 13.XII.1987 (loc. Sar-87/82, leg. Hauser). Paratypes: Malaysia, Sarawak, Serian District, Penrissen Road, 12 mls from Kuching, "Semongok Wildlife Rehabilitation Centre, Nursery Centre of the Forest Department", soil sample (extraction in Kuching) from between buttresses of large trees, alt. 50 m, 1 ad. 9(♀), 8.XII.1987 (loc. Sar-87/60, leg. Hauser). Gunung Serapi at road Kuching-Matang, soil sample (extraction in Kuching) in forest at the road to the television station, alt. 670 m, 2 subad. 8(♀), 9.XII.1987 (loc. Sar-87/64, leg. Hauser).

OTHER MATERIAL: Same data as for holotype, 1 juv. stad.?. – Altogether 5 specimens.

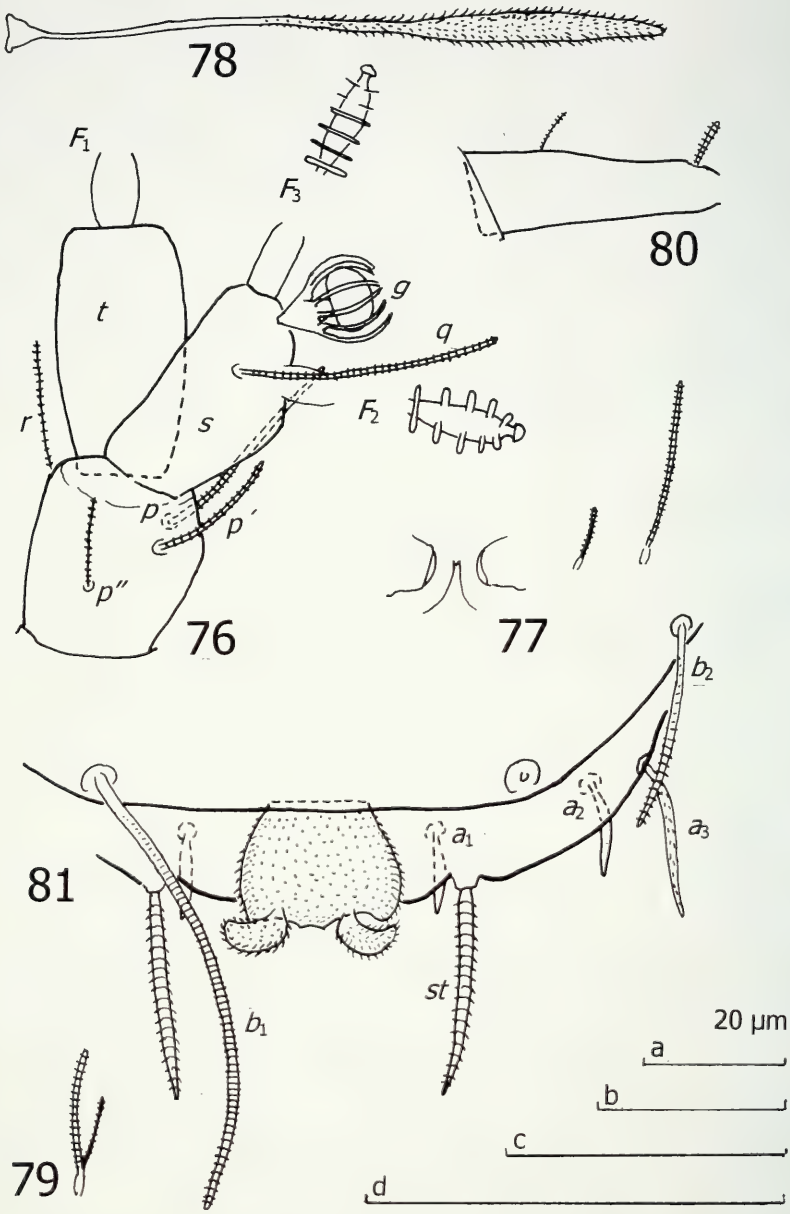
ETYMOLOGY: From the Latin crassus = thick; here meaning thickened (referring to T_3, *st* and anal plate).

DIAGNOSIS: *A. (D.) crassatus* sp. n. is a close relative of *A. (D.) bakoensis* sp. n. described above. Distinctive characters are: the shape of the bothriotricha T_3 (with longish endswelling, almost half of length of bothriotrix in *A. crassatus* sp. n., about 0.2 of that length in *A. bakoensis* sp. n.), the *st* (directed posteriorly and sparsely striate in *A. crassatus* sp. n., converging and glabrous in *A. bakoensis* sp. n.) and the shape of the anal plate (lateral margins convex and posterior appendages sickle-shaped in *A. crassatus* sp. n., lateral margins concave and posterior appendages with flattened distal surface in *A. bakoensis* sp. n.). Due to similarities in the antennae, the bothriotricha T_3, the legs and the general shape of the anal plate *A. crassatus* sp. n. may also be related, but to a less degree, to *A. (D.) thailandensis* Scheller from the Chiang Mai Province in northern Thailand (Scheller, 1995).

DESCRIPTION: *Length* = (0.32-)0.35(-0.39) mm.

Head: Not available for study.

Antennae (Fig. 76): Segment 4 with setae p, p', p'' and r; p''' not ascertained. Setae cylindrical, striate. Relative lengths of setae: p = 100, p' = 63(-78), p'' = 68(-73), r = (54)58. Tergal seta p 0.9 of the length of tergal branch t. The latter fusiform, 1.7 times as long as its greatest diameter and 1.1 times as long as sternal branch s, this 1.7(-1.8) times as long as its greatest diameter and with its anterodistal corner distinctly



FIGS 76-81

Allopauropus (D.) crassatus sp. n., holotype ad. 9(♀). (76) right antenna, sternal view; (77) collum segment, median and left part, sternal view; (78) T_3; (79) seta on trochanter of leg 9; (80) tarsus of leg 9; (81) pygidium, sternal view. Scale a: Figs 79, 80; b: Fig. 77; c: Figs 78, 81; d: Fig. 76.

truncate. Seta *q*, cylindrical, striate, (1.1-)1.2 times as long as length of *s*. Relative lengths of flagella (basal segments included) and basal segments: F_1 = (100), bs_1 = (3-5); F_2 = (35-41), bs_2 = (3-5); F_3 = (82-91), bs_3 = (5-6). F_1 (4.8-5.4) times as long as *t*, F_2 and F_3 (1.9-2.1) and (4.2-4.6) times as long as *s*, respectively. Distal calyces hemispherical, distal part of flagella axes fusiformly widened. Globulus *g* 1.3(-1.4) times as long as wide and its width 0.6(-0.7) of greatest diameter of *t*; ≈9 bracts present. Antennae glabrous.

Trunk: Setae of collum segment (Fig. 77) thin, simple, cylindrical, blunt, striate. Sublateral seta (2.8-)2.9 times as long as submedian seta; sternite process narrow, with extremely small anterior incision; appendages somewhat barrel-shaped, caps low. Process and appendages glabrous.

Setae on tergites short, thin, striate; 4+4 setae on tergite I, 6+6 on II-V, and 4+2 on VI.

Bothriotricha: Relative lengths (for holotype only): T_1 = 100, T_2 = ?, T_3 = 78, T_4 = 98, T_5 = 170. All with straight, simple axes, all but T_3 very thin. Axis of T_3 widening outward into a longish distal swelling, thickest in the middle, 0.4 of length of bothriotrix. Pubescence very short, thin, almost erect except on T_3; the latter (Fig. 78) with coarse oblique hairs.

Legs: Setae on coxa and trochanter (Fig. 79) of leg 9, furcate, branches thin, cylindrical, striate, secondary branch at least on trochanter shorter than main branch. Corresponding setae on more anterior legs simple. Tarsus of leg 9 (Fig. 80) somewhat tapering, 3 times longer than greatest diameter. Setae cylindrical, striate, proximal seta somewhat curved and a little thinner than distal seta, the latter straight, blunt. Proximal seta almost 0.2 of length of tarsus and 0.8(-0.9) of length of distal seta. Cuticle of tarsus glabrous.

Pygidium (Fig. 81): *Tergum*. Posterior margin rounded and with broad lobe between *st*, lobe about 4 times broader than long and not protruding. Relative lengths of setae: a_1 = 10, a_2 = (12-)13, a_3 = (18-)20(-21), *st* = (25-)27(-29). Setae tapering, a_1, a_2 and a_3 with short pubescence, a_1 also straight, directed posteriorly, a_2 also curved inward and directed posteriorly, a_3 also curved inward and diverging, *st* almost straight, directed posteriorly, sparsely striate. Distance $a_1 - a_1$ 3.3(-3.4) times as long as a_1, distance $a_1 - a_2$ 0.6 of distance $a_1 - a_1$ and 3 times longer than distance $a_2 - a_3$; distance *st* – *st* (1.4-)1.5 times as long as *st* and 1.2 times as long as distance $a_1 - a_1$. Tergum glabrous.

Sternum. Posterior margin between b_1 straight. Relative lengths of setae (a_1 = 10): b_1 = (60-)64, b_2 = 20(-22). Setae very little tapering, striate, b_2 somewhat curved inward, converging. b_1 1.2(-1.3) times as long as interdistance; b_2 0.7 of distance $b_1 - b_2$.

Anal plate narrowest anteriorly, anterior part of lateral margins straight, posterior part convex; broadest part at middle, 1.4 times as broad as long; posterior margin with two shallow median indentations inside posterolateral corners. Two appendages protruding posteriorly from hindmost part of sternal side inside the indentations, appendages 0.5 of length of plate, thick, sickle-shaped, diverging. Plate with appendages distinctly pubescent, hairs longest at lateral margins of plate and on appendages. Sternum glabrous.

Stage subad. 8. Tergite V with 6+4 setae. Setae in posterior row short, lanceolate, with oblique pubescence.

16. ***Allopauropus (D.) curtus*** sp. n. Figs 82-89

TYPE MATERIAL: Holotype: subad. 8(♀), Malaysia, Sarawak, Serian District, Penrissen Road, 12 mls from Kuching, "Semongok Wildlife Rehabilitation Centre, Nursery Centre of the Forest Department", soil sample (extraction at Kuching) from between buttresses of large trees, alt. 50 m, 1 ad. subad. 8(♀), 8.XII.1987 (loc. Sar-87/60, leg. Hauser).

DIAGNOSIS: *A. (D.) curtus* sp. n. seems to be most closely related to *A. (D.) adjacens* Remy from the Cape Province, South Africa, (Remy, 1956b) and *A. (D.) hortulanus* Remy from Pondichéry (Remy, 1961). They have distinct similarities in the general shape of the bothriotricha T_3 and the anal plate. The following characters are useful for distinguishing these species: the shape of the axis of bothriotricha T_3 (with short ovoid swelling in the middle in *A. curtus* sp. n., swelling very longish in *A. adjacens*, large clavate swelling in *A. hortulanus*), and the shape of the pygidial setae *st* (long, distally both widened and cut obliquely in *A. curtus* sp. n., subcylindrical and blunt in *A. adjacens* and *A. hortulanus*).

ETYMOLOGY: From the Latin curtus = truncated (referring to the distal part of pygidial setae *st*).

DESCRIPTION: *Length* = 0.45 mm.

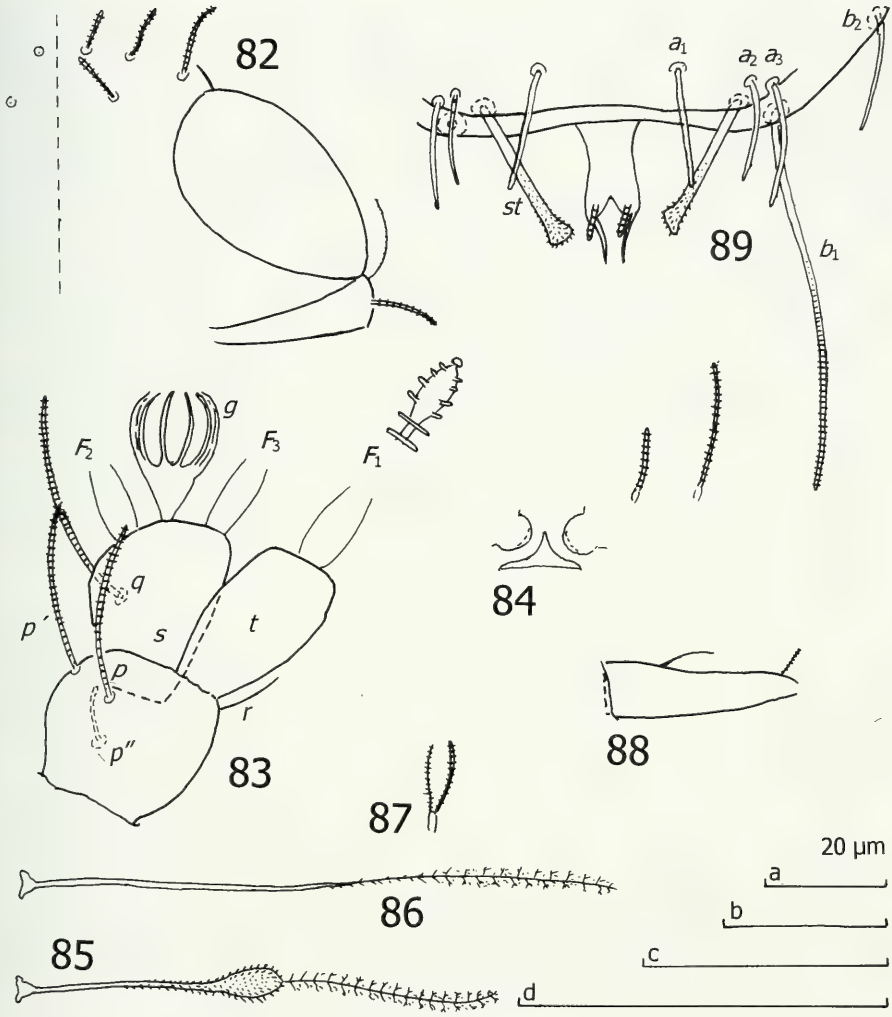
Head (Fig. 82): Posteromedian part of tergal side not available for study. Setae thin, striate. Relative lengths of setae, 1st row: a_1 = 10, a_2 = 13; 2nd row: a_1 = 13, a_2 =20, a_3 = ?, 3rd row and first 3 setae in 4th row not available for study, a_4 in 4th row = 15; lateral group: l_1 = 20, l_2 and l_3 = ?. Ratio $a_1/a_1 - a_1$ in 1st row 0.9 and in 2nd row 0.5. Temporal organs 1.1 times as long as their shortest interdistance. Head cuticle glabrous.

Antennae (Fig. 83): Segment 4 with setae *p*, *p´*, *p´´* and *r*; *p´´´* not ascertained. Setae thin, tapering, *p*, *p´*, *p´´* striate, *r* glabrous. Relative lengths of setae: *p* = 100, *p´* = 92, *p´´* = 29, *r* = 42. Tergal seta *p* 1.2 times as long as tergal branch *t*. The latter fusiform, 1.7 times as long as greatest diameter and 0.9 of length of sternal branch *s*, this 1.4 times as long as greatest diameter and with anterodistal corner distinctly truncate. Seta *q* thin, cylindrical, striate, 1.2 times as long as length of *s*. Lengths of F_1 = 44, bs_1 5.5 µm (F_2 and F_3 lost). F_1 4.4 times as long as *t*. Distal calyx of F_1 very small, distal part of flagella axis distinctly widened. Globulus *g* 1.4 times as long as wide and its width as long as greatest diameter of *t*; ≈9 bracts present. Antennae glabrous.

Trunk: Setae of collum segment (Fig. 84) simple, cylindrical, blunt, annulate. Sublateral seta 1.7 times as long as submedian seta; sternite process small, pointed anteriorly; appendages small, with low caps. Process and appendages glabrous.

Setae on tergites thin, striate; 4+4 setae on tergite I, 6+6 on II-V, and 4+2 on VI. Posterior setae on tergite VI not available for study.

Bothriotricha (Figs 85-86): Relative lengths: T_1 = 100, T_2 = ?, T_3 = 94, T_4 = ?, T_5 = 115. All with straight simple axes, all thin except T_3. The latter with clavate proximal half, distal half very thin. Pubescence short oblique on clavate part of T_3, longer, erect, arranged in whirls on distal part of other bothriotricha studied.



FIGS 82-89

Allopauropus (D.) curtus sp. n., holotype, subad. 8(♀). (82) head, anterior and right side, tergal view; (83) right antenna, tergal view; (84) collum segment, median and left part, sternal view; (85) T_3; (86) T_5; (87) seta on coxa of leg 8; (88) tarsus of leg 8; (89) pygidium, posteromedian and right part, tergal view. Scale a: Figs 85-88; b: Figs 82, 84; c: Fig. 89; d: Fig. 83.

Legs: Setae on coxa (Fig. 87) and trochanter of leg 8 furcate, branches similar to each other, thin, cylindrical, striate. Corresponding setae on more anterior legs with rudimentary secondary branch, coxal setae somewhat clavate. Tarsus of leg 8 (Fig. 88) tapering, 3.4 times as long as greatest diameter. Distal seta straight, cylindrical, blunt, striate; proximal seta curved, tapering, pointed, glabrous. Proximal seta 0.3 of length of tarsus and twice longer than distal seta. Cuticle of tarsus glabrous.

Pygidium (Fig. 89): *Tergum*. Posterior margin with shallow indentation between *st*. Relative lengths of setae: $a_1 = a_3 = 10$, $a_2 = 8$, $st = 12$. Setae a_1, a_2 and a_3, cylindrical, glabrous, a_1, also straight, somewhat diverging, a_2 and a_3 somewhat curved inward; *st* straight, converging, somewhat widening outward, distal end obliquely truncate, flattened, proximal half glabrous, distal half with short pubescence. Distance $a_1 - a_1$ 1.1 times as long as a_1, distance $a_1 - a_2$ 4 times longer than distance $a_2 - a_3$; distance $st - st$ 1.8 times as long as *st* and 1.9 times as long as distance $a_1 - a_1$. Tergum glabrous.

Sternum. Posterior margin with shallow indentation between setae b_1. Relative lengths of setae ($a_1 = 10$): $b_1 = 32$, $b_2 = 10$. Setae thin, somewhat tapering, b_1 densely striate distally, b_2 glabrous. b_1 1.2 times as long as interdistance; b_2 0.8 of distance $b_1 - b_2$.

Anal plate 1.8 times as long as broad, lateral margins concave, posterior part bilobate, lobes rounded, diverging. Four appendages protruding backwards from hindmost part of lobes: two in tergal position, short, cylindrical, blunt, striate, and two protruding from sternal side, thin, tapering, pointed, glabrous, somewhat converging. Tergal appendages 0.4 and sternal appendages 0.5 of length of plate. Plate and sternum glabrous.

17. ***Allopauropus (D.) quadrispinus*** sp. n. Figs 90-96

TYPE MATERIAL: Holotype: ad. 9(♀), Indonesia, Bali, Ubud, "Monkey Forest", at the curve in the road through the forest, under stones on slope, alt. 200 m, 30.XI.1987 (loc. Sar-87/37, leg. Hauser).

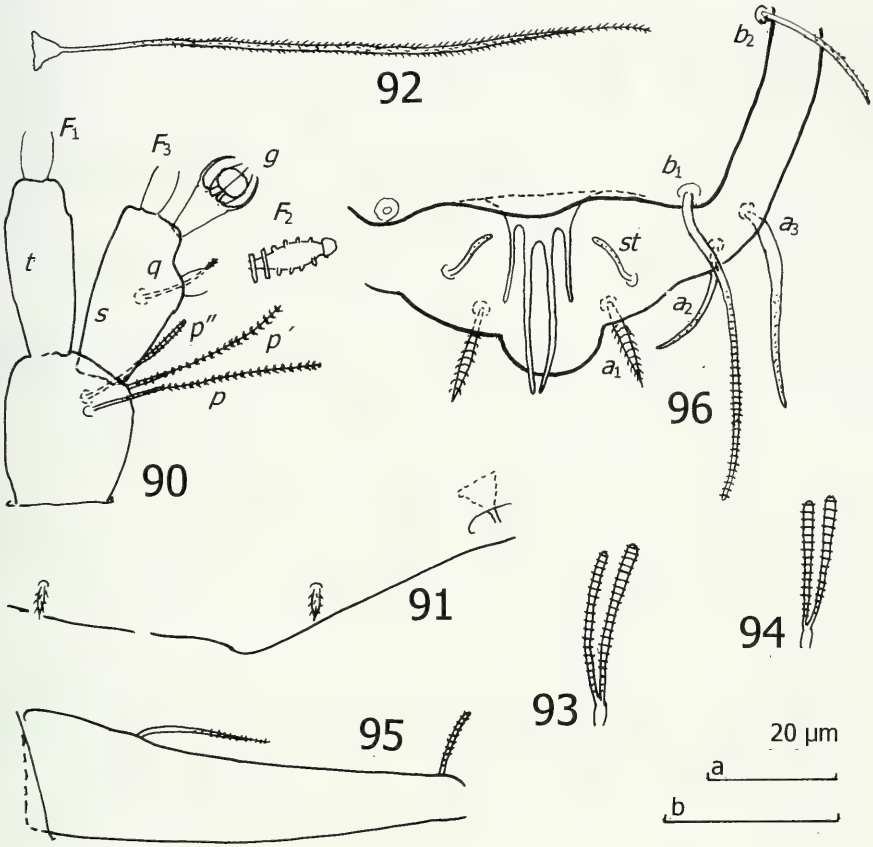
ETYMOLOGY: From the Latin quadric-, from quattuor = four and spina = spine, jag (referring to the anal plate).

DIAGNOSIS: *A. (D.) quadrispinus* sp. n. may be most closely related to *A. (D.) vinsoni* Remy from Mauritius (Remy, 1959). The anal plates have the same groundplan and the setae of the pygidial tergum are similar. Both species can be distinguished by the shape of the posterior margin of the tergum (with distinct posteromedian lobe in *A. quadrispinus* sp. n., no lobe in *A. vinsoni*) and by the shape of the anal plate (submedian appendages 3.5 times as long as plate and no sternal appendages in *A. quadrispinus* sp. n., 2.3 times as long as plate and with two short sternal appendages in *A. vinsoni*).

DESCRIPTION: *Length* = 0.82 mm.

Head: Not available for detailed study, anterior setae clavate, posterior ones cylindrical.

Antennae (Fig. 90): Segment 4 with at least 3 setae, p, p', p'', r and p''' not ascertained. Setae cylindrical, annulate-striate. Relative lengths of setae: $p = 100$, $p' = 71$, $p'' = 54$. Tergal seta p 1.4 times as long as tergal branch t. The latter fusiform, 2.5 times as long as greatest diameter and as long as sternal branch s, this 1.8 times as long as greatest diameter and with its anterodistal corner distinctly truncate. Seta q thin, striate, at least 0.5 of length of s. Flagella F_1 and F_3 broken, only base segments remaining; length of base segments of $F_1 = 5.5$ µm, those of $F_3 = 5$ µm, length of flagella $F_2 = 56$ µm and its base segment = 3 µm. F_2 2.8 times as long as s. Distal



FIGS 90-96

Allopauropus (D.) quadrispinus sp. n., holotype, ad. 9(♀). (90) left antenna, tergal view; (91) tergite VI, posterior part; (92) T_3; (93) seta on coxa of leg 9; (94) seta on trochanter of leg 9; (95) tarsus of leg 9; (96) pygidium, sternal view. Scale a: Figs 91-95; b: Figs 90, 96.

calyces F_2 hemispherical, distal part of flagella axes fusiformly widened. Globulus *g* 1.8 times as long as wide and its width 0.8 of greatest diameter of *t*; ≈9 bracts present. Antennae glabrous.

Trunk: Collum segment not available for study. Setae on anterior tergites short, cylindrical, striate; on tergite VI 4+2 all short, lanceolate, pubescent; length of posterior setae on tergite VI (Fig. 91) 0.1 of interdistance.

Bothriotricha: Most bothriotricha broken off but seems to be very thin. Lengths: T_3 = 98, T_5 = 130 µm. Axes straight, simple, pubescence short, on T_3 (Fig. 92) longer, with oblique, simple hairs.

Legs: Setae on coxa (Fig. 93) and trochanter (Fig. 94) of leg 9, large, furcate, their branches subequal, subcylindrical, striate, blunt. Corresponding setae on leg 8 similar, on legs 1-7 main branches somewhat clavate, secondary branches rudimentary. Tarsus of leg 9 (Fig. 95) tapering, 4.3 times as long as its greatest diameter. Setae

striate, proximal seta tapering, pointed, distal seta cylindrical, blunt; the latter 0.3 of length of tarsus and 0.5 of length of distal seta. Cuticle of tarsus glabrous.

Pygidium (Fig. 96): *Tergum*. Posterior margin with broad and low rounded lobe posterior of a_2, this lobe with an extra median semicircular lobe protruding from between *st*. Relative lengths of setae: $a_1 = 10$, $a_2 = 14$, $a_3 = 22$, $st = 5$. Setae tapering, a_1 straight, lanceolate, diverging, striate; a_2, a_3 and *st* subcylindrical, a_2 also thin, curved inward, converging, striate distally, a_3 also somewhat S-shaped, weakly pubescent distally, *st* somewhat S-shaped, thin, converging. Distance $a_1 - a_1$ 1.3 times as long as a_1, distance $a_1 - a_2$ 2.2 times as long as distance $a_2 - a_3$; distance $st - st$ 3 times longer than *st* and 1.6 times as long as distance $a_1 - a_1$. Tergum glabrous.

Sternum. Posterior margin between b_1 with a low median bulge below anal plate and shallow indentations between bulge and insertion areas of b_1. Relative lengths of setae ($a_1 = 10$): $b_1 = 34$, $b_2 = 15$. Setae tapering, striate distally, b_2 somewhat curved inward, diverging. b_1 1.1 times as long as interdistance; b_2 0.7 of distance $b_1 - b_2$.

Anal plate broadest at base, lateral margins concave, converging, posterior part with 4 long, thin, subparallell appendages protruding backward; submedian appendages longest, 3.5 times as long as plate, converging distally and with short pubescence there; lateral appendages 1.5 times as long as plate, glabrous, somewhat diverging distally. Plate with appendages and sternum glabrous.

18. ***Allopauropus (D.) trapezoides*** sp. n. Figs 97-103

TYPE MATERIAL: Holotype: ad. 9(♂), Malaysia, Sarawak, Bako National Park, Jalan Lintang, soil sample (extraction in Geneva) from between buttresses of *Austrobuxus nitidus* Miq. [= *Longetia malayana* (Benth.) P. & H.] (Euphorbiaceae), alt. 30 m, 11.XII.1987 (loc. Sar-87/76, leg. Hauser). Paratype: same data as for holotype, 1 ad. 9(♀). – Altogether 2 specimens.

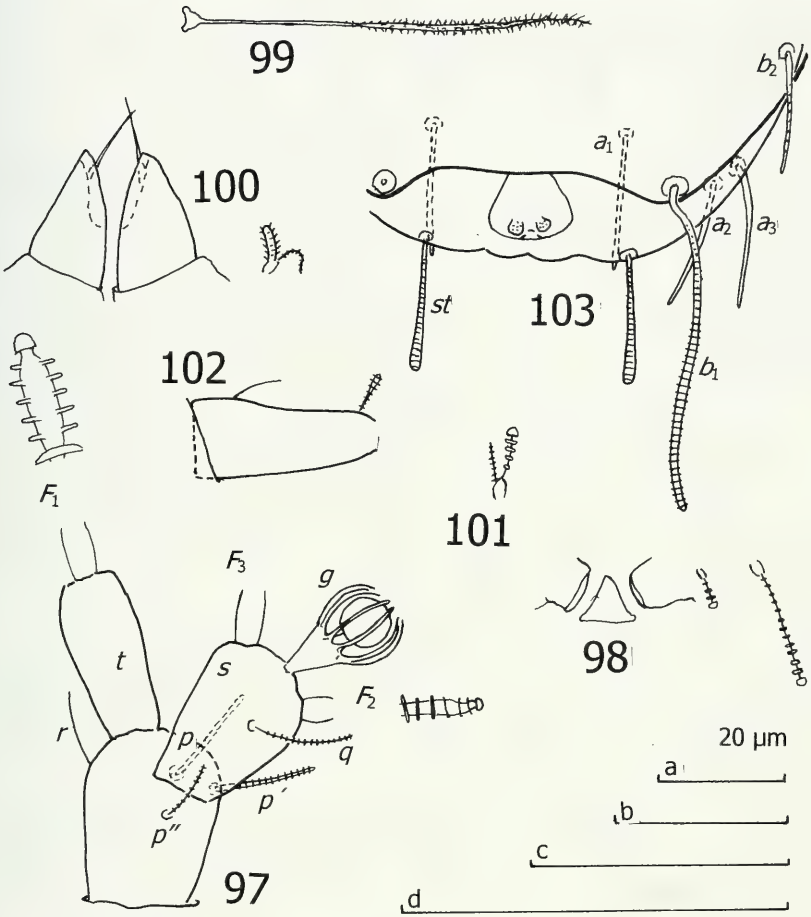
ETYMOLOGY: From the Latin trapezium = trapezium (referring to the shape of the anal plate).

DIAGNOSIS: *A. (D.) trapezoides* sp. n. is a very small species characterised by the following combination of characters not found in other species of the subgenus *Decapauropus*: antennal globulus proportionally large and with many bracts, setae of collum segment simple, annulate, with hemispherical endsegment, the T_3 with distinct pubescence of simple oblique-erect hairs, main branch of seta on coxa of leg 9 annulate with hemispherical endsegment, tarsi short, anal plate linguiform, with two short submedian appendages on distal part of sternal side.

DESCRIPTION: *Length* = 0.25(-0.30) mm.

Head: Not available for study.

Antennae (Fig. 97): Segment 4 with setae p, p', p'' and r; p''' not ascertained. Setae cylindrical, all but r striate, r very thin, glabrous. Relative lengths of setae (holotype only): $p = 100$, $p' = 92$, $p'' = 67$, $r = 77$. Tergal seta p 0.7 of length of tergal branch t. The latter somewhat fusiform, twice longer than greatest diameter and 0.9 of length of sternal branch s, this 1.4 times as long as greatest diameter and with anterodistal corner truncate. Seta q thin, cylindrical, blunt, densely striate, 0.9 of length of s. Relative lengths of flagella (basal segments included) and basal segments: $F_1 = 100$, $bs_1 = 7$; $F_2 = 47(-49)$, $bs_2 = 3(-4)$; $F_3 = (80-)84$, $bs_3 = 7$. F_1 5.0(-5.1) times as long as



FIGS 97-103

Allopauropus (D.) trapezoides sp. n., holotype, ad. 9(♀). (97) right antenna, sternal view; (98) collum segment, median and left part, sternal view; (99) T_3; (100) genital papillae and seta on coxa of leg 2, anterior view; (101) seta on coxa of leg 9; (102) tarsus of leg 9; (103) pygidium, posterior and left part, sternal view. Scale a: Fig. 99; b: Figs 98, 100-102; c: Fig. 103; d: Fig. 97.

t, F_2 and F_3 2.2 and 4.0(-4.1) times as long as *s*, respectively. Distal part of F_2 with very small calyces, distal part of flagella axes cylindrically widened in F_1, indistinctly widened in F_2. Globulus *g* proportionally large, 1.5 times as long as wide, 0.7 of length of *s* and its width somewhat wider than greatest diameter of *t*; at least 10 bracts present. Antennae glabrous.

Trunk: Setae of collum segment (Fig. 98) simple, somewhat clavate, annulate, with hemispherical endsegment. Sublateral seta 3 times longer than submedian seta; sternite process triangular, without anterior incision; appendages barrel-shaped, low, flat. Process and appendages glabrous. Setae on tergites not available for study.

Bothriotricha: Most bothriotricha broken off. Lengths: T_2 = 60, T_3 = 60(62), T_5 = 67(75) µm. Axes straight, thin. T_3 (Fig. 99) thickest, with distinct pubescence of simple, oblique - erect hairs.

Genital papillae (Fig. 100): Genital papillae conical, 1.8 times as long as greatest diameter, glabrous; distal seta thin, 0.8 of length of papilla.

Legs: Setae on coxa (Fig. 101) of leg 9 short, furcate, main branch clavate, annulate, apical segment hemispherical, secondary branch thin, somewhat shorter than main branch. Seta on trochanter and corresponding setae on more anterior legs not available for study, except on coxa of leg 2, seta there short, furcate, with branches subequal in length, main branch, cylindrical, striate, blunt, secondary branch thin, pointed, striate. Tarsus of leg 9 (Fig. 102) short tapering, 2.4(2.6) times as long as its greatest diameter. Proximal seta thin, somewhat curved, tapering distally, almost glabrous; distal seta somewhat clavate, striate. Proximal seta 0.3 of length of tarsus and 1.2 times as long as distal seta. Cuticle of tarsus glabrous.

Pygidium (Fig. 103): *Tergum*. Posterior margin rounded, two small posterior submedian bulges between *st*. Relative lengths of setae: $a_1 = a_2 = st$ =10, a_2 = (8)10. a_3 = (11)12. Setae a_1, a_2 and a_3 thin, cylindrical, glabrous, a_1 also straight, posteriorly directed, a_2 and a_3 somewhat curved inward, a_2 converging, a_3 directed backward; *st* straight, somewhat clavate, striate, directed posteriorly. Distance $a_1 - a_1$ (1.4)1.5 times as long as a_1, distance $a_1 - a_2$ 2.3 times as long as distance $a_2 - a_3$; distance $st - st$ 1.5 times as long as *st* and as long as distance $a_1 - a_1$. Tergum glabrous.

Sternum. Posterior margin between b_1 with broad shallow indentation. Relative lengths of setae (a_1 = 10): b_1 = 25(27), b_2 = 10(11). b_1 cylindrical, blunt, striate, b_2 tapering, somewhat curved inward. b_1 1.1 times as long as interdistance; b_2 0.7 of distance $b_1 - b_2$.

Anal plate narrowest at base, trapezoid, lateral margins somewhat convex, posterior margin rounded with small median indentation; two short, subglobular, submedian, diverging appendages protruding downward from posterior part of sternal side. Plate and sternum glabrous.

Genus ***Rabaudauropus*** Remy, 1953

19. ***Rabaudauropus dispar*** Scheller

Rabaudauropus dispar Scheller, 1994 (*in* Scheller *et al.,* 1994): 5-7, figs 20-30.

MATERIAL EXAMINED: Malaysia, Sarawak, Road Kuching-Serian, 18 km from Kuching, near Kampong Kuap, secondary forest, soil sample (extraction in Geneva) from between buttresses of a large tree, alt. 30 m, 1 juv., 13.XII.1987 (loc. Sar-87/86, leg. Hauser).

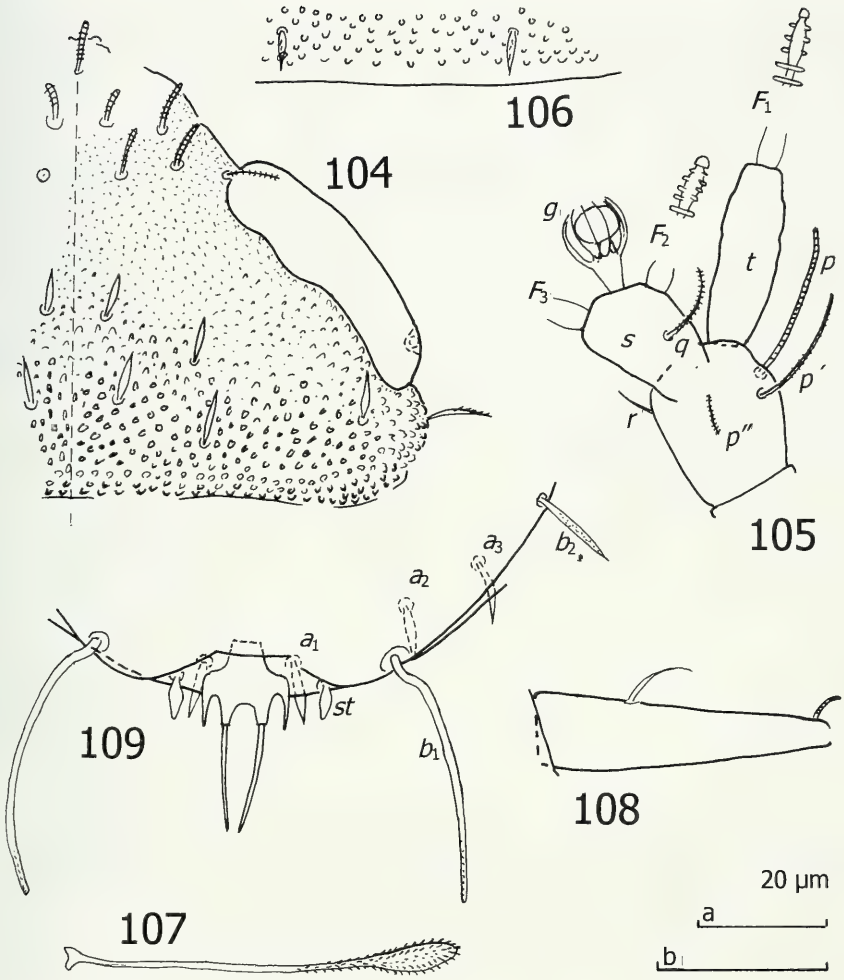
GENERAL DISTRIBUTION: The species was previously known from two sites in Sabah only (Scheller *et al.,* 1994).

Scleropauropodinae

Genus ***Scleropauropus*** Silvestri, 1902
Subgenus ***Scleropauropoides*** Remy, 1957c

20. ***Scleropauropus (S.) singapuranus*** sp. n. Figs 104-109

TYPE MATERIAL: Holotype: ad. 9(♀), Singapore, Botanical Garden, in the section "Jungle", under bark, alt. 25 m, 16.XII.1987 (loc. Sar-87/89, leg. Hauser).



FIGS 104-109

Scleropauropus (S.) singapuranus sp. n. holotype, ad. 9(♀). (104) head, median and right part, tergal view; (105) right antenna, sternal view; (106) tergite VI, posteromedian part; (107) T_3; (108) tarsus of leg 9; (109) pygidium, posteromedian and left part, sternal view. Scale a: Figs 104, 106-108; b: Figs 105, 109.

ETYMOLOGY: A latinized adjective of the name Singapura (Singapore).

DIAGNOSIS: Only four species have been described in this subgenus: *S. squameus* Remy from the Ivory Coast (Remy, 1948b), *S. mameti* Remy from Mauritius (Remy, 1959) and Sri Lanka (Scheller, 1970), *S. prunilis* Scheller from Sri Lanka (Scheller, 1970) and *S. quadriramosus* Scheller from Thailand (Scheller, 1995). *S. singapuranus* sp. n. is closest to *S. mameti* but can be distinguished from that species by the shape of the setae of the 2nd row of the tergal side of the head (cylindrical and

striate in *S. singapuranus* sp. n., lanceolate, with pubescence in *S. mameti*) and by the shape of the temporal organs of the head (in tergal view of the same breadth in anterior and posterior parts in *S. singapuranus* sp. n., much broader in anterior part than posteriorly in *S. mameti*).

DESCRIPTION: *Length* = 0.76 mm.

Head (Fig. 104): Setae in the two anterior rows cylindrical, blunt, striate, in the two posterior rows lanceolate, glabrous or with indistinct pubescence. Relative lengths of setae, 1st row: $a_1 = 10$, $a_2 = 16$; 2nd row: $a_1 = a_2 = 14$, $a_3 = 20$, 3rd row: $a_1 = a_2 = 10$, 4th row: $a_1 = a_2 = a_3 = 15$, $a_4 = 20$; setae of lateral group tapering, pointed, with oblique pubescence: $l_1 = l_2 = 34$, $l_3 = 36$. Ratio $a_1/a_1 - a_1$ in 1st and 3rd rows 0.8, in 2nd and 4th rows 0.6. Temporal organs mainly in lateral position, length 0.9 of shortest interdistance. Head cuticle distinctly granular anteriorly and inside temporal organs, coarsely granular in posteromedian and posterolateral part.

Antennae (Fig. 105): Segment 4 with setae p, p', p'' and r. Setae p, p', p'' cylindrical, blunt, striate, r very thin, tapering, glabrous. Relative lengths of setae: $p = 100$, $p' = 83$, p'' and $r = 28$. Tergal seta p 0.8 of length of tergal branch t. The latter fusiform, 3.1 times as long as its greatest diameter and 1.2 times as long as sternal branch s, this 1.8 times as long as greatest diameter and with its anterodistal corner distinctly truncate. Seta q thin, tapering, striate, 0.6 of length of s. Relative lengths of flagella (basal segments included) and basal segments: $F_1 = 100$, $bs_1 = 5$; $F_2 = 57$, $bs_2 = 3$; $F_3 \approx 52$, $bs_3 = 5$. F_1 4.5 times as long as t, F_2 and F_3 3.1 and ≈2.8 times as long as s, respectively. Distal calyces small, hemispherical, distal part of flagella axis only slightly widened. Globulus g 1.3 times as long as wide and its width 1.1 times as long as greatest diameter of t; ≈9 bracts present. Small posterior pistil in temporal organs. Antennae glabrous.

Trunk: Collum segment not available for study. Setae on tergites lanceolate, on anterior tergites glabrous, on posterior tergites with sparse oblique pubescence; 4+4 setae on tergite I, 6+6 on II-V, and 4+2 on VI. Posterior setae on tergite VI (Fig. 106) 0.2 of interdistance. All tergites with coarsely granular cuticle.

Bothriotricha: Relative lengths: $T_1 = 100$, $T_2 = 99$, $T_3 = 62$, $T_4 = 57$, $T_5 = 135$. All with straight simple axes, all thin except T_3. The latter (Fig. 107) with thick axis and distal endswelling, 3.3 times as long as wide, 0.2 of length of bothriotrix. Pubescence on T_1, T_2, T_4 and T_5 short, erect distally, T_3 glabrous in proximal half, endswelling with distinct pubescence of short, simple, oblique hairs.

Legs: Setae on coxa and trochanter not available for study. Tarsus of leg 9 (Fig. 108) slender, tapering, 3.8 times as long as its greatest diameter. Setae curved, proximal seta tapering, pointed, glabrous, distal seta similar but not pointed. Proximal seta 0.3 of length of tarsus and 2.4 times as long as distal seta. Cuticle of tarsus glabrous.

Pygidium (Fig. 109): *Tergum*. Posterior margin evenly rounded. Relative lengths of setae: $a_1 = a_2 = a_3 = 10$, $st = 7$. Setae short, lanceolate, glabrous, a_1, a_2 and a_3 also somewhat diverging, st directed posteriorly. Distance $a_1 - a_1$ 1.4 times as long as a_1, distance $a_1 - a_2$ 0.5 of distance $a_2 - a_3$; distance $st - st$ 3.6 times as long as st and 1.8 times as long as distance $a_1 - a_1$. Tergum glabrous.

Sternum. Posterior margin between setae b_1 with two rounded bulges and a distinct median indentation. Relative lengths of setae ($a_1 = 10$): $b_1 = 43$, $b_2 = 14$. b_1 sub-

cylindrical, blunt, very densely striate most distally, directed downward, b_2 lanceolate; b_1 0.9 of interdistance; b_2 0.4 of distance $b_1 - b_2$.

Anal plate narrowest at base, with one pair of lateral lobes and one pair of submedian posterior lobes; lobes separated by U-shaped indentations; each lobe with a posteriorly directed, thin, tapering appendage. Appendages protruding from lateral lobes short, 0.3 of length of plate, appendages of posterior lobes 1.4 times as long as plate. Plate with appendages and sternum glabrous.

Brachypauropodidae

Genus ***Brachypauropoides*** Remy, 1952

21. ***Brachypauropoides penanorum*** Scheller

Brachypauropoides penanorum Scheller, 1994 (*in*: Scheller *et al.,* 1994): 8-11, figs 31-42.

Material examined: Malaysia, Sarawak, Serian District, Penrissen Road, 12 mls from Kuching, "Semongok Wildlife Rehabilitation Centre, Nursery Centre of the Forest Department", soil sample (extraction at Kuching) from between buttresses of large trees, alt. 50 m, 1 juv. 3, 8.XII.1987 (loc. Sar-87/60, leg. Hauser).

General distribution: Previously known from a single locality in Sabah only (Scheller *et al.,* 1994).

Eurypauropodidae

Eurypauropodinae

Genus ***Samarangopus*** Verhoeff, 1934

22. ***Samarangopus longipenes*** Scheller

Samarangopus longipenes Scheller, 2001: 965-969, figs 39-53.

Material examined: Malaysia, Sarawak, Serian District, Penrissen Road, 12 mls from Kuching, "Semongok Wildlife Rehabilitation Centre, Nursery Centre of the Forest Department", soil sample (extraction at Kuching) from between buttresses of large trees, alt. 50 m, 6 ad. 9(♀), 8.XII.1987 (loc. Sar-87/60, leg. Hauser). – Altogether 6 specimens.

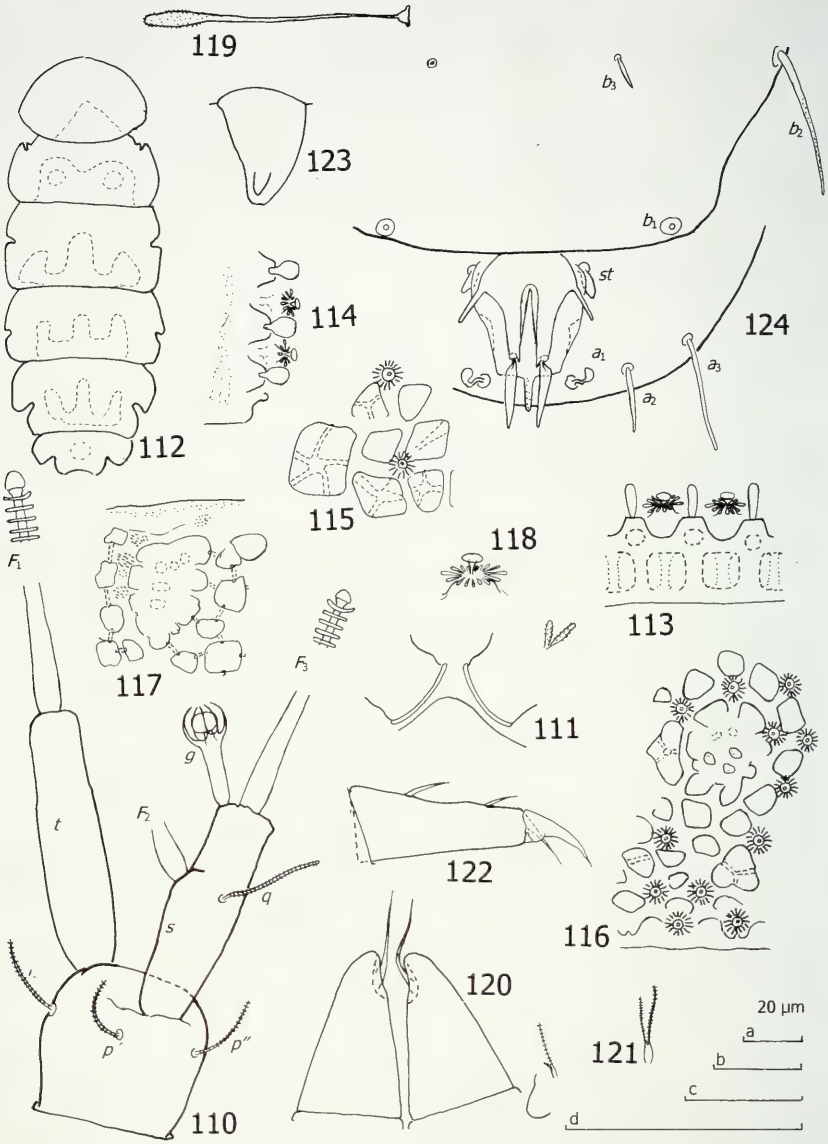
General distribution: The species was previously known from Sabah only (Scheller, 2001).

23. ***Samarangopus trilix*** sp. n. Figs 110-124

Type material: Holotype: ad 9(♂), Malaysia, Sarawak, Serian District, Penrissen Road, 12 mls from Kuching, "Semongok Wildlife Rehabilitation Centre, Nursery Centre of the Forest Department", soil sample (extraction at Kuching) from between buttresses of large trees, alt. 50 m, 8.XII.1987 (loc. Sar-87/60, leg. Hauser).

Etymology: From the Latin trilix = woven with three threads (referring to the cuticle of the tergites).

Diagnosis: *S. trilix* sp. n. closely resembles *S. browni* Remy from New Caledonia (Remy, 1957b). Distinctive character are e.g., the shape of the stalk of the antennal globulus *g* (long and subcylindrical in *S. trilix* sp. n., shorter and conical in *S. browni*), the shape of the sternal antennal branch (3.2 times as long as greatest diameter in *S. trilix* sp. n., about 2.3 in *S. browni*) and the shape of setae b_3 of the



FIGS 110-124

Samarangopus trilix sp. n., holotype, ad. 9(♀). (110) left antenna, sternal view; (111) collum segment, median and left part, sternal view; (112) body, tergal view, tergites I-VI showing areas with concentration of funnel-shaped organs; (113) tergite I, anterior margin, sternal view showing marginal protuberances, internal latice and funnel-shaped organs; (114) tergite IV, lateral margin anterior of T_3, tergal view; (115) tergite I, central part, cuticular pattern with internal latice and funnel shaped organs; (116) tergite II, right posterolateral part; (117) tergite III, central part, cuticular structures; (118) wart-like structure with funnel-shaped organ; (119) T_3; (120) genital papillae and seta on coxa of left leg 2; (121) seta on coxa of leg 9; (122) tarsus of leg 9; (123) femur of leg 1 with appendage; (124) pygidium, median and left part, sternal view. Scale a: Figs 121-122; b: Fig. 120;c: Figs 110-111, 113-117, 119, 123-124; d: Fig. 118.

pygidial sternum (glabrous and pointed, length 0.2 of interdistance in *S. trilix* sp. n., cylindrical, blunt, striate, 0.5 of interdistance in *S. browni*).

DESCRIPTION: *Length.* 1.56 mm.

Antennae (Fig. 110): Antennae glabrous; segment 4 with 3 tapering striate setae, their lengths 15 µm. Sternal branch *s* with shallow anterior indentation, anterior margin = 23 µm, posterior margin = 38 µm, Ø of base = 7 µm, maximum Ø = 12 µm, *q* thin, cylindrical, annulate-striate, l = 17 µm. Posterior margin/length of *g* 2.1, posterior margin/maximum Ø = 3.0, maximum Ø/Ø of base = 1.7. Tergal branch subcylindrical, l = 43 µm, Ø of base = 6 µm, maximum Ø = 11 µm; pore not ascertained; length of *t*/maximum Ø = 3.9. Globulus *g*, l = 17 µm, maximum Ø = 8 µm; length/-maximum Ø = 2.1; number of bracts 9, their length = 7 µm, capsule subspherical, Ø = 4 µm. Relative lengths of flagella (base segments included) and base segments: F_1 = 100, bs_1 = 22, F_2 = 87, bs_2 = 8, F_3 = ?, bs_3 = 22. F_1 3 times longer than tergal branch *t*, F_2 3 times longer than sternal branch *s*. Calyces of F_1 largest, subhemispherical, those of F_2 and F_3, hemispherical.

Trunk: Submedian setae of collum segment (Fig. 111) short, furcate, branches subcylindrical, with short pubescence, l = 6 µm. Sternite process broad, rounded anteriorly, no anterior incision. Appendages large but short, cylindrical, caps flat, somewhat larger than appendage itself. Process and appendages glabrous.

Tergites (Fig. 112): Tergite I with a single marginal row of short, somewhat clavate, glabrous protuberances (Fig. 113); lateral margins of other tergites (Fig. 114) with short spatulate protuberances. Cuticle thick, inner part of all tergites with cylindrical canals or supports around cavities in a complicated three-dimensional network (Figs 113, 115). Inner parts of tergites with surface structures of peculiar shape and unknown function (Figs 116-117). Cuticular surface near margins and especially on posterior parts of tergites with many wart-like structures with a small transparent funnel on top and a dense collar of small clavate transparent appendages surrounding its base (Fig. 118).

Length/width ratio of tergites: I = 0.6, II and IV = 0.4, III, V and VI = 0.5.

Bothriotricha: All bothriotricha but T_3 with very thin axes; these glabrous except for a minute pubescence on their distal third. T_3 (Fig. 119) with thicker axes and distal endswelling with weak pubescence. Relative lengths of bothriotricha: T_1 = 100, T_2 = 106, T_3 = 50, T_4 = 94, T_5 = 82.

Genital papillae (Fig. 120): Base segments cylindrical. Length of papillae = 56 µm, greatest Ø = 35 µm, length of seta = 20 µm. Proximal part of genital papillae subcylindrical, distal part conical, seta 0.4 of length of papilla, this 1.6 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 (Fig. 121) and trochanter of leg 9 similar to each other, thin, furcate, striate, with glabrous base; length of secondary branch 0.7 of primary one. More anteriorly these setae with rudimentary pointed glabrous secondary branches. Tarsi short, tapering, those of leg 9 (Fig. 122) 2.3 times as long as greatest diameter, with two tergal setae, both pointed and glabrous. Proximal seta 15 µm, distal one 10 µm. Proximal setae 0.3 of length of tarsus and 1.5 times as long as distal seta. Cuticle of tarsus 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 0.5 of length of tarsus. A blunt glabrous appendage, length = 7 µm, on anterior side of femur of leg 1 (Fig. 123).

Pygidium (Fig. 124): *Tergum.* Posterior margin evenly rounded. Setae glabrous, a_1 very short, clavate, curved inward, diverging; a_2 and a_3 straight, cylindrical, posteriorly directed, somewhat diverging; *st* straight, broadly lanceolate, diverging. Lengths of setae: a_1 = *st* = 6, a_2 = 12, a_3 = 20 µm. Distance a_1 - a_1 = 6, a_2 - a_2 = 34, a_3 - a_3 = 54, a_1 - a_2 = 9, a_2 - a_3 = 11, *st* - *st* = 19 µm. Distance a_1 - a_1 as long as a_1, distance a_1 - a_2 0.8 of distance a_2 - a_3; distance *st* - *st* 3.2 times as long as *st* and 0.8 of distance a_1 - a_1. Cuticle glabrous.

Sternum. Posterior margin between b_1 almost straight. Setae b_1 lost, b_2 tapering, pointed, distal 2/3 with short pubescence, b_3 lanceolate, glabrous. Lengths of setae: b_2 = 25, b_3 = 7 µm. Distance b_1 - b_1 = 48, b_2 - b_2 = 85, b_3 - b_3 = 31, b_1 - b_2 = 68, b_2 - b_3 = 55 µm. b_2 0.7 distance b_1 - b_2, b_3 0.2 of interdistance.

Anal plate 1.2 times as long as wide, widest in anterior third, broadest part forming indistinct lateral corners, from there two short, thin, cylindrical, blunt, glabrous appendages protruding obliquely backward; appendages 0.4 of length of plate; posterior 2/3 of plate divided into two tapering branches by a narrow V-shaped incision, each branch with two appendages: a submedian, very short, tapering, glabrous point, and outside it a stalked bladder, in sternal view similar to a knife-blade. The latter 0.6 of length of plate. Plate and sternum glabrous. A shield-shaped plate with digitiform posterior appendage protrudingbackward from between *st*.

24. ***Samarangopus tuberosus*** sp. n. Figs 125-137

TYPE MATERIAL: Holotype: ad 9(♀), Singapore, Labrador Hill, dry forest, soil sample (extraction at Bogor, Java) from under trees with small buttresses, alt. 40 m, 21.XI.1987 (loc. Sar-87/1, leg. Hauser).

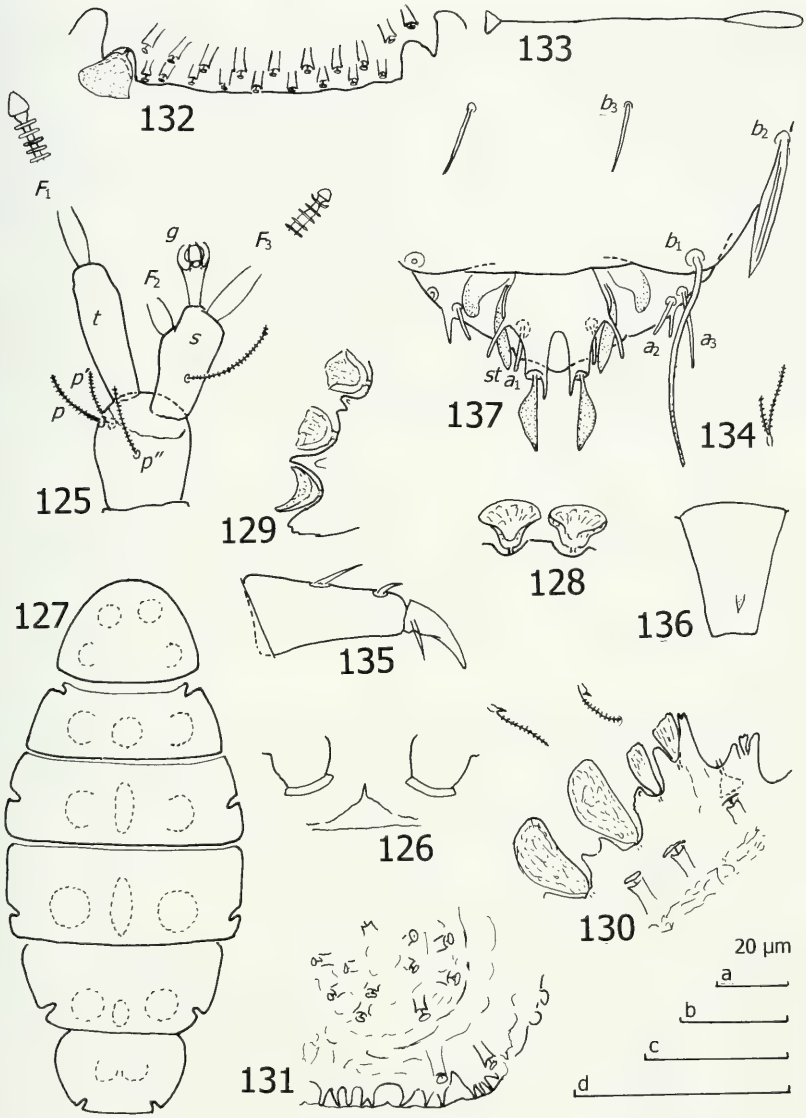
ETYMOLOGY: From the Latin tuberosus = full of protuberances, nodose (referring to the tergites).

DIAGNOSIS: *S. tuberosus* sp. n. is close to *S. segniter* Scheller from Sabah (Scheller *et al.,* 1994). Both have similar antennae, the same type of cuticular structures on the tergites and the pygidial setae b_2 are large and lanceolate. Distinguishing characters are: the shape of the distal part of the lateral protuberances of tergites I-V (cut almost squarely or rounded in *S. tuberosus* sp. n., triangular in *S. segniter*), the surface of T_3 (glabrous in *S. tuberosus* sp. n., with distinct pubescence in *S. segniter*), the length of the branches of the seta on the trochanter of leg 9 (primary branch twice longer than secondary branch in *S. tuberosus* sp. n., equal in length in *S. segniter*), the shape of the pygidial setae a_1 and *st* (a_1 straight and *st* large and lanceolate in *S. tuberosus* sp. n., a_1 curved inward and *st* short, cylindrical, blunt in *S. segniter*).

Other allied species are *S. umbraculus* Scheller and *S. spathaceus* Scheller from New Caledonia (Scheller, 1993), *S. poculifer* Scheller from Thailand (Scheller, 1995) and, *S. jacobsoni* (Silvestri) from Java (Silvestri, 1930).

DESCRIPTION: *Length* = 0.80 mm.

Antennae (Fig. 125): Glabrous; segment 4 with 3 striate setae: *p* and *p´* cylindrical blunt, *p´´* tapering pointed, their lengths: *p* and *p´´* = 10 µm, *p´* = 8 µm. Sternal branch *s*: anterior margin = 11 µm, posterior margin = 14 µm, Ø of base = 7 µm,



FIGS 125-137

Samarangopus tuberosus sp. n., holotype, ad. 9(♀). (125) left antenna, sternal view; (126) collum segment, median and left part, sternal view; (127) body, tergal view, tergites I-VI showing areas with elevated cuticle; (128) tergite I, anterior marginal protuberances, sternal view; (129) tergite I, right posterolateral corner, sternal view; (130) tergite II, anterolateral corner at insertion area of T_1, marginal protuberances and cylindrical organs with umbrella-shaped top, tergal view; (131) tergite II, posterolateral corner with marginal protuberances and cylindrical organs with umbrella-shaped top, tergal view; (132) tergite VI, posterior part, tergal view; (133) T_3; (134) seta on coxa of leg 9; (135) tarsus of leg 9; (136) femur of leg 1 with appendage; (137) pygidium, median and left part, sternal view. Scale a: Fig. 132; b: Figs 128-131, 134-136; c: Figs 125-126, 133, 137; d: Fig. 134.

maximum Ø = 9 µm, *q* tapering, striate, l = 17 µm. Posterior margin/length of *g* 1.6, posterior margin/maximum Ø = 1.6, maximum Ø/Ø of base = 1.3. Tergal branch fusiform, l = 29 µm, Ø of base = 4 µm, maximum Ø = 6 µm; pore not ascertained; length of *t*/maximum Ø = 3.3. Globulus *g*, l = 9 µm, maximum Ø = 5 µm; length/-maximum Ø = 1.8; number of bracts 7, their length = 4 µm, capsule subspherical, bottom somewhat flattened, Ø = 3 µm. Relative lengths of flagella (base segments included) and base segments: F_1 = 100, bs_1 = 13, F_2 = 73, bs_2 = 7, F_3 = 58, bs_3 = 13. F_1 3.6 times as long as tergal branch *t*, F_2 1.9 and F_3 3.4 times as long as sternal branch *s*, respectively. Calyces of F_1 largest, conical, those of F_2 and F_3 hemispherical.

Trunk: Submedian setae of collum segment (Fig. 126), furcate, main branch cylindrical and striate, secondary branch rudimentary, pointed, glabrous; submedian seta l = 10 µm, lateral seta l = 9 µm. Sternite process broad, pointed anteriorly. Appendages barrel-shaped, directed posteriorly, caps somewhat larger than distal part of appendage. Process glabrous, appendages almost so.

Tergites (Fig. 127): With 4 types of protuberances: 1. campanulate on anterior and lateral margins of tergite I (Figs 128-129); 2. wedge- or leaf-shaped on lateral margins of tergites II-VI (Fig. 130), these small or rudimentary at insertion cavities of bothriotricha; 3. smaller, cylindrical, cut squarely distally and with a small umbrella-like structure protruding from an apical cavity (Figs 130-132), these partly concentrated in groups on rounded elevations of the cuticle or in dense rows near margins of tergites; 4. Small, flat, blunt teeth in groups of 3-5 at posterior margins of tergites I-V (Fig. 131).

Number of marginal protuberances: I, 23; II, 1 small – T_1 – 9 (one smaller); III, 1 small – 3 – T_2 – 9; IV, 1 small – 4 – T_3 – 4; V, 1 small – 5 – T_4 – 1 small – 3; VI, 6 – T_5 – 1. Length/width ratio of tergites: I = 0.7, II-IV = 0.4, V = 0.5 and VI = 0.6.

Bothriotricha: All bothriotricha but T_3 with very thin axes; these glabrous, curled distally. T_3 (Fig. 133) with glabrous distal swelling, this 0.3 of length of bothriotrix. Relative lengths of bothriotricha: T_1 = 100, T_2 = 96, T_3 = 54, T_4 = ?, T_5 = 78.

Legs: All legs 5-segmented. Seta on coxa (Fig. 134) and trochanter of leg 9 similar to each other, thin, furcate, striate, with glabrous base; 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 (Fig. 135) twice longer than greatest diameter, with two tergal setae, both pointed and glabrous. Proximal seta 10, distal one 15 µm. Proximal setae 0.3 of length of tarsus and twice longer than distal seta. Cuticle of tarsus 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 0.5 of length of tarsus. A pointed glabrous shortly pubescent appendage on anterior side of femur of leg 1 (Fig. 136), its length = 4 µm.

Pygidium (Fig. 137): *Tergum.* Posterior margin rounded but with a pentagonal plate above anal plate protruding backward from between *st*, this plate narrowest anteriorly and with obtuse posterolateral corners. Two small posteriorly directed jags protrude backward at the level of setae a_2. Setae glabrous, a_1, a_2 and a_3 straight, cylindrical, glabrous, a_1 somewhat diverging, a_2 converging, a_3 straight, cylindrical, posteriorly directed; *st* lanceolate, curved inward, directed posteriorly. Lengths of

setae: a_1 = 7 µm, a_2 = 5 µm, a_3 = 11 µm, *st* = 13 µm. Distance $a_1 - a_1$ = 10 µm, $a_2 - a_2$ = 30 µm, $a_3 - a_3$ = 35 µm, $a_1 - a_2$ = 12 µm, $a_2 - a_3$ = 2 µm, *st* – *st* = 13 µm. Distance $a_1 - a_1$ 1.4 times as long as a_1, distance $a_1 - a_2$ 6 times longer than $a_2 - a_3$; distance *st* – *st* as long as *st* and 1.3 times as long as distance $a_1 - a_1$. Cuticle glabrous.

Sternum. Posterior margin between b_1 almost straight. Setae b_1 thin, tapering, striate most distally, b_2 large, lanceolate, with transparent wings, glabrous, b_3 tapering, pointed, striate most distally. Lengths of setae: b_1 = 30 µm, b_2 = 20 µm, b_3 = 10 µm. Distance $b_1 - b_1$ = 39 µm, $b_2 - b_2$ = 130 µm, $b_3 - b_3$ = 22 µm, $b_1 - b_2$ = 21 µm, $b_2 - b_3$ = 22 µm. b_2 as long as distance $b_1 - b_2$, b_3 0.4 of interdistance.

Anal plate 1.2 times as long as broad, broadest behind middle, lateral margins convex anteriorly, concave posteriorly; distal part cleft by a deep V-shaped incision into two tube-like branches; each branch with a short, submedian, straight, thorn-like, glabrous appendage, and a stalked leaf-shaped, knife-like posteriorly directed bladder, with granular surface, length of the latter appendage 0.7 of length of plate. Plate and sternum glabrous.

25. ***Samarangopus interstinctus*** sp. n. Figs 138-150

TYPE MATERIAL: Holotype: ad 9(♂), Malaysia, Sarawak, Kuching-Matang road, Gunung Serapi, soil sample (extraction at Kuching) from forest along road to the TV-station, alt. 320 m, 9.XII.1987 (loc. Sar-87/66, leg. Hauser). Paratypes: 3 ad. 9(1♂, 2♀), 1 subad. 8(♀), same data as for holotype; 1 ad (♂), 1 subad. 8(♀), Kuching-Matang road, Gunung Serapi mountain, soil sample (extraction at Kuching) from forest along road to the TV-station, alt. 670 m, 9.XII.1987 (loc. Sar-87/64, leg. Hauser).

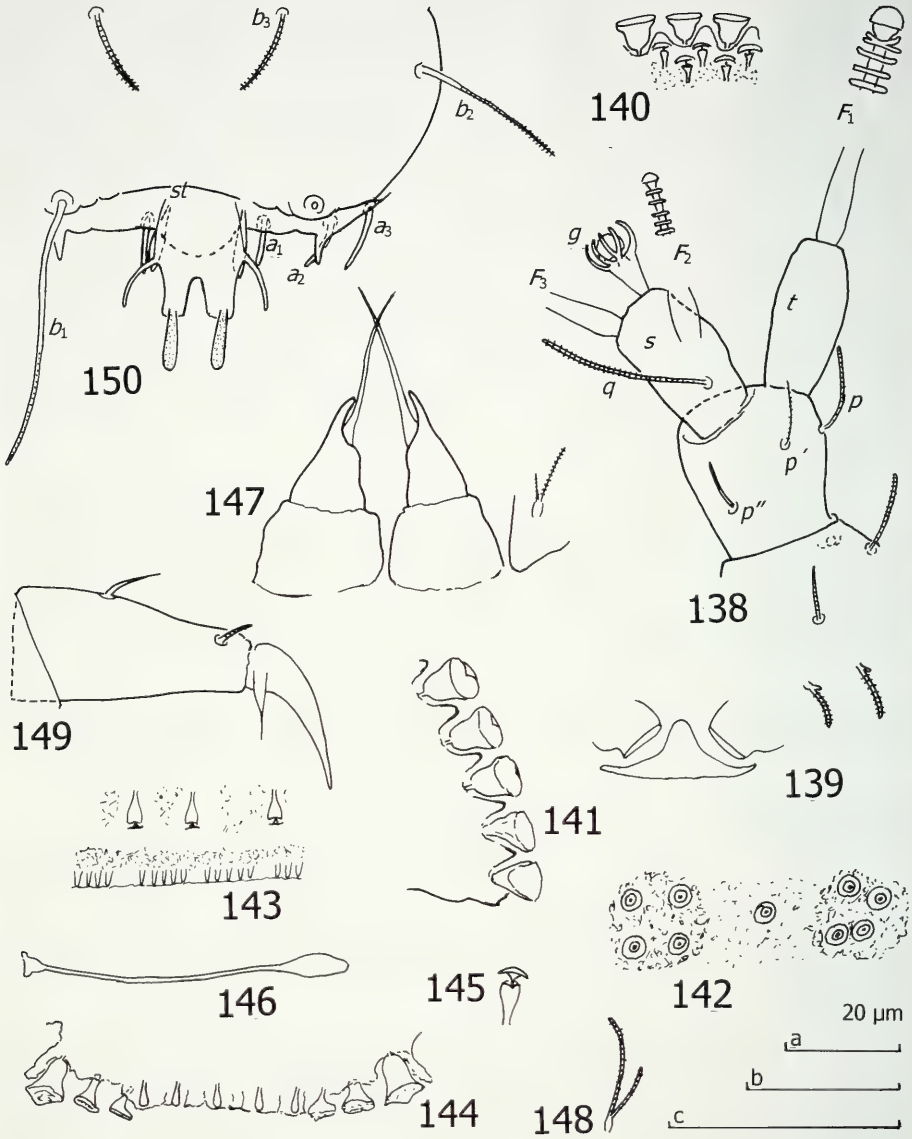
OTHER MATERIAL: Malaysia, Sarawak, Kuching-Serian road, near Kampong Kuap (18 km from Kuching), secondary forest, soil sample (extraction in Geneva) from between buttresses of a large tree, alt. 30 m, 6 ad. 9 (1♂,5♀), 2 subad. 8(♀), 13.XII.1987 (loc. Sar-87/86, leg. Hauser). – Altogether 15 specimens.

ETYMOLOGY: From the Latin interstinguo, interstinctus = here and there bestrewed with (small fungiform organs on the tergites).

DIAGNOSIS: The species described here is close to *S. poculifer* Scheller from Thailand (Scheller, 1995). These two species are generally alike in their antennae, their cuticular appendages of the tergites and in the shape of the anal plate. They can be distinguished by the shape of the process of the collum segment (rounded anteriorly in *S. interstingctus* sp. n.; cleft anteriorly in *S. poculifer*), the shape of the protuberances of the anterior margin of tergite I (large and campanulate in *S. interstinctus* sp. n.; small and wedge-shaped in *S. poculifer*), by the shape of the specialised protuberances of the tergites (clavate central column with umbrella-like transparent covering disc in *S. interstinctus* sp. n.; funnel-like, consisting of a central column surrounded by a membrane in the shape of an upside down umbrella or a wide funnel in *S. poculifer*). Good distinctive characters are also found in the shape of the appendages of the postero-lateral corners of the pygidial tergum and its setae a_3. There are also similarities, but to a less degree, with *S. papuensis* Scheller from Papua New Guinea (Scheller, 1996) and *S. segniter* Scheller from Sabah (Scheller *et al.,* 1994) as to the antennae, the cuticle of the tergites and some pygidial characters.

DESCRIPTION: *Length* = (0.41-)0.42(-0.48) mm.

Antennae (Fig. 138): Antennae glabrous; segment 4 with 3 cylindrical, blunt, sparsely and weakly striate setae, their lengths: $p = p'' = 7(-8)$ µm, $p' = 6(-7)$ µm.



FIGS 138-150

Samarangopus interstinctus sp. n., holotype, ad. 9(♂). (138) right antenna, sternal view; (139) collum segment, median and left part, sternal view; (140) tergite I, anterior margin with campanulate protuberances and fungiform organs, tergal view; (141) tergite I, posterolateral corner with marginal protuberances, sternal view; (142) tergite I, central part with elevated cuticle and fungiform organs; (143) tergite I, posterior margin; (144) tergite VI, posterior margin between insertion cavities of T_5, tergal view; (145) fungiform organ; (146) T_3; (147) genital papillae and seta on coxa of leg 2, anterior view; (148) seta on coxa of leg 9; (149) tarsus of leg 9; (150) pygidium, median and left part, sternal view. Scale a: Figs 140-143, 145, 147; b: Fig. 139; c: Figs 138, 144, 146, 148-150.

Sternal branch *s*, with shallow anterior indentation, anterior margin = 7 µm, posterior margin = 11(-12), Ø of base = 5(-6), maximum Ø = 7(-8) µm, *q* cylindrical, blunt, striate, l = 12(-14) µm. Posterior margin/length of *g* 1.7(-2.9), posterior margin/-maximum Ø = 1.5(-1.6), maximum Ø/Ø of base = (1.3-)1.5. Tergal branch *t* somewhat fusiform, l = (12-)13 µm, Ø of base = 5, maximum Ø = 6 µm; pore not ascertained; length of *t*/maximum Ø = (2.0-)2.2 . Globulus *g*, l = 6(-7) µm, maximum Ø = (4-)5 µm; length/maximum Ø = 1.2(-1.4); number of bracts 8(-9), their length = 5 µm, capsule hemispherical with flattened bottom, Ø = 3(-4) µm. Relative lengths of flagella (base segments included) and base segments: F_1 = 100, bs_1 = 16(-17), F_2 = 42(-48), bs_2 = (9-)10(-12), F_3 = 83(-90), bs_3 = 13(-14). F_1 4(-4.4) times as long as tergal branch *t*, F_2 and F_3 (1.6-)1.7 and 3.4(-3.5) times as long as sternal branch *s*. Calyces subhemispherical, those of F_1 largest, those of F_2 smallest.

Trunk: Setae of collum segment (Fig. 139) short, furcate, primary branch cylindrical, blunt, striate, secondary branch rudimentary, glabrous, submedian seta l = 6 µm, somewhat shorter than sublateral seta. Sternite process broad, anteriorly rounded, no incision. Appendages short, subcylindrical, caps flat. Process and appendages glabrous.

Tergites: Anterior and lateral margins of tergite I (Figs 140-141) with a single row of campanulate, glabrous protuberances; lateral margins of other tergites with similar type of protuberances, but longish. Number of marginal protuberances: I. (23-)24(-25); II, 1 small – T_1 – 1 small + 7(-9) + 1 small; III, 4 – T_2 – 1 small + 4(-5) + 1 small; IV, (4-)5 – T_3 – 1 small + 4; V, (4-)5 – T_4 – 1 small + 3; VI, (1 small + 3)4 – T_5 – 1(-2) + 2 small. Cuticle (Figs 142-143) thick, with coarse surface set with small cones and several fungus- or umbrella-like organs consisting of a clavate or almost cylindrical stalk covered by a circular, transparent plate similar an umbrella or a hat of a fungus (Figs 140, 145).

Bothriotricha: All but T_3 with very thin axes; these glabrous except for a minute pubescence on their distal third. T_3 (Fig. 146) glabrous and with thicker axes and distal swelling. Relative lengths of bothriotricha (for holotype only): T_1 = 100, T_2 = 114, T_3 = 68, T_4 = 90, T_5 = 81.

Genital papillae (Fig. 147): Base segments long and wide, in the shape of a truncated cone, papilla conical, with strongly narrowing distal part. Length of papillae = 20 µm, greatest Ø = 12 µm, length of seta = 30 µm; papilla 1.7 times as long as greatest diameter, seta 1.5 times as long as length of papilla. Cuticle glabrous. Coxal seta of leg 2 with short and thin but not rudimentary secondary branch, length of seta = 13 µm.

Legs: All legs 5-segmented. Seta on coxa (Fig. 148) and trochanter of leg 9 similar to each other, furcate, striate; length of secondary branch 0.6 of primary one. These setae on more anterior legs with rudimentary pointed glabrous secondary branches, but not so in leg 2 in males. Tarsi short, tapering, length in leg 9 (19-)20 µm, in leg 1 (14-)15(-16) µm. Tarsus of leg 9 (Fig. 149) (1.9-)2.0 times as long as greatest diameter, with two tergal setae, both pointed, proximal seta, l = 5 µm, glabrous, 0.3 of length of tarsus and 1.7 times as long as distal striate seta, its length = 3 µm. Cuticle of tarsi 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 0.7 of length of tarsus. A blunt glabrous appendage on anterior side of femur of leg 1, its length = 3 µm.

Pygidium (Fig. 150): *Tergum.* Posterior margin with two narrowly triangular, posteriorly directed jags protruding from level of setae a_2; small semicircular lobe protruding backwards above anal plate. Setae glabrous, a_1 and a_2 cylindrical, blunt, the former protruding backward and the latter converging, a_3 tapering, curved inward, converging, *st* somewhat clavate, directed posteriorly. Lengths of setae: $a_1 = a_2 = 5$, $a_3 = st = (6\text{-})7$ µm. Distance $a_1 - a_1 = 9(\text{-}10)$ µm, $a_2 - a_2 = (25\text{-})27$ µm, $a_3 - a_3 = (30\text{-})32(\text{-}33)$ µm, $a_1 - a_2 = 6$ µm, $a_2 - a_3 = (3\text{-})4$ µm, $st - st = (6\text{-})7$ µm. Distance $a_1 - a_1$ 1.8(-2.0) times as long as a_1, distance $a_1 - a_2$ 1.5(-2.0) times as long as distance $a_2 - a_3$; distance $st - st$ as long as *st* and 0.7 of distance a_1 - a_1. Cuticle glabrous.

Sternum. Posterior margin between b_1 with shallow indentation. Setae thin, tapering, striate, their lengths: $b_1 = 24(\text{-}26)$ µm, $b_2 = 14(\text{-}15)$ µm, $b_3 = (15\text{-})16$ µm. Distance $b_1 - b_1 = 22(\text{-}23)$ µm, $b_2 - b_2 = (37\text{-})40(\text{-}41)$ µm, $b_3 - b_3 = (15\text{-})16$ µm, $b_1 - b_2 = 16$ µm, $b_2 - b_3 = 13(\text{-}14)$ µm. b_1 0.9 of interdistance, b_2 about as long as distance $b_1 - b_2$, b_3 as long as interdistance. Sternum glabrous.

Anal plate 1.3 times as long as broad, broadest in the middle, lateral margins convex anteriorly, concave posteriorly; distal part of plate cleft by a U-shaped incision, depth about 1/3 of length of plate, incision forming two posterior branches with subparallell sides. Each of the posterior branches with a clavate appendage protruding backward, length of appendage 0.3 of length of plate. Plate glabrous, distal appendages with somewhat granular surface.

26. ***Samarangopus sarawakensis*** sp. n. Figs 151-162

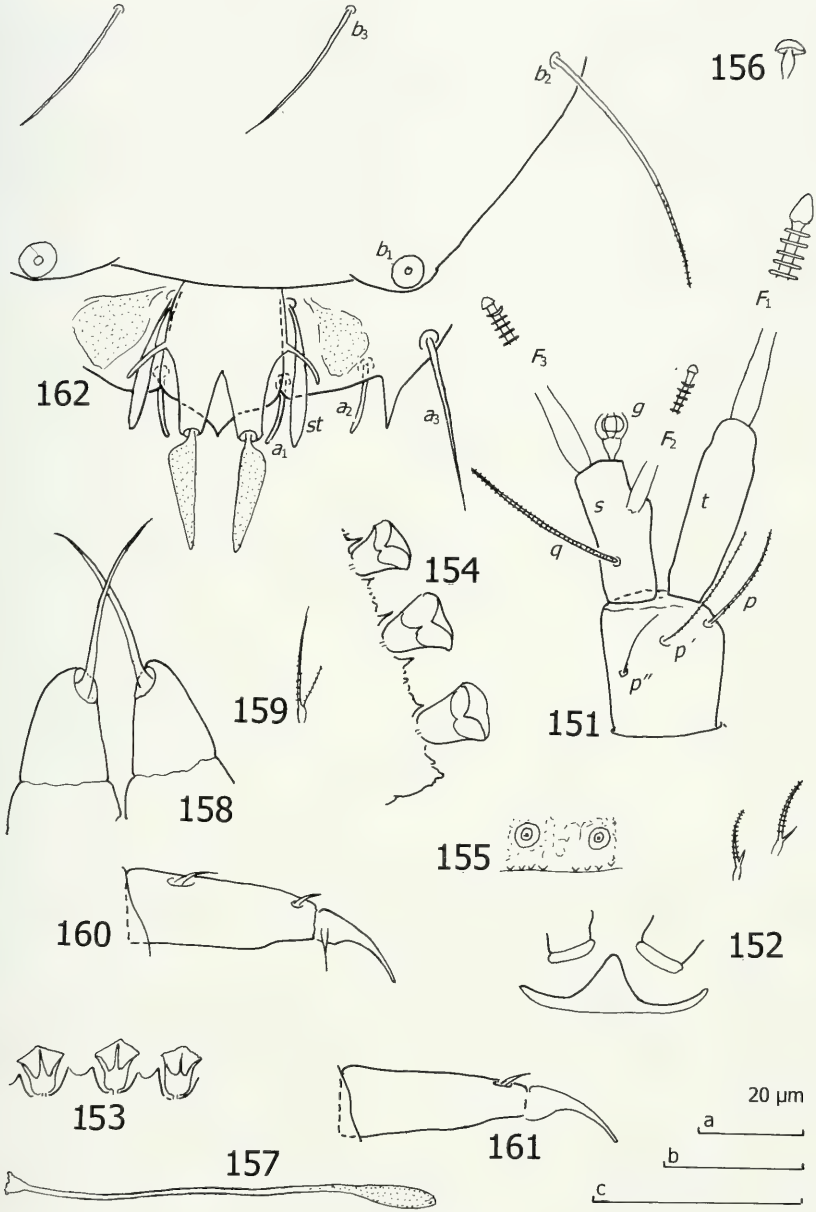
TYPE MATERIAL: Holotype: ad 9(♀), Malaysia, Sarawak, Kuching-Matang road, Gunung Serapi, soil sample (extraction at Kuching) from forest along road to the TV-station, alt. 670 m, 9.XII.1987 (loc. Sar-87/64, leg. Hauser). Paratypes: 8 ad. 9(3♂,5♀), 1 juv. 5, same data as for holotype. – Altogether 10 specimens.

ETYMOLOGY: A latinized adjective of the name Sarawak.

DIAGNOSIS: *S. sarawakensis* sp. n. is most closely related to *S. ternarius* Scheller from Sabah (Scheller, 2001). They are similar, e. g. in the shape of the antennae, the protuberances of the tergites and the appendages of the collum segment. The following characters are useful for distinguishing these two species: the shape of the collum process (triangular and without anterior incision in *S. sarawakensis* sp. n., broadly rounded with anterior incision in *S. ternarius*), the shape of the genital papillae (distal part rounded without processes in *S. sarawakensis* sp. n., with three processes around the seta in *S. ternarius*), the distal part of bothriotricha T_3 (rounded distally in *S. sarawakensis* sp. n., cut squarely distally in *S. ternarius*), the shape of the posterior margin of the median subtergal plate (with point in *S. sarawakensis* sp. n., rounded in *S. ternarius*) and the setae b_2 of the pygidial sternum (thin, tapering in *S. sarawakensis* sp. n., lanceolate and with wings in *S. ternarius*).

DESCRIPTION: *Length* = (0.64-)1.07 mm.

Antennae (Fig. 151): Glabrous; segment 4 with 3 tapering, indistinctly striate setae, their lengths (for holotype only): $p = 18$ µm, $p' = 20$ µm, p'' 10 µm. Sternal branch *s*, anterior margin = 14 µm, posterior margin = 18 µm, Ø of base = 7 µm, maximum Ø = 10(-11) µm, *q* thin, tapering, indistinctly striate, l = 25 µm. Posterior



FIGS 151-162

Samarangopus sarawakensis sp. n., holotype, ad. 9(♀). (151) right antenna, sternal view; (152) collum segment, median and left part, sternal view; (153) tergite I, anterior margin, sternal view; (154) tergite I, left posterolateral corner, sternal view; (155) tergite II, posterior margin; (156) tergite II, fungiform structure, lateral view; (157) T_3; (158) genital papillae, anterior view; (159) seta on coxa of leg 9; (160) tarsus of leg 9; (161) tarsus of leg 1; (162) pygidium, median and left part, sternal view. Scale a: Figs 152, 155; 158-161; b: Figs 151, 153-154, 157; c: Figs 156, 162.

margin/length of *g* (2.3-)2.6, posterior margin/maximum Ø = (1.8-)1.9, maximum Ø/Ø of base = 1.4(-1.6). Tergal branch subcylindrical, l = (25-)27 µm, Ø of base = 5 µm, maximum Ø = 8(-9) µm; pore not ascertained; length of *t*/maximum Ø = (2.8-)3.4. Globulus *g*, l = 7(-8) µm, maximum Ø = 5 µm; length/maximum Ø = 1.4(-1.6); number of bracts (7-)8, their length = 4 µm, capsule subspherical, bottom somewhat flattened, Ø = 4 µm. Relative lengths of flagella (base segments included) and base segments: F_1 = 100, bs_1 = (14-)15, F_2 = (43-)46, bs_2 = (7-)8, F_3 = (89-)100, bs_3 = (15-)16. F_1 3.3(-3.5) times as long as tergal branch *t*, F_2 and F_3 (2.1-)2.2 times as long as and (0.8-)0.9 of length of sternal branch *s*, respectively. Calyces of F_1 largest, conical, those of F_2 and F_3, small, hemispherical.

Trunk: Submedian setae of collum segment (Fig. 152) furcate, main branch tapering, striate, secondary branch rudimentary, pointed, glabrous, submedian seta l = 13 µm, sublateral seta l = 15 µm. Sternite process triangular, anteriorly rounded, no anterior incision. Appendages cylindrical, caps flat, somewhat larger than distal part of appendages. Process and appendages glabrous.

Tergites: Tergite I with a single marginal row of campanulate, glabrous protuberances (Figs 153-154); protuberances of anterior and lateral margins with tergal side somewhat triangularly lengthened, protuberances of anterior margin with median outward directed spine and protuberances of lateral margins with lengthened part folioform, pointed, turned downwards distally. Number of marginal protuberances: I, (27-)31; II, 1 small – T_1 – 1 small + (8-)9; III, 1 small + 5(-6) – T_2 – 1 small + 6; IV, 1 small + 6 – T_3 – (4-)5(-6); V, (6-)8 – T_4 – 4; VI, 6 – T_5 – 1. Cuticular surface coarse, near margins and especially on posterior parts of tergites with many fungiform structures (Figs 155-156); the latter with the top covered by a small transparent cover in the shape of a mushroom hat or of an umbrella.

Length/width ratio of tergites: I = 0.5(-0.6), II = 0.6, III = (4-)0.5, IV = V = VI = 0.5.

Bothriotricha: All but T_3 with very thin glabrous axes. T_3 (Fig. 157) with thicker axes and distal endswelling with weak pubescence. Relative lengths of bothriotricha (for holotype only): T_1 = 100, T_2 = 105, T_3 = 55, T_4 = ?, T_5 = 126.

Genital papillae (Fig. 158): (As long as -)1.2 times as long as greatest width. Base segments almost half of length of papillae. Length of papillae = 20 µm, greatest Ø = 17(-20) µm, length of seta = 35(-38) µm. Papilla slowly tapering, rounded distally, opening of inserting cavity of seta circular, seta thick, (1.9-)2.1 times as long as length of papilla. Cuticle glabrous. Coxal seta of leg 2 as on leg 1, length = 20 µm.

Legs: All legs 5-segmented. Seta on coxa (Fig. 159) and trochanter of leg 9 thin, furcate, striate, with glabrous base; length of secondary branch 0.4 of primary one. More anterior setae with rudimentary pointed glabrous secondary branches. Tarsi, tapering, those of leg 9 (Fig. 160) 1.6(-1.7) times as long as greatest diameter, with two tergal setae, both pointed glabrous. Proximal seta 9(-10) µm, distal one 4(-5) µm. Proximal setae (0.2-)0.3 of length of tarsus and 2.0(-2 2) times as long as distal seta. Cuticle of tarsus glabrous. No proximal seta on tarsus of leg 1 (Fig. 161). All legs with large main claw and small setose anterior secondary claw; in leg 9 the former reaching 0.6 of length of tarsus. A triangular glabrous appendage on anterior side of femur of leg 1, its length = 5 µm.

Pygidium (Fig. 162): *Tergum.* Posterior margin with two narrowly triangular, pointed jags protruding backward from between setae a_2 and a_3; a shield-like lobe, posteriorly with triangular point, protruding backward above anal plate. Setae glabrous, a_1 and a_2 cylindrical, blunt, somewhat curved inward, a_3 straight, tapering, pointed, diverging; *st* cylindrical in proximal 1/4, more outward lanceolate. Lengths of setae: a_1 = (5-)6 µm, a_2 = (4-)6 µm, a_3 = (14-)17 µm, *st* = (12-)14 µm. Distance $a_1 - a_1$ = (10-)11 µm, $a_2 - a_2$ = (25-)27(-28) µm, $a_3 - a_3$ = (38-)39(-42) µm, $a_1 - a_2$ = 9 µm, $a_2 - a_3$ = (10-)11(-12) µm, *st* - *st* = 11(-13) µm. Distance $a_1 - a_1$ 1.8(-2.0) times as long as a_1, distance $a_1 - a_2$ 1.3 times as long as distance $a_2 - a_3$; distance *st* – *st* 0.8(-1.0) of length of *st* and 1.1(-1.2) times as long as distance $a_1 - a_1$. Cuticle glabrous except for two small areas outside *st*.

Sternum. Posterior margin between b_1 with low and broad bulge. Setae b_1 lost, b_2 tapering, pointed, distal half with very short pubescence, b_3 thin, tapering, pointed, glabrous. Lengths of setae: b_2 = (25-)27(-30) µm, b_3 = (14-)15 µm. Distance $b_1 - b_1$ = (34-)36 µm, $b_2 - b_2$ ≈60 µm, $b_3 - b_3$ = 22(-28) µm, $b_1 - b_2$ = 25(-29) µm, $b_2 - b_3$ ≈20 µm. b_2 (as long as -)1.1 times as long as distance $b_1 - b_2$, b_3 (0.5-)0.6 of interdistance.

Anal plate 1.4(-1.5) times as long as wide, broadest at level of lateral appendages, these thin, cylindrical, blunt, glabrous, protruding obliquely backward; appendages 0.3 of length of plate; posterior half of plate divided into two tapering branches by a V-shaped incision, each branch provided with an almost glabrous stalked bladder, in sternal view similar to a knife-blade. These appendages 0.8 of length of plate. Plate and sternum glabrous.

Sphaeropauropodinae

Genus ***Sphaeropauropus*** Silvestri, 1930.

27. ***Sphaeropauropus arcuatus*** Scheller

Sphaeropauropus arcuatus Scheller, 2001: 981-984, figs 105-117.

MATERIAL EXAMINED: Indonesia, Java, Cibodas, *Lithocarpus-Castanopsis* forest above the Botanical Garden, tourist trail to the waterfall, soil sample (extraction at Kuching, Sarawak) from between buttresses of large trees, alt. 1380 m, 1ad. 9(♂), 26.XI.1987 (loc. Sar-87/21, leg. Hauser). – Malaysia, Sarawak, Kuching-Matang road, Gunung Serapi, soil sample (extraction at Kuching) from forest along road to the TV-station, alt. 670 m, 3 ad. 9 (♀), 9.XII.1987 (loc. Sar-87/64, leg. B. Hauser); road Kuching-Serian, 18 km from Kuching, near Kampong Kuap, secondary forest, soil sample (extraction in Geneva) from between buttresses of a large tree, alt. 30 m, 1 ad. 9(sex?), 1 juv. 6, 13.XII.1987 (loc. Sar-87/86, leg. B. Hauser). – Altogether 6 specimens.

GENERAL DISTRIBUTION: The species is here reported for the first time from Java. It was previously known from Sabah only (Scheller, 2001).

REMARKS

Pauropods have been almost unknown from the Indo-Australian area. Disregarding from Sabah in East Malaysia, only a few accidentally found species have been reported from Java (one species, Remy, 1933), Mindanao, the Palau Islands and Guam (five species, Remy, 1957d) and Papua New Guinea (one species, Scheller, 1996). The collections from Sabah, 99 specimens in all (Scheller *et al.*, 1994; Scheller, 2001), contain 18 identified species, only three of which distributed elsewhere.

The collection studied here, with 104 specimens from Singapore, Java, Bali and Sarawak, is the first one of importance from the Indonesian island arch and is one of the largest collections brought together from the Indo-Australian region. In comparison to the number of specimens, the number of species, 27, is considerable. Many of them, 18 (67%), are new to science and only nine were known earlier from other areas. Part of the material comes from botanical gardens and the like, but these figures are similar to those earlier presented for New Caledonia (Scheller, 1993). 127 specimens from there were studied and 18 new species were identified (82% of total number of species found), only four widespread species could be found. A similar picture appears when comparing the faunas of north-western Thailand, 54 specimens, 10 new species (71% of total number of species found) (Scheller, 1995), south Vietnam, 45 specimens, 7 new species (87% of total number of species found) (Scheller, 2004) and Sabah, 99 specimens, 14 new species (78% of total number of species found) (Scheller *et al.*, 1994; Scheller, 2001).

Nine of the studied species studied above have been met with before. Four of them were known from Sabah: *Hemipauropus dispar* Scheller, *Brachypauropoides penanorum* Scheller, *Samarangopus longipenes* Scheller and *Sphaeropauropus arcuatus* Scheller. The three former can now be included in the fauna of Sarawak too, and the last mentioned also occurs on Java. They may all belong to an old Indo-Australian faunal element. Of the five remaining species described earlier, *Allopauropus manjakotompensis* Remy & Bello and *A. pumilio* Remy have been reported from Madagascar and Réunion, respectively, and may be a part of an old Gondwanan fauna. This means that only three of the species in this material have ranges extending outside the Oriental region: *Allopauropus proximus* Remy, *A. pulcher* Remy and *A. mortensenii* (Hansen). The first mentioned is widely distributed in the tropics but the whole distributional range of the other two is currently not known. *A. pulcher* was described from South Africa and has later been found in the USA, and records of *A. mortensenii* also show a very discontinuous picture including Egypt, Sri Lanka, Réunion, Mauritius, Koh Chang in the Gulf of Thailand and New Caledonia. There is also a doubtful rcord from Australia (Harrison, 1914). Accordingly only three species of 27 reported here have ranges extending outside the Oriental region. The wide range element is poor.

The high portion of new species and the presence of only a few widespread species indicate a strong endemism in the Southeast Asian pauropod fauna. All available collections indicate a poorly known fauna with a high species diversity.

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New species of *Iarupea* Martínez and morphological specializations among related taxa associated with ants and termites (Coleoptera: Scarabaeidae: Eupariini)

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New species of *Iarupea* Martínez and morphological specializations among related taxa associated with ants and termites (Coleoptera: Scarabaeidae: Eupariini). - *Iarupea* Martínez is one of the South American, myrmecophilous genera of Eupariini with five species, including two species from Brazil described herein as new: *I. goias* sp. n. and *I. luisae* sp. n. The genus is redefined, a key for species, distribution, habitus photographs and illustrations are given. Adaptive modifications in external morphology of *Iarupea* and of 14 related myrmecophilous genera are summarized. Of the total number of 33 species known to occur with social insects, most numerous species are recorded in association with leaf-cutting ants *Atta* F. (18 species) and *Acromyrmex* Mayr (5 species); the second group includes species associated with fire ants *Solenopsis* Westw. (7 species) and *Iridomyrmex* Mayr (1 species) (Formicidae, Myrmicinae). Two highly derived species are recorded from termitaria of unknown hosts. Known or suspected behavioural aspects among the guests and hosts are discussed.

Keywords: Coleoptera, - Eupariini - Iarupea - new species - myrmecophilous genera - morphological specializations - New World.

INTRODUCTION

Myrmecophily or myrmecophoby is wide-spread among Coleoptera and has, in some groups, led to remarkable modifications in the external morphology. Myrmecophilous tendencies among the Neotropical Scarabaeinae and Coprinae were documented in the literature several times (Vaz-de-Mello *et al.,* 1998) while only few studies focused on the association of the Eupariini with social insects (Woodruff & Cartwright, 1967; Wojcik *et al.*, 1977, 1978). This paper represents an initial attempt to bring together all available information on the New World myrmecophilous Eupariini and their morphological specializations. *Iarupea* Martínez (1952) is a small genus with five South American species, including two new species from Brazil described herein. This originally monospecific genus was diagnosed by Stebnicka (1999a) who added to it two distinctive species transferred from *Euparia* Le Peletier Saint Fargeau & Serville. The discovery of the following two species of *Iarupea* and

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examination of additional material enabled to emphasize the most striking morphological modifications in external morphology of 15 genera containing 33 myrmecophilous and termitophilous species. Members of the genera presented in Table 1 are poorly represented in the majority of the entomological collections, almost certainly due to their inquiline habits. Of the total number of 33 species, 23 species are associated with Attini, 8 species with Solenopsidini (Formicidae, Myrmicinae) and two species are recorded from termitaria.

MATERIALS AND METHODS

The nomenclature used in this paper to describe external features follows that of Chapin (1940), Cartwright (1974) and somewhat modified terminology of Stebnicka & Howden (1996, 1997).

This study is based on the primary types of all known species and on material collected in South America and submitted for identification. The type material and other specimens studied may be found in the following repositories: Canadian Museum of Nature, Ottawa, Canada (CMNO); Florida State Collection of Arthropods, Gainesville, USA (FSCA); Hungarian Natural History Museum, Budapest, Hungary (HNHM); Institute of Systematics & Evolution of Animals, Krakow, Poland (ISEA); Muséum d'histoire naturelle, Geneva, Switzerland (MHNG); Muséum National d'Histoire Naturelle, Paris, France (MNHN); Staatliches Museum für Tierkunde, Dresden, Germany (SMTD); National Museum of Natural History, Smithsonian Institution, Washington DC, USA (NMNH); Zoologisches Museum für Naturkunde der Humboldt Universität, Berlin, Germany (ZMHB).

The most numerous specimens, particularly those from Antonio Martínez collection are deposited in the Canadian Museum of Nature, Ottawa (CMNO).

TAXONOMY

Genus ***Iarupea*** Martínez, 1953

Iarupea Martínez, 1953: 75-77.- Stebnicka 1999a: 290-291.
Euparia Le Peletier de Saint Fargeau & Serville, 1828: 357 (in part)
Iarupoides Chalumeau & Howden, 1984: 87 (nomen nudum).

TYPE SPECIES: *Iarupea lopeteguii* Martínez, by monotypy.

DIAGNOSIS: morphological modifications. Head with coarse longitudinal wrinkles, genae sharply carinate in front of eyes. Pronotum furrowed basally with wide marginal collar and postero-lateral cavities to receive elytral lobe, anterior angles concave and slightly transparent. Elytra with humeral angles prolonged anteriorly into dentiform lobes (Fig. 6), apices of lobes with microtrichomes. Legs long; middle and hind tibiae slender, very narrow at base and weakly expanded apically.

REDESCRIPTION: length 4.5- 5.0 mm. Body (Figs 1, 3-5) elongate, alutaceous, usually covered with argillaceous coating. Head moderate in size, convex medially, genae right-angled. Eyes invisible from above; antennae 9-segmented, club ovoid, 3-segmented; mouthparts adapted to soft saprophagy. Pronotum strongly convex on disc, sides narrowly explanate and sinuate to obtuse posterior angles, side margin with fringe of short, very close, club-shaped setae. Scutellum subtriangular, depressed.

Elytra narrower than pronotum, base margined and swollen, usually with large tubercles terminating intervals 3, 5, 7; intervals convex, crenate by strial punctures; epipleura oblique, reduced anteriorly, narrowed toward apex. Metathoracic wings well developed. Prosternum with triangular process; mesosternum declivous toward metasternum; mesocoxae separated, space between mesocoxae equal to width of mesofemur, meso-metasternal carina inconspicuous or lacking; metasternum long, convex; abdominal sternites fused; pygidium large, disc eroded. Profemur wide, anterior margin fringed with row of truncate setae, posterior margin widely flattened; middle and hind femora long, parallel-sided, without postfemoral lines; fore tibiae narrow, relatively short, third lateral tooth very small; middle and hind tibiae slender, apical spurs thin, slightly arcuate; tarsi shorter than tibiae, tarsomeres slender, claws fine, hornlike. Epipharynx specifically not differentiated.

MALE: terminal spur of fore tibia bent inwardly at the tip; penultimate abdominal sternite shorter and less arcuate than in female; genitalia specifically weakly differentiated, aedeagus elongate, parameres slender, as long as phallobase or slightly longer (Figs 9, 10).

FEMALE: pronotum more convex than in male; terminal spur of fore tibia straight; penultimate abdominal sternite longer than in male and slightly arcuate medially.

DISTRIBUTION: South America (Fig. 7); includes all previously published localities.

REMARKS: the unique combination of autapomorphic character states distinguishes *Iarupea* from all other genera of Eupariini. The genus is most close to *Arupaia* Stebnicka, sharing with that genus a similar overall appearance, sculpture of the head and pronotum and the elytra with humeral lobes. *Iarupea*-species are known to occur with leaf-cutting ants of the genus *Atta* F. (Table 1).

KEY TO SPECIES OF *IARUPEA*

1 Pronotum with fine, uniformly distributed granules (Fig. 6), basal collar smooth; elytral intervals 3, 5, 7 carinate basally. Brazil . . . . . *goias* sp. n.

_ Pronotum with coarse pits or irregular wrinkles, basal collar longitudinally strigose; elytral intervals 3, 5 tuberculate or carinate basally 2

2 Pronotum with coarse, longitudinally confluent wrinkles (Fig. 2); elytral striae with punctures strongly crenating intervals on each side. Bolivia, Brazil, Paraguay . . . . . *serratipennis* (Petrovitz)

_ Pronotum with coarse punctures or pits; elytral striae with punctures crenating inner margins of intervals 3

3 Base of pronotum on each side of collar with prominent tubercle, pronotal surface with coarse, rough, nearly contiguous pits; lateral intervals of elytra finely closely punctate. Argentina, Bolivia, Paraguay . *lopeteguii* Martínez

_ Base of pronotum on each side of collar slightly convex without prominent tubercle, pronotal surface differently sculptured; lateral intervals of elytra impunctate 4

4 Pronotal punctures or pits round or slightly elongate, separated by about one their diameter; elytral intervals 5, 7 carinate basally. Brazil ..... *attenuata* (Harold)

– Pronotal punctures or pits elongate, nearly contiguous, tending to coalesce into longitudinal lines; elytral intervals 3, 5 with tubercle basally. Brazil ..... *luisae* sp. n.

Iarupea lopeteguii Martínez Figs 7, 10

Iarupea lopeteguii Martínez, 1953: 77-80, fig. 9; Stebnicka 1999a: 292, fig. 5.

MATERIAL EXAMINED: Holotype and 4 paratypes (Argentina, Prov. Formosa, Puerto Irigoyen, Rio Pilcomayo) in CMNO. Other specimens (28): ARGENTINA – (14 ex) Prov. Salta, Dpto Gen. Ballivian, 1927, leg. Harrington; (2 ex) Dpto Gen. San Martin, Politos, XI.1950; (1 ex) Dpto Anta Las Lajitas, XII.1984; (2 ex) NS Telavera, XI.1957, coll. Martínez (CMNO, MHNG); (1 ex) Dpto Tartagal, 12-19.XII.1990, M. Archangelsky (ISEA, NMNH). BOLIVIA – (1 ex) Villa Montes at Rio Pilcomayo, 1-29.XI.1930, S.G. Eisenstraut (ZMHB); (4 ex) Santa Cruz, P. Cordillera, Cabezas, II.1971, coll. Martínez (CMNO). PARAGUAY – (3 ex) Dpto Boqueron, Gran Chaco, XI.1956, coll. Martínez (CMNO).

DIAGNOSTIC CHARACTERS: colour dark reddish brown; clypeal margin slightly reflexed, truncate anteriorly; surface of head with longitudinal wrinkles broken into irregular segments and with extremely short setae visible under high magnification. Pronotum convex medially, basal collar longitudinally strigose with sharp tubercle on each side; surface roughly sculptured, with large, very close, sharply edged pits bearing minute setae. Elytra parallel-sided, humeral lobes moderately long; striae impressed, strial punctures transversely crenate margins of intervals; intervals slightly convex, strongly microreticulate and minutely punctured, punctures on lateral intervals very close, 5th interval at base with large, conical tubercle. Ventral sclerites alutaceous, minutely punctate, covered with extremely short, upright setae; abdominal sternites 1-4 finely fluted along sutures, sternite 5 with longer and coarser fluting; eroded disc of pygidium longitudinally wrinkled, margin upturned. Profemur wide, perimarginal groove lacking, surface finely granulate and setigerous. Basal tarsomere of hind tarsus slightly longer than upper spur of tibia and longer than following three tarsomeres combined.

REMARKS: the species is most closely related to *Iarupea serratipennis* but may be easily recognized by the characters given in the key. Several specimens were collected to black light traps and found in the nest gallery of *Atta vollenweideri* Forel (Martínez, 1953).

Iarupea serratipennis (Petrovitz) Figs 1-2, 7, 8-9

Euparia serratipennis Petrovitz, 1973: 185-186.
?*Euparia serratipennis*: Chalumeau & Howden, 1984: 88.
Iarupea serratipennis: Stebnicka 1999a: 292, fig. 6.

MATERIAL EXAMINED: Holotype (Brazil, Minas Gerais) in MHNG. Other specimens (106): ARGENTINA – (2 ex) Prov. Misiones, Iguaçu, XII.1957, coll. Martínez (CMNO). BOLIVIA – (1 ex) Prov. Sara, coll. Steinbach (ZMHB); (1 ex) Prov. Santa Cruz, XII.1971, IX.1972, F. Plaumann (CMNO); (2 ex) Guayaramirim (Beni), 23. XI.1966, Hungarian Zool. Soil Exp, leg. Balogh & Mahunka & Zicsi (HNHM, ISEA). BRAZIL – (3 ex) (MS) Mato Grosso do Sul, Selviria, UNESP Farm, 18.III.1999, C. Flechtmann; (2 ex) (Ro) Rondonia, 62 km SW Ariquemes, near Faz. Rancho Grande, 25.IX.1992, U. Schmitz (FSCA); (1 ex) (Ma) Maranhão,

FIGS 1-6
(1) *Iarupea serratipennis* (Petrovitz): habitus of female; (2) same, sculpture of pronotum; (3) *I. attenuata* (Harold): habitus of male; (4) *I. luisae* sp. n: habitus of paratype female; (5) *I. goias* sp. n.: habitus of holotype female; (6) same, detail of pronotum and elytra.

Pedrinhas, 26.VI.1984, C. Flechtmann (ISEA); (1 ex) (MT) Mato Grosso, Xingu, XI.1963; (1 ex) (ES) Espiritu Santo, Linhares, XI.1962, coll. Martinez (CMNO); (90 ex) (Sc) Santa Catarina, Nova Teutonia, XII.1972, F. Plaumann (CMNO). PARAGUAY – (1 ex) Puerto P. Stroessner [=Ciudad del Este], 5-6.I.1966, leg. Mahunka (MHNG); (1 ex) Villarica, 25 km E Independentia, 21.I.1991, S. Endrödi-Younga (ISEA).

DIAGNOSTIC CHARACTERS: body (Fig. 1) rusty brown to dark brown, weakly shining. Clypeal margin broadly rounded on each side of shallow median emargination; surface of head with coarse, contiguous longitudinal wrinkles. Pronotum convex medially, basal collar longitudinally strigose, anterior angles concave and slightly transparent; surface strongly swollen with irregular coarse wrinkles (Fig. 2). Elytra parallel-sided, humeral lobes moderately long; striae impressed, strial punctures coarse, transversely crenate margins of intervals; intervals slightly convex or flat, intervals 3, 5 with tubercle basally, surface minutely punctate. Abdominal sternites equally, distinctly fluted along sutures; eroded disc of pygidium longitudinally strigose, margin upturned. Profemur wide, perimarginal groove fine, surface finely granulate. Basal tarsomere of hind tarsus longer than upper spur of tibia and longer than following three tarsomeres combined. Epipharynx as in Fig. 8. Male genitalia as in Fig. 9.

REMARKS: the species shows an advanced variation in the proportions and sculpture of the body. It is closest to *Iarupea lopeteguii*, but differs from that species by its more robust body and sculpture of the pronotum. Even though *I. serratipennis* is represented by the greatest number of specimens, most of them were collected to black light traps; several specimens were taken from the nests of *Atta sexdens* (L.).

Iarupea attenuata (Harold) Figs 3, 7

Euparia attenuata Harold, 1870: 23-28; Schmidt 1922: 397.
Iarupoides attenuatus: Chalumeau & Howden, 1984: 87.
Iarupea attenuata: Stebnicka, 1999a: 291-292, fig. 11.

MATERIAL EXAMINED: Lectotype "Brazil" (designated by Cartwright, 1973) in MNHN. Other specimens (17): BRAZIL – (2 ex) (Pe) Pernambuco (SMTD); (9 ex) (Pa) Pará, Jacareacanga, X.1959, coll. Martinez (CMNO, MHNG); (2 ex) (MG) Minas Gerais, Cordisburgo, Faz. Pontinha, VII.1974, F. Vaz-de-Mello (ISEA); (3 ex) (Sc) Santa Catarina, Nova Teutonia, X.1963, F. Plaumann; (1 ex) (ES) Espiritu Santo, Linhares, X.1968, M. Alvarenga (NMNH).

DIAGNOSTIC CHARACTERS: body (Fig. 3) piceous, in some specimens with slight blue lustre, weakly shining. Clypeal margin broadly rounded on each side of shallow median emargination; surface of head with coarse, contiguous longitudinal wrinkles. Pronotum convex medially, basal collar longitudinally strigose; surface with irregularly spaced, coarse, circular or slightly elongate punctures or pits separated by one to three times their diameters. Elytra parallel-sided, humeral lobes moderately long, ended by microtrichomes; striae impressed, strial punctures coarse, transversely crenate only inner margins of intervals; intervals slightly convex or flat, minutely setigerous apically, intervals 5, 7 carinate basally. Abdominal sternites equally, finely fluted along sutures, eroded disc of pygidium longitudinally strigose, margin upturned. Profemur wide, perimarginal groove fine, surface finely granulate. Basal tarsomere of hind tarsus longer than upper tibial spur and longer than following three tarsomeres combined.

REMARKS: the species is most closely related to *Iarupea luisae* sp. n. (see Remarks under that species). As indicated on the labels, some specimens of *I. attenuata* were taken from detritus cavities of the nests of *Atta sexdens* (L.).

Iarupea luisae sp. n. Figs 4, 7

TYPE MATERIAL: Holotype female, Brazil, (Ma) Maranhão, Pedrinhas, Saõ Luis Island, 29.VIII.1999, black light trap in mangrove area, E.C. Bergmann, in ISEA. Paratype female, same locality as holotype, "ex *Atta* sp. dump", in ISEA.

DESCRIPTION OF FEMALES: length 4.8-5.0 mm. Body (Fig. 4) piceous to black, weakly shining. Clypeal margin broadly rounded on each side of shallow median emargination; surface of head from anterior margin to frons with coarse, contiguous longitudinal wrinkles blending into vertical band of round, close punctures separated by about one their diameter. Pronotum convex medially, diverging posteriorly, anterior angles slightly transparent, sides widely grooved and upturned, fringed with very close, short, club-shaped setae, basal collar longitudinally strigose; pronotal surface excluding lateral groove with coarse punctures or pits tending to coalesce into longitudinal lines. Elytra parallel-sided, humeral lobes rather long, ended by microtrichomes; striae impressed, strial punctures coarse, transversely crenate margins of intervals; intervals slightly convex on disc, deplanate laterally, intervals 3, 5 with tubercle basally, surface microreticulate, impunctate. Ventral surface alutaceous; prosternal process widely triangular; mesosternum lower than metasternum with shallow, fine punctures separated by about one their diameter, posteriorly punctures scattered toward metasternum; meso-metasternal carina lacking; metasternum convex, midline impressed, discal punctures minute, scattered, lateral metasternal triangle broad, shallow, lateral area opaque, impunctate; abdominal sternites glabrous, impunctate with extremely fine fluting along sutures; pygidium broad, disc eroded, longitudinally strigose with upturned margin. Profemur with perimarginal groove and fringe of truncate setae, surface everywhere finely granular; middle and hind femora long, parallel-sided, smooth; middle and hind tibiae as long as femora, very slender and thin at base, apex fringed with 6-7 short setae, apical spurs slender, arcuate; basal tarsomere of hind tarsus subequal in length to upper spur of tibia and longer than following three tarsomeres combined.

MALE: unknown.

REMARKS: *Iarupea luisae* is most similar to *I. attenuata* from which it differs by having the pronotum broader with coarser and closer pits forming longitudinal lines.

ETYMOLOGY: named after the type-locality.

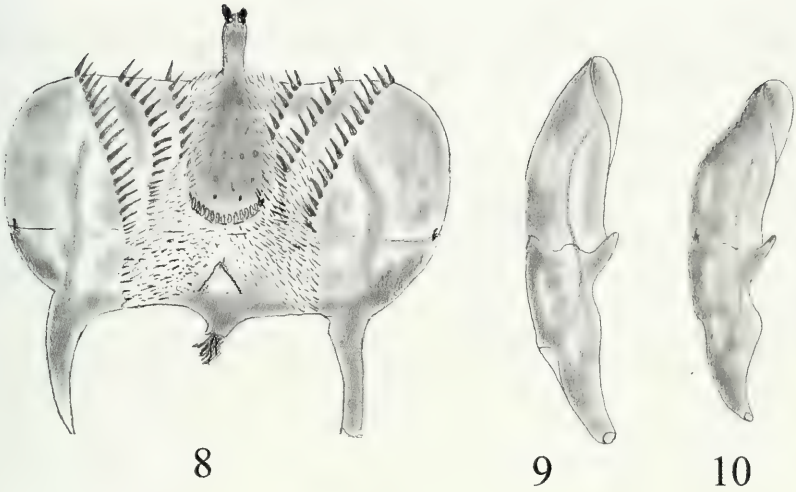
Iarupea goias sp. n. Figs 5-6, 7

TYPE MATERIAL: Holotype female: Brazil, (Go) Goias, Mun. Bela Vista de Goias, Cristianopolis, Fazenda Arapuca Velha, 21.IX.1993, *Atta* sp. nest gallery, A. Bankovics, in HNHM.

DESCRIPTION OF FEMALE: length 5.0 mm. Body (Fig. 5) castaneous, glabrous, weakly shining. Clypeal margin broadly rounded on each side of shallow median emargination; clypeal surface along anterior margin slightly concave and finely punctate, median convexity to frons with coarse longitudinal wrinkles blending into vertical band of round, fine, close punctures separated by less than one their diameter. Pronotum convex medially, diverging posteriorly, anterior angles slightly transparent, sides widely grooved and upturned, fringed with very close, short, club-shaped setae,

FIG. 7
Distribution of *Iarupea* species

basal collar wide, smooth like as lateral groove, pronotal surface finely granulate, granules separated by one their diameter or nearly so. Elytra slightly arcuate, humeral lobes rather long (Fig. 6) ended by microtrichomes; striae impressed, strial punctures coarse, transversely crenate margins of intervals; intervals slightly convex on disc, deplanate laterally, intervals 3, 5, 7 obtusely carinate basally, surface microreticulate, impunctate. Ventral surface alutaceous; prosternal process triangular; mesosternum lower than metasternum, finely punctate in anterior third, punctures posteriorly become longitudinal, shallow, tending to coalesce into lines; meso-metasternal carina lacking; metasternum convex, midline impressed, discal punctures minute, scattered, lateral metasternal triangle broad, shallow, lateral area opaque, impunctate; abdominal sternites glabrous, impunctate with extremely fine fluting along sutures; pygidium broad, disc eroded, longitudinally strigose with upturned margin. Profemur with perimarginal groove and fringe of truncate setae, surface finely punctate; middle and hind femora long, parallel-sided, smooth; middle and hind tibiae as long as femora, very slender and thin at base, apex fringed with 5-6 short setae, apical spurs slender,



FIGS 8-10
(8) *Iarupea serratipennis* (Petrovitz): epipharynx; (9) same, male genitalia in lateral view; (10) *I. lopeteguii* Martínez: male genitalia in lateral view.

arcuate; basal tarsomere of hind tarsus longer than upper tibial spur and equal in length to following three tarsomeres combined.

MALE: unknown.

REMARKS: I decided to describe this species on the basis of a single specimen, because its remarkably distinctive features are diagnostic. *Iarupea goias* sp. n. differs from all other species in the genus by its unusual sculpture of the pronotum (Fig. 6).

ETYMOLOGY: named after the type-locality.

RELATED GENERA AND THEIR MORPHOLOGICAL SPECIALIZATIONS

Euparia Le Peletier de Saint Fargeau & Serville, 1828: 357, et Auctt.- Chalumeau & Howden 1984: 85-87.

DISTRIBUTION: Southern United States, Central America, Venezuela, West Indies.

The numerous, world-wide species originally assigned to this genus have been transferred to the other existing or newly described genera (Stebnicka & Howden, 1996). *Euparia* includes presently three species (Chalumeau & Howden, 1984) characterized by following morphological modifications: head broad; clypeal and prothoracic indentations forming a cavity to receive appendages and fore legs; pronotum with sides explanate, setaceous; elytra with humeral angles prolonged anteriorly into dentiform lobe; middle and hind legs long, femora longer than tibiae; tibiae thin, narrowed at base. Hosts are known for two species:

Euparia castanea Le Peletier de Saint Fargeau & Serville, 1828 and *E. mirabilis* (Balthasar, 1945). These species are sympatric, very similar externally and difficult to

distinguish. Most likely both species were studied in USA by Wojcik *et al.* (1977) and taken from excavated nests of tropical fire ants *Solenopsis geminata* F. and southern fire ants *S. xyloni* McCook.

Arupaia Stebnicka, 1999a: 289.

DISTRIBUTION: Brazil.

Monospecific genus, closely related to *Euparia* and to *Iarupea*, sharing with both these genera some morphological modifications: head broad, surface longitudinally wrinkled; presence of clypeal and prothoracic cavities to receive appendages and fore legs; pronotum with basal collar and explanate sides; elytra with humeral angles prolonged anteriorly into dentiform lobe; middle and hind legs long and thin.

Arupaia friedenreichi (Harold, 1870) (Brazil) - collected in the nest of *Solenopsis geminata* F.

Selviria Stebnicka, 1999a: 287.- 2005a: 23-25.

DISTRIBUTION: Brazil.

The genus includes two species and seems to be most closely allied to *Euparia*. The unusual morphological modifications are: cuticle orange, strongly shining, smooth; head broad; sides of pronotum very widely explanate with upturned margin; elytral striae very fine; elytral margin narrowly explanate and upturned; mesosternum flattened, mesocoxae separate; legs very long, middle and hind tibiae thin, tarsal segments thick. Host is known for one species:

Selviria matogrossoensis Stebnicka, 1999a (Brazil) – one specimen found in the nest of *Solenopsis invicta* Buren.

Euparixia Brown, 1927: 288.- Woodruff & Cartwright, 1967: 6; Gordon & McCleve 2003: 685-686.

DISTRIBUTION: USA (Arizona, Louisiana), Cuba, Guatemala, Mexico, Panama.

The genus includes presently 10 species with following morphological modifications: clypeal margin inflexed; pronotum strongly constricted basally with sides explanate; elytral epipleurae covering episternum, epimeron and apices of elongated and widely separated mesocoxae; legs long, slender. *Euparixia* is most closely related to *Euparixoides* Hinton containing five cryptic species of unusual appearance (Stebnicka & Skelley 2005), however, nothing is known on their hosts associations. Six species have been recorded in association with ants:

Euparixia duncani Brown, 1927 (Arizona) - most likely associated with *Acromyrmex versicolor* Pergande and/or *Atta mexicana* Smith.

Euparixia moseri Woodruff & Cartwright, 1967 (Louisiana) - specimens taken from nest excavation (fungus garden central cavity and detritus cavity) of *Atta texana* (Buck).

Euparixia bruneri Chapin, 1940 (Cuba) - collected in the nest of *Atta insularis* Guérin known only from Cuba.

Euparixia formica Hinton, 1934 (Mexico).- collected in the nest of *Atta mexicana* Smith.

Euparixia costaricensis Hinton, 1936 (Costa Rica).- species associated with *Atta colombica* Guér. and *Atta cephalotes* (L.).

Euparixia campbelli Gordon & McCleve, 2003 (Guatemala) - collected in large detritus cavity of the nest of *Atta* sp.

Lomanoxia Martínez, 1951: 23-29.- Krikken, 1972: 70; Stebnicka, 1999c: 2; Skelley & Howden, 2003: 186.

DISTRIBUTION: Argentina, Brazil, Bolivia, Paraguay, Surinam, Costa Rica, Trinidad.

The genus includes five species with following morphological modifications: body egg-shaped; pronotal and elytral margins with row of long setae; elytra flattened and sharply inflexed at 8th interval forming a broad false epipleural fold, surface with prominent setation and with scale-like setae; mesocoxae widely separated; mesepisternum, mesepimeron and elongated mesocoxae hidden; legs long. Hosts are known for three species.

Lomanoxia costulata (Harold, 1867) (Brazil) - collected in Surinam from detritus cavities of the excavated nest of *Atta sexdens* (L.).

Lomanoxia alternata Krikken, 1972 (Surinam) - collected from detritus cavities of the excavated nest of *Atta cephalotes* (L.).

Lomanoxia canthonopsis Skelley & Howden, 2003 (Costa Rica) - found in refuse piles of *Atta cephalotes* (L.).

Flechtmanniella Stebnicka, 1999b: 287.

DISTRIBUTION: Brazil.

Monospecific genus closely related to *Lomanoxia*, sharing with that genus some morphological modifications: body shape oval; presence of clypeal and prothoracic indentations to receive appendages and fore legs; elytra flattened and sharply inflexed at 8th interval forming a broad false epipleural fold; mesocoxae widely separated; middle and hind tibiae short, expanded apically, tarsal segments short, thick.

Flechtmanniella laticollis (Petrovitz, 1973) (Brazil) - found in the nest of fungus growing ants *Acromyrmex lobicornis* (Emery).

Lomanoxoides Stebnicka, 1999a: 293-294.- Stebnicka & Skelley, 2005: 29.

DISTRIBUTION: Argentina, Bolivia, Brazil, Paraguay, Peru, Panama, Honduras.

The genus includes seven species having most of the morphological characters unmodified like as in the other free-living taxa of the tribe: body oblong oval, convex; pronotum usually with swellings; elytral intervals subcarinate or carinate at middle with row of fine setae. Hosts are known for two species:

Lomanoxoides nigrolineatus (Hinton, 1938) (Panama) - found in debris piles of *Atta* sp. and in refuse of *Atta colombica* Guér.

Lomanoxoides tesari (Balthasar, 1963) (Paraguay) - found in the nests of *Atta sexdens* (L.).

Paraplesiataenius Chalumeau, 1992: 194.- Stebnicka 2003a: 444.

DISTRIBUTION: Southeastern Brazil, Uruguay, Argentina.

The genus is closely related to *Lomanoxoides* and includes three *Aphodius*-appearing species with slightly modified morphological characters: body oblong oval, convex, shining; pronotal and elytral margins with row of setae; lateral elytral intervals at apex with short scarce setae; hind tibiae distinctly expanded apically. Hosts are known for all species of the genus:

Paraplesiataenius tremolerasi (Schmidt, 1911) (Argentina) – collected in Argentina in the nest of *Acromyrmex lobicornis* (Emery), in Uruguay found together with *A. lundi* Sant.

Paraplesiataenius catarinaensis Stebnicka, 2003a (Brazil) – collected in the nest of *Acromyrmex* sp.

Paraplesiataenius genieri Stebnicka, 2003a (Brazil) – found together with *Acromyrmex* sp.

Martineziella Chalumeau, 1986: 386.

Distribution: Southern USA, Argentina, Paraguay, Uruguay, Bolivia, Brazil, Guiana, Mexico, Cuba, Dominican Republic.

The genus includes six species having most of the morphological characters unmodified like as in the free-living species of the tribe: body elongate, convex; pronotum with sides explanate, fringed with very close, truncate setae; legs long. Hosts have been recorded for two species:

Martineziella vandykei (Hinton, 1936) (Mexico) - paratypes were taken from the nests of "a small, red, bitting ants" (Hinton, 1936); other specimens collected in detritus remnants of the nests of *Solenopsis invicta* Buren.

Martineziella dutertrei (Chalumeau, 1983) (Cuba) = *Myrmecaphodius excavaticollis* (non Blanchard, 1843): Woodruff, 1973: 101-102, fig. 212; Wojcik *et al.,* 1977: 329-334.

This species is widely distributed from southern USA to Argentina and occasionally very abundant. Collins & Markin (1971) reported this species from 98% of the fire ant nests they examined in the United States and they observed in the laboratory that the beetles in proximity to ants released a strong musky odour. A complete life cycle of the beetles apparently occurs in the nests where their preimaginal stages also have been found. *M. dutertrei* is known to occur in numerous nests of *Solenopsis invicta* Buren (red fire ant), *S. richteri* Forel (black fire ant), *S. geminata* F. (tropical fire ant), *S. xyloni* McCook (southern fire ant) and *Iridomyrmex humilis* (Mayr) (argentine ant).

Myrmecaphodius Martinez, 1952: 85.- Stebnicka 1999a: 292.

Distribution: Argentina.

Monospecific genus related to *Martineziella*. Its morphological modifications are as follows: head coarsely longitudinally wrinkled; pronotum strongly convex, sides explanate in anterior half, basal margin strong, wide at middle with longitudinal costulae, pronotal surface with deep, large pits.

Myrmecaphodius proseni Martinez, 1952 (Argentina).- Stebnicka 1999a: 293 - type series (29 specimens) and other individuals examined were collected in the nest gallery of fire ants *Solenopsis saevissima* Smith.

Haroldiataenius Chalumeau, 1981: 137.

DISTRIBUTION: Southern United States, Mexico, Guatemala, Honduras.

About seven species are assigned to this genus (revision in preparation by Stebnicka). The morphological characters reveal a rather weak modifications: body oval, strongly convex; abdominal sternites and pygidium with row of blunt setae. Host is known for two species:

Haroldiataenius hintoni (Saylor, 1933) (Mexico) - collected in Guatemala in detritus remnants of the nest of *Atta mexicana* Smith.

Haroldiataenius limbatus (Bates, 1887) (Mexico) - found in Guatemala in "Atta sp. dump" (label data by J. Baster).

Ataenius Harold, 1867: 82, et Auctt.

DISTRIBUTION: Pantropical.

The genus contains presently about 190 species distributed throughout American continent and West Indies. The morphological characters of a number of species show some insignificant modifications, such as: head larger than usual; surface of body with rows of thick setae or cuticle coarsely, roughly sculptured (usually smooth or punctate); pronotal lateral margin fringed with close, truncate or club-shaped setae (usually setae are scarcer and slender); legs longer than usual; tarsal segments thick (usually slender). From among 190 species only two species are indicated in association with ants:

Ataenius holopubescens Hinton, 1938 (Mexico) - collected from detritus remnants in the nests of *Atta mexicana* Smith.

Ataenius variopunctatus Schmidt, 1922 (Argentina) - rare species known only from Buenos Aires. From among 6 specimens available to study one specimen was glued on card together with a specimen of ant and labeled "*Solenopsis* sp." by J. Daguerre.

Batesiana Chalumeau, 1983: 143-144.

DISTRIBUTION: Panama, Costa Rica, Brazil.

Monospecific genus with advanced morphological modifications: head very large; pronotum short and very broad; presence of clypeal and prothoracic indentations to receive appendages and fore legs; elytra strongly elevated medially, lateral and apical intervals with row of irregular tubercles (glands?); mesosternum deplanate, mesocoxae widely separated; fore tibiae short and narrow with two reduced lateral teeth; middle and hind tibiae short, strongly expanded apically, covered with dense hair; tarsi short and thick with long hair.

Batesiana tuberculata (Bates, 1887) (Panama) - collected in Brazil with "termites".

Napoa Stebnicka, 1999d: 290-291.

DISTRIBUTION: Ecuador.

Monospecific genus closely related to *Batesiana* with advanced morphological specializations: head very large; presence of clypeal and prothoracic indentations to

receive appendages and fore legs; elytra globular, lateral and apical intervals with row of irregular tubercles (glands?); mesosternum deplanate and calloused, mesocoxae widely separated; prosternum, mesosternum and mesocoxae with distinct pockets or cavities of possible mycangial function.

Napoa peckorum Stebnicka, 1999d (Ecuador) - specimens found in broken termite nest.

REMARK: the genus *Cartwrightia* Cartwright, was recently assigned to the tribe Eupariini by Skelley & Howden (2005) on the basis of some character states shared with *Lomanoxia*. Apart from the general appearance of *Cartwrightia* strongly resembling various genera of Rhyparinae, the shape of head and characters of mouthparts of bitting type exclude this genus from the Eupariini. The bitting type of mouthparts is one of the principal diagnostic characters for Aegialiinae, Aulonocneminae and Rhyparinae as well.

DISCUSSION

The members of fifteen euparine genera here considered (Table 1) are characterized by more or less advanced morphological specializations. Although they have no distinct trichomes, exudatoria or exocrine glands attractive to the ants, their external features are frequently unusual. Some species have retained a generalized appearance and differ little from their free-living relatives, while others seem to be highly derived. These species, like as all other members of the tribe, have the mouthparts of filtering type (adapted for soft saprophagy) and they are unable to consume any hard particles of food. It means, that food preferences may include liquid or subliquid organic contents of specific enzymatic qualifications (Stebnicka, 1985).

The morphological changes are always connected with function which a part of the body concerned has to perform. These modifications can be grouped as follows: 1/ rudimentation or disappearance of sclerites, 2/ displacement of sclerites, 3/ development of new parts in preexisting sclerites, 4/ transformation of organs or their portions, 5/ abnormal (hypertelic) development of organs. It is unclear whether these characteristics are important to the integration of the guests into host colonies since the supporting behavioural information is not available. Species of *Iarupea* possess humeral microtrichomes, however, their function may be suspected only. Long legs with relatively thick tarsi probably allow guests to keep up with their hosts. The ability to pull appendages and fore legs into ventral cavities most certainly has a defensive significance and allows the beetles to survive occasional aggressive reactions by their hosts. The functions of other specializations, for example the presence of elytral swellings or tubercles (glands?) are not at all clear.

The species of Eupariini listed in Table 1 have been observed in association with leaf-cutting (fungus growing) ants *Atta* Fabricius and *Acromyrmex* Mayr and with fire ants *Solenopsis* Westwood and *Iridomyrmex* Mayr (Myrmicinae). The distribution and biology of the gardening ants has been summarized by Weber (1972). Attini are widely distributed in America and have the largest colonies. Their fungus gardens consist mostly of vegetable material and insect fecal material to which the ants add saliva and liquid fecal droplets. The ants either cast out exhaused substrate and dead ants or store it in separate chambers of the nest, and these large volumes of decaying

TABLE 1: Eupariini species associated with termites and with ants *Atta* F., *Acromyrmex* Mayr, *Solenopsis* Westw. and *Iridomyrmex* Mayr (Myrmicinae)

Eupariini species	Host species	Locality	References
Iarupea lopeteguii	*Atta vollenweideri* nest gallery	Argentina, Prov. Formosa	Martinez, 1953
I. attenuata	*Atta sexdens*	Brazil, Minas Gerais	label data by Martinez
I. serratipennis	*Atta sexdens*	Brazil, Mato Grosso do Sul	label data by Steinbach
I. goias sp. n.	*Atta* sp. nest gallery	Brazil, Goías	label data by Bancovics
I. luisae sp. n.	*Atta* sp. dump, mangrove area	Brazil, Saõ Luis Island	label data by Bergmann
Euparia castanea/E. mirabilis	*Solenopsis xyloni, S. geminata*	Southern USA	Wojcik *et al.*, 1977
Arupaia friedenreichi	*Solenopsis geminata*	Brazil, Santa Catarina	label data by Triplehorn
Selviria matogrossoensis	*Solenopsis invicta*	Brazil, Goías	label data by Morgante & Silva
Euparixia duncani	*Acromyrmex versicolor*	USA (Arizona)	Woodruff & Cartwright, 1967
E. moseri	*Atta texana*	USA (Louisiana)	Woodruff & Cartwright, 1967
E. bruneri	*Atta insularis*	Cuba	Woodruff & Cartwright, 1967
E. formica	*Atta mexicana*	Mexico	Woodruff & Cartwright, 1967
E. costaricensis	*Atta colombica, A. cephalotes*	Costa Rica	Woodruff & Cartwright, 1967
E. campbelli	*Atta* sp.	Guatemala	Gordon & McCleve, 2003
Lomanoxia costulata	*Atta sexdens*	Surinam	Krikken, 1972
L. alternata	*Atta cephalotes*	Surinam	Krikken, 1972
L. canthonopsis	*Atta cephalotes*	Costa Rica	Skelley & Howden, 2003
Flechtmanniella laticollis	*Acromyrmex lobicornis*	Brazil, Saõ Paulo	label data by Martinez
Lomanoxoides nigrolineatus	*Atta colombica*	Panama	Stebnicka & Skelley, 2005
L. tesari	*Atta sexdens*	Paraguay	Stebnicka, 1999a
Paraplesiataenius tremolerasi	*Acromyrmex lobicornis*	Argentina	Chalumeau, 1992
	A. lundi	Uruguay	label data by Fernandez
P. catarinaensis	*Acromyrmex* sp.	Brazil, Santa Catarina	Stebnicka, 2003a
P. genieri	*Acromyrmex* sp.	Brazil, Bahia	Stebnicka, 2003a
Martineziella vandykei	*Solenopsis invicta*	Mexico	label data by Stinger
Martineziella dutertrei (=*Myrmecaphodius excavaticollis*)	*Solenopsis invicta, S. richteri, S. geminata, S. xyloni, Iridomyrmex humilis*	USA (Alabama, Florida, Georgia, Louisiana, Mississippi, Texas)	Wojcik *et al.*, 1977
Myrmecaphodius proseni	*Solenopsis saevissima*	Argentina, Buenos Aires	Martinez, 1952
Haroldiataenius hintoni	*Atta mexicana*	Guatemala	Saylor, 1933
H. limbatus	*Atta* sp.	Guatemala	label data by Baster
Ataenius holopubescens	*Atta mexicana*	Mexico	Stebnicka, 2003b
A. variopunctatus	*Solenopsis sp.*	Argentina`	Stebnicka, 2005
Batesiana tuberculata	"termites"	Brazil	label data by Degallier
Napoa peckorum	"broken termite nest"	Ecuador	Stebnicka, 1999d

refuse may attract the beetles. The fire-ants *Solenopsis* form populous colonies usually in open soil localities, often on pastures under cow dung and often in close proximity to the nests of large ants from whom they steal brood and other food (Moody & Franke, 1982).

Judging from the rather scarce collection data, the beetles exploit either abandoned mounds of ants and the active colonies. The small euparine beetles visiting or living in the colonies of ants are practically defenceless, in particular in the nests of *Solenopsis*, the workers of which are extremely aggressive and possess a painful sting. Kistner (1979) has identified a number of mechanisms that enable the integration of guests into host colonies, for example the guests may use chemical means and mimic chemical communication systems of the hosts. Collins & Markin (1971) recorded *Martineziella dutertrei* from 98% of the fire ant nests they examined in the United States and they observed in the laboratory that the beetles in nearness of ants released a strong musky odour. It seems most likely that either the ants and beetles may produce, in some conditions, the integrative pheromones, for example, the beetles may be attracted by odorous secretion, a glandular substantion skatole/indole (Brown *et al.,* 1979; Keegans *et al.,* 1993) used by hosts to mark their trails. The integrative mechanisms are complicated and very diffcult to explain, however, the most important factor which lures beetles to the nests of ants is that the large host colonies have a higher diversity of microhabitats and sources of food. The vast amounts of decomposing vegetable matter collected and discarded by ants constitute nutritionally richest resource for saprophagous beetles of Eupariini, therefore, their possible role of the nests cleaners may be tolerated or accepted by hosts.

The development of fungus-gardens of both ants and termites was probably one of the factors which led to extensive invasion of their nests by various beetles in later times.

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Hisonotus hungy sp. n. (Siluriformes, Loricariidae) a new species from arroyo Tirica, Misiones, Argentina

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***Hisonotus hungy* sp. n. (Siluriformes, Loricariidae) a new species from arroyo Tirica, Misiones, Argentina. -** *Hisonotus hungy* sp. n. is described from the arroyo Tirica, río Paraná basin in Misiones province, Argentina. *Hisonotus hungy* sp. n. is diagnosed by the following combination of characters: 20-22 lateral plates, 5 branched anal-fin rays, absence of pad on snout tip, blunt and deep snout, snout 45.5-50.9 (% in HL), eye 13.4-17.1 (% in HL), predorsal unpaired plates absent; vent completely covered by two rows of large lateral platelets and one median series with irregular plates.

Keywords: Freshwaters fish - loricariids - Hypoptopomatinae - *Hisonotus* - South America - río Paraná basin.

INTRODUCTION

The arroyo Urugua-í together with the río Iguazú are the main tributaries of the río Paraná in the province of Misiones, Argentina. Eight kilometers from the confluence with the río Paraná, a hydroelectric dam was built at the end of the eighties. Before the construction of the dam, several collecting trips had been done which resulted in the description of new species such as *Oligosarcus menezesi* Miquelarena & Protogino, 1996; *Bryconamericus sylvicola* Braga, 1988; *Australoheros tembe* (Casciotta, Gómez & Toresani, 1995); *Gymnogeophagus che* Casciotta, Gómez & Toresani, 2000, and *Astyanax leonidas* Azpelicueta, Casciotta & Almirón, 2002.

The lake formed by the dam receives several streams; the arroyo Tirica is one of the smaller ones flowing into the lake from the south.

The aim of this paper is to describe a new species of *Hisonotus* recently collected from the arroyo Tirica, arroyo Urugua-í basin.

MATERIAL AND METHODS

Specimens were cleared and counterstained following Taylor & Van Dyke (1985). Measurements were taken as straight line distances using digital calliper to the nearest 0.1 mm. Values of the holotype are indicated by an asterisk. Institutional

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abbreviations are as listed in Leviton *et al.* (1985) with the addition of Asociación Ictiológica, La Plata, Argentina (AI) and Zoología Vertebrados, Facultad de Ciencias, Universidad de la República, Montevideo, Uruguay (ZVC-P).

COMPARATIVE MATERIAL EXAMINED (SL IN MM): *Hisonotus candombe* Casciotta, Azpelicueta, Almirón & Litz, 2006: ZVC-P 5595, holotype, 29.9, República Oriental del Uruguay, Departamento Salto, río Uruguay basin, arroyo Palomas. AI 177, 1 ex. (C&S) 29.7, same collecting data. – *Hisonotus charrua* Almirón, Azpelicueta, Casciotta & Litz 2006: ZVC-P 5639, holotype, 50.7, República Oriental del Uruguay, Departamento Tacuarembó, río Uruguay basin, Cañada de Los Peña. AI 171, 3 ex., 21.0-32.2 (C&S), República Oriental del Uruguay, Río de la Plata basin, arroyo Tropa Vieja, Departamento Canelones. – *Hisonotus maculipinnis* (Regan, 1912): AI 122, 1 ex., 27.5 (C&S), Argentina, Corrientes province, río Paraná, Ita Ibaté. AI 123, 5 ex., 23.4-27.0, Argentina, Corrientes province, río Paraná basin, Esteros del Iberá, Rincón del Diablo, Laguna Yacaré. – *Hisonotus* cf. *laevior* Cope, 1894: AI 178, 6 ex., 30.0-38.0, Brasil, Rio Grande do Sul, São Leopoldo, Rio Jacuí basin, rio dos Sinos, 29°45'S - 51°10'W. – *Hisonotus paulinus* (Regan, 1908): BMNH 1907.7.6.9, holotype, Brasil, rio Piracicaba, São Paulo (examined by J. Maclaine, Natural History Museum, London). – *Hisonotus* sp. A, AI 120, 1 ex., 23.3, Argentina, Misiones, río Uruguay basin, arroyo Oveja Negra. – *Hisonotus* sp. B: MHNG 2408.025, 10 ex., 17.8-29.0, Paraguay, route 2, arroyo Pirayú. *Hisonotus ringueleti* Aquino, Schaefer & Miquelarena, 2001: AI 179, 1 ex., 36.4, República Oriental del Uruguay, Departamento Artigas, río Uruguay basin, arroyo Lenguazo. – *Hisonotus taimensis* (Buckup, 1981): AI 216, 7 ex., 38.6-55.0, República Oriental del Uruguay, Rocha, arroyo Las Conchas, 34°24.05'S-54°17.05'W. – *Epactionotus aky* Azpelicueta, Almirón, Casciotta & Koerber, 2004: AI 124, holotype, 30.5, Argentina, Misiones province, río Uruguay basin, arroyo Garibaldi. – *Epactionotus yasi* Almirón, Azpelicueta & Casciotta, 2004: MACN-ict 8649, holotype, 1 ex. 32.0, Argentina, Misiones province, río Iguazú basin, arroyo Lobo.

RESULTS

Hisonotus hungy sp. n. Fig 1, Table 1

HOLOTYPE: MACN-ict 8860, 35.7 mm SL, Argentina, Province of Misiones, río Paraná basin, arroyo Tirica, affluent of arroyo Urugua-í (26°01'S - 55°22'W), coll: S. Koerber, R. Filiberto, J. O. Fernández Santos, 5 January 2001.

PARATYPES: same collecting data as holotype: AI 189, 5 ex., (1 C&S) 31.5-37.6 mm SL; ZFMK 39472-75, 4 ex., 30.4-42.0 mm SL; MHNG 2664.79, 2 ex., 31.9-37.0 mm SL; ZSM 33313, 2 ex., 33.3-36.7 mm SL.

DIAGNOSIS: *Hisonotus hungy* sp. n. is diagnosed by the following combination of characters: 20-22 lateral plates, 5 branched anal-fin rays, absence of pad on snout tip, blunt and deep snout, snout 45.5-50.9 (% in HL), eye 13.4-17.1 (% in HL), predorsal unpaired plates absent; vent completely covered by two rows of large lateral platelets and one median series with irregular plates.

DESCRIPTION: Morphometrics of holotype and 13 paratypes are presented in Table 1. Body elongated, head deep and short (Fig. 1). Greatest body depth at dorsal-fin origin. Head as wide as trunk. Dorsal profile of head convex from snout tip to dorsal-fin origin. Snout tip rounded in dorsal view, without enlarged odontodes. One pair of rostral median plates without notch. Several plates placed in anterior area of nares, leaving a narrow naked surface. Eyes placed dorsolaterally, horizontal eye diameter shorter than nare diameter. Iris diverticulum present, about half of pupil diameter. Three infraorbitals surrounding orbit, fourth infraorbital expanded ventrally. Margins and surface of lips covered with papillae. Maxillary barbels short. Jaw teeth bifid, tooth slender with major cusp expanded distally and a very minor one pointed.

FIG. 1
Hisonotus hungy sp. n., holotype, 35.7 mm SL, Argentina, Province of Misiones, río Paraná basin, arroyo Tirica (26°01'S - 55°22'W), lateral, dorsal, and ventral views.

Absence of accessory teeth on premaxilla and dentary. One series of teeth, 10-17 (mode 12) on premaxilla and 8-15 (mode 11) on dentary. Pterotic-supracleithrum bearing large openings. Preopercular sensory canal directed towards pterotic-supracleithrum.

Body covered by dermal plates except for a naked area around base of pelvic fins, lateral opening of swimbladder capsule, and area between pectoral girdle and lower lip. Posrostral and anterior rostral plates slightly reflected ventrally. Five lateral series of plates on trunk. Plates of dorsal series continuous; mid-dorsal series

TABLE 1. Morphometric data of the holotype and 13 paratypes of *Hisonotus hungy* sp. n. SD: standard deviation.

	Holotype	Range	Mean	SD
Standard length (mm)	35.7	30.4-42.3		
Percents of SL				
Predorsal distance	42.9	42.2-46.8	44.6	1.69
Head length	32.8	31.1-35.8	33.8	1.62
Cleithral width	23.5	22.5-26.9	24.9	1.32
Dorsal-fin spine length	22.4	21.1-25.0	23.0	1.29
Trunk length	17.6	15.1-18.4	17.2	0.85
Pectoral-fin spine length	24.6	22.2-27.8	25.2	1.66
First pelvic-fin ray length	20.2	15.4-20.5	18.5	1.63
Abdominal length	19.6	19.6-22.2	20.9	0.92
Caudal peduncle length	34.7	32.0-39.2	35.5	2.34
Caudal peduncle depth	12.0	10.6-13.3	12.1	0.71
Head depth	18.5	16.3-19.4	18.2	0.91
Snout length	15.1	15.0-17.8	16.5	0.95
Horizontal eye diameter	5.3	4.7-5.7	5.2	0.29
Interorbital width	13.4	13.0-14.9	14.0	0.55
Percents of HL				
Head depth	56.4	50.5-56.9	54.0	2.13
Snout length	46.2	45.5-50.9	48.8	1.90
Horizontal eye diameter	16.2	13.4-17.1	15.5	0.88
Interorbital width	41.0	38.4-45.5	41.4	2.21
Cleithral width	71.8	70.9-77.6	73.7	2.22

incomplete, and continuous. Median series 20 (5), 21 (4), 22 (5*). Mid-ventral series incomplete and continuous; plates of ventral series continuous. Plates bearing lateral-line canal incomplete and discontinuous, anterior portion of median series with 4 (5), 5 (7*), 6 (2) perforated plates; posterior portion with 7 (7*), 8 (3), 9 (1), 11(1), 12 (1), and 13 (1) perforated plates. First two lateral line plates small, second one placed on rib of sixth vertebra. Abdomen almost completely covered by plates, arranged in two lateral rows of two or three plates each and a median row with several plates irregularly arranged (Fig. 1). Three pairs of post anal plates, first one meeting at midline and last third separated by small external portion of first anal-fin proximal radial. Coracoid and cleithrum exposed ventrally, excluded very small *arrector fossae* area. Absence of unpaired predorsal plates.

Odontodes covering head, trunk, and fin rays. Head and trunk odontodes uniformly distributed. Odontodes usually small on body, except for somewhat enlarged odontodes on ventral margin of snout, on pectoral and pelvic spines, and a tuft formed by a few odontodes in some specimens. Odontodes along anterior margin of snout bi-serially arranged, dorsad and ventrad series not separated by a naked area.

Dorsal fin with one spine and 7 branched rays, its origin posterior to vertical through pelvic-fin origin. Dorsal fin moved posteriorly behind seventh vertebra. First dorsal-fin proximal radial articulated with eighth vertebra. Adipose fin absent. Pectoral fin with one spine and 6 branched rays, reaching nearly half of pelvic-fin length. Very large pectoral-fin axillary slit present Pelvic fin with one unbranched and 5 branched

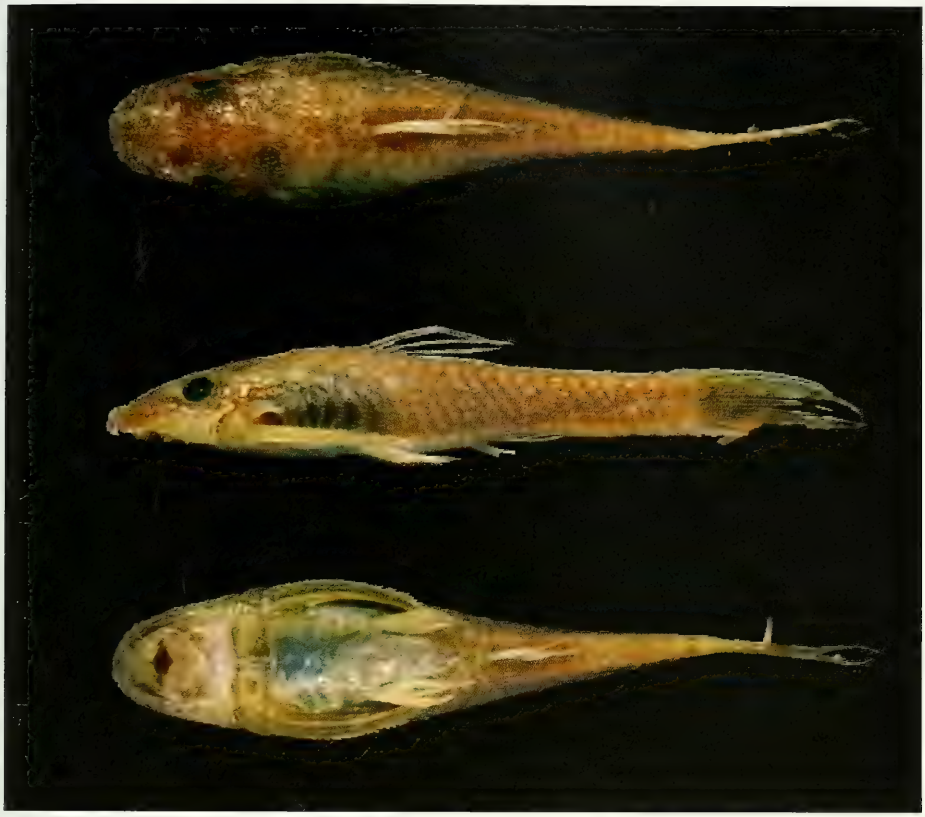

FIG. 2
Hisonotus paulinus, holotype BMNH 1907.7.6, Brasil, São Paulo, rio Piracicaba, dorsal, lateral and ventral views.

rays, reaching anal-fin origin in females and surpassing it only in males. Fleshy flaps on pelvic fins of males. Caudal fin with fourteen branched rays.

Neural spine of seventh vertebra contacting nuchal plate partially. Neural arch of seventh vertebra without expansion.

COLOR IN LIFE: Background brown-chocolate, with clear lines between snout and eyes, extending backward to postemporo-supracleithrum. Ventral margin of snout, area around pectoral and pelvic fin insertions yellowish. Two light dots on caudal fin, upper most and lower most caudal-fin rays light. Dorsal, pectoral, pelvic, and anal fins with dots forming bands.

COLOR IN ALCOHOL: Ground color of dorsolateral body surface brownish, ventral surface of head and body pale brown. In some specimens a narrow light stripe from snout tip to anterior nare, continuing posteriorly, very faint until supraoccipital level. Ventrolateral margin of snout and head light brown. Pectoral, pelvic, dorsal, and anal fins pale brown with dots forming series of darker bands. Caudal fin dark brown

excluded two light triangular dots near half way. Both light dots placed on first three or five dorsal and ventral branched rays. Tip of lower and upper caudal lobes usually light.

SEXUAL DIMORPHISM: Pelvic-fin spines of males longer than that of females (17.7-20.5 vs. 15.4-17.1% SL; 4 females and 10 males). Distal tip of pelvic fins surpassing anal-fin origin in males. Males have fleshy flap on pelvic fins and triangular genital papilla. Females bear rounded and broad genital papilla.

ETYMOLOGY: The specific epithet *hungy* is a guaraní word that means brown. A noun in apposition.

DISTRIBUTION AND HABITAT: This species is only known from the arroyo Tirica, a tributary of the arroyo Urugua-í. The arroyo Tirica, at bridge of provincial road 237-km 29, is a stream with two different environments; one of them had the natural vegetation of the region, whereas in the other one coniferous trees were introduced. *Hisonotus hungy* was collected in the portion of the stream where a plantation of small coniferous let the brook to be exposed completely to sunlight. Photographs of live specimens, the environment, and a map with the geographical distribution are provided by Koerber (in prep.) and Evers & Seidel (2005, sub *H.* cf. *ringueleti*).

The following species were caught together with *H. hungy* from the arroyo Tirica: *Astyanax eigenmanniorum*, *A.* cf. *fasciatus*, *A.* cf. *troya*, *Australoheros tembe*, *Bryconamericus iheringii*, *Characidium* sp., *Corydoras carlae*, *Gymnogeophagus che*, *Heptapterus mustelinus*, *Oligosarcus jenynsii*, *O. paranensis*, and *Schizodon nasutus*.

DISCUSSION

The genus *Hisonotus* includes 16 nominal species (Aquino *et al.*, 2001 and Britski & Garavello, 2003) from different basins in Brasil, Argentina, and Uruguay. Recently, two new species, *H. charrua* and *H. candombe*, have been described from río Uruguay basin (Almirón *et al.*, 2006; Casciotta *et al.*, 2006).

The species described from the upper río Paraná basin are *H. insperatus* Britski & Garavello, 2003, *H. depressicauda* (Miranda Ribeiro, 1918), *H. depressinotus* (Miranda Ribeiro, 1918), *H. paulinus* (Regan, 1908), and *H. francirochai* (Ihering, 1928). *Hisonotus maculipinnis* was recorded in the lower Paraná basin, from "La Plata" without precise locality.

Among the species of *Hisonotus* distributed in the Río de la Plata basin, and Lagoa dos Patos system, *H. hungy* sp. n. differs from all of them – except *H. paulinus* – by the number of lateral plates (20-22 vs. 23-31).

Hisonotus hungy also differs from *H. ringueleti*, *H. charrua*, and *H. candombe* by the absence of soft pad in the snout tip. The other species living in the basin is *H. maculipinnis* which has a large free area in the anterior margin of the snout that is not present in *H. hungy* and the profile of the snout strongly depressed whereas *H. hungy* has a blunt and deep snout.

In spite of papers by Schaefer (1991, 1998) and Aquino *et al.* (2001), the genus *Hisonotus* has not been clearly defined phylogenetically. In addition, the tribe Otothyrini diagnosed by Schaefer (1991, 1998) is considered a paraphyletic group at

FIG. 3
Hisonotus hungy sp. n. from arroyo Tirica in aquarium, specimen not preserved.

present (Gauger & Buckup, 2005). Gauger & Buckup (2005) included some new osteological characters to define the genera of Hypoptopomatinae. Considering those characters, *H. hungy* has the mesethmoid covered by prenasal plates, rostral plates wider than long, lateral ethmoid not exposed on dorsal surface of head, infraorbital canal entering in the neurocranium via sphenotic, supraoccipital without crest, pectoral girdle completely exposed, *arrector fossae* reduced to a small area close to midline, mid-dorsal series with about 16 plates, dermal plates of thorax and abdomen large, regularly distributed, thorax and abdomen completely covered by dermal plates, first post anal plate meeting at midline, and neither traces of modifications nor unpaired platelets located in adipose-fin region.

Eschmeyer (2006) indicated Argentina with doubts in the distribution of *Hisonotus paulinus* (Regan, 1908) described from rio Piracicaba, São Paulo, Brasil (Fig. 2). This citation is taken from Lopez *et al.* (2003) that recorded *H.* cf. *paulinus* from arroyo Tirica, Misiones. The specimens mentioned by those authors were collected by one of the present paper authors (SK) together with the specimens examined in this study. The holotype of *H. paulinus* has the same number of lateral plates, nonetheless it differs from *Hisonotus hungy* in having 4 branched anal-fin rays vs. 5 (we do not know if it is an anomalous specimen); the snout is long and depressed, 38.2% vs. 30.0-32.3% of predorsal length (compare dorsal and lateral views of both species in the figures).

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Phylogenetic position, morphology and natural history of the Vietnamese water skink *Tropidophorus noggei* Ziegler, Vu & Bui, 2005 (Sauria: Scincidae)

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Phylogenetic position, morphology and natural history of the Vietnamese water skink *Tropidophorus noggei* Ziegler, Vu & Bui, 2005 (Sauria: Scincidae). - The depressed-bodied water skink species *Tropidophorus noggei* was recently described from Phong Nha - Ke Bang National Park, a karst forest region in the Truong Son, central Vietnam. Subsequent field research at the type locality led to the finding of additional specimens which allowed to extend the knowledge about the species' morphology including hemipenis morphology. The molecular positioning of the species within *Tropidophorus* supports that the body depression recognized in several Indochinese taxa is likely to have occurred at least twice in parallel as an adaptation to saxicolous habitats. New insights into the natural history of *Tropidophorus noggei* are given, including habitat choice, abundance, activity and habits, as well as the species' feeding and reproductive ecology.

Keywords: Sauria - Scincidae - Lygosominae - *Tropidophorus* - *T. noggei* - mitochondrial DNA sequence data - systematics - morphology - natural history - Vietnam.

INTRODUCTION

Recently, Honda *et al.* (2005) presented a molecular phylogeny of the oriental lygosomine genus *Tropidophorus* Duméril & Bibron, 1839, including the recently described *T. latiscutatus*, *T. matsuii* and *T. murphyi* (Hikida *et al.*, 2002). These water skink species exclusively share distinctly depressed bodies, as well as saxicolous habitats. Hikida *et al.* (2005) assumed that the strongly depressed body shape reflects an adaptation to narrow rock crevices as shelters, as known also from few other lizard families, such as Cordylidae Gekkonidae, Iguanidae, Lacertidae, and Xenosauridae

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(Vitt, 1981; Doughty & Shine, 1995; Ballinger *et al.,* 2000). Subsequently, the analyses of Honda *et al.* (2005) showed that the characteristic body shape has independently evolved in *T. murphyi* and in the common ancestor of *T. latiscutatus* and *T. matsuii.* However, another depressed-bodied *Tropidophorus* species was not included in Honda *et al.*'s (2005) molecular approach: *T noggei*, which was described recently from a karst forest region in the Truong Son mountain range, Vietnam (Ziegler *et al.,* 2005). It is the aim of this study to clarify the phylogenetic position of this further depressed-bodied *Tropidophorus* by molecular means as well as to add new data to the morphology and natural history of the barely known species.

MATERIAL AND METHODS

Specimens collected by local people subsequently to the original description of *T. noggei* (Ziegler *et al.,* 2005) in the region of Phong Nha - Ke Bang, Quang Binh Province, Vietnam, were deposited in the following collections: Department of Herpetology and Ichthyology, Muséum d'histoire naturelle, Geneva (MHNG), Switzerland (MHNG 2683.99); Science Research Centre of the Phong Nha - Ke Bang National Park, Quang Binh Province, Vietnam (PNNP 111, PNNP 112, PNNP 174, PNNP 175).

To examine the phylogenetic position of *Tropidophorus noggei* in the general framework of related species of the genus we sequenced a portion of the mitochondrial 16S rRNA gene of MHNG 2693.99 (GenBank accession number: EF611186) and compared it with the following species of *Tropidophorus* (sequences were taken from the GenBank): *T. berdmorei* (AB028823), *T. grayi* (AB222957), *T. partelloi* (AB222962), *T. baconi* (AB222953), *T. sinicus* (AB222954), *T. cocincinensis* (AY308323 and AB222959), *T. baviensis* (AB222958), *T. hainanus* (AB222960), *T. murphyi* (AB222961), *T. robinsoni* (AB222955), *T. thai* (AB222956), *T. latiscutatus* (AB222950), *T. matsuii* (AB222952), *T. brookei* (AB222949), *T. beccarii* (AB222951), and *Tropidophorus* sp. (AY308322). *Eutropis longicaudata* (AF153572) was used as outgroup.

DNA was extracted using a modified Chelex-Protocol (Walsh *et al.,* 1991; Schmitz, 2003). The primers 16sar-L (light chain; 5' - CGC CTG TTT ATC AAA AAC AT - 3') and 16sbr-H (heavy chain; 5' - CCG GTC TGA ACT CAG ATC ACG T - 3') of Palumbi *et al.* (1991) were used to amplify a section of the mitochondrial 16S ribosomal RNA gene. PCR cycling procedure followed Schmitz *et al.* (2005). PCR products were purified using Qiaquick purification kits (Qiagen). Sequences (including complimentary strands for assuring the accuracy of the sequences) were obtained using an automatic sequencer (ABI 377). The obtained sequences (lengths referring to the aligned sequences including gaps) comprised 593 bp. Sequences were aligned using ClustalX (Thompson *et al.,* 1997; default parameters) and manually checked using the original chromatograph data in the program BioEdit (Hall, 1999). We used PAUP* 4.0b10 (Swofford, 2002) to compute the uncorrected pairwise distances for all sequences.

We performed maximum parsimony (MP), Neighbor-joining (NJ) and Bayesian (PP) reconstructions. For Bayesian analysis parameters of the model were estimated

from the data set using MrModeltest 2.2 (Nylander, 2005). The NJ-analysis used the uncorrected 'p-distances'. Additionally, we used bootstrap analyses with 2000 (MP) and 20000 (NJ) pseudoreplicates to evaluate the relative branch support in phylogenetic analysis. For the MP analysis, we used the "heuristic search" with the "random addition" option of PAUP* (Swofford, 2002) with 10 replicates, using the TBR (tree bisection-reconnection) branch swapping option. All Bayesian analyses were performed with MrBayes, version 3.0b4 (Huelsenbeck & Ronquist, 2001). We ran two MCMC analyses for 10^6 generations each. The initial 100000 (10%) trees were disregarded as "burn-in". We consider posterior probabilities (PP) of 95% or greater to be significantly supported. The exact parameters used for the Bayesian analyses followed those described in detail by Reeder (2003).

Specimens recorded during ecological studies in Phong Nha - Ke Bang from 17 June to 27 August 2006 by two of us (AH and TZ) were only studied in the field or captured for taking most important measurements (to the nearest milimeter, using a digital vernier caliper) and scalation characters and were subsequently released. Capture took place at night, beyond the skink's activity phase. We used a long pair of tweezers to reach and grasp the skinks in their hiding places within narrow karst rock crevices. Prior to their release, specimens were marked by a green-coloured deco marker (label Edding 4000) for enabling the recognition of eventual recaptures.

Abbreviations are as follows: SVL - snout-vent length; TaL - tail length; TL - total length; HL - head length (distance from tip of snout to posterior margin of interparietal); HW - maximum head width; BB - dorsal body bands between limbs; MS - transversal midbody scale count; MD - middorsal (paravertebral) scales (from the posterior end of parietals to posterior margin of thigh); D - transversal dorsal scales at midbody; V - transversal ventral scales at midbody; L - keeled rows of lateral scales at midbody.

The invertedly fixed hemipenes of the adult male specimen MHNG 2683.99 were removed from the tail base and brought to subsequent eversion based on a method described by Pesantes (1994) for snakes and then successfully applied to lizards by Ziegler & Böhme (1997). After the temporarily storation in 2% potassium hydroxide solution (KOH) at 25°C, the subsequently everted outer genital organs were stored in 70% ethanol (see also Ziegler *et al.,* 2005).

For measuring the temperature and humidity we used a digital thermo- and hygrometer; weighing of the skinks (in cotton bags) was carried out with a spring balance (maximum 100g, in 1g steps). Skink photographs in the field were taken with a Canon IXUS 55 digital camera.

RESULTS AND DISCUSSION

Molecular Systematics

All molecular analyses produced an almost identical tree topology shown in Fig. 1. We excluded 106 bp from all analyses which were too variable to be aligned unambiguously. The heuristic search of the MP analysis produced 4 most-parsimonious trees (tree length = 261; CI = 0.475; RI = 0.557; RC = 0.264). The comparison between the different likelihood scores for each model showed that the GTR+I+G model (Yang

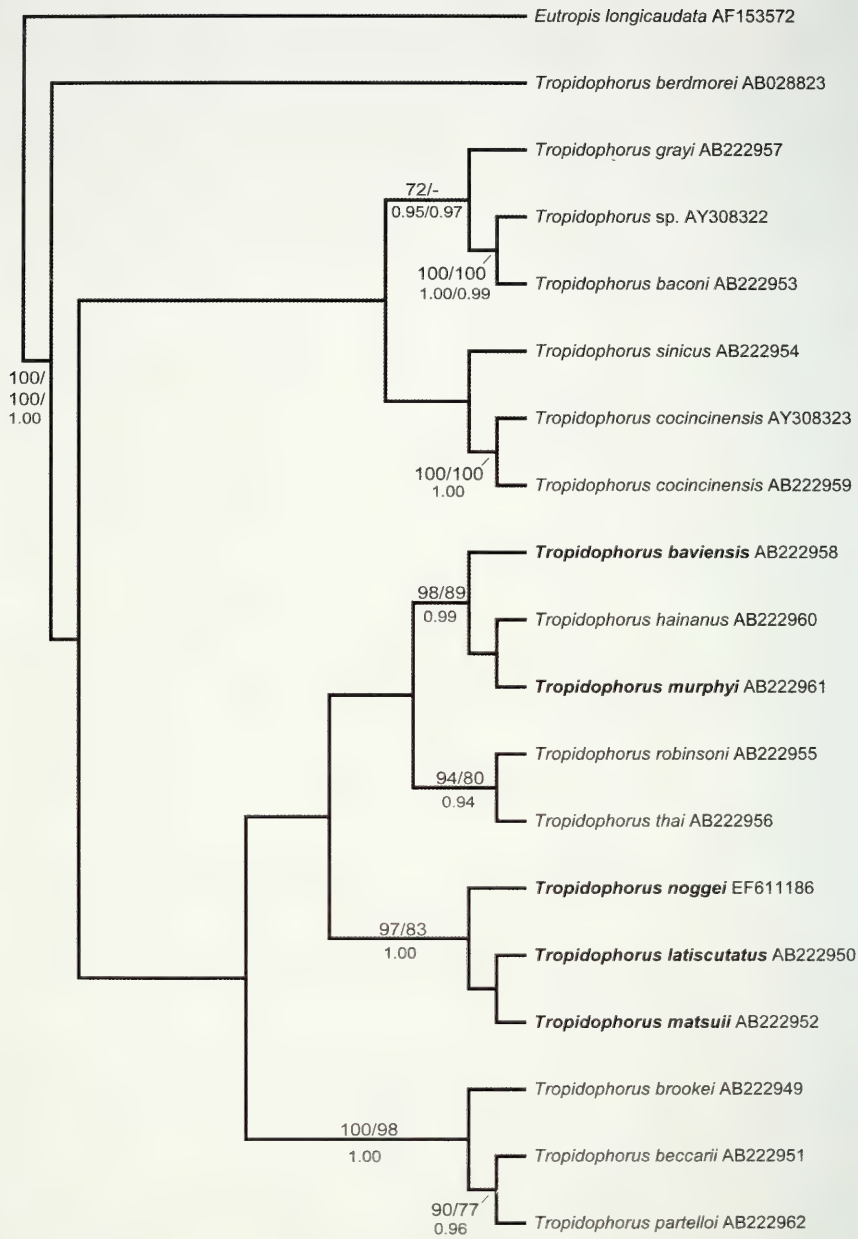


FIG. 1

Cladogram based on 487 bp of the mitochondrial 16S ribosomal RNA gene sequences. Values above the nodes represent bootstrap values in percent for neighbor-joining (NJ) and maximum parsimony (MP) analyses, respectively; lower values are Bayesian posterior probabilities (PP). Only significant values (≥70 for NJ and MP; ≥0.95 for PP) are shown. Depressed-bodied species of *Tropidophorus* are written in bold.

et al., 1994) was determined to be the optimal ML model for data set. This model incorporates unequal base frequencies [$\pi_{(A)} = 0.3274$, $\pi_{(T)} = 0.2145$, $\pi_{(C)} = 0.2593$, $\pi_{(G)} = 0.1987$], a proportion of invariable sites (I = 0.4742), and a gamma distribution shape parameter (a = 0.4343). The optimal ML tree had a log-likelihood of -lnL = 2183.2847.

As expected for the comparatively short sequences compared, none of the trees showed any basal resolution but all analyses identified the same 7 terminal groups, all of which received significant bootstrap values to strongly support them. Therefore, we cannot specifically comment on the valitidy of the results of Honda *et al.* (2005) which indicated a basal split within *Tropidophorus* and separated a clade of continental Indochinese species exclusive of *T. cocincinensis* and *T. microlepis* from one comprising *T. cocincinensis*, *T. microlepis* and species from Borneo, Sulawesi and the Philippines. But in all our analyses *Tropidophorus noggei* clustered well supported by bootstrap values (NJ: 94/MP: 83/PP: 1.00) in a clade with *T. latiscutatus* and *T. matsuii* and therefore fits well into the principal "Indochina clade" of Honda *et al.* (2005).

Within *Tropidophorus* four more or less depressed-bodied species had been known before the description of *T. noggei* (Hikida *et al.,* 2002; Honda *et al.,* 2005; Ziegler *et al.,* 2005). While two moderately depressed species were collected from small areas in northeastern and eastern Thailand (*T. latiscutatus*, *T. matsuii*), one futher species with an extremely depressed head and body was found from one limited area in northern Vietnam (*T. murphyi*). All three species most resemble *T. baviensis* Bourret, 1939 from northern Vietnam in body size, body shape, and scutellation. However, the body depression in *T. baviensis* is by far not so prominent as in the other three species. In all our phylogenetic trees *T. baviensis* clusters with very significant bootstrap support in one of the terminal clades together with *T. hainanus* and *T. murphyi* (NJ: 98/MP: 89/PP: 0.99). The newly described *Tropidophorus noggei* is a further species with a moderately depressed body and head, and its phylogenetic position as a member of a clade together with *T. latiscutatus* and *T. matsuii* (which are clearly separated from the former clade) confirms that the body depression recognized in several Indochinese species is likely to have occurred convergently at least twice as an adaptation to saxicolous habitats, as was presumed by Honda *et al.* (2005). Also the direct comparison of the uncorrected distance data confirms both the species status of *T. noggei* from its closest relatives *T. matsuii* and *T. latiscutatus* (3.29% and 2.68%, respectively), as well as the distinctness and separation of the two above metioned terminal clades (internal distances: 2.68%-3.29% ("*noggei*-clade") and 2.88%-3.91% ("*baviensis*-clade"); distances between the two clades: 5.76%-6.78%).

Morphology

Beside the male holotype ZFMK 83668, the specimen MHNG 2683.99 represents the second collected male specimen of *Tropidophorus noggei*. Hence, we herein provide a detailed description in the following:

The measurements of MHNG 2683.99 are as follows: snout-vent length 101.8 mm; tail length 104.5 mm; total length 206.3 mm; head length (distance from tip of snout to posterior margin of interparietal) 17.1 mm; head width 16.7 mm; head height 10.3 mm; snout length (from tip to anterior margin of eye) 7.6 (left) to 8.0 (right) mm; eye to tympanum length (from hind margin of eye to anterior border of tympanum)

8.9 mm; tympanum width 2.6 mm; tympanum height 3.7 mm; snout to forelimb length 36.8 mm; axilla to groin length 51.4 mm; minimum neck width 13.6 mm; midbody width 21.6 mm; midbody height 12.1 mm; forelimb length (from body insertion to base of claw of fourth finger) 29.0 mm; hindlimb length (from body insertion to base of claw of fourth toe) 38.7 mm; length of fourth toe (without claw) 13.4 mm.

This second preserved adult male known of *T. noggei* largely corresponds with the description of the male holotype provided by Ziegler *et al.* (2005), except for the following characters: 1) frontonasal being not only in contact with rostral, nasals, anterior loreals, and prefrontals, but also with the frontal (because the prefrontals are separated, and not in contact, as it is the case in the male holotype); 2) frontal in contact with frontonasal; 3) supraoculars laterally bordered by two (right) to three (left) supraciliaries (versus five supraciliaries each in the holotype); 4) left supraciliary row complete along the entire length of the lateral edge of the supraoculars, as it is also the case in the holotype, but right supraciliary row incomplete (ending at third supraocular); 5) each parietal is followed by two enlarged nuchals (three in the holotype); 6) 43 middorsal scales (instead of 44 in the holotype) from posterior end of parietals to posterior margin of thigh (paravertebral scales); 7) subdigital lamellae smooth, numbering 20 (versus 18-20 in the holotype) on the fourth digit of the pes; 8) seven pale brown transverse bands (opposite to eight to nine in the holotype) are discernible on the dorsum between the limbs and ten or more light bands (opposite to 17 in the holotype) on the dorsal tail.

Some important measurements, the number of dorsal body bands and selected scalation characters of four female specimens that were collected in Phong Nha - Ke Bang subsequent to the original description (Ziegler *et al.,* 2005) are listed in Tab. 1. Respective data of additional 14 specimens that were captured and subsequently released between 16 July and 27 August 2006 are summarized in Tab. 2. Due to this new data gathered from the afore mentioned 19 specimens in addition to the type series, the diagnosis of *T. noggei* given in Ziegler *et al.* (2005) must be partially modified as follows: 1) existence of six to nine (mean 7.5) transverse body bands between the limbs; 2) the supraoculars are bordered by two to five supraciliaries; 3) the number of midbody scale rows ranges from 22-24 (mean 22.4), with 5-6 (mean 5.9) dorsals, each 5-6 (mean 5.2) laterals, and 6-7 (mean 6.1) ventral scales; 4) 43-49 (mean 47.1) middorsal (paravertebral) scales (see also Tab. 3).

Hemipenis Morphology

A description of the partly everted hemipenes of the holotype of *Tropidophorus noggei* was provided by Ziegler *et al.* (2005). Meanwhile, with the subsequently everted and ca. 15 mm long left hemipenis of the specimen MHNG 2683.99 (Fig. 2) we have a better prepared outer genital organ at hand. It corresponds very well with the description of the hemipenes of the holotype, viz. being elongate, unpigmented and having a smooth pedicel without any further ornamentation, too. The sperm groove of the left hemipenis of the specimen MHNG 2683.99 is bordered with lips, apically forked and each running as well along the apical lobes. Furthermore, the truncus laterally bears each a thin-skinned tissue bulge. Asulcally, the transitory area between the truncus and apex is at a turgid state marked by two inflated, thin-skinned rises;

TABLE 1. Selected measurements (in mm), number of dorsal body bands between limbs and some scalation characters of the four female *Tropidophorus noggei* deposited in the collection of the Science Research Centre of the Phong Nha - Ke Bang National Park, Quang Binh Province; for abbreviations see Material and Methods.

	PNNP 111	PNNP 112	PNNP 174	PNNP 175	Min - max (x ± s)
SVL	101.4	104.2	101.2	110.2	101.2 - 110.2 (104.3 ± 4.2)
HL	20.3	20.6	19.6	21.1	19.6 - 21.1 (20.4 ± 0.6)
HW	16.1	16.0	15.7	16.9	15.7 - 16.9 (16.2 ± 0.5)
BB	8	7	7	6	6 - 8 (7 ± 0.8)
MS	22	22	24	23	22 - 24 (22.8 ± 1.0)
D	5	5	6	5	5 - 6 (5.3 ± 0.5)
V	6	6	6	6	6
L	5/6	5/6	6/6	6/6	5 - 6 (5.8 ± 0.5)

along each of the outer margins of the two rises, few plicae (petala sensu Savage, 1997; terminology used herein after Ziegler & Böhme, 2004) are discernible. Although the apical lobes of the everted left hemipenis of the specimen MHNG 2683.99 are terminally not completely everted, they allow a better genital morphological analysis than it was the case with the only partially protruded hemipenes of the holotype of *T. noggei*. Asulcally, above the two inflated, thin-skinned rises the actual plica ornamentation stretches more or less horizontally along the sulcal, lateral and asulcal sides of the apex, below the apical lobes. These plicae, which are relatively difficult to discern and therefore hardly countable, are differentiated from the truncus by a distinct tissue seam. In addition, the "deeply bifurcated hemipenis" corroborates placement of the genital morphologically poorly known genus *Tropidophorus* in the *Sphenomorphus* group (Greer, 1979; Greer & Biswas, 2004).

NATURAL HISTORY

Habitat and abundance

Despite recent field research from June to August 2006 within different areas of the karst forests of Phong Nha - Ke Bang National Park, we only could record *T. noggei* in a single mountainous region of Cha Noi area (Figs. 3, 8), from where also the type series originated (Ziegler *et al.,* 2005). However, this is not astonishing, as the genus *Tropidophorus* exhibits considerable local endemism (e. g. Greer & Biswas, 2004). All specimens of *T. noggei* subsequently seen by us were found in the primary forest in altitudes between 300-400 m above sea level. Within seven field nights at such higher elevations we recognized 17 different specimens, of which 14 could be captured for marking and taking selected measurements as well as scalation characters and sub-

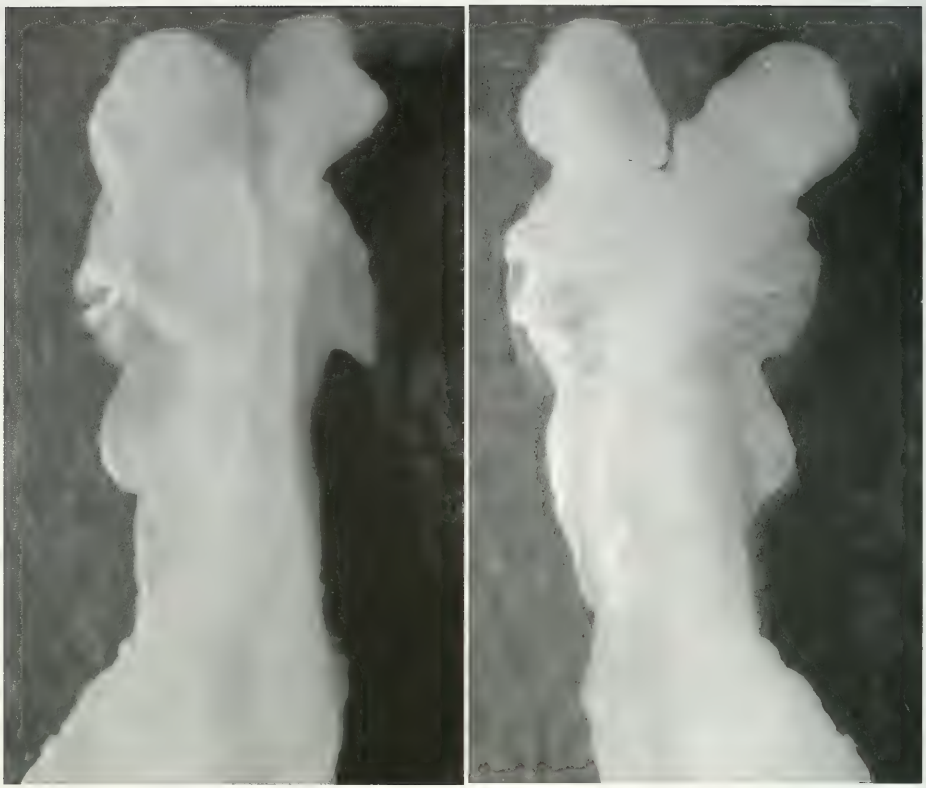


FIG. 2

Sulcal (a) and asulcal (b) view of the formerly invertedly fixed and subsequently everted left hemipenis of *Tropidophorus noggei* (MHNG 2683.99).

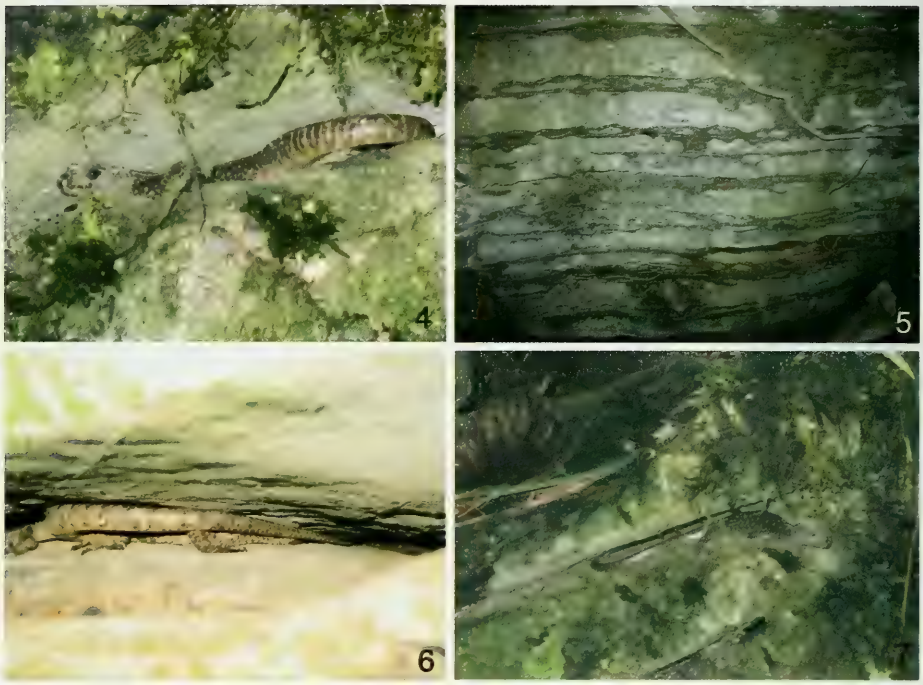
TABLE 2. Sex, selected measurements (in mm), transversal dorsal body bands between limbs, and selected scalation characters of the 14 captured and subsequently released specimens of *Tropidophorus noggei* from Phong Nha - Ke Bang (for abbreviations see material and methods); * - with regenerated tail tip.

Nr.	Sex	SVL	TaL	HL	HW	BB	MD	MS	D	V	L
1	ad.	104.2	124.6	22.5	17.2	7		22	6	6	5/5
2	ad.	90.0	106.0	20.2	14.1	6	48	22	6	6	5/5
3	ad.	68.8	93.0	16.2	12.1	8	47	22	6	6	5/5
4	ad.	94.1	91.0*	22.5	17.8	7	43	22	6	6	5/5
5	f pre	96.2	101.5	21.2	17.0	7	49	22	6	6	5/5
6	ad.	106.5	123.5	21.0	16.3	8	48	23	6	7	5/5
7	f pre	93.6	97.0*	20.0	15.3	8	48	22	6	6	5/5
8	juv.	71.5	89.2	16.3	12.0	7	48	22	6	6	5/5
9	juv.	84.9	113.8	19.9	14.2	8	48	22	6	6	5/5
10	ad.	94.2	109.2	22.2	17.1	8	47	23	6	6	6/5
11	f pre	103.3	97.4	22.1	16.2	6	49	22	6	6	5/5
12	f pre	102.1	93.8	21.3	17.1	7	48	23	6	6	5/6
13	ad.	84.4	111.3	21.2	17.0	7			6	6	
14	juv.	84.6	119.2	19.8	15.3	7	45	24	6	6	6/6

FIG. 3
Map showing the single known locality of *Tropidophorus noggei*.

sequently were released at the capture site. Eleven different specimens of *T. noggei* were recorded at a transect of 0.5 km within a single night only, from 19:14h to 23:37h, pointing to a regionally high abundance. Because eight of the 14 marked individuals have been captured at prominent karst formations, we were able to subsequently relocate the individual sites. After a period of five weeks we found six of the eight skinks at the same location anyway. This recapture rate of 75% explicitly argues for a seldom relocation, thus the territorial habits of *T. noggei*.

All our records of *Tropidophorus noggei* took place in heights of 0.3 to 1.5 m above the ground. With a piece of shed skin found on 21 June 2006 in a chink of a karst rock projection together with an observation of a specimen dwelling inside a karst crevice we also could prove that the species is at least able to climb up to 1.8 m height above the ground. The vertical diameter of the karst rock crevices in which we found live specimens, measured seven to 50 mm (mean ca. 20 mm). With the dorso-ventrally depressed body as well as the robust and resistant scalation the species is exceedingly adapted to such narrow rock crevices (Figs. 4-5). All specimens recognized by us were found solitarily, however, nine (i. e. ca. 64%) of the 14 captured specimens lingered in crevices of immediate vicinity, within distances of 0.3 to 1 m to each other. This suggests, that *T. noggei* occupies certain territories and that adults as well as juveniles together with adults occur in close vicinity.



FIGS 4-7
(4) *Tropidophorus noggei* active during daytime in front of its hiding place, a narrow karst rock crevice. (5) Such narrow karst rock crevices represent the microhabitat of *Tropidophorus noggei*. (6) *Tropidophorus noggei* at night in its hiding place in typical sleeping as well as defending position. (7) *Tropidophorus noggei* during daytime lurking at the entrace of a karst crevice.

Further lizard species that were observed by us in syntopy with *T. noggei* were scincids of the genera *Lygosoma* and *Scincella*, the gekkonids *Cyrtodactylus phongnhakebangensis*, *C. cryptus*, *Gekko gecko*, *G. scientiadventura*, as well as the agamids *Acanthosaura lepidogaster* and *Calotes emma* (Heidrich *et al.,* 2007; Ziegler *et al.,* 2007). As potential predators of at least juvenile *T. noggei* we found large centipedes (*Scolopendra* sp., *Scutigera* sp.) crawling in and around the karst rock crevices. Furthermore, the snake species *Psammodynastes pulverulentus* and *Protobothrops cornutus*, as well as *Lycodon* representatives were observed occuring together with *T. noggei*.

Activity and habits

Ziegler *et al.* (2005) reported, that *T. noggei* specimens were found at night at the base of karst rock outcrops in front of horizontal and narrow rock crevices about 30 to 50 cm above the forest floor. After being disturbed, they escaped into the narrow rock crevices, where they were well concealed and anchored up to 15 to 30 cm inside the karst rock crevices. During our recent ecological field work we could find out that most skinks spent the night resting or sleeping in narrow rock crevices. We further

FIG. 8
Habitat of *Tropidophorus noggei* in Cha Noi area, Phong Nha - Ke Bang National Park, Quang Binh Province, Truong Son, central Vietnam.

observed a typical defensive position (Fig. 6), with the tail, being laterally positioned in front of the body to protect the damageable trunk parts and the head. It seems that the species is also able to autotomize its tail once being heavily grasped at, which was once observed by us on 21 June 2006. Further, *T. noggei* was observed by us to be mainly active during daytime. However, also at daytime, the crevices were seldomly left. For example, the adult specimen 1 (see Tab. 2 and 4), that was observed at the afternoon of 7 August 2006 for a period of two hours (15:15 to 17:15), left its crevice only once for a short time and remained only in a range of about one meter in doing so. The skink rather spent most of the two hours of our observation lurking at its crevice entrance (Fig. 7).

Reproduction

Concerning reproductive biology, the testes of the male MHNG 2683.99 measured 5.8-6.3 mm in length and 3.2-3.6 mm in width. The testes of the commensurate male holotype measured 9.0 mm in length and 6.2 mm in width (Ziegler *et al.*, 2005). Whilst the specimen MHNG 2683.99 most probably was collected during the dry season, the larger testes of the holotype may be established by its collect at the end of the dry season. One of the two female paratypes, that was also collected at the end

TABLE 3. Maximum snout-vent length, head length, and head width of the three type specimens of *Tropidophorus noggei* (from Ziegler *et al.*, 2005), of the subsequently collected male MHNG 2683.99, of the four specimens deposited in the Science Research Centre of the Phong Nha - Ke Bang National Park (see Table 1), and of the 14 captured and subsequently released specimens (see Table 2), as well as minima, maxima, mean and standard deviation of the number of dorsal body bands between the limbs and of selected scalation characters (for abbreviations see material and methods).

	n	Min-max x ± s
SVL max.	22	110.2 mm
HL max.	22	22.5 mm
HW max.	22	17.8 mm
BB	22	6-9 (7.5 ± 0.9)
MD	16	43-49 (47.1 ± 2.1)
MS	21	22-24 (22.4 ± 0.7)
D	22	5-6 (5.9 ± 0.4)
V	22	6-7 (6.1 ± 0.2)
L	21	5-6 (5.2 ± 0.4)

TABLE 4. Collecting date, sex, weight (in g), time of discovery, temperature, relative humidity and vertical karst crevice diameter (CD: in mm) as well as crevice height above ground (CH: in m) for the 14 captured and subsequently released specimens of *Tropidophorus noggei* from Phong Nha - Ke Bang. For abbreviations see Material and Methods; further abbreviations are as follows: Ad. - adult; f - female; pre - pregnant; juv. - subadult.

Nr.	Date	Sex	Weight	Time	Temp.	Humidity	CD	CH
1	16.7.	ad.	25	18:56	24.9°C	94%	18	1.0
2	17.7.	ad.	19	19:14	24.3°C	94%	13-27	1.0
3	17.7.	ad.	6.5	19:25	24.3°C	94%	7-19	0.3
4	17.7.	ad.	23	19:49	24.1°C	93%	22-34	1.5
5	17.7.	f pre	24.5	19:55	24.1°C	93%	33-50	1.5
6	17.7.	ad.	30.5	20:37	24.3°C	93%	9-23	0.4
7	17.7.	f pre	22	21:14	24.4°C	92%	14-22	1.2
8	17.7.	juv.	6.5	21:25	24.4°C	93%	18	1.2
9	17.7.	juv.	14	21:45	24.4°C	92%	11	1.3
10	17.7.	ad.	19.5	22:16	24.4°C	92%	11-30	1.4
11	17.7.	f pre	24	22:27	24.2°C	88%	14.5-16	0.8
12	17.7.	f pre	30	23:37	24.2°C	88%	17-20	0.7
13	27.8.	ad.	21	21:10	25.0°C	86%		1.0
14	27.8.	juv.		21:20	25.0°C	86%	14-18	1.1

of the dry season, contained three large eggs of about 13 x 10 mm diameter. The four female specimens deposited in the collection of the Science Research Centre of the Phong Nha - Ke Bang National Park most probably were collected during different seasons. The two specimens (PNNP 111, PNNP 112), that most probably were collected during the dry season, contained nine and 18 small eggs of 2-3 and 1-4 mm maximum diameter, respectively. In contrast, the specimen PNNP 174 contained five eggs of 12.5 x 8 mm maximum diameter, and in the dissected specimen PNNP 175 we found seven eggs of 10.6 x 8.9 mm size. Throughout July, at the end of the dry season, we found pregnant females in the field (see Tab. 4), well recognizable from their distinctly swollen bodies. It should be interesting to continue with studying the species' reproductive mode (see Hikida *et al.,* 2002), because several authors have assumed that in lizards the physical constraint from the crevice-dwelling habits provides an evolutionary force to some reproductive traits, such as relative clutch mass and frequency of clutch production (Vitt, 1981, 1993; Doughty & Shine, 1995).

Diet

With respect to feeding ecology, we found remains of a worm-like invertebrate (cf. Annelida) in the stomach of MHNG 2683.99. The stomachs of the four females deposited in the collection of the Science Research Centre of the Phong Nha - Ke Bang National Park contained each remains of a worm (Annelida) in the specimens PNNP 174 and PNNP 175, and three ants (Hymenoptera: Formicidae) in the specimen PNNP 111. The stomach of the female PNNP 112 was empty, but its gut contained four ants, four termites (Isoptera) and one katydid (Ensifera). Whereas the guts of the specimens PNNP 174 and PNNP 175 were empty, the gut of PNNP 111 contained five ants. The contents of the gastro-intestinal tracs of the afore mentioned specimens together with the data obtained from the dissected holotype and one female paratype of *T. noggei* (see Ziegler *et al.*, 2005) are summarized in Fig. 9.

The most frequent prey items were ants and termites, followed by annelid worms (see Fig. 9). However, the higher prey item amount in the guts as can be seen in Fig. 9 is put down to an accumulation of prey fragments that are hard to digest to not digestible, as is the case with chitin fragments of ants and termites. For this reason, and because gut contents usually do not contain easily digestible prey like soft-skinned insect larvae or worms, and therefore have limited value in comparison with more diverse stomach contents, stomach and gut content data were presented separately in Fig. 9 (see also Ziegler, 2003). Therefore the high number of ant and termite prey items must be carefully interpreted. In addition, only prey item numbers are presented in Fig. 9 and not their respective masses. To visualize this in a direct comparison: three of the relatively large annelid worms (with at least 3 mm body diameter) were found in the stomachs of three (43%) of the altogether seven dissected skinks, but the much more smaller ants were only in the guts of two individuals (29%) and the 5 mm small termites only in the gut of a single skink (14%). Based on the worms' high biomasses and the fact that 43 percent of the skinks had worm remains in their stomach, it can be assumed that worms play an important role in the feeding ecology of *T. noggei.* In addition, it is interesting to note, that ants only were found in the gastro-intestinal tracts of the specimens PNNP 111 and PNNP 112, the latter one of which contained as

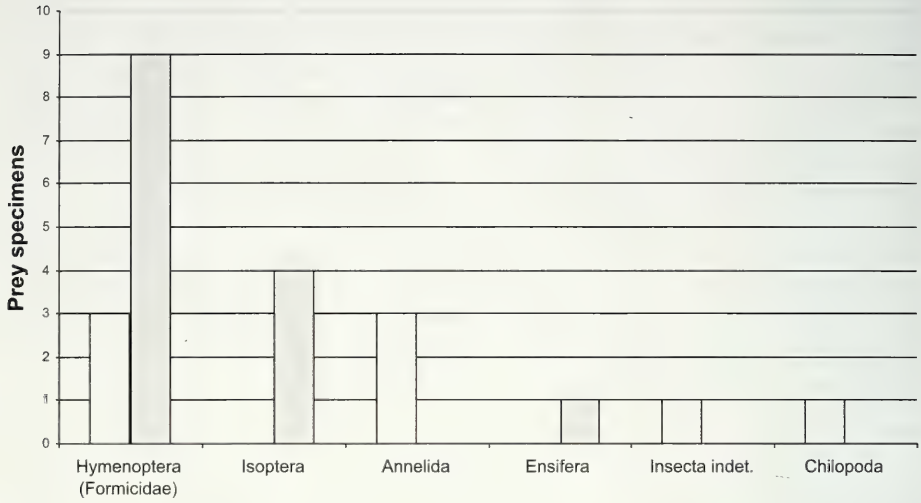


FIG. 9

Number of prey items found in the stomachs (white columns) and guts (grey columns) of seven examined specimens of *Tropidophorus noggei*.

single skink specimen also termites. Due to their small egg sizes, both skinks most probably were collected during another season than the females PNNP 174 and PNNP 175, which both had worm remains in their stomachs, as well as the male MHNG 2683.99, that most probably was collected during or at the end of the dry season. This further would allow the conclusion of a seasonal food supply and prey spectrum, respectively, because it can be expected that the worm abundance increases with beginning rains. However, during our field work in July and August 2006 we found both earth worms, as well as ants and termites in and around the karst crevices being inhabited by *T. noggei*.

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Studies of the genus *Anthelephila* Hope (Coleoptera: Anthicidae) – 10. Species related to *A. imperatrix*

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Studies of the genus *Anthelephila* Hope (Coleoptera: Anthicidae) – 10. Species related to *A. imperatrix*. - *Anthelephila imperatrix* LaFerté-Sénectère, 1849, *A. subtruncata* (Pic, 1899) and male characters of *A. besucheti* Bonadona, 1989, *A. congoana* Uhmann, 1981 and *A. ovipennis* (Bonadona, 1984) are redescribed. Eight new species are described: *A. cardamontis* sp. n. (India), *A. curvitarsis* sp. nov. (South Africa), *A. aratrix* sp. n. (India), *A. irula* sp. n. (India), *A. kresli* sp. n. (Nepal), *A. lobulicula* sp. n. (Nepal), *A. sculpta* sp. n. (India, Bhutan) and *A. vanhillei* sp. n. (South Africa). New synonymy, *A. imperatrix* LaFerté-Sénectère, 1849 (= *Formicomus punctaticeps* Pic, 1916 syn. n.), is proposed. Status of *F. cribriceps* Marseul, 1876 is discussed and its previous placement in synonymy with *A. imperatrix* LaFerté-Sénectère, 1849 is supported.

Keywords: Coleoptera - Anthicidae - *Anthelephila* - systematics - new species - new synonymy.

INTRODUCTION

An informal *A. imperatrix* species-group is here established for five known and eight newly described species of the genus *Anthelephila* Hope, 1833. Apart from their prevailing aptery and simple forelegs of the males, the included species are distinguished by possession of the simpler structure of male abdominal segment VIII, nearly straight lateral mesosternal margins, and the paired incisions on the posterior, exposed margin of the prosternum. All of these characters occur rarely within the genus, and some of them suggest, along with the discontinuous ranges, a rather basal position of this species-group, and also a closer relationship of *Anthelephila* to *Stenidius* LaFerté-Sénectère, 1847.

ABBREVIATIONS AND EXPLANATIONS

The following abbreviations of collections are used (in round brackets):

ADBC collection Augusto Degiovanni, Bubano, Italy
AMGS Albany Museum, Grahamstown, South Africa
BMNH The Natural History Museum, London, England

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DCDC collection Donald S. Chandler, Durham, New Hampshire, U. S. A.
GUPC collection Gerhard Uhmann, Pressath, Germany
HNHM Hungarian Natural History Museum, Budapest, Hungaria
MHNG Muséum d'histoire naturelle, Genève, Switzerland
MNHB Museum für Naturkunde der Humboldt Universität, Berlin, Germany
MNHN Muséum National d'Histoire Naturelle, Paris, France
NHMB Naturhistorisches Museum, Basel, Switzerland
NHMW Naturhistorisches Museum, Wien, Austria
NKME Naturkundemuseum Erfurt, Erfurt, Germany
NMPC National Museum, Prague, Czech Republic
SANC S. A. National Collection of Insects, ARC – Plant Protection Research Institute, Pretoria, South Africa
SMF Senckenberg-Museum, Frankfurt am Main, Germany
SMNS Staatliches Museum für Naturkunde, Stuttgart, Germany
TMP Transvaal Museum, Pretoria, South Africa
ZILS Universitets Zoologiska Institut, Lund, Sweden
ZKDC collection Zbyněk Kejval, Domažlice, Czech Republic

The author's comments on the type material are placed in square brackets: [p] = printed, [h] = handwritten. Exact label data are quoted only for the type specimens. Separate labels are indicated by back slashes (\ ). The terminology of body setation follows Werner & Chandler (1995).

SYSTEMATICS

Anthelephila imperatrix species-group

Diagnosis: Small to medium sized (2.6-4.6 mm), almost exclusively apterous species, very rarely with fully developed metathoracic wings (only six specimens of *A. imperatrix* and *A. kresli* sp. n.); posterior margin of prosternum with a pair of incisions (Fig. 7, best observed after removing the coxae); elytra ovoid, often rather strongly convex and subtruncate/truncate apically, with obsolete humeri and lacking postscutellar impression (characters related to aptery); forelegs in males simple; meso- and metatibiae often modified (six species); lateral margins of mesosternum nearly straight (Fig. 35); tergum VII lacking paired spinulose patches on dorsal side (a character possibly related to aptery, patches may be used in folding of metathoracic wings); male sternite VIII less differentiated, median sclerite indistinct and paired prongs more or less tightly joined medially, latero-basal plates inconspicuous; male tergite VIII forming single sclerite; tegmen trilobed apically; median lobe of aedeagus terminating in a pair of narrow projections (Fig. 15). Species included: *A. aratrix* sp. n., *A. besucheti*, *A. cardamontis* sp. n., *A. curvitarsis* sp. n., *A. congoana*, *A. imperatrix*, *A. irula* sp. n., *A. kresli* sp. n., *A. lobulicula* sp. n., *A. ovipennis*, *A. sculpta* sp. n., *A. subtruncata* and *A. vanhillei* sp. n.

Distribution: One Asian species, *A. imperatrix*, exhibits a wide distributional range. All other species are known from limited regions in the following countries: South Africa (3); Zaire, Uganda and Kenya (2); south-western India and Sri Lanka (3); north-eastern India and Nepal (4).

COMMENTS: It should be emphasized, that *A. imperatrix* species-group is established as an informal group of convenience. Its polyphyletic origin is not excluded, as the following important character states appears to be primitive and/or variable within the genus:

Mesosternal margins: In *Anthelephila* the lateral mesosternal margins are typically moderately arcuate in their posterior half (see figs 1, 6 by Kejval, 2003). Straight margins, exhibited by members of *A. imperatrix* species-group, occur in more primitive Anthicinae and they are considered to be the ancestral state (Chandler, 1982). However, the form/width of lateral arms of mesosternum shows variation and some *Anthelephila* species appears to be intermediate in this character.

Abdominal segment VIII: The modified male segment VIII is regarded as a synapomorphy for the genera of Formicomini Bonadona, 1875 (Kejval, 2003), and species of *Anthelephila* are characterized almost exclusively by the more complicated structure of this segment (sternite VIII differentiated into five separable parts, tergite VIII composed of two sclerites). Consequently, the rather simple structure of segment VIII in the *A. imperatrix* species-group represents either a more primitive condition within the genus, or a derived form characterized by simplification.

Prosternal incisions: In all *Anthelephila* the portion of the prosternum beneath the coxae is sclerotized and extended posteriorly as a distinct sclerite. The posterior margin of this sclerite is typically simple and shallowly emarginate (see Fig. 6 by Kejval, 2003), very rarely with a pair of incisions (Fig. 7). The phylogenetic significance of these prosternal incisions is not clear. Moreover, this character is not restricted to the *A. imperatrix* species-group. Showing clear variation in prominence, it occurs also in *A. kanheri* Kejval, 2002 and several related species inhabiting the region of Western Ghat on the Indian subcontinent, which are rather typical *Anthelephila* with well-developed metathoracic wings, more complicated structure of segment VIII and modified forelegs in males. Other Indian species, more widely distributed and showing similarities in male characters to this small group, lack prosternal incisions completely.

Remarkably, the related genus *Stenidius* resembles species of *A. imperatrix* group in having a less complicated structure of the modified abdominal segment VIII, and its species often display similar prosternal incisions.

A KEY TO SPECIES OF *A. IMPERATRIX* SPECIES-GROUP

1(4) Dorsal outline of pronotum rather strongly convex in anterior two thirds, impressed and then distinctly bulging before base in lateral view (Fig. 6); anterior portion of pronotal disc with conspicuous median longitudinal impression/groove.

2(3) Ordinary punctation and setation of elytra very sparse, scattered; posterior band of contiguous punctures and thicker whitish setae directed postero-mediad from lateral margins (Fig. 8); male sternum VII with conspicuous postero-median process (Fig. 10) . . . . . *A. aratrix* sp. n.

3(2) Ordinary punctation and setation of elytra somewhat denser; posterior band of contiguous punctures and thicker whitish setae directed antero-mediad from lateral margins (Fig. 2); male sternum VII modified, but lacking any postero-median process . . . . . *A. imperatrix* LaFerté-Sénectère

4(1) Entire dorsal outline of pronotum more or less convex in lateral view; pronotal disc rather evenly shaped, median longitudinal impression absent or at most moderately indicated and inconspicuous.

5(10) Elytra rather sparsely and evenly punctured and setose, lacking any bands/patches of more densely spaced punctures and contrasting whitish setae, their setation pale, longer, with conspicuous erect setae; male metasternum simple.

6(7) Elytra rufous, with paired dark spots at about midlength laterally and subapically (Fig. 1); surface of head and pronotum almost entirely smooth (excepting fine wrinkles in postero-lateral impressions of pronotum), finely punctured and very glossy . . . . . *A. cardamontis* sp. n.

7(6) Elytra largely dark coloured, at most with paler base and suture; surface of head and/or pronotum coarsely corrugated, more distinctly punctured.

8(9) Dorsal corrugation of head obsolete, punctation distinct; lateral margin of elytra moderately convex subapically, elytral apices rounded; male character as in Figs 22-25 . . . . . *A. irula* sp. n.

9(8) Dorsal corrugation of head conspicuous, punctation concealed by corrugation and thus less distinct; lateral margin of elytra slightly concave subapically, elytral apices rather pointed; male characters as in Figs 16-18 . . . . . *A. besucheti* Bonadona

10(5) Elytra unevenly punctured and setose, except ordinary punctures/setae with two, paired, transverse to oblique bands/patches of denser, mostly contiguous punctures and thicker whitish setae, if punctation nearly evenly sparse and setose bands/patches vaguely indicated (sparse) to indistinct, then setation of elytra uniformly short and inconspicuous, lacking longer, more raised setae; male metasternum with a pair of protrusions posteriorly, bordering laterally more or less prominent postero-median impression.

11(20) Dorsal punctation of head distinct but comparatively fine and sparse; setation generally short and inconspicuous, whitish setose bands/patches sparser, vaguely indicated to indistinct; Afrotropical species.

12(15) Species nearly uniformly dark in colour, including legs and antennae, at most basal 2-3 antennomeres slightly paler; head somewhat widely rounded posteriorly in dorsal view; basal protarsomere in males rather short and narrow.

13(14) Pronotum wider, less narrowed and constricted posteriorly in dorsal view, its postero-lateral impressions rather shallow and situated close before base; male middle legs uniformly short setose, mesofemora simple, mesotibiae subapically strongly excavated on inner side (Figs 75, 76); metatibiae rather simple apically; other male characters as in Figs 77-79 . . . . . *A. vanhillei* sp. n.

14(13) Pronotum more narrowed and constricted posteriorly in dorsal view, its postero-lateral impressions deeper and more distant from base; male middle legs with long setae on inner side (Fig. 71), mesofemora slightly produced on inner side distally, mesotibiae simple; inner apical margin

of metatibiae projecting into blunt process (Fig. 69); other male characters as in Figs 70, 72-74 . . . . . *A. subtruncata* (Pic)

15(12) Species with dark body and distinctly paler legs, antennae and palpi (at least partly); head posteriorly circular to oval in dorsal view; basal protarsomere in males enlarged, conspicuously long.

16(17) Postero-lateral impressions of pronotum conspicuous, more distant from base and thus pronotum clearly constricted in posterior half in dorsal view (Fig. 3); whitish setose bands/patches of elytra indistinct, at most slightly indicated; basal protarsomere in males narrow, curved (Fig. 39); other male characters as in Figs 38, 40-43 . . . . . *A. curvitarsis* sp. n.

17(16) Postero-lateral impressions of pronotum somewhat less conspicuous, situated near base; whitish setose bands/patches rather sparse but distinct, especially posterior one; basal protarsomere in males wider, straight.

18(19) Base of head somewhat unevenly rounded, slightly produced medially; male metatibiae uniformly, sparsely setose; male characters as in Figs 26-29; female tergum VII triangular, strongly narrowed, bluntly pointed apically (Fig. 34) . . . . . *A. congoana* Uhmann

19(18) Base of head rather evenly rounded; male metatibiae subapically with small patch of brownish, short and dense setae on inner side (Fig. 36); other male characters as in Figs 30-33; female tergum VII subtriangular, moderately narrowed, rather rounded apically (Fig. 37) . . . . . *A. ovipennis* (Bonadona)

20(11) Dorsal punctation of head coarse and rather dense, punctures separated by about their diameter; setation much longer and more raised, whitish setose bands/patches dense, conspicuous; Oriental/Palaearctic species.

21(22) Pronotum distinctly narrower than head including eyes; punctation of head and pronotum clearly different, punctures of pronotum, especially the postero-dorsal and lateral ones, much finer that those of head; male characters as in Figs 58-61, 63 . . . . . *A. lobulicula* sp. n.

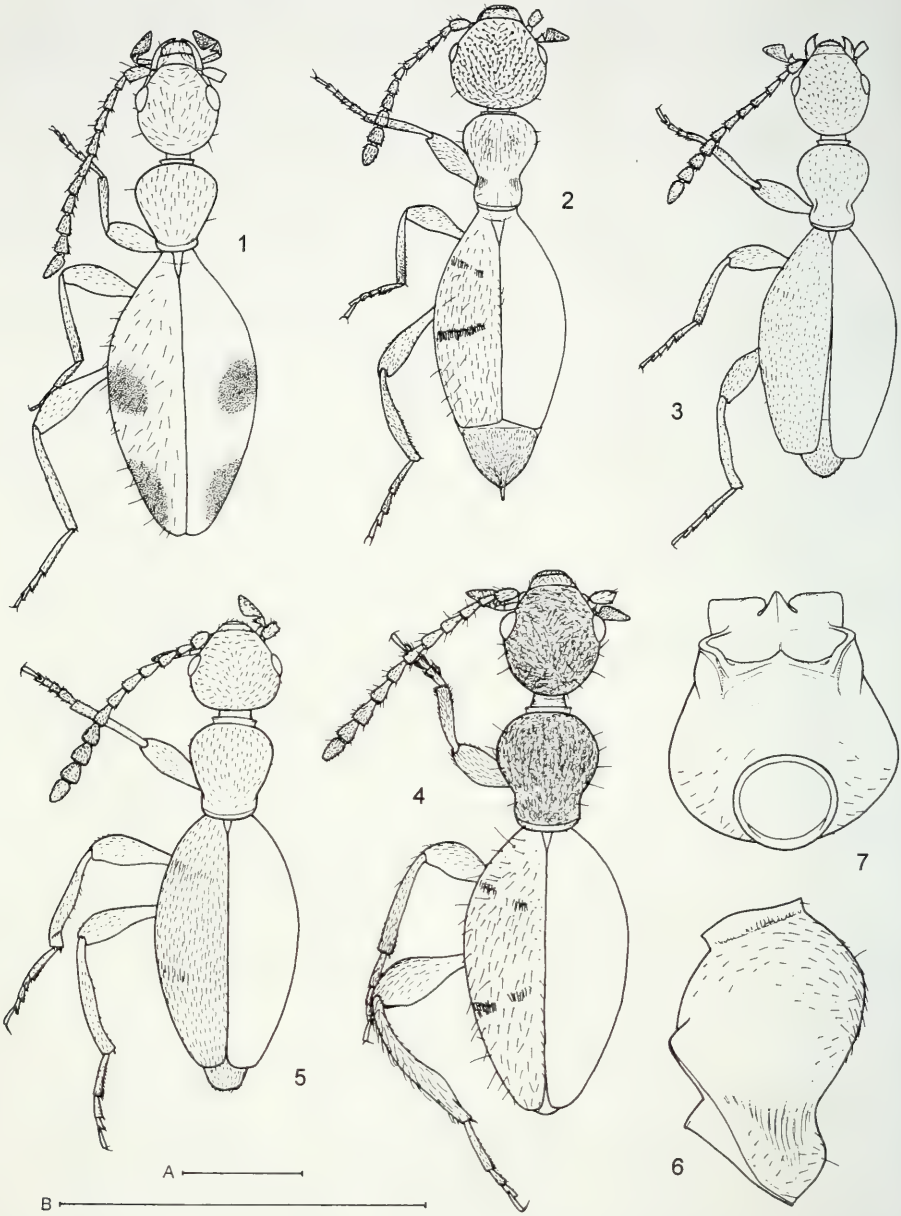
22(21) Pronotum at most slightly narrower than head including eyes; punctation of head and pronotum nearly identical.

23(24) Surface of head and pronotum less glossy, very coarsely and rather evenly sculptured, punctures situated in nearly contiguous, rather deep, pit-like impressions; male characters as in Figs 64-68 . . . . . *A. sculpta* sp. n.

24(23) Surface of head and pronotum normally, coarsely and somewhat unevenly punctured, with interspaces smooth and glossy; male characters as in Figs 54-57, 62 . . . . . *A. kresli* sp. n.

Anthelephila aratrix sp. n. Figs 8-15

TYPE MATERIAL: Holotype ♂, INDIA W. Bengal Darjeeling dist. Algarah 1800 m 9-X-78 Besuchet Löbl \ Anthelephilus imperator (Laferté) det.G.Uhmann 1986 (MHNG). – Paratypes: 1 ♂, 1 ♀, same data as holotype (ZKDC, MHNG). – 1 ♀, same data as holotype, except: 250 m [see Remarks] (MHNG). – 1 ♂, Darjeeling Distr India Bhakta B. \ Gorco Bethan 840m 21.IV.1979 \ Anthelephila imperator (LaF.) det. D. Telnov, 2000 (NHMB). – 1 ♂, Darjeeling Distr India Bhakta B. \ Chuba 670m, 11.IV.1979 \ Anthelephila imperator LaF. det. D. Telnov,



FIGS 1-7

Habitus of *Anthelephila*: (1) *A. cardamontis* sp. n., male. (2) *A. imperatrix* LaFerté-Sénectère, female. (3) *A. curvitarsis* sp. n., male. (4) *A. sculpta* sp. n., male. (5) *A. vanhillei* sp. n., male. *A. imperatrix* LaFerté-Sénectère: (6) pronotum, lateral view. (7) pronotum, antero-ventral view. Scale (1 mm): A – Figs 1-5, B – Figs 6, 7.

1999 (ZKDC). – 1 ♀, Darjeeling Distr India Bhakta B. \ Monshong 1350m 23.XI. \ Anthelephila imperator (LaF.) det. D. Telnov, 2000 (NHMB). – 1 ♀, Indien Darjeeling D Ch. J. Rai \ Kalimp. 800m Upper Janake 17.IV.1987 \ Anthelephila imperator LaF. det. D. Telnov, 1999 (NHMB).

ETYMOLOGY: From Latin *arator* (ploughman); named in reference to peculiar, plough-like shaped process of male sternum VII.

DESCRIPTION: Body length 2.9-3.5 mm (holotype 3.3 mm).

MALE (holotype): Identical with *A. imperatrix*, except for the following characters: antennae somewhat more slender in distal third; ordinary setation of elytra sparser, posterior band of contiguous punctures and thicker whitish setae directing from lateral margin postero-mediad (Fig. 8); procoxae angulately produced, punctation of metafemora somewhat finer and less conspicuous. Sternum VII (Figs 9, 10) emarginate posteriorly and projecting ventrad into peculiar, conspicuously large median process, apical portion of this process abruptly curved posteriad, and strongly widened, trapezoidal in ventral view, and with small denticle on each side latero-basally. Tergum VII (Fig. 11) truncate posteriorly, its posterior margin moderately sinuous. Sternite VIII (Figs 12, 13); paired prongs robust, rather simple, arcuately curved ventrad in lateral view, their dorso-median margin dilated mediad at about midlength into small, rounded process; setation of prongs inconspicuous, short, fine and scattered. Tergite VIII (Fig. 12) nearly parallel-sided in dorsal view, truncate posteriorly, with rounded postero-lateral angles, finely and shortly setose. Aedeagus (Figs 14, 15); apical portion of tegmen 0.8 times as long as basal-piece, trilobed apically, middle lobe conspicuously wide, strongly and nearly evenly narrowing towards pointed apex, slightly longer than apically rounded, lateral lobes; apical paired projections of median lobe of aedeagus flattened, angulately dilated laterad and ventrad subapically, rounded apically.

FEMALE: Externally identical with male, except as follows: procoxae simple; sternum VII simple, evenly rounded posteriorly; tergum VII triangular, narrowed and rounded apically, its apical portion rather strongly vaulted, but evenly shaped, lacking a median edge or protrusion.

VARIABILITY: Inconspicuous.

DIFFERENTIAL DIAGNOSIS: *A. aratrix* sp. n. is habitually very similar and undoubtedly closely related to *A. imperatrix*, but differs substantially in most male characters; see the above description and the key.

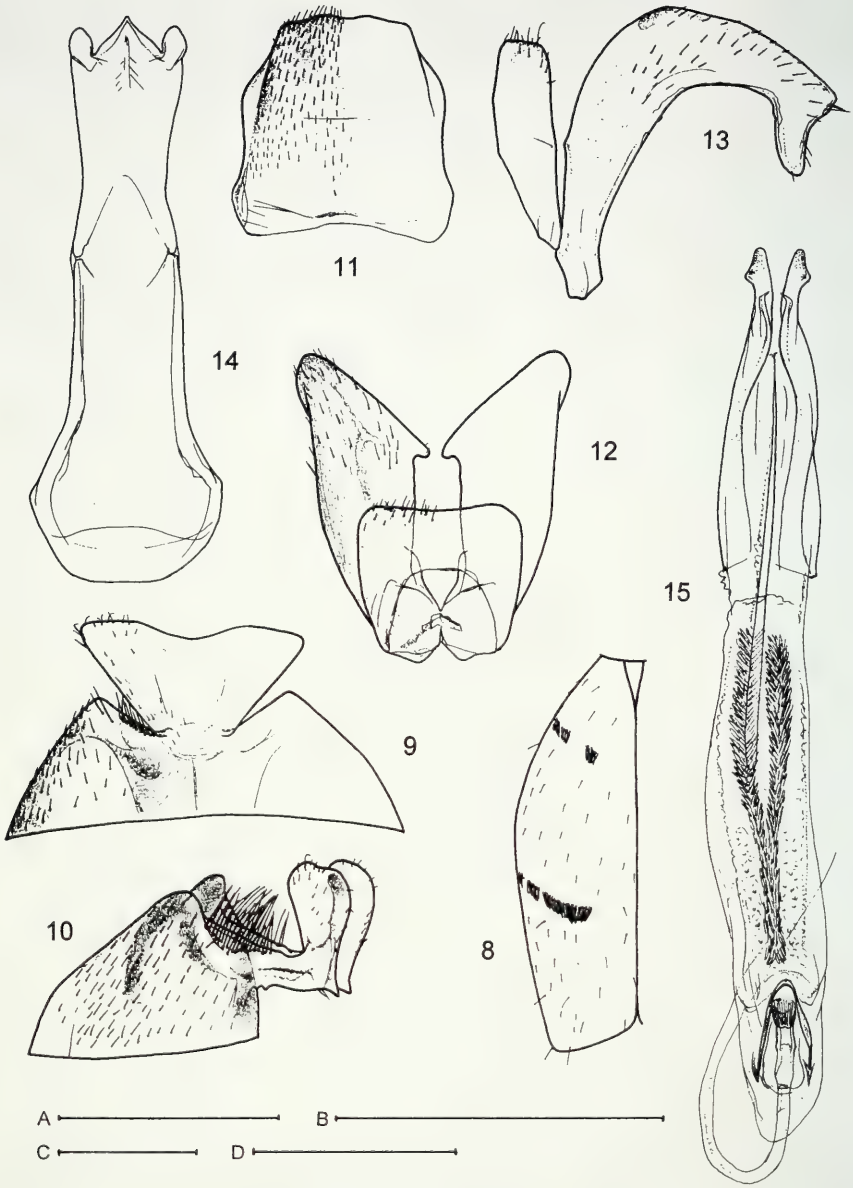
DISTRIBUTION: India (West Bengal).

REMARKS: With respect to the identical sample number, handwritten on the other side of label, all the type specimens from Algarah should bear the same locality data; the altitude "250 m" in a paratype from MHNG is definitely a labeling mistake (G. Cuccodoro, pers. comm.)

Anthelephila besucheti Bonadona, 1989 Figs 16-18

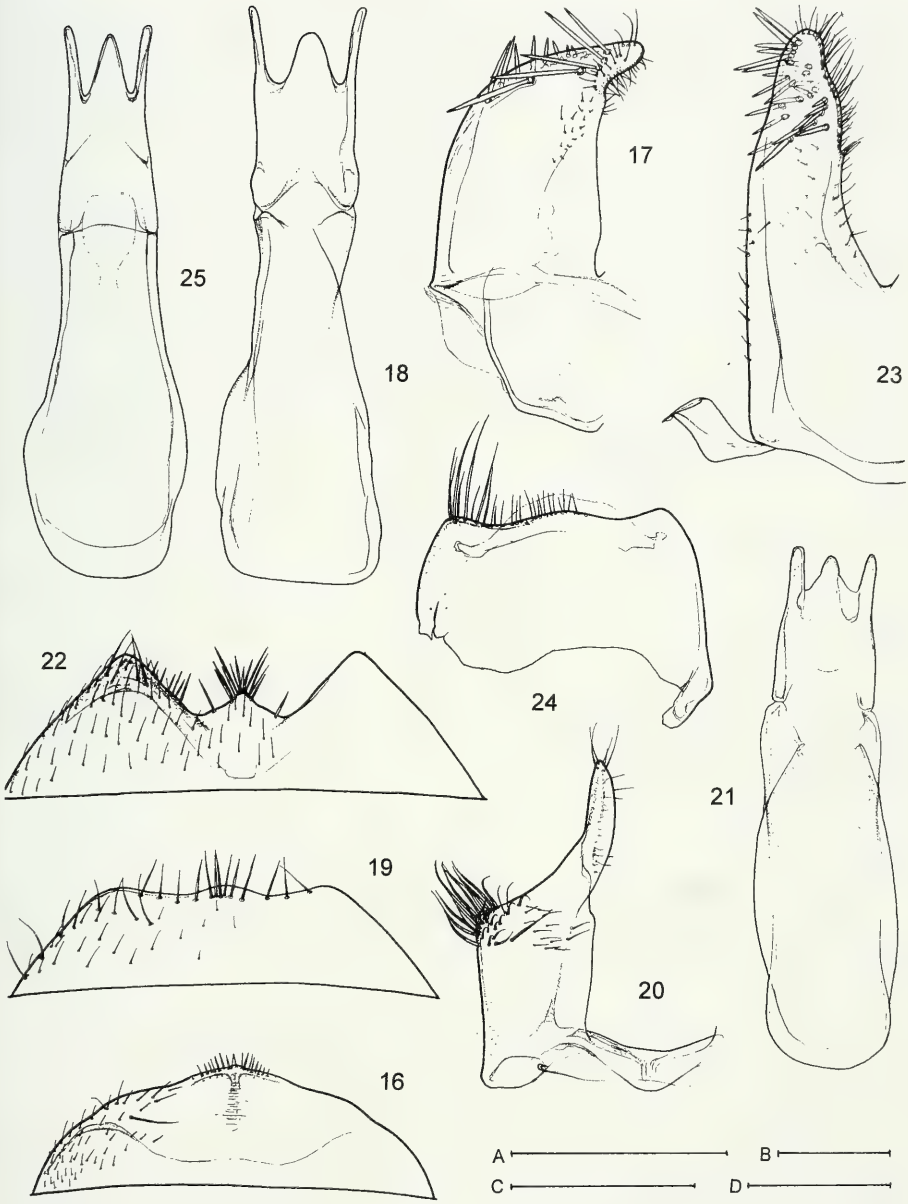
Anthelephilus besucheti Bonadona, 1989: 263, figs 6, 14, 16-18.

TYPE MATERIAL: Holotype ♂, CEYLAN SouthernYala nat. park 24.I.1970 Mussard Besuchet Löbl [p+h] Holotype [p; red label] \ Anthelephilus besucheti nsp. P.Bonadona dét. 1976 [p+h] (MHNG). – Paratypes: 1 ♂, 2 ♀♀, same data as holotype (MHNG, 1 ♀ ZKDC). – 1 ♂,



FIGS 8-15

Anthelephila aratrix sp. n., male: (8) elytron. (9) sternum VII, ventral view. (10) the same, lateral view. (11) tergum VII. (12) segment VIII, dorsal view. (13) the same, lateral view. (14) tegmen. (15) median lobe of aedeagus. Scale (1 mm): A – Fig. 8; (0.5 mm): B – Figs 14, 15, C – Fig. 11, D – Figs 9, 10, 12, 13.



FIGS 16-25

Anthelephila besucheti Bonadona, male: (16) sternum VII. (17) sternite VIII (half). (18) tegmen. *A. cardamontis* sp. n., male: (19) sternum VII. (20) sternite VIII (half). (21) tegmen. *A. irula* sp. n., male: (22) sternum VII. (23) sternite VIII (half). (24) tergite VIII. (25) tegmen. Scale (0.2 mm): A – Fig. 20, B – Fig. 16, C – Figs 17, 18, 23, 25, D – Figs 19, 21, 22, 24.

1 ♀, CEYLAN Northern, Mullaittivu 6.II.70 Mussard Besuchet Löbl [p+h] \ Paratype [p; red label] \ Anthelephilus besucheti nsp. P.Bonadona dét. 1976 [p+h] (MHNG). – 1 ♂, CEYLAN North western Rajakadaluwa 31.I.1970 Mussard Besuchet Löbl [p+h] \ Paratype [p; red label] \ Anthelephilus besucheti nsp. P.Bonadona dét. 1976 [p+h] (MHNG). According to Bonadona (1989), the three paratypes from Yala and Mullaittivu are deposited also in the coll. Bonadona (MNHN; not examined).

REDESCRIPTION: Body length 2.8-3.5 mm (holotype 2.8 mm).

MALE (paratype, Yala): Mesosternum, metasternum and all legs simple. Sternum VII (Fig. 16) nearly simple, slightly produced and bluntly pointed postero-medially, its apical margin with numerous short, stiff setae. Tergum VII moderately widely rounded posteriorly, with apical margin slightly emarginate medially in dorso-caudal view. Sternite VIII (Fig. 17); paired prongs rather simple, dorso-ventrally flattened, conspicuously wide, strongly narrowed, convergent and rounded apically; each prong with five, conspicuously long, thick setae dorsally and about eight shorter, thick setae ventrally, along lateral margin. Tergite VIII simple, its posterior margin rather widely rounded, sparsely setose. Aedeagus (Fig. 18); apical portion of tegmen 0.6 times as long as basal-piece, trilobed apically, middle lobe wide, rounded apically, distinctly shorter and wider than narrow lateral lobes.

FEMALE (paratype, Yala): Externally identical with male, except as follows: both sternum and tergum VII evenly rounded posteriorly, sternum impressed ventro-medially and with apex moderately bent ventrad.

DIFFERENTIAL DIAGNOSIS: *Anthelephila besucheti* is closely related to *A. irula* sp. n. from southern India. For their separation see the key and the differential diagnosis of the latter species.

DISTRIBUTION: Sri Lanka.

Anthelephila cardamontis sp. n. Figs 1, 19-21

TYPE MATERIAL: Holotype ♂, S-INDIA, Kerala state, 10 km SW of Kumily, Vallakadavu vill. env., 77°07'E 9°31'N \ Cardamom hills, alt. ca 1000 m, 24.xii.1993, sifted, Z. Kejval & D. Boukal lgt. (NMPC). – Paratypes: 7 ♂♂, same data as holotype (ZKDC, 1 specim. in MHNG).

ETYMOLOGY: Named after the type locality; composed of cardamom (Cardamom hills Mts.) and Latin montium/montis (mountain ridge).

DESCRIPTION: Body length 3.4-3.8 mm (holotype 3.4 mm).

MALE (holotype): Body rufous, head moderately darker, elytra with two pairs of vaguely outlined, brown black spots (Fig. 1); anterior spots circular, situated at about midlength, distinctly separated from both suture and lateral margins, posterior spots situated apically, slightly touching latero-apical margins; antennae, legs and palpi rufous.

Head: 1.3 times as long as wide, longitudinally oval, nearly evenly rounded posteriorly in dorsal view; posterior temporal angles entirely obsolete. Surface smooth, very glossy; dorsal punctation distinct but rather sparse and uneven. Setation short, mostly subdecumbent, with scattered suberect to erect, slightly longer setae. Eyes medium sized, moderately convex. Antennae rather long, clearly exceeding base of

pronotum, moderately but distinctly enlarged in apical third; antennomere X 1.2 times and antennomere XI 2.1 times as long as wide.

Thorax: Pronotum 1.2 times as long as wide, slightly narrower than head including eyes, unevenly, somewhat widely rounded anteriorly, strongly and nearly straightly narrowing posteriad, and shallowly impressed postero-laterally close before base (not constricted posteriorly in dorsal view); entire dorsal outline of pronotum convex, only slightly impressed close before basal margin; pronotal disc evenly shaped, without longitudinal impressions. Surface largely smooth and very glossy, postero-lateral impression shortly, distinctly wrinkled and this basal corrugation extending also somewhat dorso-laterally; dorsal punctation as on head, somewhat denser mesally. Setation as on head. Both mesosternum and metasternum simple.

Elytra: 1.7 times as long as wide, longitudinally ovoid, strongly convex, narrowed and rather conjointly rounded apically; humeri entirely obsolete; postscutellar impression absent. Surface smooth, very glossy; punctation somewhat finer and distinctly sparser than on head. Setation distinctly longer than on head, and generally more raised, mostly decumbent, with numerous erect setae. Metathoracic wings nearly entirely reduced.

Legs: Penultimate tarsomeres rather narrow, with terminal tarsomere articulated before midlength; all legs simple. Setation normally developed, inconspicuous.

Abdomen: Sternum VII (Fig. 19) rather simple, somewhat truncate and with posterior margin slightly sinuous, sparsely setose, with some longer, mostly scattered stiff setae. Tergum VII narrowed and nearly evenly rounded posteriorly. Sternite VIII (Fig. 20); paired prongs wide and nearly parallel-sided in basal half, angulately protruding laterad at about mid-length and then strongly narrowed and converging, with apex laterally flattened and rounded; surface of prongs finely setose along ventral margin of their apical narrowed portion, and with tuft-like accumulation of longer, stiff setae on/near lateral protrusions. Tergite VIII simple, arcuate, with posterior margin evenly rounded, sparsely setose.

Aedeagus (Fig. 21): Apical portion of tegmen 0.4 times as long as basal-piece, trilobed apically, middle lobe wide basally, strongly narrowing towards blunt apex, slightly shorter than evenly narrow, lateral lobes.

FEMALE: Unknown.

VARIABILITY: Some of the examined specimens are generally more pale in colour and with very fine punctation on the surface (probably teneral specimens).

DIFFERENTIAL DIAGNOSIS: *Anthelephila cardamontis* sp. n. may resemble *A. irula* sp. n. and *A. besucheti* by the evenly sparse punctation of the elytra and the simple metasternum in males. It differs from these species especially by the paler colouration, the presence of dark spots on the elytra, the smooth and glossy surface of both the head and pronotum, and in the morphology and setation of male sternum VII and sternite VIII.

DISTRIBUTION: India (Kerala).

COMMENTS: The specimens were collected by sifting forest litter.

Anthelephila congoana Uhmann, 1981 Figs 26-29, 34

Anthelephilus congoanus Uhmann, 1981: 193, figs 4-9.

TYPE MATERIAL: Holotype ♂, Soil-Zoological Exp. Congo-Brazzaville Sibiti Irho rain forest [p] \ 2.12.1963. No331 beaten in forest leg. Balogh & Ziczi [p] \ Holotypus 1980 Anthelephilus congoanus Uhmann [p+h; red frame] \ Typus [p; red label] \ Anthelephilus congoanus n.sp. det.G.Uhmann 1980 [p] (HNHM). – Paratypes: 1 ♀, 331 [p; bluish label] \ Congo-Exped. d. Inst. Syst. Zool. Budapest 16.X.63. – 21.I.64. Fundort No.: 331 [p+h] \ Sibiti, Irho oil-palm plantat. 2. XII. 1963 leg. Balogh / Zicsi [p+h] \ Para-typus [p; red label] \ Anthelephilus congoanus n. sp. det. G. Uhmann 1980 [p] \ Paratypus 1980 Anthelephilus congoanus Uhmann [p+h; red frame] (DCDC). – 1 ♂, Congo-Exped. d. Inst. Syst. Zool. Budapest 16.X.63. – 21.I.64. Fundort No.: 261 [p+h] \ Sibiti, Irho rain forest K 27.11.1963 leg. Balogh / Zicsi [p+h] \ 261 [p; bluish label] \ Paratypus 1980 Anthelephilus congoanus Uhmann [p+h; red frame] \ Para-typus [p; red label] \ Anthelephilus congoanus n. sp. det. G. Uhmann 1980 [p] (DCDC). – 1 ♂, Soil-Zoological Exp. Congo-Brazzaville Sibiti Irho rain forest \ 26.11.1963. No 249 singled on fallen fruits leg. Balogh & Zicsi \ Paratypus 1980 Anthelephilus congoanus Uhmann \ Para-typus \ Anthelephilus congoanus n.sp. det.G.Uhmann 1980 [p] (HNHM). – 1 ♀, Soil-Zoological Exp. Congo-Brazzaville Kindamba, Méya Bangou forest \ 9.11.1963. No 141 singled fallen fruits in forest leg. Endrödy-Younga [the 3th to 5th label the same] (HNHM). – 2 ♂♂, 2 ♀♀, Soil-Zoological Exp. Congo-Brazzaville Lefinie reservation Nambouli river \ 11.1.1964. No 652 beaten in galery forest leg. Balogh & Ziczi [the 3rd to 5th label the same] (HNHM, ZKDC). – 1 ♀, Congo-Exped. d. Inst. Syst. Zool. Budapest 16.X.63.-21.I.64. Fundort No.: 597 \ Lefinie, Reservat. Namboúli River, 1.7. K. búshes/forest 1964 leg. Balogh/Zicsi \ 597 [the 3th to 5th label the same] (HNHM).

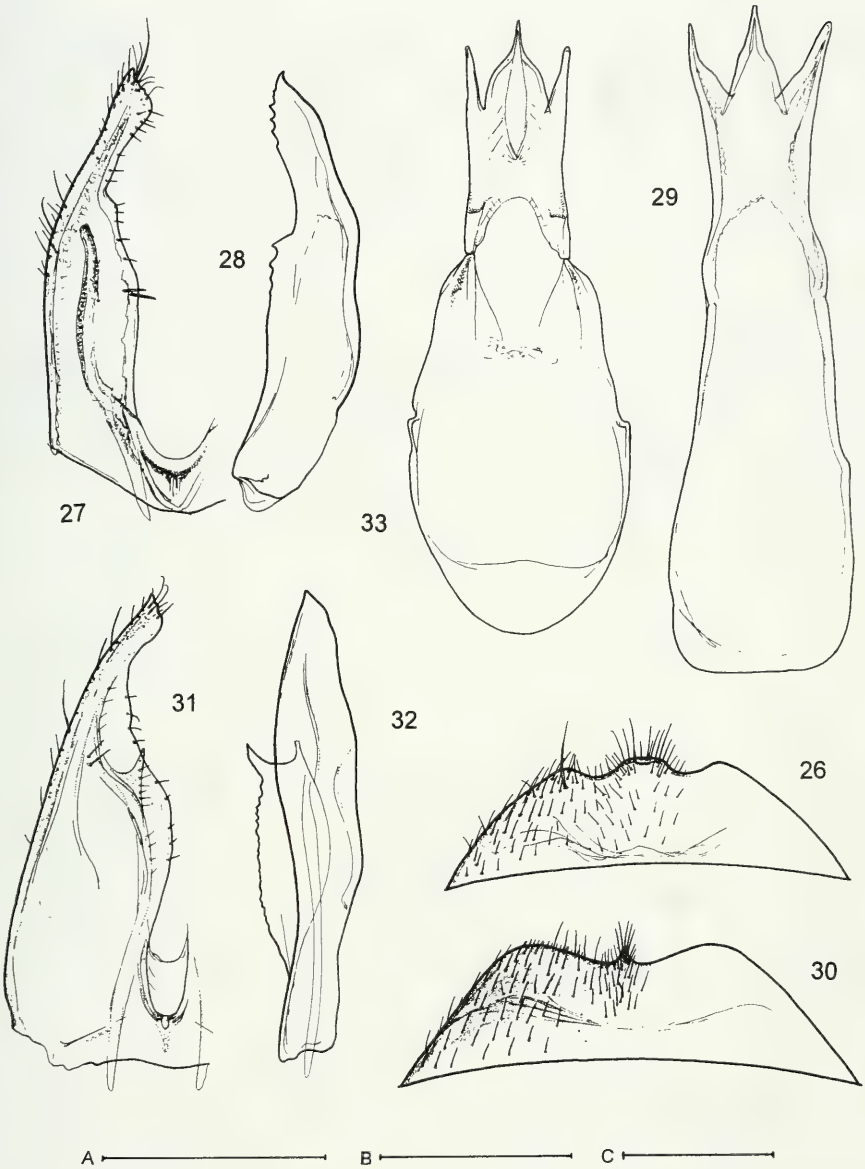
OTHER MATERIAL EXAMINED: 2 ♂♂, 2 ♀♀, Uganda, Ruwenzori Mts., above Bundibugyo, 1300m, 21.V.1993, Cuccodoro & Erne leg. (MHNG, 1 specim. ZKDC). – 1 ♂, Uganda, Ruwenzori, above Kilembe, 1950 m, 4.v.1993, Cuccodoro & Erne leg. (MHNG). – 1 ♀, W-Uganda, SW of Hioma, Rwera env., 30.xi.2001, M. Snížek leg. (ZKDC).

REDESCRIPTION: Body length 3.5-4.3 mm.

MALE (paratype, ZKDC): Mesosternum simple; metasternum with a pair of strong, apically setose protrusions posteriorly, near median margin of metacoxae. All legs simple and normally setose; basal protarsomere enlarged, rather long and wide. Sternum VII (Fig. 26) with posterior margin distinctly sinuous, its middle lobe wider, slightly upturned apically and more lengthily setose. Tergum VII evenly rounded posteriorly. Sternite VIII (Figs 27, 28); prongs rather simple, narrowed and moderately converging distally in dorsal view, their ventral margin/edge coarsely denticulate at about midlength and subapically, apex of prongs somewhat obliquely truncate and pointed; setation of prongs less conspicuous, rather fine and scattered, with some longer setae apically. Tergite VIII with posterior margin moderately emarginate medially. Aedeagus (Fig. 29); apical portion of tegmen 0.8 times as long as basal-piece, trilobed apically, all three lobes narrowing towards apex, middle lobe slightly longer and more pointed.

FEMALE (paratype, DCDC): Externally identical with male, except as follows: metasternum simple, lacking paired protrusions; basal protarsomere of smaller size; sternum VII simple, its posterior margin slightly unevenly rounded and bearing a tuft of dense, longer setae medially; tergum VII (Fig. 34) strongly narrowed, tapering and longer, densely setose apically.

VARIABILITY: Moderately variable in characters of corrugation and micro-sculpure of the head and pronotum. Some of the specimens from Uganda differ in the



FIGS 26-33

Anthelephila congoana Uhmann, male: (26) sternum VII. (27) sternite VIII (half). (28) prong of sternite VIII (outline), lateral view. (29) tegmen. *A. ovipennis* (Bonadona), male: (30) sternum VII. (31) sternite VIII (half). (32) prong of sternite VIII (outline), lateral view. (33) tegmen. Scale (0.2 mm): A – Figs 27, 28, 31, 32, B – Fig. 29, C – Figs 26, 30, 33.

more distinct corrugation of the frontal surface of the head, extending posteriad along median margins of eyes, and/or in the less glossy, finely microsculptured surface of the pronotum, especially on the lateral sides.

DIFFERENTIAL DIAGNOSIS: *Anthelephila congoana* is most closely related to *A. ovipennis*, as suggested especially by the very similar form of male sternite VIII, but differs by the head being somewhat unevenly rounded and slightly produced postero-medially, the simply setose male metatibiae, male sternum VII sinuous apically with a wide middle lobe, male tergite VIII moderately emarginate apically, female sternum VII tapering apically, as well as by some details in morphology of male sternite VIII and the tegmen.

DISTRIBUTION: Zaire, Uganda.

Anthelephila curvitarsis sp. n. Figs 3, 38-43

TYPE MATERIAL: Holotype ♂, S. Afr: Kruger Nat. Pk Pumbe sands 24.12 S - 31.55 E \ 22.11.1994; E-Y: 3063 groundtraps Endrödy, Bellamy \ ground traps with meat bait (TMP). – Paratypes: 1 ♂, same data as holotype (ZKDC); 1 ♀, S. Afr: Little Karoo Gamkaberg, 1000 m 33.44 S - 21.57 E \ 21.12.1993; E-Y: 3069 ground traps, 24 days leg. Endrödy-Younga \ groundtrap with banana bait (TMP). – 1 ♂, 4 ♀♀, SOUTH AFRICA: KZN Tembe Elephant Park, Sihangwane Area 27.02S 32.25E 100 m 03.ii.1996 R. Stals \ Habitat: Sand forest Sieved from forest litter \ National coll. of insects Pretoria, S. Afr. (SANC, 1 ♀ ZKDC).

ETYMOLOGY: Composed from Latin *curvatus* (curved) and tarsus; named in reference to the curved basal protarsomere of the males.

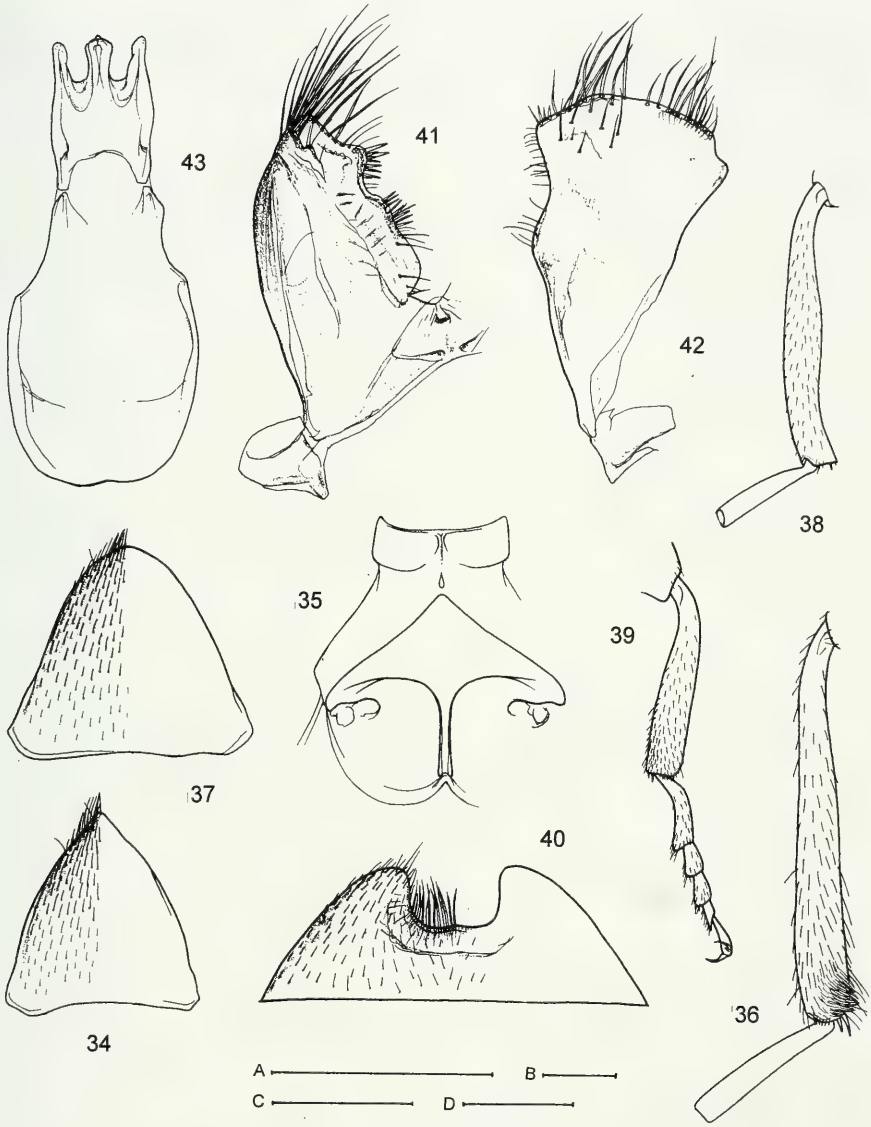
DESCRIPTION: Body length 2.8-3.6 mm (holotype 3.6 mm).

MALE (holotype): Body uniformly black; legs dark brown, base of tibiae and tarsi paler, rufous brown, antennae and palpi dark brown, basal and apical antennomeres slightly paler.

Head: 1.3 times as long as wide, longitudinally oval, with base rather evenly rounded in dorsal view; posterior temporal angles entirely obsolete. Surface with extremely fine, dense, net-like microsculpture and thus only moderately glossy; dorsal punctation distinct, but somewhat obscured by microsculpture, uneven, punctures rather shallow, separated by more than their diameter. Setation inconspicuous, very short, fine, mostly appressed, with few short, erect setae. Eyes small, slightly convex. Antennae moderately exceeding base of pronotum, distinctly enlarged in apical third; antennomere X slightly transverse, 0.95 times as long as wide, antennomere XI 1.4 times as long as wide.

Thorax: Pronotum 1.3 times as long as wide, moderately narrower than head including eyes, evenly round/globose anteriorly in dorsal view, strongly narrowing posteriad and distinctly impressed postero-laterally (constricted posteriorly in dorsal view, Fig. 3); entire dorsal outline of pronotum more or less convex in lateral view; pronotal disc with shallow median longitudinal furrow in anterior and posterior thirds. Surface only moderately glossy, with the same microsculpture as head, bottom of postero-lateral impressions very finely wrinkled; dorsal punctation slightly coarser than on head, especially mesally and dorso-laterally in posterior third. Setation as on head, inconspicuous. Mesosternum simple. Metasternum with a pair of distinct longitudinal protrusions posteriorly, near median margin of metacoxae, their edge covered with brownish, felt-like setation.

Elytra: 1.9 times as long as wide, ovoid, strongly convex, narrowed and truncate apically; humeri entirely obsolete; postscutellar impression absent. Surface some-



FIGS 34-43

(34) *Anthelephila congoana* Uhmann, female tergum VII. *A. ovipennis* (Bonadona), male: (35) mesosternum and adjacent sclerites. (36) metatibia. (37) female tergum VII. *A. curvitarsis* sp. n., male: (38) metatibia. (39) protibia with tarsus. (40) sternum VII. (41) sternite VIII (half). (42) prong of sternite VIII, lateral view. (43) tegmen. Scale (0.2 mm): A – Figs 41, 42, B – Figs 34-39, C – Fig. 43, D – Fig. 40.

what uneven and less glossy; punctation similar, only moderately sparser than on head and pronotum. Setation similar to that on head, very short and inconspicuous, with very vague indication of two transverse bands of slightly thicker, whitish setae. Metathoracic wings almost entirely reduced.

Legs: Penultimate tarsomeres rather narrow, terminal tarsomere subapically in metatarsi; metatibiae moderately sinuous, apically strongly angulately produced on inner side (Fig. 38); basal protarsomere conspicuously long, distinctly curved (Fig. 39). Setation normally developed, inconspicuous.

Abdomen: Sternum III with shallow longitudinal impression postero-medially. Sternum VII (Fig. 40) deeply emarginate posteriorly, its postero-median margin long and densely setose. Tergum VII evenly rounded posteriorly. Sternite VIII (Figs 41, 42): paired prongs short and wide in dorsal view, strongly widened in apical half in lateral view, hollowed dorso-medially, their ventral median margin sinuous and bearing numerous densely spaced, stiff setae, wide apex of prongs conspicuously long and richly setose. Tergite VIII arcuate, nearly evenly rounded posteriorly.

Aedeagus (Fig. 43): Apical portion of tegmen 0.5 times as long as basal-piece, trilobed apically, middle lobe moderately widening towards subtruncate apex and with small apical protuberance, as long as and apically wider than lateral lobes.

Female: Externally identical with male, except as follows: antennae slender, less enlarged distally; metasternum simple, lacking paired protrusions; metatibiae simple, rather straight, basal protarsomere much shorter and straight; sternum III evenly convex, lacking impression; sternum VII simple, its posterior margin quite evenly rounded.

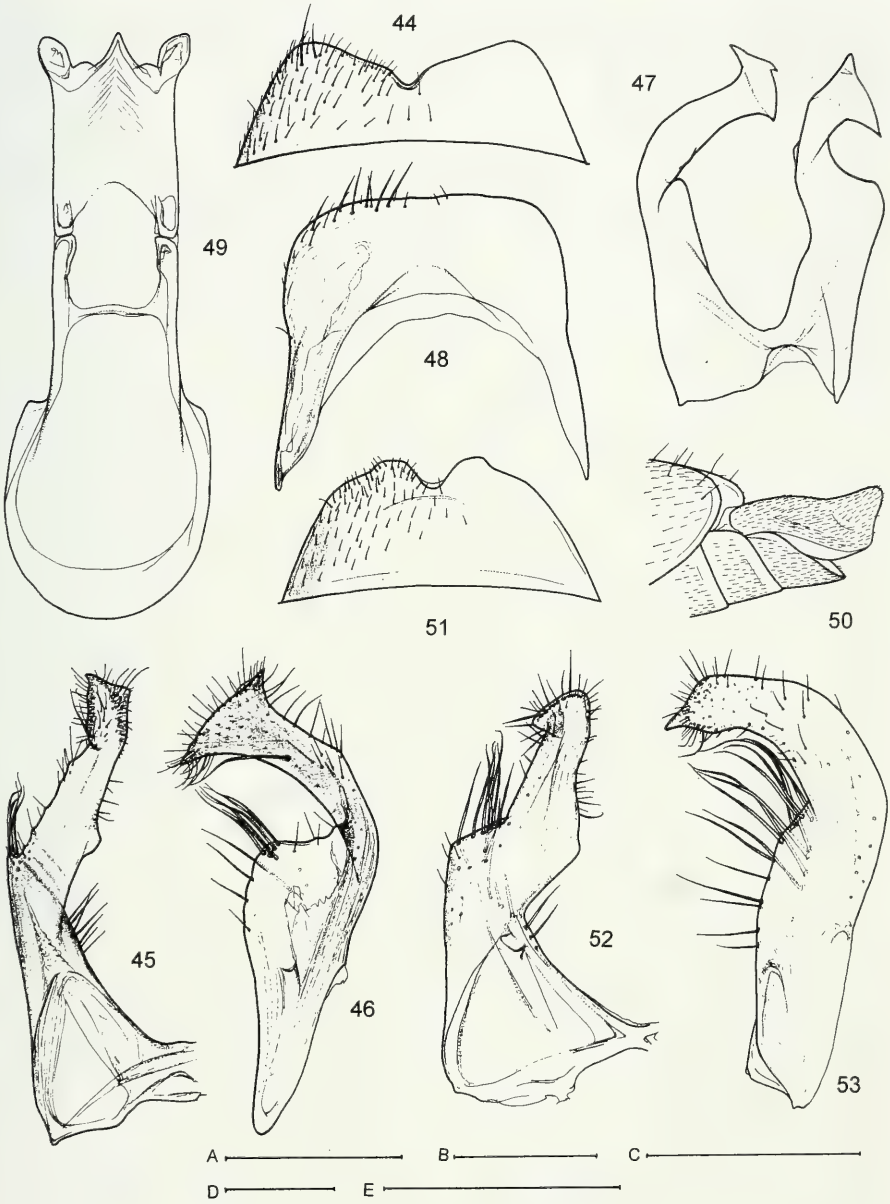
Differential diagnosis: Of the related Afrotropical species, *Anthelephila curvitarsis* sp. n. may resemble *A. congoana* in having a more elongate and posteriorly rather oval head, but differs clearly by the pronotum being strongly impressed postero-laterally and distinctly constricted in dorsal view, and by all the male characters (e.g. long and curved basal protarsomere, moderately sinuous, angulately produced and and simply setose metatibiae apically on inner side, quite different forms of sternum VII and sternite VIII).

Distribution: South Africa.

Anthelephila imperatrix LaFerté-Sénectère, 1849 Figs 2, 6, 7, 44-53

Anthelephilus imperator LaFerté-Sénectère, 1849a: 2, fig. 2.
Anthelephilus imperator LaFerté-Sénectère, 1849b: 66, fig. 2; see Chandler (2000).
Anthelephila imperatrix: Krekich-Strassoldo, 1931: 15, fig. 30.
Anthicus formicarius Nietner, 1856: 533.
Anthicus quisquiliarius Nietner, 1857b: 20.
Anthicus myrmecodes Gemminger, 1870: 123.
Formicomus (*Anthelephilus*) *imperator* var. *ruficolor* Pic, 1916a: 5.
Formicomus cribriceps Marseul, 1876: 459.
Formiconus [sic!] (*Anthelephilus*) *cribriceps*: Miwa, 1931: 180 (misspelling).
Anthelephila cribraceps [sic!]: Hua, 2002: 131 (misspelling).
Formicomus (*Antelephilus* [sic!]) *punctaticeps* Pic, 1916b: 11, **syn. n.**

Type material: *Anthelephilus imperator* – Holotype ♂ [lacking distal antennomeres and foreleg]: 47394 [p] \ Linga Rottg. [h; grey label] \ imperator Laf.*typ. [h; grey label] \ Type [p; reddish label] \ Hist.-Coll. (Coleoptera) Nr. 47394 Anthelephilus imperator Laf. Linga. Roettger Zool. Mus. Berlin [p; yellow label, black frame] (MNHB). *Formicomus punctaticeps* – Syntypes: 1 ♂, Kulu [p] \ type [h; yellowish label] \ TYPE [p; red label] \ Muséum Paris Coll. M. Pic [p] \ Anthelephilus punctaticeps Pic [h] (MNHN). – 1 ♂, Kulu [h] \ Museum Paris Coll. M. Pic [p]. *F. imperator* var. *ruficolor* – Syntypes: 2 ♂♂, Manille ... [h; partly illegible] \ type



FIGS 44-53

Anthelephila imperatrix LaFerté-Sénectère (Indonesia): (44) male sternum VII. (45) male sternite VIII (half). (46) prong of male sternite VIII, lateral view. (47) male sternite VIII, antero-dorso-lateral view. (48) male tergite VIII (49) tegmen. (50) apical portion of female abdomen, lateral view. *A. imperatrix*, male (Japan): (51) sternum VII. (52) sternite VIII (half). (53) prong of sternite VIII, lateral view. Scale (0.2 mm): A – Fig. 49, B – Figs 44-46, 48, C – Figs 52, 53, D – Figs 47, 51; (1 mm): E – Fig. 50.

[h] \ TYPE [p; red label] \ v. ruficolor Pic [h]; 4 specimens, bearing label "Manille" or "Manille Baer", but lacking the type labels (MNHN, coll. Pic). *Formicomus cribriceps* – Syntypes: 1 ♂, 1 ♀ [mounted on common label]: Formicomus cribriceps Japon ... [h; yellowish round label; partly illegible]; 5 specimens, mounted in the same way, but lacking the locality label (all MNHN).

Other material examined: INDONESIA: 2 ♀♀, Sumatra, Aceh-Selatan Prov., Babahrot, 100 m, 7.vii.1983, J. Klapperich leg. (SMNS). – 1 ♀, C Sulawesi, 17 km E Pendolo, 800 m, 120.45.49 E 2.06.33 S 4.-9.vii.1999, Bolm leg. (SMNS). – 3 ♂♂, 3 ♀♀, Lombok, Sembalun Lawang, Mt. Rinjani, 1700 m, 6.-8.ii.1995, Bolm leg. (SMNS, ZKDC). – 1 ♀, Lombok, Senggigi Pemenang, 20.xi.1999, E. Heiss leg. (ZKDC). – 2 ♀♀, Ceram Island, Wahai env., 12.ii.1989, M. Jäch leg. (NHMW). – 5 ♂♂, 2 ♀♀, Sula Islands (E of Sulawesi), Mangole Island, vii.-xii.1977, V. & G. Wegener leg. (NHMB, ZKDC). PHILIPPINES: 1 ♂, 2 ♀♀, Mindanao, Maramag Prov., Portulin, 750 and 1700 m, 3.-4.i.1991, Bolm leg. (NHMB). VIETNAM: 1 ♂, Hanoi, riverbank, 26.ix.1980, F. Hieke leg. (GUPC). – 1 ♂, SE of Hanoi, Yen So, 19.-23.iv.1966, G. Topál leg. (ZKDC). – 3 ♀♀, Da Nang, 2.-3.xi.1970, A. R. Gillogly leg. (GUPC, DCDC). USA (pacific territories): 2 ♂♂, 2 ♀♀, Mariana Islands, Saipan Island, 28.viii.1951, R. M. Bohart leg. (DCDC, ZKDC). – 1 ♀, Saipan Island, vi.1958, N.L.H. Krauss leg. (DCDC). – 1 ♂, 1 ♀, Mariana Islands, Guam Island, Piti, 18.vii.1936, O. H. Swezey leg. (BMNH). – 1 ♀, Guam Island, Yona, 21.iv.1936, E. H. Bryan leg. (BMNH). – 2 ♀♀, Guam Island, Pago Bay, 2.vi.1945, H. S. Dybas leg. (DCDC). – 1 ♀, Guam Island, ca 1.5 km SE of Asan, 180-250 m, 5.xi.1947, H. S. Dybas leg. (DCDC); 1 ♀, Mariana Islands, Tinian Island, 1.-14.iv.1945, H. S. Dybas leg. (DCDC). – 1 ♂, Palau Islands, Koror Island, 24.xi.1947, H. S. Dybas leg. (DCDC). – 2 ♂♂, 1 ♀, Hawaii, Honolulu, Internat. Airport, 19.ii.1968, G. Funasaki leg. (DCDC, GUPC). JAPAN: 3 ♂♂, 2 ♀♀, G. Lewis leg. (BMNH). – 5 ♂♂, 14 ♀♀, Kyushu, Oita, Reitter (NMPC, ZKDC). – 2 ♂♂, 1 ♀, Honshu, Kobe, Harada, 23.ix.1915, J. E. Lewis leg. (BMNH). – 1 ♀, Honshu, Kobe, Hyogo, 18.iv.1931 (NMPC); series of specimens, Honshu, Idzu, vi.1910, S. Akiyama leg. (BMNH). – 1 ♂, 2 ♀♀, Okinawa Island, Motobu Peninsula, W slope of Katsu Dake, ca 800 m, 28.ix.1945, F. G. Werner leg. (DCDC, ZKDC, GUPC). – 1 ♂, 1 ♀, Okinawa, Yogi, Naha, 10.viii.1951, F. G. Werner leg. (DCDC). CHINA: 1 ♂, NE Zhejiang Prov., Chusan [=Zhoushan] Archipelago, Entrance Island, Walker leg. (BMNH). – 1 ♀, N Zhejiang Prov., ca 100 km SW of Shanghai, Haining, Walker leg. (BMNH). – 1 ♀, Fukien Prov., Kuatun, 10.v.1946, Tschung Sen. leg. (SMNS). – 1 ♂, Guangxi Prov., Gul Lin, 30.xii.1981, Rougemont leg. (coll. Bonadona, MNHN). TAIWAN: 1 ♂, Akau, E. Csiki coll. (HNHM). NEPAL: 2 ♂♂, Kathmandu, Baneshwar, 1300 m, 21.-25.vi.1998, W. Schawaller leg. (SMNS, ZKDC). – 1 ♂, same data, except: 1350 m, 20.-21.v.2000 (SMNS). – 1 ♂, Kathmandu valley, Pashupatinath, Bagmati River, 1300 m, 14.x.1992, A. Weigel leg. (NKME). – 1 ♂, 1 ♀, NE of Kathmandu, Gorkana Park, near Bagmati river, 27°43'N 85°23'E, 29.ix.1996, M. Hartman leg. (NKME, ZKDC). – 2 ♂♂, same data, except: 1300-1400 m, 28.v.1997, Grill/Hartmann leg. (NKME). – 6 ♂♂, 3 ♀♀, same data, except: 1280 m, 24.xi.1998 (NKME). – 7 ♂♂, 1 ♀♀, same data, except: 1340 m, 17.vi.1999 (NKME). – 1 ♂, 1 ♀, same data, except: Bagmati riverbank, 1350 m, 15.6.2001, A. Kopetz leg. (NKME). – 4 ♂♂, 2 ♀♀, 6 km SSW of Kathmandu, bank of Taudaha Lake, 27°39'N 85°09'E, 1300 m, 17.vii.2001, M. Hartmann leg. (NKME, ZKDC). – 1 ♂, Dhaulagiri Himal, Kali Gandaki valley, Jhi vill. N Beni, 1750 m, 16.vi.1998, Berndt & Schmidt leg. (ZKDC). – 1 ♂, 1 ♀, Annapurna Mts., S of Ulleri, Ghorepani, 2000 m, 16.vi.1993, Schmidt leg. (ZKDC). – 1 ♀, Kathmandu Prov., Godwari, 1600 m, 31.iii.1984, Löbl leg. (MHNG). – 1 ♀, E-Nepal, Arun valley, Chichila, 1950 m, 31.v.1983, M. Brancucci leg. (NHMB). – 1 ♀, E-Nepal, Biratnagar, 140 m, 21.v.1980, W. Wittmer leg. (NHMB). INDIA: 1 ♂, Meghalaya, Shillong (NHMW). – 3 ♀♀, West Bengal, Nagarkanda, 3.-14.i.1980, G. Topál leg. (GUPC). – 1 ♀, West Bengal, Calcutta, 6.vii.1972, Basel Exped. 1972 (coll. Bonadona, MNHN). – 3 ♂♂, 1 ♀, Orissa, Ganjam Prov., N of Berhampur (=Brahmapur), Kalasandrapur env., 20.-21.ii.1994, Z. Kejval leg. (ZKDC). – 1 ♂, 1 ♀, Uttaranchal, W of Almora, H. G. Champion leg. (BMNH). – 4 ♂♂, 5 ♀♀, Uttaranchal, 22 km N of Rishikesh, 450 m, 30.x.1979, I. Löbl leg. (MNHG, GUPC). – 1 ♂, 3 ♀♀, Uttaranchal, 16 km of Srinagar, 550 m, 29.x.1979, I. Löbl leg. (MNHG, ZKDC). – 26 ♂♂, 29 ♀♀, Uttaranchal, ca 13 km NW of Nainital, Khairna Bridge env., 900-1000 m, 13.-17.vii.2003, Z. Kejval & M. Trýzna leg. (ZKDC). – 8 ♂♂, 16 ♀♀, Uttaranchal, 10 km NE of Rishikesh, Henval river valley, Shivpuri env., ca 450 m, 26.vii.2003,

Z. Kejval & M. Trýzna leg. (ZKDC). – 1 ♂, 4 ♀♀, Uttaranchal, 20 km NE of Rishikesh, Ganga river valley, Kaudiyala env., ca 500 m, 25.-27.vii.2003, Z. Kejval & M. Trýzna leg. (ZKDC). – 1 ♂, Uttaranchal, Haldwani-Kathgodam, ca 800 m, 21.-22.vii.2003, Z. Kejval & M. Trýzna leg. (ZKDC). – 2 ♂♂, 5 ♀♀, Uttaranchal, 30 km N of Rishikesh, NW of Chamba, Arakot env., 1500 m, 29.-31.vii.2003, Z. Kejval & M. Trýzna leg. (ZKDC). – 5 ♂♂, 7 ♀♀, Uttaranchal, 25 km W of Mussoorie, Yamuna river valley, Juido env., ca 750 m, 5.-7.vii.2003, Z. Kejval & M. Trýzna leg. (ZKDC). – 11 ♂♂, 7 ♀♀, Uttaranchal, Dehra Dun, 12.iii.1952, R. N. Kothari leg. (DCDC). – 1 ♀, Uttaranchal, Baijnath, 26.vii.-28.vii.2003, E. Kučera leg. (ADBC). – 8 ♂♂, 5 ♀♀, Uttaranchal, Gangani, 1250 m, 13.-20.vi.1981, M. Brancucci leg. (NHMB). – 1 ♂, 1 ♀, Uttaranchal, Barkot, 1000-1200 m, 5.-12.vi.1981, M. Brancucci leg. (NHMB). – 1 ♀, Rajasthan, SE of Bharatpur, Keoladeo Ghana Nat. Park, 27°09'N 77°31'E, ca 170 m, 6.ix.1985, C. W. & L. B. O'Brien leg. (DCDC). – 1 ♀, 10.-12.viii.1989, Hiermeier leg. (ZKDC). – 14 ♂♂, 16 ♀♀, same locality, 13.-14.vii.2006, Z. Kejval leg. (ZKDC). – 1 ♀, Rajasthan, Udaipur, Sajjan Niwas Gardens, 24°34'N 73°41'E, 600 m, 3.-8.vii.2006, Z. Kejval leg. (ZKDC). – 2 ♂♂, Maharashtra, ca 15 km E of Savantvadi, 15°55'N 75°53'E, riverside, ca 40 m, 22.v.2006, Z. Kejval leg. (ZKDC). – 1 ♂, Goa, Salcete, 13.-16.iv.1990, E. Heiss leg. (ZKDC). – 1 ♂, 1 ♀, Karnataka, Ablathi, 12°17' N 76°06' E, x.1984, W. Lorenz leg. (GUPC). – 2 ♂♂, 3 ♀♀, Kerala, Palghat hills, Malampuzha Dam, 150 m, 27.xi.1972, Besuchet, Löbl & Mussard leg. (MHNG, coll. Bonadona MNHN). – 1 ♀, Kerala, Palghat-Coimbatore, Walayar Forest, 400 m, 23.xi.1972, Besuchet, Löbl & Mussard leg. (MHNG). – 8 ♂♂, 5 ♀♀, Tamil Nadu, Nilgiri hills, 15 km SE of Kotagiri, Kunchappanai env., 76°56' E 11°22' N, ca 900 m, 13.-20.v.1994, Z. Kejval leg. (ZKDC). SRI LANKA: 1 ♂, 1 ♀, Kandy, Mahaweli Ganga riv., 450-500 m, 30.i.-1.ii.1970, Besuchet, Löbl & Mussard leg. (MHNG).– 1 ♂, Nuwara Eliya, 18.ix.1963 (BMNH). – 2 ♂♂, 4 ♀♀, 12.iv.1882, G. Lewis leg. (BMNH). – 2 ♂♂, 1 ♀, Kandy, near Mahaweli Ganga river, 23.iii.1994, Z. Kejval leg. (ZKDC). – 1 ♀, Galle Prov., Habaraduwa, 20.8.-4.9.1982, H. J. Bremer leg. (GUPC). PAKISTAN: 1 ♂, 5 ♀♀, Swat, Col de Karakar, 1300 m, 19.v.1983, Besuchet & Löbl leg. (MHNG). – 2 ♂♂, 7 ♀♀, Swat, Madyan, 1400 m, 16.v.1983, Besuchet & Löbl leg. (MHNG). – 1 ♂, 3 ♀♀, Swat, Jowar, 1100 m, 19.v.1983, Besuchet & Löbl leg. (MHNG). – 1 ♂, Swat, Manglaur, 1150 m, 9.v.1983, Besuchet & Löbl leg. (MHNG). – 1 ♂, 2 ♀♀, Hazara, Balakot, 900 m, 4.vi.1983, Besuchet & Löbl leg. (MHNG). – 4 ♂♂, 2 ♀♀, Dir, Dir, 1500 m, 20.v.1983, Besuchet & Löbl leg. (MHNG). – 2 ♂♂, 1 ♀, Punjab, Rawalpindi, Ayub Nat. Park, 28.viii.1985, C. W. & L. B. O'Brien leg. (DCDC, ZKDC). – 1 ♂, Punjab, Rawal Lake Dam, 1.ix.1965, C. W. & L. B. O'Brien leg. (DCDC).

REDESCRIPTION: Body length 2.7-3.7 mm.

MALE (Indonesia, Lombok, ZKDC): Head and pronotum rufous; elytra largely rufous brown, with rufous base; legs, basal antennomeres and palpi rufous.

Head: 1.1 times as long as wide, globose, evenly to somewhat widely rounded posteriorly; posterior temporal angles indistinct, rounded. Eyes small, moderately convex. Surface smooth, glossy, conspicuously punctured; dorsal punctures large and rather shallow, unevenly spaced, separated mostly by less than their diameter, at places sparser, especially postero-medially. Setation evenly short, mostly subdecumbent to appressed, with sparsely scattered, short erect setae. Antennae short, slightly exceeding base of pronotum, moderately enlarged in apical third; antennomere X slightly, 1.1 times, and antennomere XI 1.7 times as long as wide.

Thorax: Pronotum 1.3 times as long as wide, much narrower than head including eyes, moderately widely rounded anteriorly, strongly narrowing posteriad and distinctly impressed postero-laterally (constricted) in dorsal view (Fig. 2); dorsal outline of pronotum convex in anterior two thirds, then impressed and distinctly bulging before base in lateral view (Fig. 6); pronotal disc anteriorly with conspicuous median longitudinal impression/groove, apex of antebasal bulge vaguely divided medially by shallow median impression. Surface smooth, glossy, posterior constriction

of pronotum distinctly wrinkled laterally to dorso-laterally; dorsal punctation uneven, generally much finer and sparser than on head, more distinct at dorsal, convex places alonside longitudinal impression, while bottom of impression appears to be nearly impunctate. Setation as on head. Both mesosternum and metasternum simple.

Elytra: 1.7 times as long as wide, convex, clearly truncate apically; humeri entirely obsolete; postscutellar impression absent. Surface glossy; punctation uneven, ordinary punctures generally much finer and sparser than on head; in addition with fine, densely spaced, nearly contiguous punctures forming two paired oblique bands (Fig. 2); anterior bands narrow, situated in basal third, directing postero-mediad from lateral sides, posterior bands situated shortly behind mid-length, wider, more conspicuous, directing antero-mediad from lateral sides. Setation mostly as short as on head, subdecumbent to appressed, with scattered longer, erect setae, mostly pale, with setae of dense punctures contrastingly whitish, thicker, quite appressed and forming distinct setose bands. Metathoracic wings almost entirely reduced.

Legs: Penultimate tarsomeres rather narrow, terminal tarsomere rather subapical in metatarsi; all legs simple. Metatibiae rather distinctly and densely punctured, especially on inner side; setation normally developed, slightly denser and more raised on metatibiae.

Abdomen: Sternum VII (Fig. 44) truncate posteriorly, its posterior margin nearly straightly sloping towards small median notch/impression in ventral view. Tergum VII with posterior margin nearly evenly rounded, surface subapically somewhat more convex and with indication of rounded, median longitudinal edge. Sternite VIII (Figs 45, 46); paired prongs narrow in dorsal view, with lobe-like dilatation in basal half ventrally in lateral view, arcuately curved ventrad in apical half, truncate and axe-like shaped apically in lateral view, their apical widened portion with three points/ protrusions (Fig. 47); surface of prongs with several longer, stiff setae at apex of ventral dilatation. Tergite VIII (Fig. 48) simple, widely rounded posteriorly.

Aedeagus (Fig. 49). Apical portion of tegmen 0.5 times as long as basal-piece, parallel-sided, trilobed apically, middle lobe nearly evenly narrowing towards bluntly pointed apex, about as long as apically wider, rounded lateral lobes.

Female (Indonesia, Lombok, ZKDC): Externally identical with male, except as follows: sternum VII simple, evenly rounded posteriorly; tergum VII clearly modified (Fig. 50), projecting medially, subapically, and forming conspicuous, laterally flattened process, exceeding apical margin of tergum, surface of tergum alongside subapical process distinctly impressed.

Variability: Body colouration varies from rufous to brown black. Head globose to slightly widely rounded posteriorly in dorsal view, its dorsal surface may be smooth to somewhat uneven, shallowly longitudinally wrinkled anteriorly. Humeri clearly protruding and metathoracic wings fully developed in the six specimens from Meghalaya (Shillong), Uttaranchal (16 km of Srinagar) and Rajasthan (Keoladeo Ghana Nat. Park).

Distinctly variable in male/female abdominal characters. Male tergum VII often with more or less distinct median subapical protrusion. Process of female tergum VII of different size and form; inconspicuous, forming rather rounded edge in the

specimens from Japan, Taiwan and China; more or less protruding in the specimens from Nepal (differences even within the same locality sample); female tergum VII strongly tapering, evenly shaped without any median, subapical process/edge in the specimens from Rajasthan (Keoladeo Ghana Nat. Park). Morphology of male sternum VII and sternite VIII varies in details extremely as follows; the specimens from Japan and Taiwan: sternum VII deeply emarginate/notched postero-medially, lateral sides of emargination moderately lobed (Fig. 51), paired prongs of sternite VIII less dilated in basal half, their apical portion simple, moderately enlarged and then narrowing towards pointed apex (Figs 52, 53); the specimens from Nepal: postero-median emargination/notch of sternum VII less conspicuous and its postero-lateral sides rather evenly rounded, paired prongs of sternite VIII distinctly dilated in basal half, dorsal margin of their apical portion with minute pointed angle to distinctly projecting process; the specimens from Rajasthan (Keoladeo Ghana Nat. Park): sternum VII evenly emarginate and rounded posteriorly, paired prongs of sternite VIII less dilated in basal half, their apical portion simple, nearly evenly narrowing towards pointed apex.

DIFFERENTIAL DIAGNOSIS: *Anthelephila imperatrix* is very conspicuous in having the deeply longitudinally impressed and posteriorly clearly constricted pronotum, large, globose and rather coarsely punctured head, and whitish setose bands on the elytra. It shares this combination of characters only with *A. aratrix* sp. n., and differs by the characters given in the description of the latter species and in the key.

DISTRIBUTION: Recorded from Indonesia (Uhmann, 1988), Philippines (Pic, 1903, 1916a), India (Krekich-Strassoldo, 1931; Uhmann, 1983, 1987; Telnov, 2003), Bangladesh (Bonadona, 1978), Laos, Vietnam, Sri Lanka, Nepal and Pakistan (Uhmann, 1983, 1987, 1988, 1989; Telnov, 2003), Japan: Honshu, Shikoku, Kyushu, Tsushima and Ryukyu Islands (Nomura, 1962; Werner, 1965; Sakai, 1989; Lafer, 1996; mostly as *F. cribriceps*), China: Zhejiang, Fukien and Guangxi Prov. (Uhmann, 1988, as *F. cribriceps*), Taiwan (Krekich-Strassoldo, 1913; Miwa, 1931; Uhmann, 1983; Hua, 2002; mostly as *F. cribriceps*) and from the USA and Japanese territories in the Pacific Ocean: Bonin, Volcano, Mariana, Caroline and Palau Islands (Blair, 1942; Werner, 1965).

COMMENTS: Nietner (1856) described *Anthicus formicarius* from Sri Lanka and later (Nietner, 1857) proposed replacement name, *A. quisquiliarius*, because of homonymy with *A. formicarius* LaFerté-Sénectère, 1849. Gemminger (1870) overlooked this fact and proposed for the same reasons another replacement name, *A. myrmecodes*. Both former names were synonymized with *Anthelephilus imperator* by Krekich-Strassoldo (1913).

Having studied the type specimens of *Formicomus imperator* var. *ruficolor* and *F. punctaticeps*, I failed to find any significant differences from *A. imperatrix* and I believe them to be identical. The former taxon was first placed in synonymy with *A. imperatrix*, without any comments, by Telnov (2003). All the examined specimens of *Anthelephilus* (or *Anthelephila*) *punctaticeps*, listed for India, Nepal and Bhutan by Uhmann (1986, 1987, 1990a) and Telnov (2003), were found to be misidentified; they form a part of the type series of *Anthelephila kresli* sp. n., *A. lobulicula* sp. n., and *A. sculpta* sp. n.

Formicomus cribriceps was described by Marseul (1876) based on specimens from Japan ("Nagasaki et Hiogo") collected by M. G. Lewis. It was synonymized with *Anthelephilus imperator* by Krekich-Strassoldo (1913), who found the specimens from Indonesia, Sri Lanka, Taiwan and Japan identical, showing only differences in colouration. This synonymy was followed by Winkler (1927) and Telnov (2003), and ignored by Miwa (1931), Nomura (1962), Sakai (1989), Lafer (1996), and Hua (2002). In his check-list of Japanese insects, Sakai (1989) listed both *Anthelephila imperatrix* and *A. cribriceps*, based on the differences between specimens from "Japan proper" and the Japanese island territories in the Pacific Ocean, treated as *Anthelephilus imperator* by Werner (1965) (M. Sakai, pers. comm.). In my opinion, the examined specimens of *A. imperatrix* from Japan, Taiwan, China (= *F. cribriceps*), and especially those from Rajasthan (Keoladeo Ghana Nat. Park) show detailed but distinct differences in male/female abdominal characters from the typical form. Despite this, I have refrained from treating them as separate taxa (most likely as geographical subspecies), mainly because of the variation of these characters observed in the specimens from Nepal, and lack of material from China and the riverbasins of the Ganges and Brahmaputra in India.

Based on label data of the examined specimens, *A. imperatrix* has been collected by sweeping grasses, sifting garbage-heap, forest leaf litter, in decaying coconut logs and under washed up plant material. In India, I found it locally quite common on/near various rooting, vegetable matter, especially near riverbanks. Considering its aptery, comparatively less conspicuous variation of the male characters and distribution of the related species, *A. imperatrix* is very probably a native of the Asian mainland, and most of its island occurences, especially in the case of Micronesia and Hawaii, are to be regarded as rather recent introductions.

Anthelephila irula sp. n. Figs 22-25

TYPE MATERIAL: Holotype ♂, S-INDIA, Tamil Nadu state, Nilgiri hills, 15 km SE of Kotagiri, Kunjappanai env., 76°56'E 11°22'N, ca 900m, 22-30.v.1999, Z. Kejval & M. Trýzna lgt. (NMPC). Paratypes: 7 ♂♂, 8 ♀♀, same data as holotype (ZKDC, 1 specim. each in BMNH, MHNG, MNHN, NHMB, SMNS, DCDC, GUPC). – 1 ♂, Tamil Nadu, 15 km SE of Kotagiri, Kunchappanai env., 76°56'E 11°22'N \ Nilgiri hills, alt. 900 m, 17.-28.xi.1993, D. Boukal & Z. Kejval lgt. (ZKDC).

ETYMOLOGY: Named after Irulas, one of the original tribes inhabiting Nilgiri hills.

DESCRIPTION: Body length 2.6-3.6 mm (holotype 3.4 mm).

MALE (holotype): Head and pronotum rufous brown; elytra largely brown black, with rufous brown base, suture, lateral margins and with very vaque indication of paler transverse spot in basal third; legs rufous brown, tarsi slightly paler, antennae and palpi rufous, apical 2-3 antennomeres slightly paler.

Head: 1.2 times as long as wide, evenly rounded posteriorly in dorsal view; posterior temporal angles obsolete. Eyes small to medium-sized, moderately convex. Surface smooth, distinctly but rather sparsely punctured, very glossy; dorsal punctures unevenly spaced, separated mostly by about twice their diameter or sparser. Setation comparatively long and raised, subdecumbent to decumbent, evenly long, with

sparsely scattered erect setae. Antennae rather short, at most moderately exceeding base of pronotum, distinctly enlarged in apical third; antennomere X slightly, 1.1 times, antennomere XI 1.6 times as long as wide.

Thorax: Pronotum as long as wide, as wide as head including eyes, rather widely rounded anteriorly, strongly narrowing posteriad and shallowly impressed postero-laterally before base in dorsal view (not constricted); entire dorsal outline convex in lateral view; pronotal disc evenly shaped, without impressions. Surface conspicuously sculptured dorsally, smooth and glossy only antero-laterally (near procoxal cavities) and dorso-medially before base; dorsal side largely rather coarsely and densely corrugated; postero-lateral impressions coarsely, longitudinally wrinkled, with rather dorso-laterally situated wrinkles passing into dorsal corrugation; dorsal punctation similar to that on head, but mostly obscured by corrugation. Setation as on head, less raised setae rather subdecumbent; about four erect setae on each side antero-laterally more conspicuous and they appear to be articulated on minute protuberances, slightly protruding from lateral outline in dorsal view. Both mesosternum and metasternum simple.

Elytra: 1.7 times as long as wide, strongly convex, narrowed and conjountly rounded apically in dorsal view; humeri entirely obsolete; postscutellar impression absent. Surface smooth, sparsely punctured, very glossy; punctation as coarse as on head but much sparser, interspaces seem to be extremely finely and sparsely punctured. Setation rather evenly long, distinctly longer than on head, mostly suberect, with sparsely scattered, erect setae. Metathoracic wings almost entirely reduced.

Legs: Penultimate tarsomeres rather narrow, with terminal tarsomere articulated before midlength; all legs simple. Setation normally developed, moderately longer and denser on inner side of metatibiae.

Abdomen: Sternum VII (Fig. 22) deeply emarginate posteriorly, with short and wide median process, bearing dense, stiff setae apically. Tergum VII simply rounded posteriorly, its apical margin slightly emarginate medially. Sternite VIII (Fig. 23); paired prongs simple, dorso-ventrally flattened, rather straightly projecting, rounded apically; each prong, excepting fine setation of median margin, with numerous long and thick setae in apical third (about 17 ventrally and 5 dorsally). Tergite VIII (Fig. 24) somewhat truncate posteriorly, its posterior margin moderately sinuous and with several long setae laterally.

Aedeagus (Fig. 25): Apical portion of tegmen 0.6 times as long as basal-piece, nearly parallel-sided, trilobed apically, middle lobe wider, evenly narrowing towards rounded apex, slightly shorter than evenly narrow lateral lobes.

FEMALE: Externally identical with male, except as follows: sternum VII simple, rather evenly rounded posteriorly; tergum VII evenly rounded posteriorly.

VARIABILITY: Slightly variable in colouration and characters of corrugation; paler spots in basal third of elytra mostly quite indistinct; dorsal surface of head in several specimens slightly corrugated mesally and near median margins of eyes; dorsal corrugation of pronotum somewhat variable in its extent, always prominent mesally.

DIFFERENTIAL DIAGNOSIS: *Anthelephila irula* sp. n. differs from the closely related *A. besucheti* by largely the smooth and more distinctly punctured surface of the

head, moderately convex lateral subapical margins and rounded apices of the elytra, male abdominal sternum VII deeply emarginate posteriorly and with a distinct median process (cf. Figs 16, 22), prongs of male sternite VIII longer and narrower, rather straightly projecting (cf. Figs 17, 23), and male tergite VIII somewhat truncate posteriorly, with posterior margin moderately sinuous and longer setose.

DISTRIBUTION: India (Tamil Nadu).

COMMENTS: The specimens were collected near a stream in 1999, in plant debris on a sandy bank and in gaps between large stones.

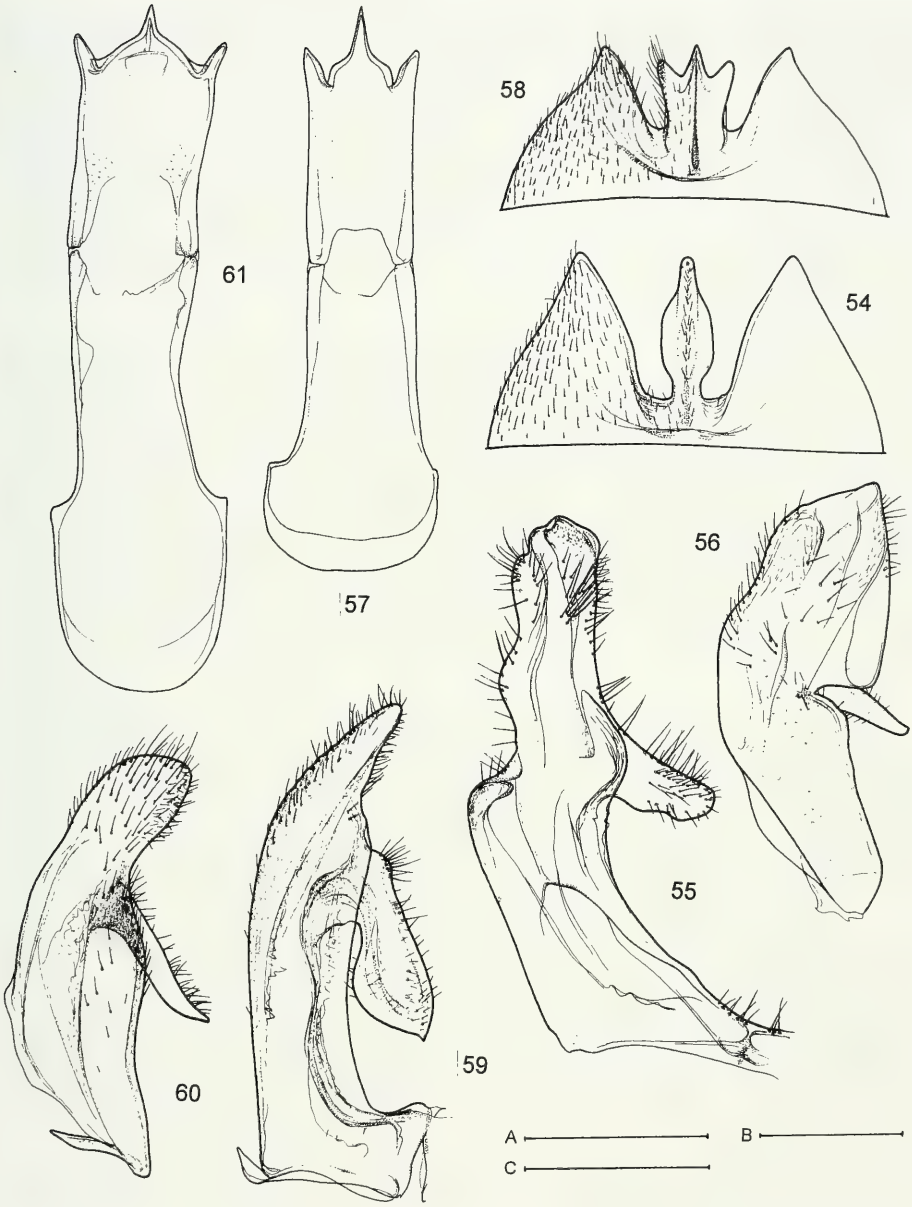
***Anthelephila kresli* sp. n.** Figs 54-57, 62

TYPE MATERIAL: Holotype ♂, NEPAL, 27.v.1999 Kathmandu, Swayambunath stupa, P. Kresl lgt. (NMPC). – Paratypes: 1 ♂, same data as holotype (ZKDC). – 1 ♂, W-NEPAL, Dhawalagiri Myagdi Distr., Kali-Gandaki Khola, 1100-1400m, Tatopani Probst, 27/28.6.1986 [yellow frame] \ Anthelephilus punctaticeps (Pic) det.G.Uhmann 1988 (ZKDC). – 1 ♂, W-NEPAL, Buri Gandaki Macha Khola-Kholabenesi 1650m, 29.5.-4.6. leg. Probst 1990 [yellow frame] \ Anthelephilus punctaticeps (Pic) det.G.Uhmann 1990 (ZKDC). – 1 ♀, E-NEPAL, Dhankuta Arun Valley, Lamobagar Gola 27.5.-3.6.1980, 1000-14000 m leg. C. Holzschuh (ZKDC). – 1 ♂, NEPAL-Expeditionen Jochen Martens \ 246 Gorkha Dist., Darondi Khola unterhalb Barpak bis Doreni 1100-900m Waldreste 12Aug83 Martens & Schawaller \ Senckenberg-Museum Frankfurt/Main \ Anthelephilus punctaticeps (Pic) det.G.Uhmann 1984 (SMF). – 3 ♂♂, 4 ♀♀, Nepal420 Kathmandu Distr. Kathmandu-Baneshwar 1350 m, 18.IV.1995, Martens & Schawaller \ Anthelephilus punctaticeps (Pic) det.G.Uhmann 1996 (SMNS, 1 specim. in GUPC). – 1 ♂, 2 ♀♀, 583 NEPAL: Kathmandu Baneshwar 1300 m, 21.-25:IV.1998 leg. W. Schawaller \ Anthelephilus punctaticeps (Pic) det.G.Uhmann 2000 (SMNS). – 1 ♂, Nepal444 Mustang Distr. Kali Gandaki, Dana 1500-1300 m, 14.V.1995 Martens & Schawaller \ Anthelephilus punctaticeps (Pic) det.G.Uhmann 1996 (SMNS). – 1 ♀, Nepal447 Myagdi Distr. Mahabhir to Beg Khola 1100-1050 m, 15.V.1995 Martens & Schawaller \ Anthelephilus punctaticeps (Pic) det.G.Uhmann 1996 (SMNS). – 1 ♀, Nepal449 Myagdi Distr. Beg Khola village to Bega 1050-1650 m, 16.V.1995 Martens & Schawaller \ Anthelephilus punctaticeps (Pic) det.G.Uhmann 1996 (SMNS). – 1 ♀, 210 Dhading Dist., unter Samari Banjyang, 1000 - 1300 m, 23 Juli 83, kulturland Martens & Schawaller leg. \ Anthelephilus punctaticeps (Pic) det.G.Uhmann 1984 (GUPC). – 2 ♂♂, 1 ♀, NEPAL, Prov. Bagmati Kathmandu, Bagmati nr. Gorkhana Park 27°43'N; 85°20'E 1340 m NN, 17.VI.1999 leg. A. Weigel \ Sammlung Naturkundemuseum Erfurt \ Anthelephila punctaticeps (Pic) det. D. Telnov, 2000 (NKME, 1 specim. in ZKDC). – 1 ♂, NEPAL Kathmandu Swayambhunath Templehügel 24.VI.1997 leg. A. Weigel \ Anthelephilus punctaticeps (Pic) det. G. Uhmann 1998 (ZKDC). – 1 ♂, NEPAL, Kathmandu, N Bagmati River, 1300 m NN, 06.VI.1995 leg. M. Hartmann \ Anthelephilus punctaticeps (Pic) det. G. Uhmann 1996 (NKME). – 1 ♂, NEPAL Kathmandu, N Safaripark, Mauer 06.VI.1995 1300 m Ü.NN leg. A. Weigel \ Anthelephilus punctaticeps (Pic) det. G. Uhmann 1996 (NKME). – 1 ♀, NEPAL oc. 1300 m Kathmandu NW, Balaju Vishnumati River, 17.VI.1999 leg. A. Weigel \ Sammlung Naturkundemuseum Erfurt \ Anthelephila punctaticeps (Pic) det. D. Telnov, 2000 (NKME). – 1 ♂, Indien Darjeeling D. Bhakta B. \ Pedong 23-28.III.87 \ Anthelephila punctaticeps Pic det. D. Telnov, 1999 (NHMB).

ETYMOLOGY: Dedicated to Petr Kresl (Spůle, Czech Republic), collector of the holotype.

DESCRIPTION: Body length 3.7-4.6 mm (holotype 4.0 mm).

MALE (holotype): Head brown black; pronotum largely dark rufous brown, distinctly darkened, nearly brown black with slight rufous tinge dorsally; elytra dark brown to brown black, with rufous brown base, lateral margins, and with indication of two pairs of vague, narrow, paler bands (their location identical with that of the setose



FIGS 54-61

Anthelephila kresli sp. n., male: (54) sternum VII. (55) sternite VIII (half). (56) prong of sternite VIII, lateral view. (57) tegmen. *A. lobulicula* sp. n., male: (58) sternum VII. (59) sternite VIII. (60) prong of sternite VIII, lateral view. (61) tegmen. Scale (0.2 mm): A – Figs 55, 59, 61, B – Figs 56, 57, 60; (0.5 mm): C – Figs 54, 58.

bands, see below); antennae rufous brown basally, becoming darker, brown black in apical third, palpi brown black; legs largely brown black, basal narrowed portion of femora rather contrastingly yellowish to pale rufous, tarsi rufous brown.

Head: 1.2 times as long as wide, somewhat unevenly rounded posteriorly, with base slightly produced medially in dorsal view; posterior temporal angles entirely obsolete. Surface smooth, conspicuously punctured, glossy; dorsal punctures rather coarse, unevenly spaced, separated mostly by about their diameter, at places denser, sparser posteriorly. Setation fine, mostly subdecumbent, with sparsely scattered, somewhat longer, erect setae. Eyes small, rather convex. Antennae moderately exceeding base of pronotum, weakly enlarged in apical third; antennomere X 1.4 times, antennomere XI 2.2 times as long as wide.

Thorax: Pronotum 1.3 times as long as wide, moderately narrower than head including eyes, evenly rounded anteriorly, distinctly narrowing posteriad and rather shallowly impressed postero-laterally in dorsal view; entire dorsal outline convex in lateral view; pronotal disc with very slight indication of shallow, median longitudinal impression in anterior third. Surface smooth, conspicuously punctured, glossy, postero-lateral impression at most very shortly, inconspicuously wrinkled; punctation as on head, rather evenly coarse, covering the whole surface (including lateral sides), somewhat sparser laterally, near procoxal cavities, and postero-dorsally. Setation as on head, erect longer setae more numerous. Mesosternum simple. Metasternum with a pair of distinct, apically setose protuberances postero-medially, near median margin of metacoxae.

Elytra: 1.7 times as long as wide, strongly convex, subtruncate apically, with elytral apices separately rounded; humeri entirely obsolete; postscutellar impression absent. Surface smooth, distinctly punctured, glossy; punctation uneven, ordinary punctures generally much finer and mostly sparser than on head, especially in apical third; additionally with densely spaced, nearly contiguous punctures, forming two paired bands, touching neither lateral margins nor suture; anterior bands situated in basal third, narrow to interrupted, more oblique, directing postero-mediad from lateral sides, posterior bands situated shortly behind mid-length, more conspicuous, wider, narrowing towards suture, transverse to slightly oblique antero-mediad from lateral sides. Setation mostly as short as on head, subdecumbent, with scattered, long, erect setae (somewhat longer than erect setae of head); setation mostly pale, setae of dense punctures contrastingly whitish, thicker, nearly appressed, forming distinct setose bands, some whitish, more raised setae scattered near base. Metathoracic wings almost entirely reduced.

Legs: Rather robust; penultimate tarsomeres narrow, terminal tarsomere rather subapical in metatarsi; metatibiae somewhat uneven on inner side just beyond mid-length. Setation normally developed.

Abdomen: Sternum VII (Fig. 54) with posterior margin very deeply emarginate and with conspicuous median process, about as long as lateral lobes of emargination; median process wide, laterally flattened, with rounded dorsal and sharper ventral longitudinal edge, its apex curved ventrad and bluntly pointed. Tergum VII subtruncate posteriorly, with rounded postero-lateral angles, and shallowly impressed subapically. Sternite VIII (Figs 55, 56); paired prongs robust, strongly widened in distal half in

lateral view, with conspicuous, long and wide, flattened process ventro-medially at about mid-length, surface of prongs uneven, variously buckled, their lateral sides with several gibbosities in dorsal view. Tergite VIII (Fig. 62) nearly parallel-sided in dorsal view, distinctly, widely emarginate posteriorly, its postero-ventral side somewhat produced and exceeding median part of emargination in dorsal view; rounded lateral lobes of emargination long and rather densely setose.

Aedeagus (Fig. 57): Apical portion of tegmen 0.8 times as long as basal-piece, parallel-sided, trilobed apically, middle lobe wide basally, abruptly narrowed, elongated and rather sharply pointed apically, much exceeding narrower and bluntly pointed lateral lobes.

FEMALE: Externally identical with male, except as follows: metasternum simple, lacking paired protrusions; metatibiae narrower and rather straight; sternum VII simple, evenly rounded posteriorly; tergum VII evenly rounded posteriorly, shallowly impressed and with short, median longitudinal edge subapically.

VARIABILITY: Rather variable in colouration; some specimens darker coloured with both pale bands of elytra indistinct, in contrast other specimens paler coloured as follows: both head and pronotum dark rufous brown, elytra with basal third (as far as anterior band), both lateral margins and suture, and posterior transverse bands rufous brown, legs brown, nearly basal half of antennae rufous brown. The paratype from Dhankuta district (ZKDC) with rounded, but protruding elytral humeri and well developed metathoracic wings.

DIFFERENTIAL DIAGNOSIS: *Anthelephila kresli* sp. n. is related to *A. lobulicula* and *A. sculpta* spp. n., as suggested by the similar form of male sternite VIII (paired prongs with large process ventro-medially). It differs from *A. lobulicula* sp. n. by its robust appearance, wider and coarsely punctured pronotum, simple (not trilobed) apex of the median process of male sternum VII, and by numerous details in morphology of the male sternite and tergite VIII (cf. Figs 55, 56 and 59, 60). See the differential diagnosis of the latter species and the key for its separation from *A. sculpta* sp. n.

DISTRIBUTION: Nepal, India (West Bengal).

***Anthelephila lobulicula* sp. n.** Figs 58-61, 63

TYPE MATERIAL: Holotype ♂, NEPAL-Expeditionen Jochen Martens \ 344 Taplejung Distr., confluence of Kabeli Khola and Tada Khola, 1000-1000 m, mixed broad-leaved forest, 23.-25.Apr 88 Martens & Schawaller \ Anthelephilus punctaticeps (Pic) det.G.Uhmann1989 (SMNS).

ETYMOLOGY: Composed from Latin *lobulus* (small lobe) and *culus* (posterior, abdomen); named in reference to the form of male abdominal sternum VII.

DESCRIPTION: Body length 3.6 mm.

MALE (holotype): Head and pronotum black; elytra black, with brownish base and brownish tinge in apical third; antennae and palpi brown black, basal antennomeres rufous brown; legs largely brown black to black, basal narrowed portion of meso- and metafemora pale yellowish, tarsi rufous brown.

Head: 1.1 times as long as wide, somewhat unevenly rounded posteriorly, with base slightly produced medially; posterior temporal angles entirely obsolete. Surface

smooth, glossy, distinctly punctured, with some shallow wrinkles anteriorly on frons; dorsal punctation uneven, punctures mostly coarse, separated by about their diameter, finer and more widely spaced near base. Setation mostly rather short, subdecumbent, with sparsely scattered, slightly longer, erect setae. Eyes small, moderately convex. Antennae moderately exceeding base of pronotum, only slightly enlarged in apical third; antennomere X 1.3 times, antennomere XI 2.1 times as long as wide.

Thorax: Pronotum 1.7 times as long as wide, distinctly narrower than head including eyes, evenly rounded anteriorly, distinctly narrowing posteriad and rather sharply impressed postero-laterally in dorsal view; entire dorsal outline convex in lateral view, strongly convex before midlength; pronotal disc with weak median longitudinal impression at about midlength. Surface smooth, glossy, somewhat less distinctly punctured, postero-lateral impressions finely wrinkled; dorsal punctation much finer and sparser than on head. Setation as on head. Mesosternum simple. Metasternum with a pair of distinct, apically setose protrusions postero-medially, near median margin of metacoxae.

Elytra: 1.7 times as long as wide, convex, truncate apically; humeri entirely obsolete; postscutellar impression absent. Surface smooth, glossy, less distinctly punctured; punctures generally nearly as fine as on pronotum, unevenly spaced, mostly sparser than on head and pronotum; additionally with very densely spaced, nearly contiguous punctures, forming paired bands/patches, touching neither lateral margins nor suture; anterior band composed more likely of two small, narrowly connected patches of dense punctures, situated in basal third, directed obliquely postero-mediad from lateral sides, posterior band situated shortly behind mid-length, more conspicuous, with small patch of dense punctures, narrowly separated medially. Setation rather evenly long, moderately longer than on head, mostly decumbent to suberect, with sparsely scattered, erect setae; setation mostly fine and pale, setae of dense punctures contrastingly whitish, thicker, subdecumbent to appressed, forming distinct setose bands. Metathoracic wings almost entirely reduced.

Legs: Penultimate tarsomeres rather narrow, terminal tarsomere rather subapical in metatarsi; all legs simple. Setation normally developed.

Abdomen: Sternum VII (Fig. 58) with posterior margin very deeply emarginate and with conspicuous median process, about as long as lateral lobes of emargination; median process wide, distinctly trilobed apically, its ventral side over the whole length with keel-like median edge. Tergum VII rounded posteriorly, its apical margin slightly emarginate medially. Sternite VIII (Figs 59, 60); paired prongs robust, moderately arcuate in dorsal view, with conspicuous, flattened, fin-like process ventro-medially at about mid-length, apical portion of prongs simple, rounded apically, rather evenly setose. Tergite VIII (Fig. 63) nearly parallel-sided, subtruncate and moderately emarginate posteriorly, with postero-ventral margin somewhat produced.

Aedeagus (Fig. 61): Apical portion of tegmen 0.6 times as long as basal piece, nearly parallel-sided, trilobed apically, middle lobe conspicuously wide basally, strongly narrowed, elongated and sharply pointed apically, moderately exceeding narrow, apically rounded and moderately divergent lateral lobes.

FEMALE: Unknown.

DIFFERENTIAL DIAGNOSIS: *Anthelephila lobulicula* sp. n. shares the similar general form of male sternite VIII with *A. kresli* and *A. sculpta* spp. n., but differs by the slender appearance, less distinct punctation of the pronotum (dorsal punctures much finer than those on head), and in the male characters.

DISTRIBUTION: Nepal.

***Anthelephila ovipennis* (Bonadona, 1984)** Figs 30-33, 35-37

Formicomus (*Anthelephilus*) *ovipennis* Bonadona, 1984: 486, figs 23, 28-30.

TYPE MATERIAL (not examined): Holotype, ♂, CONGO: Belin \ Anthelephilus ovipennis (coll. Pic, MNHN). – Paratypes: 4 specim., Kivu, territoire Uvira, Mulenge, 2010 m, vestige de forêt ombrophile, récolté dans lhumus, V.1951 (N. Leleup leg.) \ A. ovipennis Pic (coll. Pic, MNHN). – 2 specim., Kivu: Tshibinda, XI.1932 (L. Burgeon leg.) \ Formicomus près subfasciatus \ Anthelephilus ovipennis (coll. Pic, MNHN).

OTHER MATERIAL EXAMINED: 1 ♂, ZAIRE, Kivu, Irangi, 800 m, 22.ii.1985, H. Mühle leg. (ZKDC). – 4 ♂♂, 1 ♀, RUANDA, Pref. Cyangugu, Nyakabuye env., 17.ii.1985, H. Mühle leg. (GUPC, ZKDC). – 3 ♂♂, 5 ♀♀, same locality, but different dates: 12.-19.vii.1984, 28.xi.1984, 22.iii.1985, 3.x.1985 or 19.xii.1985 (GUPC, ZKDC).

REDESCRIPTION: Body length 3.2-4.1 mm.

MALE (Ruanda, ZKDC): Mesosternum simple; metasternum with a pair of robust, apically setose protrusions postero-medially, near median margin of metacoxae. Metatibiae rather stout distally, with small patch/tuft of short, thicker, yellowish rufous, laterad pointing setae and numerous long, finer, pale setae on inner side subapically (Fig. 36); basal protarsomere enlarged, rather long and wide. Sternum VII (Fig. 30) moderately emarginate posteriorly and with small, bluntly pointed median process, bearing several longer setae apically; dorsal side of median process with short longitudinal edge. Tergum VII evenly rounded posteriorly. Sternite VIII (Figs 31, 32); prongs wide, strongly narrowed in apical third in dorsal view, their apex somewhat obliquely truncate and pointed; ventral side of prongs with longitudinal, distally abruptly shortened slat/lobe, its outer edge finely denticulated and terminating distally in robust, pointed process; setation less conspicuous, rather fine and sparse, with scattered longer setae laterally and apically. Tergite VIII simple, arcuate, evenly rounded posteriorly. Aedeagus (Fig. 33); apical portion of tegmen 0.6 times as long as basal-piece, parallel-sided, trilobed apically; middle lobe wide basally, strongly narrowed at about midlength, elongated and pointed apically, exceeding narrow, apically rounded, lateral lobes.

FEMALE (Ruanda, ZKDC): Externally identical with male, except as follows: metasternum simple, lacking paired protrusions; basal protarsomere smaller, narrow; metafemora narrower distally, uniformly simply setose; sternum VII simple, somewhat unevenly rounded posteriorly, and with a tuft of long, stiff setae apically; tergum VII subtriangular, rounded and with longer, dense stiff setae apically (Fig. 37).

DIFFERENTIAL DIAGNOSIS: *Anthelephila ovipennis* is closely related to *A. congoana*, as suggested especially by the very similar form of the prongs of male sternite VIII, but differs by the head being rather evenly rounded posteriorly, the male metatibiae subapically with a small patch of short, dense, yellowish rufous setae on

inner side, male sternum VII shallowly emarginate posteriorly and with a small, bluntly pointed median process, male tergite VIII evenly rounded apically, female tergum VII rather rounded apically, as well as by some details in morphology of male sternite VIII and the tegmen.

DISTRIBUTION: Zaire, Ruanda, Uganda.

COMMENTS. As stated by Bonadona (1984), he found the types of *Formicomus ovipennis* in the collection of Maurice Pic (MNHN) and described this species using a Pic's manuscript name.

***Anthelephila sculpta* sp. n.** Figs 4, 64-68

TYPE MATERIAL: Holotype ♂, INDIA Meghalaya Khasi Hills 5.XI. Nongpoh 700m Besuchet-Löbl 78 [1978; p] \ Anthelephilus punctaticeps (Pic) det.G.Uhmann 1986 (MHNG). – Paratypes: 5 ♂♂, 5 ♀♀, same data as holotype (6 specim. in MHNG, 4 specim. in ZKDC). – 1 ♂, 1 ♀, INDIA Assam Manas 200m 23.X.78 Besuchet-Löbl [p] \ Anthelephilus punctaticeps (Pic) det.G.Uhmann 1986 (MHNG, GUPC). – 1 ♂, same data, except: 22.X.78 (GUPC). – 1 ♂, INDIA W. Bengal Darjeeling dist. Teesta 250m 10.X.1978 Besuchet Löbl \ Anthelephilus punctaticeps (Pic) det.G.Uhmann 1986 (MHNG). – 1 ♂, BHUTAN 1981 Bhakta B. \ Phuntsholing 2/400 m 3.IX. \ Anthelephila punctaticeps Pic det. D. Telnov, 1999 (NHMB).

ETYMOLOGY: From Latin *sculptilis* (carved, sculptured); named in reference to the coarse sculpture of the head and pronotum.

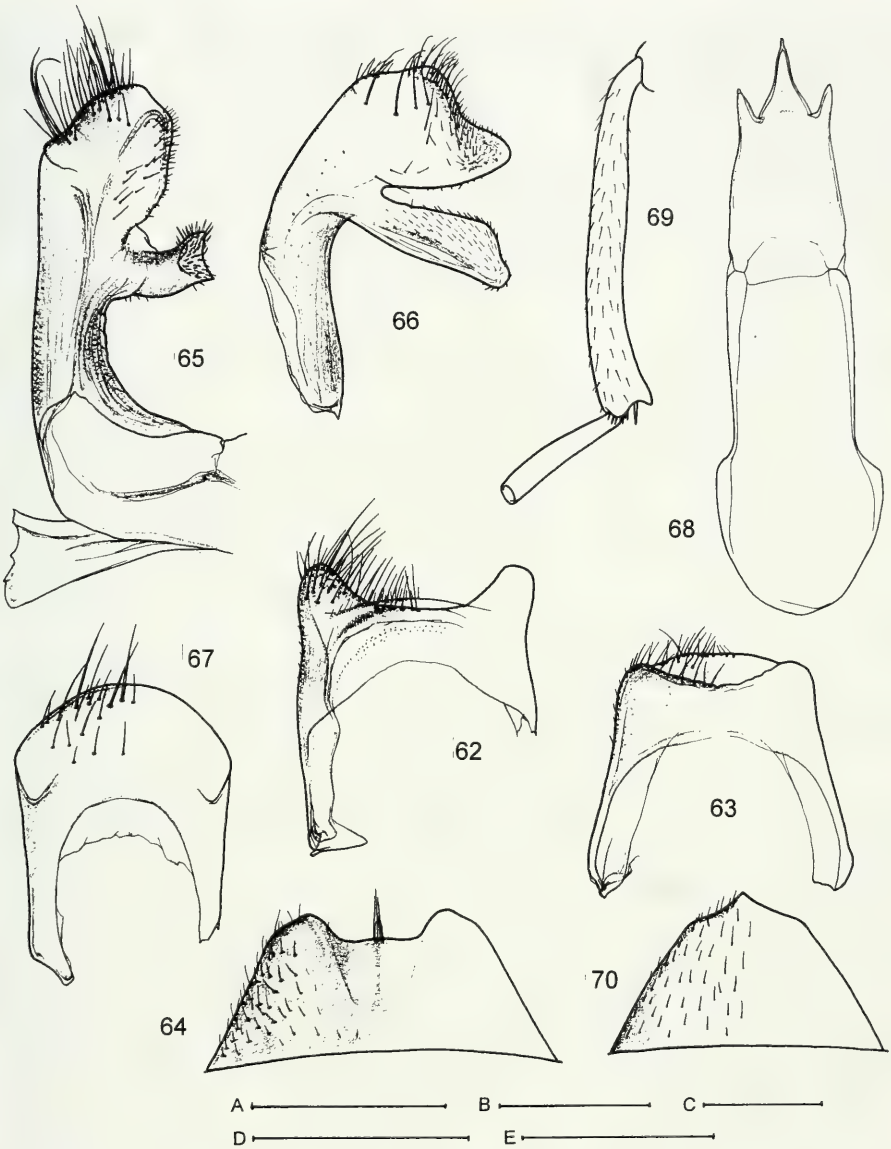
DESCRIPTION: Body length 3.9-4.3 mm.

MALE (holotype): Head and pronotum rufous brown; elytra dark rufous brown, with vague indication of two narrow, paler bands (their location identical with that of setose bands, see below); antennae and palpi rufous; legs brown with rufous tinge, basal narrowed portion of femora pale rufous, tarsi rufous brown.

Head: 1.2 times as long as wide, somewhat unevenly rounded posteriorly, with base slightly produced medially in dorsal view; posterior temporal angles entirely obsolete. Surface less glossy, very coarsely and rather evenly sculptured, including ventral side; punctures situated in deep, pit-like impressions, dorsal impressions narrowly separated, at places nearly contiguous. Setation moderately long, subdecumbent to decumbent, with few distinctly longer, erect setae. Eyes small, rather convex. Antennae rather short, slightly exceeding base of pronotum, moderately enlarged in apical third; antennomere X 1.2 times, antennomere XI 1.9 times as long as wide.

Thorax: Pronotum 1.3 times as long as wide, only slightly narrower than head including eyes, regularly rounded anteriorly, distinctly narrowed and shallowly impressed postero-laterally in dorsal view; entire dorsal outline convex in lateral view; pronotal disc with very slight indication of median longitudinal impression close before midlength (obscured by coarse sculpture). Surface characters as on head, pit-like impressions rather evenly covering the whole surface, including unwrinkled postero-lateral impressions. Setation as on head, long erect setae somewhat more numerous. Mesosternum simple. Metasternum with a pair of distinctly protruding, apically setose protrusions postero-medially, near median margin of metacoxae.

Elytra: 1.7 times as long as wide, strongly convex, narrowed, subtruncate to nearly conjointly rounded apically in dorsal view; humeri entirely obsolete; post-



FIGS 62-70

Male tergite VIII: (62) *Anthelephila kresli* sp. n. (63) *A. lobulicula* sp. n. *A. sculpta* sp. n., male: (64) sternum VII. (65) sternite VIII. (66) prong of sternite VIII, lateral view. (67) tergite VIII. *A. subtruncata* (Pic), male: (69) metatibia. (70) sternum VII. Scale (0.2 mm): A – Fig. 65, B – Figs 66, 68, C – Figs 62-64, 67; (0.5 mm): D – Fig. 70, E – Fig. 69.

scutellar impression absent. Surface smooth, glossy, distinctly punctured; punctation uneven, ordinary punctures rather coarse, sparse in basal half, becoming finer and even sparser posteriad; additionally with densely spaced, nearly contiguous punctures,

forming paired, transverse to moderately oblique bands/patches; anterior band composed more likely of two separated patches of dense punctures, situated in basal third, posterior band situated shortly behind mid-length, more conspicuous, with small, narrowly separated patch of dense punctures antero-medially. Setation mostly distinctly longer than on head, decumbent to suberect, with sparsely scattered, erect setae; ordinary setae fine and pale, setae of dense punctures contrastingly whitish, thicker and blunt, nearly appressed, forming distinct setose bands (Fig. 4), some whitish setae scattered also along suture in basal and apical third and between setose bands laterally. Metathoracic wings almost entirely reduced.

Legs: Robust; penultimate tarsomere rather narrow, terminal tarsomere subapical in metatarsi; metatibiae somewhat swollen, with longitudinal, strongly protruding ridge on inner side in distal half. Setation rather more distinct, metatibiae conspicuously long setose.

Abdomen: Sternum VII (Fig. 64) with posterior margin distinctly emarginate and with small tuft of longer setae medially. Tergum VII evenly rounded posteriorly. Sternite VIII (Figs 65, 66); paired prongs rather robust, laterally flattened in distal half, with conspicuous, long and wide, flattened process ventrally close behind midlength; surface of prongs largely bare, densely setose and with numerous long setae in apical portion, median side of ventral process densely short setose. Tergite VIII (Fig. 67) simple, its posterior margin somewhat unevenly rounded, with slight lateral angle, with some longer setae scattered postero-medially.

Aedeagus (Fig. 68): Apical portion of tegmen 0.7 times as long as basal-piece, moderately narrowed and trilobed apically, middle lobe wide basally, nearly evenly narrowing towards pointed apex, much exceeding short lateral lobes.

FEMALE: Externally identical with male, except as follows: metasternum simple, lacking paired protrusions; metatibiae lacking longitudinal inner ridge; sternum VII simple, evenly rounded posteriorly; tergum VII flattened to shallowly impressed and with short, median longitudinal edge subapically.

DIFFERENTIAL DIAGNOSIS: *Anthelephila sculpta* sp. n. appears to be related to *A. kresli* sp. n. and *A. lobulicula* sp. n., as suggested by the similar general form of male sternite VIII (prongs with large process ventro-medially). It can be easily recognized by the coarse sculpture of the head and pronotum, male metatibia with longitudinal inner ridge, male sternum VII less deeply emarginate posteriorly and lacking median process, and by numerous details in other male characters.

DISTRIBUTION: India (Meghalaya, West Bengal, Assam), Bhutan.

***Anthelephila subtruncata* (Pic, 1899)** Figs 69-74

Formicomus (*Anthelephilus*) *subtruncatus* Pic, 1899: 105.

TYPE MATERIAL: Syntypes: 1 ♀, type [h; yellowish label] \ Type [p; red label] \ Museum Paris Coll. M.Pic [p; blue label] \ F. subtruncatus Pic [new label, not Pic's handwritting] (MNHN). – 1 ♂, [h; illegible] \ Af aus^{le} [h; = Afrique australe, see Comments] \ Museum Paris Coll. M. Pic [p; blue label] (MNHN).

OTHER MATERIAL EXAMINED: 1 ♂, 3 ♀♀, South Africa, N of Port Elizabeth, Dunbrody, 8.i., 6.ii. or 10.ii.1903 (coll. Pic, MNHN; BMNH). – 1 ♀ [nearly completely damaged], South Africa, S of Grahamstown, Boknes, 10.i.1948, J. C. vanHille leg. (coll. Pic, MNHN). – 1 ♂,

2 ♀♀, South Africa, Cape Prov., Somerset East, 23.-31.xii.1930, R. E. Turner leg. (BMNH, 1 specim. in ZKDC). – 2 ♀♀, same data, except: x.1930 (BMNH). – 1 ♀, South Africa, East Cape Prov., Katberg, xii.1932, R. E. Turner leg. (BMNH). – 2 ♂♂, South Africa, East Cape Prov., Kasouga, 30.x.1977, J. C. vanHille leg. (DCDC). – 1 ♀, South Africa, Eastern Cape, Alexandria-Woody Cape, 10.-13.xii.1997, I. Jeniš leg. (ZKDC). – 1 ♀, South Africa, Eastern Cape Prov., Woodi Cape Nat. Reserve near Alexandria, 28.xi.-1.xii.2000, S. Bečvář leg. (ADBC). – 3 ♂♂, 10 ♀♀, South Africa, E Cape Prov., Grahamstown, 19.v.1946, W. E. Collett leg. (AMGS). – 1 ♀, same locality, 12.iii.1953, H. D. Brown leg. (AMGS). – 1 ♂, 2 ♀♀, South Africa, E Cape Prov., Hogsback, xii.1959, J. C. van Hille leg. (AMGS, ZKDC). – 1 ♂, 2 ♀♀, same locality, 30.ix.1947, E. Rogers leg. (AMGS). – 1 ♀, South Africa, E Cape Prov., Kasouga, i.1940 (AMGS). – 1 ♂, South Africa, E. Cape Prov., Dunbrody, x.1902, J. O'Neil leg. (AMGS). – 2 ♂, South Africa, E Cape Prov., Keurboons river, iv.1944, Bester & Collett leg. (AMGS).

REDESCRIPTION: Body length 2.9-3.9 mm.

MALE (syntype): Dark brown to brown black, nearly unicoloured.

Head. 1.2 times as long as wide, somewhat unevenly, slightly widely rounded posteriorly in dorsal view; temporal angles indistinct, entirely rounded. Surface with fine, dense microsculpture and thus less glossy, somewhat uneven in anterior half on frons, distinctly punctured; dorsal punctures unevenly spaced, separated mostly by about twice their diameter. Setation short, mostly subdecumbent to appressed, with few short, erect setae. Eyes small, at most moderately convex. Antennae distinctly exceeding base of pronotum, moderately enlarged in apical third; antennomere X 1.2 times and antennomere XI 1.9 times as long as wide.

Thorax: Pronotum 1.2 times as long as wide, moderately narrower than head including eyes, nearly evenly rounded anteriorly, strongly narrowing posteriad and distinctly, rather sharply impressed postero-laterally (constricted) in dorsal view; entire dorsal outline of pronotum convex in lateral view; pronotal disc with indication of median longitudinal impression/furrow in anterior half and posteriorly before base. Surface with dense microsculpture and thus less glossy, similarly as in head, in addition uneven, longitudinally corrugated postero-dorsally; bottom of postero-lateral impressions microsculptured (without coarse wrinkles) and adjacent basal area distinctly punctured; dorsal punctation similar to that on head. Setation as on head. Mesosternum simple. Metasternum with a pair of conspicuously projecting, apically pointed protrusions postero-medially, near median margin of metacoxae.

Elytra: 1.6 times as long as wide, strongly convex, narrowed and subtruncate apically; humeri entirely obsolete; postscutellar impression absent. Surface smooth, distinctly punctured, glossy; punctation mostly sparser and finer than on head, especially in apical third, at places moderately denser (posterior setose band, see below). Setation similar to that on head, at most slightly longer, appressed, with scattered short erect setae, mostly pale, some appressed setae whitish and thicker, forming two vague, transverse bands, situated in basal third and shortly behind midlength of elytra, some whitish setae scattered also laterally and near base. Metathoracic wings strongly reduced.

Legs: Penultimate tarsomeres rather narrow, terminal tarsomere subapical in metatarsi; mesofemora slightly dilated on inner side subapically (Fig. 71); mesotibiae slightly bent and rather stout; metatibiae enlarged and curved distally, with inner apical margin projecting into blunt process, with single apical spine (Fig. 69). Setation mostly normally developed; mesofemora and mesotibiae on inner side with numerous, conspicuously long, raised setae (Fig. 71).

Abdomen: Sternum VII (Fig. 70) nearly simple, triangular and apically pointed posteriorly. Tergum VII evenly rounded posteriorly. Sternite VIII (Figs 72, 73); paired prongs simple, wide, strongly narrowed and moderately converging apically in doral view, their apex curved ventrad and with robust dent-like process on ventral side subapically; setation of prongs rather short and scattered, inconspicuous. Tergite VIII simple, with posterior margin rounded and slightly emarginate medially.

Aedeagus (Fig. 74): Apical portion of tegmen 0.6 times as long as basal-piece, trilobed apically, apical lobes nearly identical, wide basally and nearly evenly narrowing towards blunt apex.

FEMALE: Externally identical with male, except as follows: metasternum simple, lacking paired protrusions; middle legs simple, uniformly short setose; metatibiae narrow, simple, lacking subapical process, and with two apical spines; sternum VII with posterior margin evenly rounded apically.

VARIABILITY: Some specimens from Somerset East with head more distinctly wider than pronotum, surface of pronotum more glossy, unwrinkled postero-dorsally, with fine corrugation indistinct, and with dorsal, median longitudinal impression of pronotum either rather distinctly or only slightly indicated anteriorly behind collar.

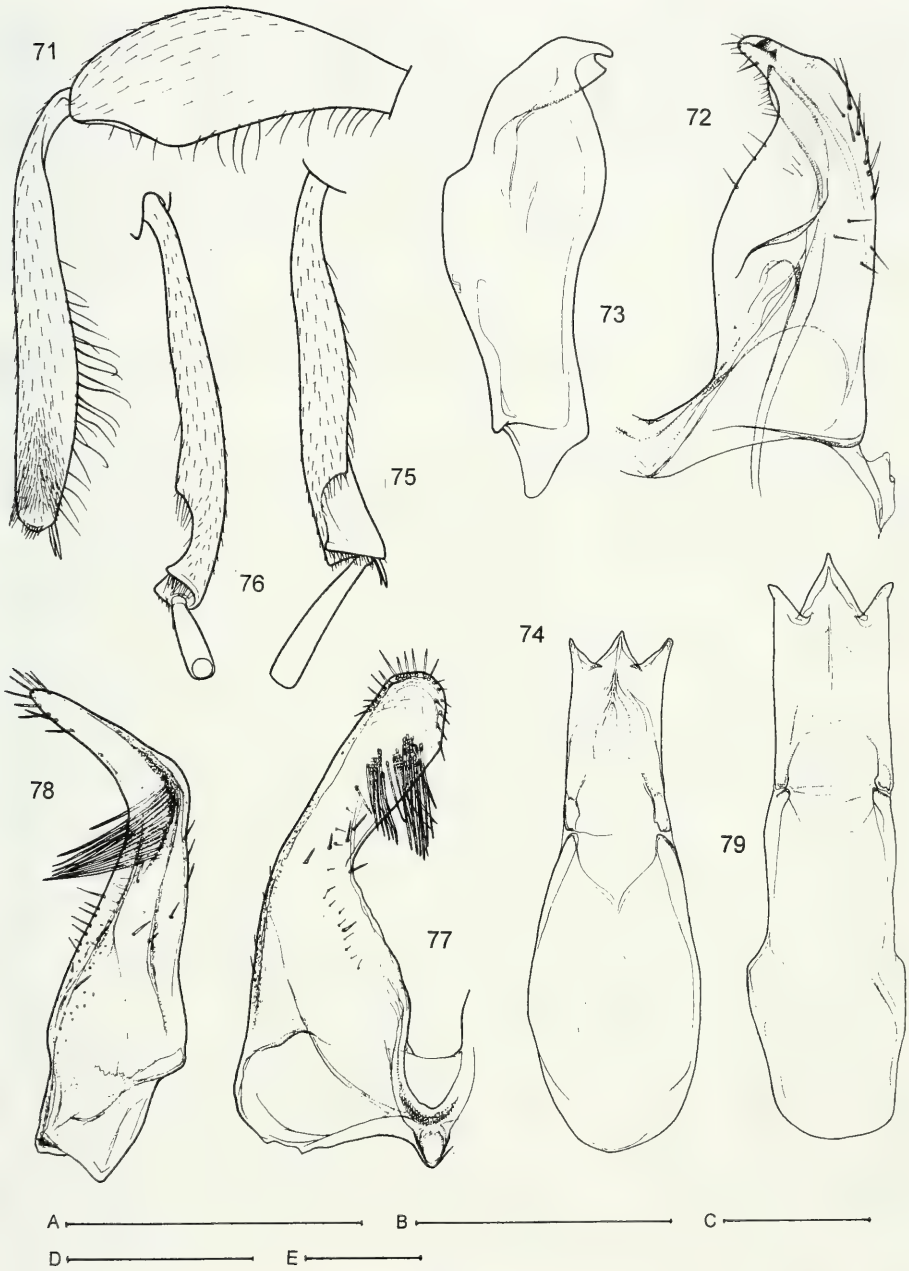
DIFFERENTIAL DIAGNOSIS: Of the related Afrotropical species, *Anthelephila subtruncata* resembles especially *A. vanhillei* sp. n. by its dark colouration and by the head somewhat widely rounded posteriorly. It can be distinguished from this species by form of the pronotum and by a number of clear differences in male characters (see the differential diagnosis of the latter species and key).

DISTRIBUTION: South Africa (Eastern Cape Prov.).

COMMENTS: Pic (1899) described *Formicomus subtrunctatus* based on specimens collected in southern Africa ("Afrique australe") and provided to him by M. H. Donckier. The record from Cape Province by Hille (1961) is based on the type specimens of *A. vanhillei* sp. n. The record from Uganda by Uhmann (1990b) is dubious and very probably is based on a misidentification.

Anthelephila vanhillei sp. n. Figs 5, 75-79

TYPE MATERIAL: Holotype ♂, S.Afr., S.W. Cape Arniston, dunes 34.39 S - 20.13 E \ 29.8.1983; E-Y:1996 coastal dunes, day leg. Endrödy, Penrith (TMP). – Paratypes: 11 ♂♂, 12 ♀♀, same data as holotype (TMP, 4 specim. in ZKDC). – 1 ♀♀, same data as holotype except: "Arniston, inland" and "E-Y:1994 groundtraps, 59 days" (TMP). – 6 ♂♂, 9 ♀♀, S.Afr., S.W. Cape Struisbaai 34.46 S - 20.03 E \ 28.8.1983; E-Y: 1989 groundtraps, 60 days leg. Endrödy, Penrith \ groundtrap with banana [or meat or faeces] bait (TMP, 2 specim. in ZKDC). – 1 ♀, S.Afr., S.W.Cape Gansbaai, 10 km NE 34.31 S - 19.25 E \ 27.8.1983; E-Y: 1983 groundtraps, 63 days leg. Endrödy, Penrith \ groundtrap with faeces bait (TMP). – 1 ♀, S.Afr., S.W.Cape Stanford, 13 km S. 34.40 S - 19.26 E \ 27.8.1983; E-Y: 1982 under stones, carc. leg. Endrödy, Penrith (TMP). – 2 ♂♂, 3 ♀♀, SOUTH AFRICA Eastern Cape Alexandria - Woody Cape 10 - 13.12.1997 Ivo Jeniš leg. (ZKDC). –.7 ♂♂, 6 ♀♀, S. Afr. Cape Prov. De Hoop Vlei. 20 miles E Bredasdorp 2.I.51. No. 107 \ Swedish South Africa Expedition 1950-1951 Brinck-Rudebeck \ Formicomus subtruncatus Pic det. J C.vanHille Oct. 1960 [three ♀♀ in addition with sex-mark label] (ZILS). – 1 ♂, S. Afr. Cape Prov. Mosselbaai 8-9.I.51 No. 127 \ Swedish South Africa Expedition 1950-1951 Brinck-Rudebeck \ Formicomus subtruncatus Pic det. J C.vanHille Oct. 1960 (ZILS). – 1 ♂, Cape Province: Mossel Bay. Dec. 1934 [p] \ S.AFRICA: R.E. Turner.



FIGS 71-79

Anthelephila subtruncata (Pic), male: (71) mesofemur with tibia. (72) sternite VIII (half). (73) prong of sternite VIII (outline), lateral view. (74) tegmen. *A. vanhillei* sp. n., male: (75, 76) mesotibia, different views. (77) sternum VII. (78) prong of sternite VIII, lateral view. (79) tegmen. Scale (0.2 mm): A – Figs 77, 78, B – Figs 72, 73, C – Fig. 74, D – Fig. 79, E – Figs 71, 75, 76.

B.M. 1935-73. [p; with blue line] \ Formicomus subtruncatus Pic det. J.C. van Hille [h] (BMNH). – 1 ♀, Cape Province. Mossel bay. August 1932. [p] \ S. Africa R.E. Turner. Brit. Mus. 1932-421. [p; with blue line] \ on ... B. M [h; partly illegible] \ Formicomus subtruncatus Pic det. J.C. van Hille [h] (BMNH). – 3 ♂♂, 1 ♀, Sedgefield 14 Dec. 1977 J. C. van Hille \ Formicomus subtruncatus Pic det. J.C. v. Hille (GUPC, 1 ♂ ZKDC). – 3 ♂♂, 2 ♀♀, Boknes 8-I-1947 J. C. van Hille \ Entomology Dept. Albany Museum Somerset Street Grahamstown 6139 \ Formicomus subtruncatus Pic det. J. C. v. Hille (AMGS). – 1 ♂, 3 ♀♀, same data, except: 10-I-1948 (AMGS).

Etymology: Named in honour of the late J. C. van Hille, well known specialist in the Afrotropical Anthicidae.

Description: Body length 3.2-3.9 mm (holotype 3.8 mm).

Male (holotype): Body brown black, nearly unicoloured; legs dark brown to brown black; antennae brown black, basal 2-3 antennomeres partly at most slightly paler; palpi brown black.

Head: 1.2 times as long as wide, rather widely rounded posteriorly in dorsal view (Fig. 5); posterior temporal angles rounded. Surface with fine, dense microsculpture and thus less glossy, distinctly punctured; dorsal punctures separated mostly by about twice their diameter. Setation short, appressed to subdecumbent, with few short, inconspicuous erect setae. Eyes small, at most moderately convex. Antennae distinctly exceeding base of pronotum, moderately but distinctly enlarged distally; antennomere X 1.2 times and antennomere XI 1.8 times as long as wide.

Thorax: Pronotum 1.3 times as long as wide, distinctly narrower than head including eyes, nearly evenly rounded anteriorly, only moderately narrowing posteriad and rather shallowly impressed postero-laterally in dorsal view (Fig. 5); entire dorsal outline of pronotum moderately convex in lateral view; pronotal disc with slight indication of median longitudinal impression/furrow in anterior half. Surface with dense microsculpture and thus less glossy, similarly as in head; bottom of postero-lateral impressions microsculpured (without coarse wrinkles) and adjacent basal area distinctly punctured; dorsal punctation similar to that on head, finer and sparser posteriorly near base. Setation as on head. Mesosternum simple. Metasternum with a pair of conspicuously projecting, apically setose protrusions postero-medially, near median margin of metacoxae.

Elytra: 1.7 times as long as wide, strongly convex, narrowed and subtruncate apically; humeri entirely obsolete; postscutellar impression absent. Surface smooth, glossy, distinctly punctured; punctation generally somewhat finer and sparser than on head, especially in apical third, at places somewhat denser (posterior setose band, see below). Setation similar to that on head, appressed, with scattered short and inconspicuous erect setae, mostly pale, some appressed setae whitish and thicker, forming two vague, transverse bands, situated in basal third and shortly behind midlength of elytra, some whitish setae scattered also laterally and near base. Metathoracic wings almost entirely reduced.

Legs: Penultimate tarsomeres rather narrow, terminal tarsomere subapical in metatarsi; mesotibiae modified, moderately curved inwards and strongly excavated on inner side subapically (Figs 75, 76); metatibiae moderately curved inwards apically and thus with inner apical margin slightly produced, with single apical spur. Setation

largely normally developed; mesotibiae with some longer setae on inner side, near/on margins of subapical excavation.

Abdomen: Sternum VII simple, slightly unevenly rounded posteriorly, its apical margin shortly, densely setose. Tergum VII evenly rounded posteriorly. Sternite VIII (Figs 77, 78); paired prongs rather simple, wide at base, strongly narrowed before midlength, curved ventrad, dorso-ventrally flattened and convergent in apical half, their apex rounded; each prong with a tuft of conspicuously long, stiff setae on ventral side, and with some short, stiff setae on/along apical margin. Tergite VIII simple, rounded posteriorly, with apical margin slightly emarginate medially.

Aedeagus (Fig. 79): Apical portion of tegmen 0.7 times as long as basal-piece, parallel-sided, trilobed apically, middle apical lobe wide basally, nearly evenly narrowing towards pointed apex, moderately longer than somewhat divergent lateral lobes.

FEMALE: Externally identical with male, except as follows: metatibiae simple, with two apical spurs; metasternum simple, lacking paired protrusions; middle legs simple, rather shortly setose; sternum VII with posterior margin quite evenly rounded.

VARIABILITY: Distinctly variable in prominence of surface microsculpture; some specimens from Struisbaai and all from Alexandria (Woody Cape) and Sedgefield with surface of head and pronotum at least partly rather smooth and glossy. Similarly, surface of elytra in some specimens uneven and somewhat less glossy.

DIFFERENTIAL DIAGNOSIS: *Anthelephila vanhillei* sp. n. differs from the most closely related and possibly sympatric species, *A. subtruncata*, by the pronotum rather shallowly impressed (less constricted) postero-laterally in dorsal view, by the conspicuously modified male mesotibiae, male sternum VII rounded posteriorly, and by the form and setation of the prongs of male sternite VIII (cf. Figs 72, 73 and 77, 78).

DISTRIBUTION: South Africa.

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Re-description of the holotype of *Vipera eriwanensis* (Reuss, 1933) (Serpentes: Viperidae)

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Re-description of the holotype of *Vipera eriwanensis* (Reuss, 1933) (Serpentes: Viperidae). - The missing holotype of *Vipera eriwanensis* described by Reuss in 1933 is re-described, and the questions relating to the source, number of individuals and species in the type series are answered. A review of the papers by Reuss relating to this taxon is made, and a complete chresonym list is given. The decisions leading to the designation of a neotype are discussed, remarks are made on the source of the individual, the revalidation of the holotype and accordingly the change of the type locality is proposed.

Keywords: Taxonomy - neotype - holotype - type locality - Armenia.

INTRODUCTION

The systematics of the steppe vipers of the *V. ursinii* and *V. renardi* groups is one of the most debated subjects in viperid taxonomy. Recently, Nilson & Andrén (2001) evaluated the taxonomy of these groups and answered, to some extent, many of the questions.

Vipera eriwanensis is a small sized viper from the *Vipera* (*Acridophaga*) *ursinii* complex with a distribution restricted to the Armenian plateau, including the political regions of Armenia, western Azerbaijan and eastern Turkey (Nilson & Andrén, 2001).

The taxon was described by Reuss (1933) as *Acridophaga* (*renardi*) *eriwanensis* based on a male specimen in the Zoological Museum, Berlin (ZMB) collected according to Reuss by Prof. Ramme during a trip in 1929. The author set the type locality as: near Eriwan (Yerevan), at around 2000 m altitude. The one sentence long description contained just three characters, 21 dorsal scales, 140+1 ventral scales and 9 supralabial scales, thus this diagnosis may fit other Viperid taxa in the area as well. A more detailed description, containing beneath the previously mentioned three characters the number of subcaudal scales ($37^1/_2$ on the left, 37 on the right plus 1 scale), and accompanied by a drawing (Fig. 5a on page 215) and a photograph of the head of this individual (Fig. 5 on page 217), was published later (Reuss, 1935b) (Fig. 2). Interestingly, the details on the source of the individual do not agree in the two works. Reuss (1935b) noted that the specimen was collected by Prof. Dr Ramme and head of preparatory Richter from the Zoological Museum, Berlin during a research trip

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in 1929/30. He also mentioned that he had the snake alive for some time, but now, it is in the teaching collection ("Lehrsammlung") of the Museum.

In general nobody wanted to deal with the taxa described by Reuss. He was a splitter, describing in fifteen years over 50 new taxa of Viperidae from Europe and Asia. Reuss was severely criticized about his publications throughout his life (e.g. Lankes, 1925; Müller, 1929; Werner, 1930; Stucken, 1935) as these new taxa did not resolve any questions, but led to complete chaos in the European and Asian Viperidae taxonomy. Many of the Reuss types could not be found, and some of his taxa were never mentioned in lists of synonymy. The only one who tried, and gave a list of some taxa and types described by Reuss, was Schwarz (1936). Most probably his identification of the type status of many individuals was based on the personal communications with Reuss and not published data.

Schwarz (1936) had not listed the specimen from Yerevan as being one of the known museum specimens at that time. This might have been the reason why Kramer (1961) stated that the type had disappeared. His statement was taken as a fact, and later several authors, with or without reference to Kramer's work, stated that the type is lost (Saint Girons, 1978; Joger, 1984; Bruno, 1985; Golay *et al.*, 1993; McDiarmid *et al.*, 1999; Nilson *et al.*, 1999; Kutrup *et al.*, 2005). It seems that Kramer (1961) was wrong in this case and with some other Reuss types as well. He also stated that the type of *Acridophaga uralensis* (presently a synonym of *Vipera renardi renardi*) stored in the ZMB was destroyed, which is not true; it is still preserved in the collection (Holotype ZMB 2856, Paratype ZMB 65910).

Confusion was caused by a photograph published in 1929 (Reuss, 1929). The short paper on snake venoms (Reuss, 1929) included four photographs of different *Vipera* species, one of them depicting a living small sized viper, which was not the same as that depicted by Reuss in 1935 (Reuss, 1935b). Nilson *et al.* (1999) and Nilson & Andrén (2001) supposed that the type series consisted of more than a single specimen. This was based on personal communication with Erich Sochurek and a reproduction of the 1929 photograph which according to Sochurek showed the type. Nilson *et al.* (1999) argued that this photograph of a live specimen shows a viper of the *Vipera kaznakovi* complex, which might be *V. darevskii*, *V. pontica* or *V. dinniki*, thus in the absence of type material and for reasons of stability considered it appropriate to designate a neotype. Actually Reuss had only a single male individual, and all of his remarks about this taxon were based on this specimen (Reuss, 1933, 1935b, 1937). The misleading picture (p. 37 in Reuss, 1929) shows a viper of the *Vipera ursinii* complex, probably *V.u. macrops*, which is also stated in the photograph's caption ("Orsinsche Kreuzotter"-Ursinii Adder). The name *eriwanensis* has not been used in this paper, and no other paper published before the description (i.e. Reuss, 1933). The slide archive of the Natural History Museum in Vienna houses a reproduction of this photograph, which was probably sent to Nilson and co-workers by Erich Socurek. This work of Reuss has been erroneously cited as "Fünf Fotos von Giftschlangen" instead of "Schlangengift-ein Verjüngungsmittel?" (Kramer, 1961; Nilson *et al.*, 1999; Nilson & Andrén, 2001).

A neotype was designated by Nilson *et al.* (1999), an adult male (GNM Re.ex. 5158) collected on the mountain Ara-Iler, Armenia, north of Yerevan in May 1972 and

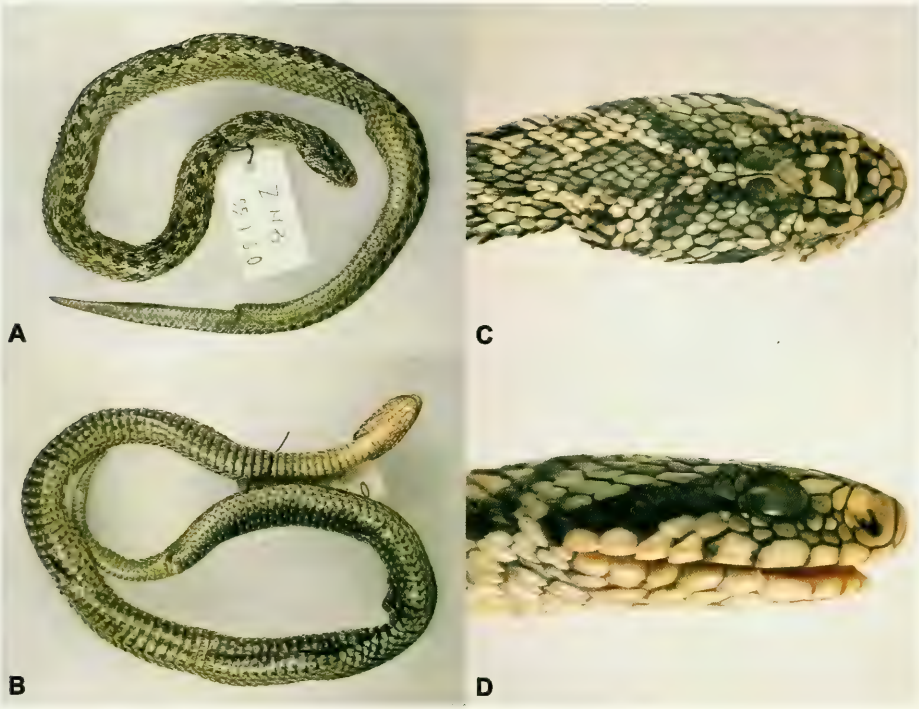

FIG. 1
The holotype: dorsal view (A), ventral view (B), dorsal view of the head (C), and lateral view of the left side of the head (D). Photographs by Michael Franzen.

donated by the Zoological Institute, St. Petersburg to Göteborg Natural History Museum.

The *V. eriwanensis* type individual was rediscovered in September 2005 during a revision of the *Vipera* material, including the Reuss collection, housed in the ZMB.

The specimen catalogued as ZMB 55160 remained unnoticed in the teaching collection for several decades; it was probably moved into the main collection in the 1990s and received the actual catalogue number in 1996. The snake was donated by the collectors, Ramme and Richter, to the ZMB on 9 May 1928 (together with 21 other amphibians and reptiles from Persia, Armenia and Caucasus under number C 869 of the access-catalogue). The actual jar contains an original label written by the collectors containing the following information: Armenia Goktscha-See (Lake Sevan) above Schordsha (Shordzha), at 2000 m altitude, 2.IX.1927 †21.XI.1927, Ramme-Richter S.G., Acridophaga renardi ("Bergform"-Mountain form), weight 29 in alcohol, before 28 gr.

The area of Shordzha lays within the known range of the species and is a well known locality for *Vipera eriwanensis* (Chernov, 1939; Orlov & Tuniyev, 1990; Nilson *et al.*, 1995; Aghasyan, 1996; Nilson & Andrén, 2001).

We can just hypothesize why Reuss has written the locality Yerevan. One possibility might have been, that he chose this well known locality because only a few people were aware of the location of the Lake Sevan.

CHRESONYMY

A.[*cridopahaga*] (*renardi*) *eriwanensis* Reuss, 1933: 373.
Acridophaga renardi eriwanensis–Reuss (1935a: 152).
Acridophaga renardi eriwanensia–Reuss (1935b: 216, 215-Fig. 5a, 217-Fig. 5). [Incorrect spelling, lapsus for *eriwanensis*, hence not available (ICZN 1999: Art. 33.3.).]
Vipera ursinii renardi (part.)–Schwarz (1936: 186).
A.[*cridophaga*] *renardi eriwarensis*–Reuss (1937: 1788). [Incorrect spelling, lapsus for *eriwanensis*, hence not available (ICZN 1999: Art. 33.3.).]
Vipera ursinii renardi (part.)–Mertens & Wermuth (1960: 203).
Vipera ursinii renardi (part.)–Kramer (1961: 698, 699, 700, 701, 715). [Assigned to the western group of his southeastern and southwestern steppe form-"südöstliche und südwestliche Steppenform".]
Acridophaga eriwanensis–Kramer (1961: 715). [As cited in the synonymy of *Vipera ursinii renardi*.]
Vipera ursinii ebneri (part.)–Saint Girons (1978: 582, 583).
Vipera ursinii eriwanensis (part.)–Joger (1984: 62, 63).
Vipera ursinii eriwanensis (part.)–Golay *et al.* (1993: 290).
Vipera ursinii eriwanensis (part.)–Bruno (1985: 74).
Vipera ursini eriwanensis–Orlov & Tuniyev (1990: 2, 6, 8, 10, Plate 3, 19-Fig. 9, 22, 23, 24, 30-Fig. 16, 31). [Incorrect subsequent spelling for *ursinii*.]
Vipera eriwanensis–Höggren *et al.* (1993: 12, 17).
Vipera ursinii–McDiarmid *et al.* (1999: 409).
Vipera eriwanensis–Nilson & Andrén (2001: 218, 219, 220, 221, 222, 223, 224).
Vipera renardi eriwanensis–Joger & Dely (2005: 343, 345, 348, 349).

DESCRIPTION OF THE HOLOTYPE

ZMB 55160; adult male; Lake Sevan above Shordzha at 2000 m a.s.l. [Yerevan], Armenia; Ramme and Richter leg. 2.IX.1927; Ramme and Richter don. 9.V.1928.

Body proportions (all in mm; measures right/left; *un-measurable): body length 370; tail length 55; head length (from the corner of the mouth) 16.32; head width (at its widest part) 10.55; head depth (behind the eyes) 5.13; distance between the eyes (measured on the dorsal edge of the eyes, across the head) 6.87; distance between the eyes and the rostrum (between the anterior edge of the eye and the rostrum) 5.49/5.61; eye vertical diameter (longest diameter) */2.02; eye horizontal diameter (longest diameter) 2.65/2.75; distance between the lower edge of the eyes and the edge of the mouth */1.96; fontal length 4.27; frontal width 2.98; rostral length 2.65; rostral width (distance between the contact points with the apical scale) 0.70; rostral width (distance between contact points with the nasorostral scales) 2.59; nasal diameter (longest) 2.67/2.69; nostril diameter (longest) 1.20/1.24.

Scalation (counts right/left; *un-countable): 4 preventrals; 135 ventrals; 23 dorsals on the neck (counted at the 10th ventral); 21 on midbody (in the middle of the rostrum-cloaca length); 17 on the tail (5 ventrals from the anal scale); last row with 23 dorsal scales, at 14th ventral; first row with 21 dorsals, at the 15th ventral; reduction from 21 to 19 dorsals, at the 116th ventral; reduction from 19 to 17 dorsals, 131st ventral; subcaudals 36/36$^{1}/_{2}$ + 1; 9/9 supralabial scales; forth and fifth supralabials

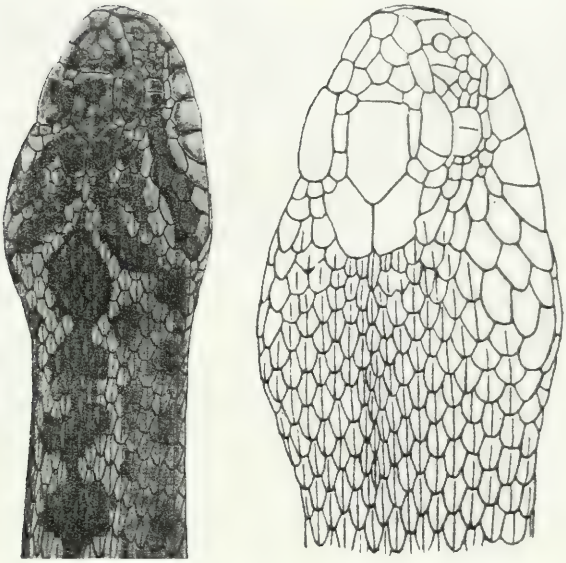

FIG. 2
Figure 5 and drawing 5a from the 1935 work by Reuss (1935b).

bellow the eyes; 10/10 sublabial scales; undivided rostral; rostral separated from the nasal scales by 1/1 nasorostral scale; nasal scales divided into 2 in the posteriour middline; nostrils situated on the bottom of the nasal scales; 5/5 loreal scales; 11/9 scales in the first circumocular row; 2/3 scales situated between the circumocular row and the supralabials, but do not form a complete second circumocular row; two big, undivided supraocular scales, separated from the frontal by 3/3 smaller scales; parietals big, not fragmented; one apical scale; 2/2 canthal scales; 5 intercanthal scales; 8 scales between the eyes (total number of scales between the supraoculars); 4 second chinshields; 6/5 scales on the sides of the mental row (the scales in first longitudinal rows are counted); */30 gular scales (total number of gular scales counted, delimited by the sublabials and the mental row).

COLOUR PATTERN (pale-caused by the alcohol; counts right/left): Dorsal pattern consists of 67/66 brown rounded zigzag windings on the body (the tips of the windings counted to the one above the cloaca), and 24/27 on the tail. The windings are bordered by a lighter (probably light brown) coloured area, while laterally the ground colour is darker. Lateral body pattern consists of narrow brown spots. Head pattern formed by two separated dark oblique bands, which run from the frontal scale to the lateral side of the head a bit backwards from the corner of the mouth. Two darker spots can also be observed: one covering the frontal, supraocular and intersupraocular scales the other the apical, canthal and intercanthal scales. Laterally two dark, 2-3 scales wide, bands are running from the corner of the eye to the corner of the mouth. Ventral side, both on body and tail, light but dark spotted, throat light (Fig. 1).

REMARKS

My scale counts greatly agree with Reuss'. The same number of dorsal and supralabial scales have been counted. The difference in the number of ventral scales is one, 140 according Reuss (counted probably without using a dissection microscope) and 139 (4 preventrals and 135 ventrals) according my counts. Reuss (1935b) counted $37^1/_2$ subcaudal scales on the on the left side, 37 on the right side, and probably included into here all paired bigger scales that are found on the ventral surface of the tail bellow the anal scale. I did not include the first pair of scales which are situated bellow the anal plate but are not connected with each other. As it can be assessed with certainty that the individual rediscovered is the holotype described by Reuss in 1933 and depicted on the figures of the 1935 work (Fig. 2), this should regain its type status, according to the Art. 75.8. of the International Code of Zoological Nomenclature (ICZN, 1999) and the neotype should be set aside. The erroneous type locality, Yerevan, should be corrected to with Lake Sevan above Shordzha at 2000 m a.s.l., the correct collection locality of the specimen according to the Recomendation 76A.2. of the Code (ICZN, 1999).

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Introduction. A short introduction to the background and the reasons for the work.

Material 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, description, distribution, 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" (text file: $ = ♂, £ = ♀).

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 author-date system (name-year 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.* (1995) or (Brown *et al.*, 1995; White *et al.*, 1996) should be used. In the text authors' names have to be written in standard type face. However, in the list of references they should be formatted in SMALL CAPITALS (see below). The list of references must include all publications cited in the text and only these. References must be listed in alphabetical order of authors, in the case of several papers by the same author, the name has to be repeated for each reference. The title of the paper and the name of the journal must be given in full in the following style:

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.

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Figures. These may be line drawings or half tones, not integrated in the text-file, and all should be numbered consecutively. Figures should be arranged in plates which can be reduced to 122 x 160 mm. Drawings and lettering should be prepared to withstand reduction. Magnification should be indicated with scale lines. Authors should refrain from mixing drawings and half tones. Originals of figures (ink drawings, photographs, slides) should be submitted together with the revised version of the accepted manuscript. Original drawings will not be returned automatically. The *Revue suisse de Zoologie* declines responsibility for lost or damaged slides or other documents. If scanned figures are submitted on CD, this should be clearly indicated on the print-out. Scanned line drawings must be saved as TIF files in bitmap mode with a resolution of at least 600 dpi. Half tone illustrations and photos must have at least 300 dpi resolution.

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