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REVUE SUISSE DE ZOOLOGIE 111 (1): 3-10; mars 2004

New earthworms of *Pheretima* and *Pithemera* (Oligochaeta: Megascolecidae) from Mt. Arayat, Luzon Island, Philippines

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New earthworms of *Pheretima* and *Pithemera* (Oligochaeta: Megascolecidae) from Mt. Arayat, Luzon Island, Philippines. - Three new species of *Pheretima* and two new species of *Pithemera* are described from Mt. Arayat: *Pheretima arayatensis* sp. n., *Pheretima simsi* sp. n., and *Pheretima castilloi* sp. n., *Pithemera rotunda* sp. n., and *Pithemera philippinensis* sp. n. *Pheretima arayatensis* sp. n., *Pheretima simsi* sp. n., and *Pheretima castilloi* sp. n. have spermathecae in segment ix, vi, and vi-viii, respectively. *Pithemera rotunda* sp. n., and *Pithemera philippinensis* sp. n. have spermathecae in segment v-ix. The former species has numerous circular genital markings, but the latter *Pithemera* species has no genital markings. Descriptions of the new species are provided, including illustrations of the ventral view, male pore region, and spermathecae.

Key-words: Earthworms - *Pheretima* - *Pithemera* - Megascolecidae - Oligochaeta - Mt. Arayat - Philippines - taxonomy.

INTRODUCTION

Mt. Arayat is an isolated volcanic mountain in the large plains of central Luzon, north of Manila. Its forested upper elevations have always been isolated from other mountain ecosystems, such as the central Cordillera to the north and west, the Caraballo Range to the north, and the southern Sierra Madre to the east. The remaining forests of Mt. Arayat are an important refuge for biota whose habitats would otherwise be destroyed in the region. Its biogeographic importance as an isolated peak is now accentuated by deforestation and conversion of land to intensive agriculture. As part of a biotic survey of the earthworms of the Philippines, specimens were collected from Mt. Arayat in March, 2001. In this paper, we report three new species of *Pheretima* Kinberg, 1867 and two new species of *Pithemera* Sims & Easton, 1972. James (2004) described 21 new species of Megascolecidae of which 18 were new species of the genus *Pheretima* from the Mt. Kitanglad Range, Mindanao Island. He followed the systematics of Sims & Easton (1972). These authors assigned species

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with the intestinal caeca(um) originating in or near xxii to this genus, *Pithemera*. They also defined four species groups within *Pithemera*, one of which is the *bicincta* group, containing the generotype *Pithemera bicincta* (Perrier, 1875). We report 2 new species of the *bicincta* group herein.

Holotypes and paratypes are deposited in the National Museum of Annelids of the Philippines (NMA). Paratypes are deposited in the Field Museum of Natural History (FMNH), and the Museum of Natural History of Geneva (MHNG).

DESCRIPTIONS

Pheretima arayatensis James & Hong sp. n. Figs 1A-B

Material: Holotype: One clitellate (NMA 0003741): Philippines, Luzon Island, Pampanga Province, Mt. Arayat (15°12.29'N, 120°43.25'E), 410 m, litter layers in forest, 14 March 2001, Y. Hong & A. Castillo colls. 3 paratypes: 1 clitellate (NMA 0003746), 1 clitellate (FMNH 10012), 1 clitellate (MHNG 34807): Same data as for holotype. Other material: Same data as for holotype, 4 clitellate, 18 aclitellate specimens; Mt. Arayat (15°12.34'N, 120° 43.90'E), 330 m, litter layers in forest, 1 clitellate, 1 semiclitellate, 13 March 2001.

Etymology: The species is named for its type locality.

Diagnosis: Spermathecal pore in 8/9, brown dorsal pigment, genital marking absent.

Description: Brown dorsal pigment. Dimensions 88-141 mm by 5.8-6.3 mm at segment x, 7.0-7.2 mm at xxx, 5.1-5.5 mm at clitellum, segments 96-115; body cylindrical in cross-section. Setae regularly distributed around segmental equators, numbering 54 at vii, 87 at xx; 5-6 between male pores, size, distance regular; setal formula AA:AB:YZ:ZZ = 2:1:2:4 at xiii. Clitellum annular xiv-xvi; setae invisible externally.

First dorsal pore 12/13, spermathecal pore midventral deep in intersegmental furrow 8/9, with thickened surrounding tissue, monothecate. Female pore single in xiv, 0.3 mm oval shape, 0.5 mm openings of copulatory bursae paired in xviii, distance between male pores 2.1 mm. Genital marking lacking.

Septa 5/6-7/8 thick, 8/9 absent, 9/10 thin, only a small membrane connected to 10/11, not to body wall, 10/11-13/14 thick, muscular. Gizzard large in viii-x, intestine begins in xv, small paired lymph glands from xxviii along dorsal vessel; intestinal caeca simple, originating in xxvii, and extending anteriorly to xxii, each consisting of a finger-shaped sac; typhlosole low simple fold from xxvii. Hearts x-xiii esophageal; ix lateral, right side large, left very reduced.

Ovaries and funnels in xiii, single spermatheca in ix with nephridia on spermathecal ducts; spermatheca with small ampulla, ducts shorter than ampulla, 2 diverticula each composed of 5 separate chambers on single stalks or double stalks terminating in two chambers, club-shaped. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi. Seminal vesicles two pairs in xi, xii with dorsal lobes, pseudovesicles xiii, prostates in xviii, with stout muscular duct entering center of the copulatory bursae without stalked glands. Vas deferens muscular xiv-xviii. Pads or other structures like penis on inside of copulatory bursae.

Remarks: The species shares the brown dorsal pigment, dimensions, setae, and monothecate condition with *Pheretima ambonensis* Cognetti, 1913 from Ambon, Indonesia. *Pheretima arayatensis* has 2 spermathecal diverticula each composed of 5

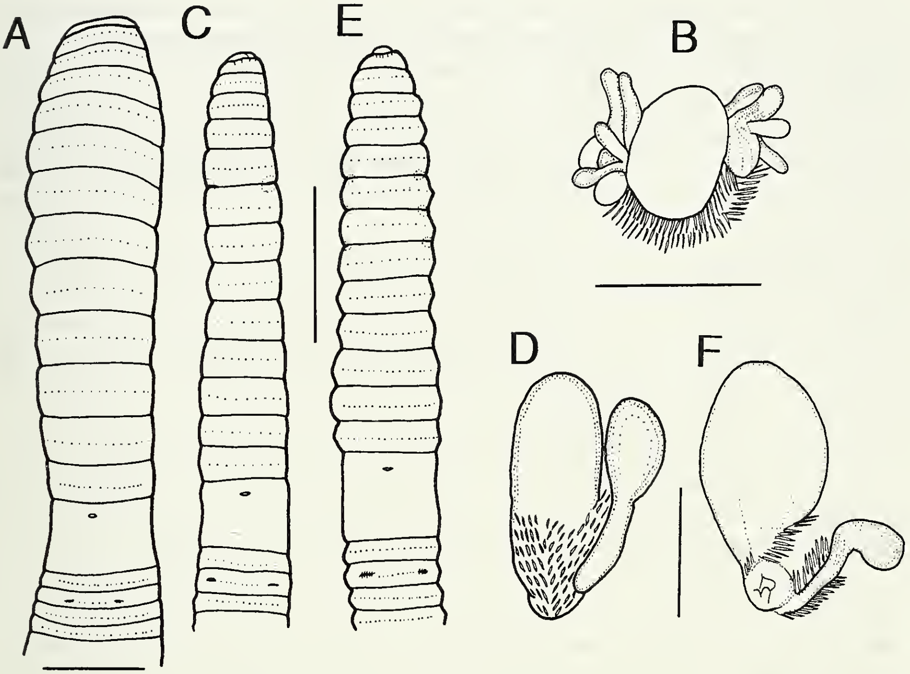

FIG. 1

A-B. *Pheretima arayatensis* sp. n. A: ventral view; B: spermathecae. C-D. *Pheretima simsi* sp. n. C: ventral view; D: spermathecae. E-F. *Pheretima castilloi* sp. n. E: ventral view; F: spermathecae. Scale bars = 5 mm (A, C, E), 2 mm (B), 1 mm (D, F).

separate chambers on single stalks or double stalks terminating in two chambers, but *P. ambonensis* has a thick duct and only 2 diverticula on single stalks. Also *Pheretima arayatensis* has its spermathecal pore in 8/9 and spermatheca in ix, but *P. ambonensis* has the spermathecal pore in 7/8 and spermatheca in vii.

Pheretima simsi James & Hong sp. n. Figs 1C-D

Material: Holotype: One clitellate (NMA 0003742): Philippines, Luzon Island, Pampanga Province, Mt. Arayat (15°12.41'N, 120°44.45'E), 1050 m, litter layers in forest, 13 March 2001, Y. Hong & O. Castillo colls. 3 paratypes: 1 clitellate (NMA 0003747), 1 clitellate (FMNH 10013), 1 clitellate (MHNG 34808): Same data as for holotype. Other material: Same data as for holotype, 4 clitellate, 6 aclitellate specimens; Mt. Arayat (15°12.34'N, 120°43.90'E), 330 m, litter layers in forest, 9 clitellate, 2 aclitellate, 13 March 2001.

Etymology: Named for Dr R. W. Sims, who made good contributions to earthworm systematics.

Diagnosis: Spermathecal pores in 5/6. Diverticulum, as long as ampulla, chamber and stalk showing spermatozoal iridescence, nephridia covering duct-ampulla junction, part of ampulla.

Description: Brown dorsal pigment. Dimensions 68-91 mm by 2.6-2.8 mm at segment x, 2.8-3.1 mm at xxx, 2.7-3.0 mm at clitellum, segments 82-97; body cylindrical in cross-section. Setae regularly distributed around segmental equators, numbering 31-33 at vii, 39-47 at xx; 6-8 between male pores, size, distance regular; setal formula AA:AB:YZ:ZZ = 1.5:1:2:3 at xiii. Clitellum annular xiv-xvi; setae invisible externally.

First dorsal pore 11/12, 12/13, spermathecal pores in 5/6, at lateral margin of ventrum, white color, with slightly protuberant lips. Female pore single in xiv, 0.4 mm oval shape, 0.5 mm openings of copulatory bursae paired in xviii, distance between male pores 2.5 mm. Genital marking lacking.

Septa 5/6-8/9 thin, 9/10 absent, 10/11-12/13 thick, muscular, 13/14 thin. Gizzard usual in viii, intestine begins in xv, small paired lymph glands from xxviii along dorsal vessel; intestinal caeca simple, originating in xxvii, and extending anteriorly about to xxvi, each consisting of a finger-shaped sac; typhlosole low simple fold from xxvii. Hearts x-xiii esophageal; ix lateral, viii to gizzard, vii lateral, with branches to anterior gizzard wall.

Ovaries and funnels in xiii, paired spermathecal in vi with nephridia on spermathecal ducts; spermatheca with small ampulla, duct very short, diverticulum, as long as ampulla, chamber and stalk showing spermatozoal iridescence, nephridia covering duct-ampulla junction, part of ampulla. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi. Seminal vesicles two pairs in xi, xii with narrow dorsal lobes, prostates in xvii- xix, with stout muscular duct entering center of the copulatory bursae without stalked glands. Copulatory bursa opening flanked by anterior, posterior pads, male pore within large convoluted opening on roughly conical protrusion from copulatory bursa roof.

Remarks: *Pheretima simsi* keys to the *urceolata* group in Sims & Easton (1972), which is composed of two species, *P. urceolata* Horst 1893 and *P. baweanensis* Michaelsen, 1924. Gates (1961) synonymized these two species and *P. ditheca* Michaelsen, 1928. The species shares the lack of setae in the clitellum, 31 setae per segment at vii, and spermathecal pores in 5/6 with *P. urceolata. Pheretima simsi* differs from *P. urceolata* in having as the ampulla long as the diverticulum, and in having short caeca. The locality of *Pheretima simsi* is close to human disturbance and activity, as was the collection site of *P. urceolata*. The present species is similar to *Pheretima kitangladensis* (James, 2004), but *P. kitangladensis* has no dorsal or ventral setal gaps, and has vertical lamellae in the esophagous. Also, *P. kitangladensis* is quite remote from human disturbance at a high elevation site (2250 m), but *Pheretima simsi* and *P. urceolata* were collected from low and mid- elevation sites (330-1050 m, 1100 m). *P. urceolata* was collected from Sumatura, Kupang, Timor, Indonesia and *P. kitangladensis* from Mt. Kitanglad Range, Mindanao Island, Philippines.

Pheretima castilloi James & Hong sp. n. Figs 1E-F

Material: Holotype: One clitellate (NMA 0003743): Philippines, Luzon Island, Pampanga Province, Mt. Arayat (15°12.43'N, 120°44.38'E), 900 m, litter layers in forest, 13 March 2001, Y. Hong & A. Castillo colls. 3 paratypes: 1 clitellate (NMA 0003748), 1 clitellate (FMNH 10014), 1 clitellate (MHNG 34809): Same data as for holotype. Other material: Mt. Arayat (15°12.41'N, 120°44.45'E), 1050 m, litter layers in forest, 4 clitellate, 1 aclitellate, 13 March 2001.

Etymology: The species is named after the type's collector, Augusto Castillo.

Diagnosis: Spermathecal pores in 5/6-7/8, genital marking absent.

Description: Brownish dorsal pigment. Dimensions 59-81 mm by 3.1-3.3 mm at segment x, 3.2-3.3 mm at xxx, 3.0-3.3 mm at clitellum, segments 64-81 body cylindrical in cross-section. Setae regularly distributed around segmental equators, numbering 26-28 at vii, 46-50 at xx; 7-12 between male pores, size, distance regular; setal formula AA:AB:YZ:ZZ = 1:1.5:2:6 at xiii. Clitellum annular xiv-xvi; setae invisible externally.

First dorsal pore 12/13, paired spermathecal pores in 5/6-7/8, at lateral margin of ventrum, distance between spermathecal pores 3.0 mm. Female pore single in xiv, 0.4 mm oval shape, 0.4 mm openings of copulatory bursae paired in xviii, distance between male pores 2.5 mm. Genital marking lacking.

Septa 5/6-7/8 thin, 8/9 absent, 9/10 very thin, attached to 10/11, 10/11 thick, 11/12-13/14 thin. Gizzard usual in viii-x, intestine begins in xv, small paired lymph glands from xxviii along dorsal vessel; intestinal caeca simple, originating in xxvii, and extending anteriorly about to xxiv, each consisting of a small finger-shaped sac; typhlosole very low simple fold from xxvii. Hearts x-xiii esophageal; ix lateral, very small viii to gizzard, vii lateral, extra esophageal vessel pharynx to ventral esophageal, then to clitellum area xiii to xiv, xv.

Ovaries and funnels in xiii, paired spermatheca in vi-viii, viii with nephridia on spermathecal ducts; spermatheca with small ampulla pouch, duct shorter than ampulla, diverticulum golf club-shaped, shorter than ampulla. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi. Seminal vesicles two pairs in xi, xii with dorsal lobes, prostates in xvi- xviii, with stout muscular duct entering center of copulatory bursae without stalked glands. Copulatory bursa opening flanked by circular pads anterior, posterior, pads backed by glandular chambers, male pore within long slit on side of conical protrusion from copulatory bursa roof.

Remarks: In Sims & Easton (1972) *Pheretima castilloi* keys to a couplet offering a choice between one and four thecal segments, corresponding to the *urceolata* and *lejokana* (genital marking present), *darnleiensis* (genital marking absent) species groups, respectively. However, the present species has three pairs of spermathecal pores in 5/6-7/8. Therefore *Pheretima castilloi* is unlike all known *Pheretima.*

Pithemera rotunda James & Hong sp. n. Figs 2A-B

Material: Holotype: One clitellate (NMA 0003744): Philippines, Luzon Island, Pampanga Province, Mt. Arayat (15°12.41'N, 120°44.45'E), 1050 m, litter layers in forest, 13 March 2001, Y. Hong & A. Castillo colls. 3 paratypes: 1 clitellate (NMA 0003749), 1 clitellate (FMNH 10015), 1 clitellate (MHNG 34810): Same data as for holotype. Other material: Same data as for holotype, 3 clitellate, 15 aclitellate specimens; Mt. Arayat (15°12.43'N, 120°44.38'E), 900 m, litter layers in forest, 7 clitellate, 1 aclitellate, 13 March 2001.

Etymology: The name *rotunda* is Latin for circular, referring to the shape of the genital marking.

Diagnosis: Spermathecal pores in 4/5-8/9, male pores in xviii, on 0.3 mm small hardened slightly protuberant circular porophore. Genital markings numerous circular within thickened epidermal area.

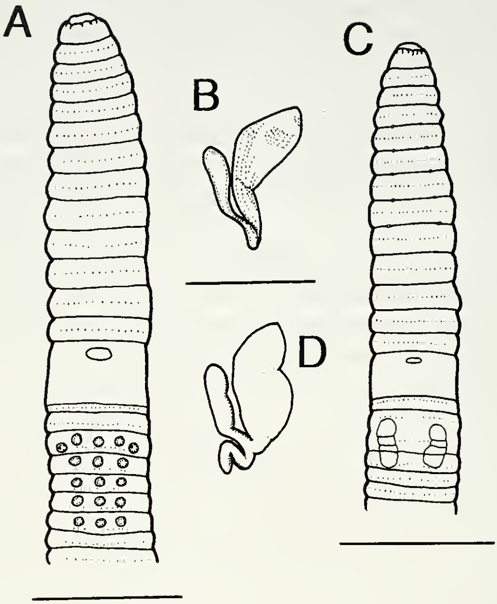

FIG. 2

A-B. *Pithemera rotunda* sp. n. A: ventral view; B: spermathecae. C-D. *Pithemera philippinensis* sp. n. C: ventral view; D: spermathecae. Scale bars = 5 mm (C), 2 mm (A), 1 mm (B, D).

Description: Worm unpigmented. Dimensions 31-44 mm (aclitellates 25-32) by 2.0-2.4 mm at segment x, 2.3-2.6 mm at xxx, 1.9-2.0 mm at clitellum, segments 79-91; body cylindrical in cross-section. Setae regularly distributed around segmental equators, numbering 49-54 at vii, 48-61 at xx; 9 between male pores, size, distance regular; setal formula AA:AB:YZ:ZZ = 2:1:1:3 at xiii. Clitellum annular xiv-1/2xvi; xvi setae visible, dorsal pore invisible externally.

First dorsal pore 12/13, five pairs of spermathecal pores in 4/5-8/9, very small white spot in lateral margin of ventrum. Female pores paired in xiv, 0.3 mm oval shape, male pores in xviii, on 0.3 mm small hardened slightly protuberant circular porophore, pores 1.9 mm apart. Circular raised genital markings numerous; 2 on right side xviii, 3 between male pores xviii, 3 presetal in xix, xx, xxi, xxii; genital markings within white thickened epidermal area.

Septa 5/6 thin, 6/7 thick, 7/8 thin, 8/9 absent, 9/10, 10/11 thin, 11/12, 12/13 some muscular thickening, 13/14 thin. Gizzard usual in viii-ix, intestine begins in xv; intestinal caeca simple, originating in xxii, and extending anteriorly about to xxi, each consisting of a small triangle-shaped sac; typhlosole about 1/3 lumen diameter simple fold from xxii. Hearts x-xii esophageal; ix lateral, viii absent, vi, vii lateral.

Ovaries and funnels in xiii, spermathecae in v-ix; no nephridia on spermathecal ducts; spermathecae with small strawberry-shaped ampulla, ducts shorter than ampulla, diverticulum club-shaped, shorter than ampulla. Male sexual system holandric, testes and funnels in single large sacs in x, xi; sacs attached to front side of septum 10/11, 11/12, sacs do not enclose hearts, sacs of xi enclose seminal vesicles. Seminal vesicles two pairs in xi, xii without dorsal lobes, prostates multilobed in xvi- xx, ectal half of duct expanded, muscular.

Remarks: *Pithemera rotunda* keys to the *bicincta* group in Sims & Easton (1972), which is composed of two species, *Pithemera bicincta* (Perrier, 1875) and *Pithemera violacea* (Beddard, 1895). Like *P. bicincta* and *P. violacea, P. rotunda* has spermathecal pores in 4/5-8/9, and the spermathecal ampulla is longer than the diverticulum. *Pithemera rotunda* has three circular papillae in segments xviii to xxii, but *P. bicincta* has paired genital papillae extending from segments xviii to xix, and 1 pair of genital papillae just behind the male pores on 18/19. Only one pair of genital papillae is present in *P. violacea* just lateral to and behind the male pores (Beddard, 1895).

Pithemera philippinensis James & Hong sp. n. Figs 2C-D

Material: Holotype: One clitellate (NMA 0003745): Philippines, Luzon Island, Pampanga Province, Mt. Arayat (15°12.41'N, 120°44.45'E), 1050 m, litter layers in forest, 13 March 2001, Y. Hong & A. Castillo colls. 2 paratypes: 1 clitellate (FMNH 10016), 1 clitellate (MHNG 34811): Same data as for holotype. Other material: Same data as for holotype, 11 aclitellate specimens; Mt. Arayat (15°12.43'N, 120°44.38'E), 900 m, litter layers in forest, 3 clitellate, 1 aclitellate, 13 March 2001.

Etymology: The species is named for its type locality.

Diagnosis: Spermathecal pores in 4/5-8/9, male pores xviii on foot print- shaped pads extending to 17/18-18/19. Genital marking absent.

Description: Light brown dorsal pigment. Dimensions 51-54 mm (semiclitellate 41-48) by 2.3-2.5 mm at segment x, 2.8-3.3 mm at xxx, 2.5-2.6 mm at clitellum, segments 78-90; body cylindrical in cross-section. Setae regularly distributed around segmental equators, numbering 56-68 at vii, 49-61 at xx; 9 between male pores, size, distance regular; setal formula AA:AB:YZ:ZZ = 3:1:1:2 at xiii. Clitellum annular xiv-1/2xvi; xvi setae visible, dorsal pore invisible externally.

First dorsal pore 12/13, five pairs of spermathecal pores in 4/5-8/9, small white spots, lateral. Female pores paired in xiv, 0.4 mm oval shape, male pores xviii on foot print-shaped pads extending to 17/18-18/19, 2.0 mm between male pores. Genital marking lacking.

Septa 5/6-7/8 thin, 8/9 absent, 9/10-11/12 thick, 12/13, 13/14 thin. Gizzard usual in viii-ix, intestine begins in xv; intestinal caeca simple, originating in xxii, and extending anteriorly about to xxi, each consisting of a small triangle-shaped sac; typhlosole simple fold about 1/4 lumen diameter from xxii. Hearts x-xii esophageal; ix lateral, viii lateral.

Ovaries and funnels in xiii, spermathecae in v-ix; no nephridia on spermathecal ducts; spermathecae with small pouch, diverticulum sausage-shaped, as long as ampulla. Male sexual system holandric, testes and funnels in ventral paired sacs in x, xi. Seminal vesicles two pairs in xi, xii, prostates in xvii- xix, two main lobes, ental half of ducts slender, non muscular; ectal half of ducts enlarged, muscular tapered at both ends; body wall surface over external male pads covered with densely packed, tiny tubules, probably nephridia or modified nephridia serving a glandular function.

Remarks: The species also keys to the *bicincta* group in Sims & Easton (1972), but unlike the other members, *Pithemera philippinensis* has foot print-shaped pads extending over 17/18-18/19.

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REVUE SUISSE DE ZOOLOGIE 111 (1): 11-20; mars 2004

Redescription of *Monticellia magna* (Rego, dos Santos & Silva, 1974) (Eucestoda: Monticelliidae) parasite of *Pimelodus* spp. (Pisces: Siluriformes) from Argentina, and morphological study of microtriches

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Redescription of *Monticellia magna* (Rego, dos Santos & Silva, 1974) (Eucestoda: Monticelliidae) parasite of *Pimelodus* spp. (Pisces: Siluriformes) from Argentina, and morphological study of microtriches. - *Monticellia magna* (Rego, dos Santos & Silva, 1974) is redescribed and the microtriches and their distribution are studied for the first time. This species is characterised by the following combination of characters: (1) vagina anterior to cirrus pouch; (2) muscular asymmetrical sphincter present; (3) testes in one layer and in two fields connected anteriorly and posteriorly; (4) vitelline follicles distributed cortical, paramuscular and a few follicles medullary; (5) internal longitudinal musculature strongly developed; and (6) scolex with filiform microtriches in apical region, filiform and spiniform microtriches in central cavity, marginal ring and nonadherent surface of suckers, and spiniform microtriches in neck and immature proglottides. The species parasitised fishes of *Pimelodus* spp. Strict specificity of South American proteocephalids for their hosts is placed into consideration since recently new host records have been reported, especially for hosts commercially exploited.

Key-words: microtriches - Proteocephalidea - *Monticellia magna* - Pimelodidae - host specificity - Argentina.

INTRODUCTION

Monticellia magna (Rego, dos Santos & Silva, 1974) was originally described from *Pimelodus clarias* (Bloch, 1782) (junior synonym) (= *P. blochii* Valenciennes, 1840, original combination) as *Nomimoscolex magna*. However, de Chambrier & Vaucher (1997) studied the type material and found it composed by specimens that belong to two different genera, *Proteocephalus* and *Monticellia*; and transferred *N. magna* to *Monticellia*.

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Latter, Rego & Pavanelli (1992) described *Monticellia loyolai* from *Pimelodus maculatus* Lacépède, 1803. De Chambrier & Vaucher (1999) synonymized this species with *M. magna* based on the study of the type material and new material collected in Paraguay. Eventhough, these authors exposed remarkable and distinctive characters for *M. magna*, and did not present drawings of this species.

During a survey of proteocephalidean cestodes from freshwater teleost fishes in Argentina, specimens of *M. magna* were collected from *Pimelodus albicans* (Valenciennes, 1840), *P. argenteus* Perugia, 1891, and *P. maculatus*. *M. magna* is described in detail for the first time in this paper, based on type and the new material. The surface of the tegument of the scolex and portions of the strobila were studied using scanning electron microscopy (SEM).

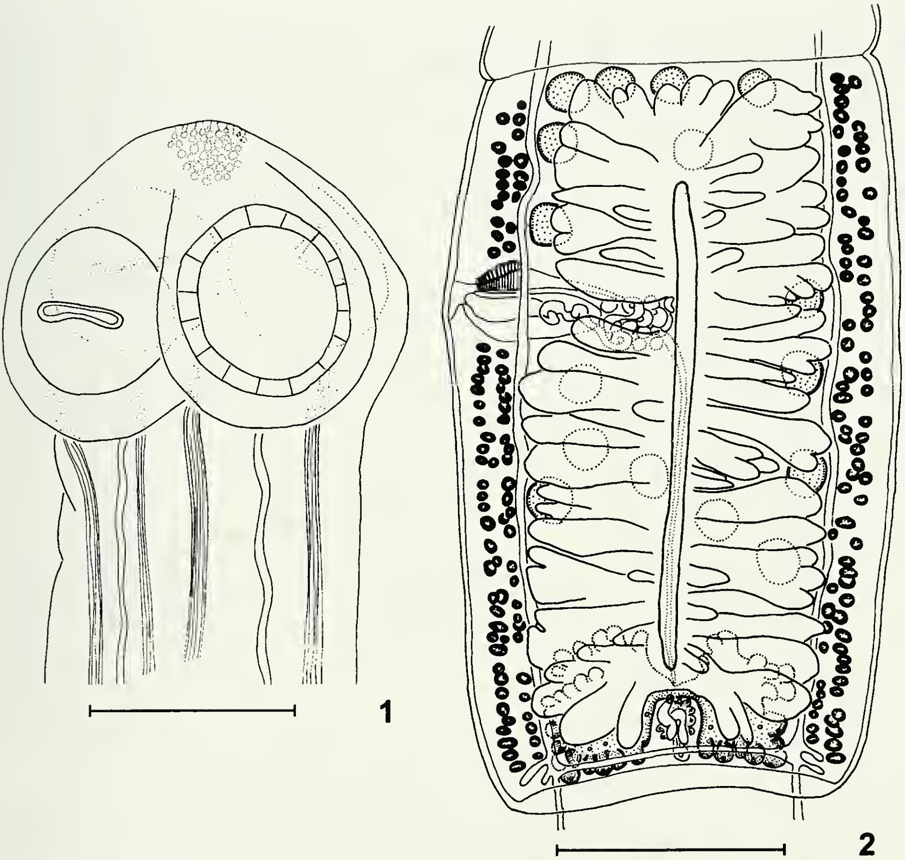
MATERIAL AND METHODS

Eighty specimens of *P. albicans*, 6 of *P. argenteus* and 212 of *P. maculatus* from Colastiné, La Plata, and Paraná rivers were examined for helminths. Worms found in the intestine were isolated and fixed in hot 4% v/v formaldehyde solution and stored in 75% v/v ethanol. Entire tapeworms were stained with Langeron´s alcoholic chlorhydric carmine (Langeron, 1949), differentiated in acid ethanol, dehydrated through a gradual ethanol series, cleared in beechwood creosote and mounted in Canada balsam. Thick transverse hand-cutting serial sections of proglottides were stained following the same procedure. Eggs were mounted in distilled water, after fixation for drawing. Three specimens were prepared for SEM as follows: post-fixed in 1% osmium tetroxide, dried with tetrametylsilane (Analyticals›, Carlo Erba), mounted on stubs with adhesive tape, sputter coated with gold in a Thermo VG Scientific Polaron SC 7630 and examined with a Philips XL 30 scanning electron microscope. Microthrix density values (D) were obtained by counting microtriches from randomly selected areas of 1 μm^2. Voucher specimens of *M. magna* from Argentina were deposited at Colección Parasitológica del Museo Argentino de Ciencias Naturales "Bernardino Rivadavia", Buenos Aires, Argentina (MACN-Pa), and at the Natural History Museum, Geneva, Switzerland (MHNG). Syntypes of *M. magna* (Rego, dos Santos & Silva, 1974) and *M. loyolai* (Pavanelli & Machado dos Santos, 1992) from Helminthological Collection of the Instituto Oswaldo Cruz (CHIOC) were also studied. The information on taxonomic classification of fishes was obtained from FishBase Online (www.fishbase.org). All measurements are given in micrometers, unless otherwise stated, with the range followed by the mean, the standard deviation and the number of measurements (n) in parentheses. Measurements of microtriches were determined from photomicrographs. Illustrations were made with the aid of a camera lucida using Nomarski interference contrast in a Zeiss Axioscope microscope.

RESULTS

Monticellia magna (Rego, dos Santos & Silva, 1974) Figs 1-14
Nomimoscolex magna Rego, dos Santos & Silva, 1974
Monticellia loyolai Pavanelli & Machado dos Santos, 1992

Type host: *Pimelodus clarias* (Bloch, 1782) (junior synonym) (= *P. blochii* Valenciennes, 1840, original combination).



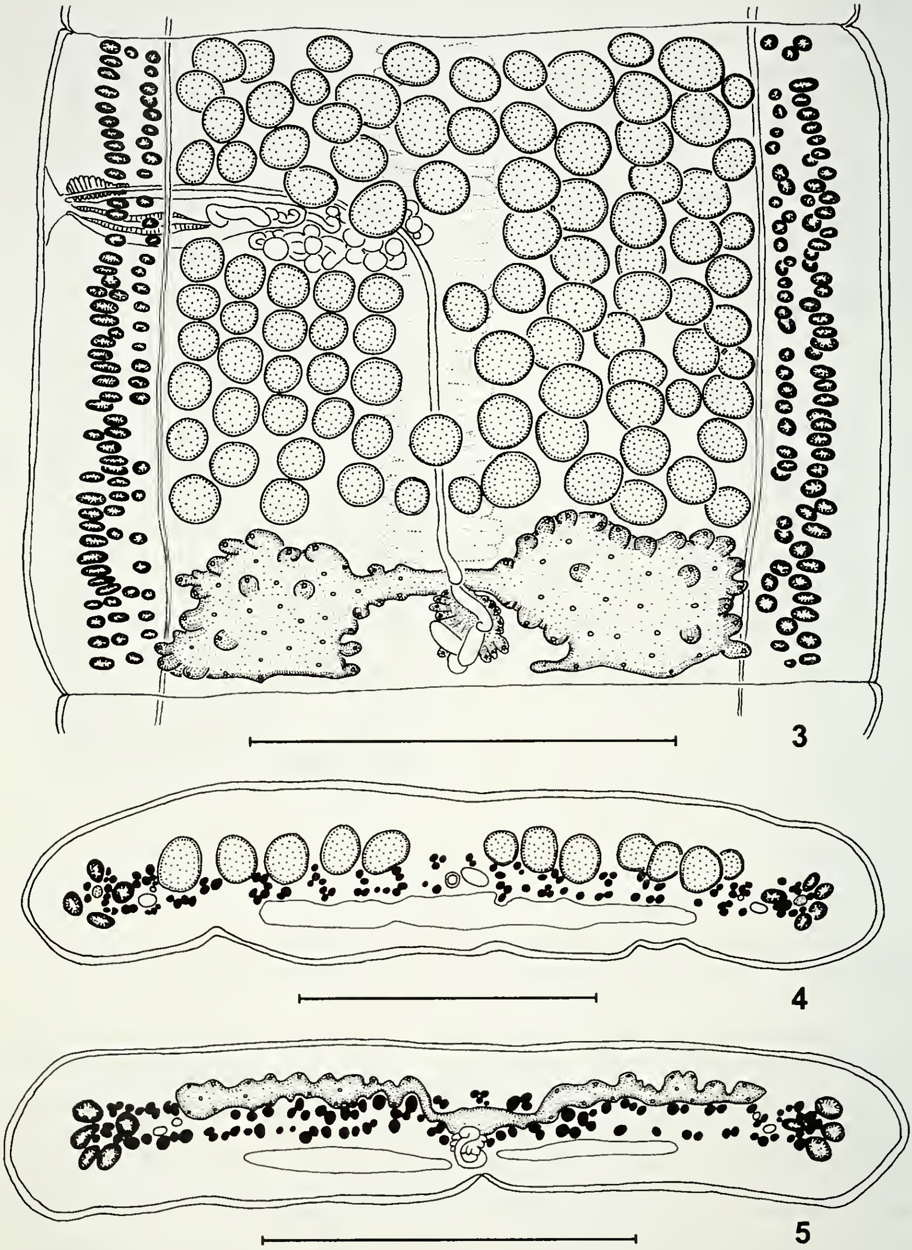
Figs 1-2

Monticellia magna (Rego, dos Santos & Silva, 1974). 1. Scolex, apical region showing unicellular gland cells. 2. Gravid proglottis, ventral view. Scale-bars: 1 = 250 μm; 2 = 500 μm.

Additional hosts: *Pimelodus albicans* (Valenciennes, 1840), vernacular name: moncholo, bagre blanco; *Pimelodus argenteus* Perugia, 1891, vernacular name: bagre blanco; *Pimelodus maculatus* Lacépède, 1803, vernacular name: bagre amarillo (Siluriformes: Pimelodidae).

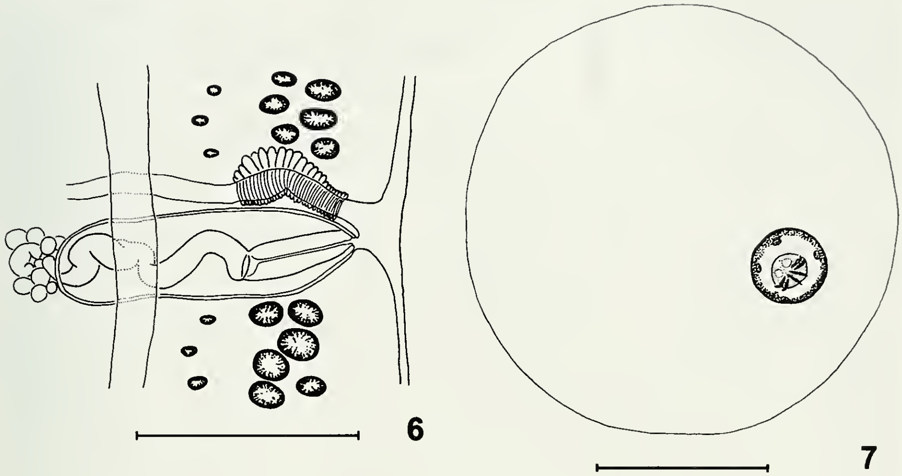
Material studied: **Argentina**: 1) Buenos Aires Province, Buenos Aires Port, La Plata river (34°37'S, 58°22'W), MACN–Pa 419/1-3, collected from *P. albicans* on 23/10/1989, and MACN-Pa 423/1-2 collected from *P. maculatus* on 10/09/1994. 2) Santa Fé Province, Santo Tomé City, Colastiné river (tributary of Paraná river) (31°40'S, 60°46'W), MACN–Pa 423/3-4 and MNHG 34660 INVE, collected from *P. maculatus* on 15/02/2002 and 31/07/2001 respectively, and MACN-Pa 424/1-2 and MNHG 34661 INVE collected from *P. argenteus* on 13/12/2002. Type specimens from **Brazil**: 1) Mato Grosso State, Esperanza Port, syntypes *M. magna* (Rego, dos Santos & Silva, 1974) CHIOC 31049 a-c, 2 contracted specimens; CHIOC 33137 (= 4476), fragment of strobila; CHIOC 33139 (= 4480), fragment of strobila. 2) Paraná State, Paraná river, *M. loyolai* (Pavanelli & Machado dos Santos, 1992), CHIOC 32715 (holotype); CHIOC 32716 c-d and 32717 a-b transverse sections of proglottides (paratypes).

Prevalence: 40% (80 *P. albicans* examined), 33% (6 *P. argenteus* examined), 70% (212 *P. maculatus* examined).



FIGS 3-5

Monticellia magna (Rego, dos Santos & Silva, 1974). 3. Mature proglottis, dorsal view. 4-5. Transverse sections of proglottides showing internal longitudinal musculature, and topography of the genitalia. 4. Transverse section anterior to ovary. 5. Transverse section at level of ovary. Scale-bars: 3-5 = 500 µm.

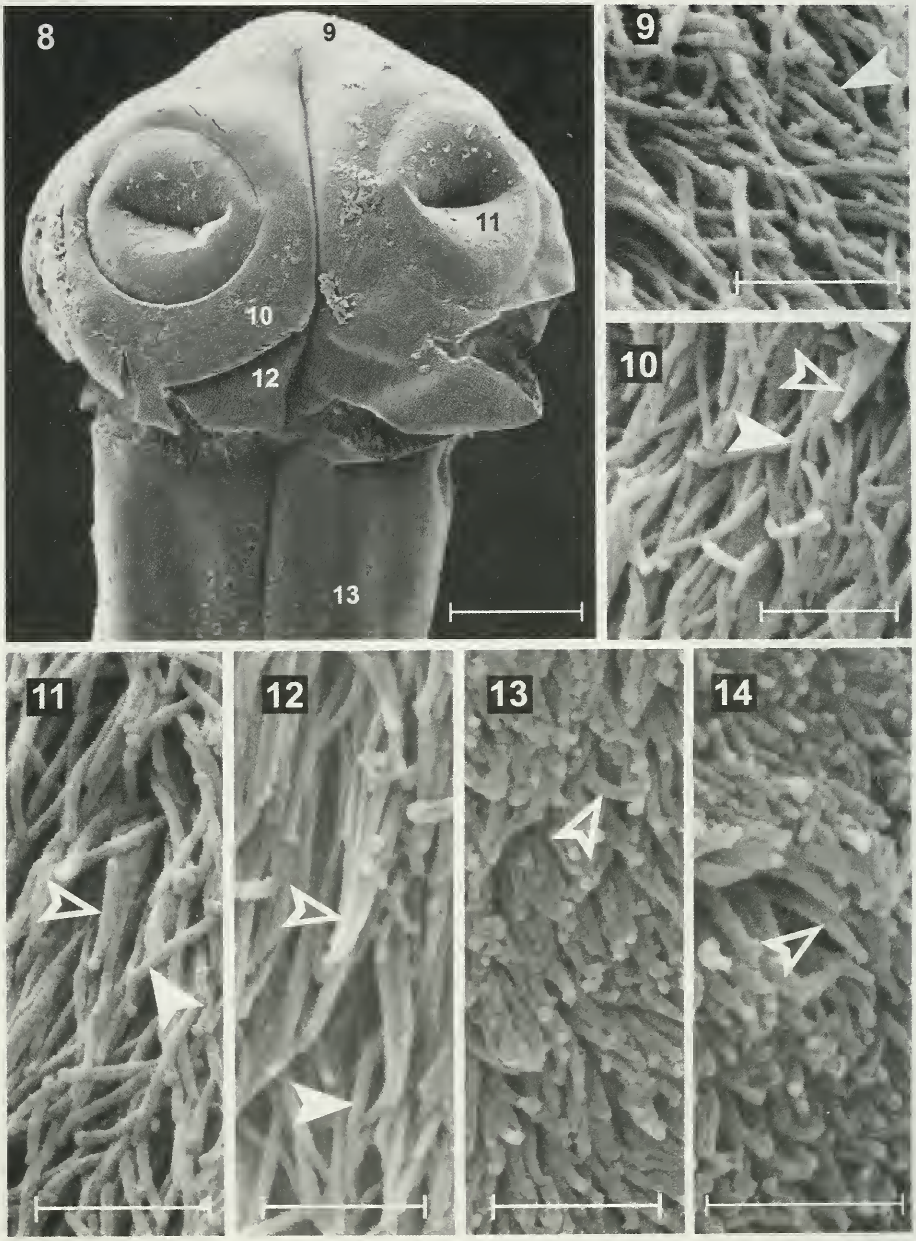


FIGS 6-7
Monticellia magna (Rego, dos Santos & Silva, 1974). 6. Detail of cirrus pouch and vagina showing the asymmetrical sphincter. 7. Eggs drawn in distilled water, after fixation. Scale-bars: 6 = 200 µm; 7 = 100 µm.

Intensity of infection: 2-20 worms per fish.
Site of infection: anterior and middle part of intestine.

Description (based on 15 specimens and measurements on 9 specimens from Argentina): Proteocephalidea, Monticelliidae, Monticelliinae. Testes, ovary and uterus cortical. Vitelline follicles partly in the cortex and partly in the medulla. Medium size worms, 23-125 mm, flattened dorsoventrally. Strobila acraspedote, anapolytic, consisting of 53-125 (n = 9) proglottides: 20-60 immature, 8-22 mature, and 12-60 gravid.

Scolex wider than proliferation zone (Figs 1, 8), 480-830 (582 ± 58, n = 9) wide. Apical organ absent, numerous spherical-shaped glandular cells with granular inclusions, distributed in apical region. Apical region of scolex proper covered with densely packed filiform microtriches 1.1-1.3 (n = 4) long, 0.1 wide, D = 21-25 (n = 4) (Fig. 9). Suckers spherical to oval, unilobate, uniloculate, strongly muscular, 220-300 (246, n = 18) long, 160-300 (217) wide. Central cavity surface of suckers covered with filiform microtriches 0.8-1.2 (n = 5) long, 0.1 wide, interspersed with spiniform microtriches 0.9-1.1 (n = 6) long, 0.2-0.3 wide, D = 23 filiform : 1-2 spiniform (n = 4) (Fig. 11). Marginal ring surface of suckers covered with filiform microtriches 0.9-1.2 (n = 5) long, 0.1 wide, interspersed with spiniform microtriches 1.0-1.3 (n = 6) long, 0.2-0.3 wide, D = 14-20 filiform : 1-2 spiniform (n = 4) (Fig. 10). Nonadherent surface of suckers covered with filiform 1.0-1.2 (n = 5) long, 0.1 wide, interspersed with spiniform microtriches, 1.1-1.3 (n = 4) long, 0.2 wide, D = 8-14 filiform : 2-3 spiniform (n = 4) (Fig. 12). Proliferation zone (neck), 800-3000 (1422, n = 9) long, surface covered with spiniform microtriches, 0.6-0.8 (n = 4) long, 0.2 wide, D = 31-35 (n = 4) (Fig. 13).



FIGS 8-14. *Monticellia magna* (Rego, dos Santos & Silva, 1974) SEM micrographs. 8. Scolex in dorsoventral view, and positions of high magnification views for Figs 9-13. 9. Apical region surface, filiform microtriches. 10-12. Suckers: marginal ring, central cavity, and nonadherent surface, respectively, filiform microtriches interspersed with spiniform microtriches. 13. Proliferation zone surface, spiniform microtriches. 14. Immature proglottis surface, spiniform microtriches. Scale-bars: 8 = 100 μm; 9-12, 14 = 1 μm; 13 = 2 μm. Full arrows show filiform microtriches, empty arrows show spiniform microtriches.

Immature proglottides wider than long, 120-590 (338, n = 12) long, 430-800 (598) wide. Immature proglottides surface covered with spiniform microtriches 0.6-0.7 (n = 5) long, 0.2 wide, D = 38-43 (n = 4) (Fig. 14). The surface of proliferation zone and the immature proglottis is covered with spiniform microtriches, and they are the regions with higher densities (D = 31-35 and 38-43 respectively). Mature proglottides wider than long or longer than wide, 400-1010 (674 ± 154, n = 37) long, 880-2620 (1340 ± 547) wide (Fig. 3). Gravid proglottides wider than long or longer than wide, 500-2200 (1150 ± 373, n = 34) long, 870-2740 (1602 ± 621) wide (Fig. 2).

Internal longitudinal musculature strongly developed, forming thick fibre bundles, delimiting a reduced medulla. Osmoregulatory canals situated between testes and vitelline follicles. Ventral canal, 12-20 in diameter, with secondary osmoregulatory canals ending on ventral surface lateral to ovarian lobes. Dorsal canal, 5-10 in diameter (Figs 4, 5).

Testes cortical, total number 85-146 (106, n = 22) in mature proglottides, 40-100 (70, n = 18) in diameter; in one layer, in two fields connected anteriorly and posteriorly (Fig. 3). Occasionally, 1-3 testes overlapping vas deferens and distal part of cirrus pouch. Cirrus pouch pyriform with thin muscular wall, 210-320 (260 ± 36, n = 31) long, 40-85 (66 ± 13) wide; occupying 21-29% (24% ± 2, n = 31) of proglottis width in mature proglottides. Cirrus occupying about 30-62% of cirrus pouch length. Vas deferens coiled, 20-25 in diameter, usually not surpassing mid-line of body in mature proglottides. Genital pores irregularly alternating, situated anteriorly at 20-42% (28% ± 4, n = 31) of proglottis width.

Vagina anterior (99%) to cirrus pouch, 13-20 in diameter, strongly asymmetrical and muscular sphincter present (Fig. 6). Ovary cortical, with 2 lobulate lobes; occupying 56-74% (67% ± 4, n = 31) of proglottis width in mature proglottides.

Vitelline follicles cortical and paramuscular, with 1-2 follicles lying in medulla. Forming 2 lateral bands concentrated in mid-lateral region of proglottis, interrupted at cirrus pouch and vagina level on ventral side, reaching 98-100% of total proglottis length (Figs 3, 4, 5).

Uterine primordium stem and uterine branches cortical. Uterine branches occupying up to 70% of gravid proglottis width; 19-29 (22, n = 14) lateral branches opposite to cirrus pouch side, and 18-28 (20) on cirrus pouch side. Cortical uterine diverticula nearly completely overlap the ovary. Mature eggs released by a ventral longitudinal slit (Fig. 2). Eggs with thick hyaline outer envelope, 160-275 (228, n = 7) in diameter; embryophore , 35-48 (41, n = 7) in diameter; oncosphere 18-20 (n = 7) in diameter; hooks 10-12 long (Fig. 7).

DISCUSSION

The genus *Monticellia* La Rue, 1911 includes 11 species, all distributed in the Neotropical region: *M. amazonica* de Chambrier & Vaucher, 1997, *M. belavistensis* Pavanelli, Machado, Takemoto & dos Santos, 1994, *M. coryphicephala* (Monticelli, 1891), *M. dlouhyi* de Chambrier & Vaucher, 1999, *M. lenha* Woodland, 1933, *M. magna*, *M. mandi* (Pavanelli & Takemoto, 1996), *M. megacephala* Woodland, 1934, *M. ophisterni* Scholz, de Chambrier & Salgado-Maldonado, 2001, *M. spinulifera*, Woodland, 1935, and *M. ventrei* de Chambrier & Vaucher, 1999. *M. diesingii*

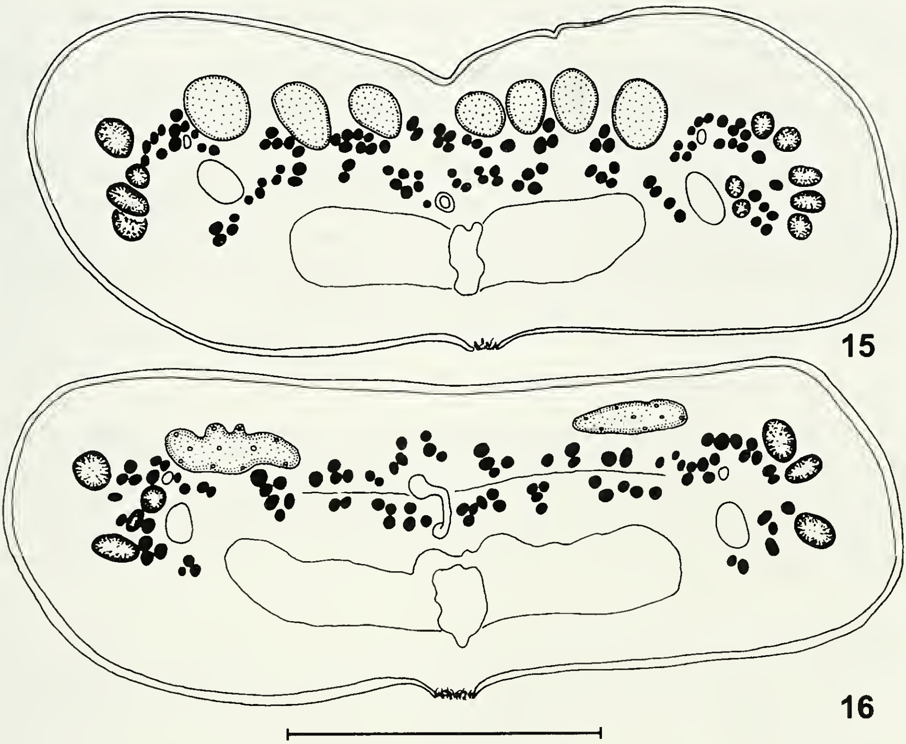
(Monticelli, 1891) and *M. macrocotylea* (Monticelli, 1892) are considered species inquirendae (Rego *et al.,* 1999).

Among the morpho-anatomical features studied in this redescription the following combination of characters are important to characterise *M. magna*: (1) vagina anterior to cirrus pouch; (2) muscular asymmetrical sphincter present; (3) testes in one layer and in two fields connected anteriorly and posteriorly; (4) vitelline follicles distributed cortical, paramuscular and a few follicles medullary; (5) internal longitudinal musculature strongly developed; and (6) scolex with filiform microtriches in apical region, filiform and spiniform microtriches in central cavity, marginal ring and nonadherent surface of suckers, and spiniform microtriches in proliferation zone and immature proglottides.

The syntypes of *M. magna* were studied and the conspecificity with the specimens from Argentina was confirmed. Transverse sections were not available from the material examined. The holotype and the paratypes of *Monticellia loyolai* (= *M. magna*) were also studied. The asymmetrical vaginal sphincter and uterine branches nearly completely overlapping the ovary were clearly observed in type specimens. The vitelline follicles are situated cortical, paramuscular, and medullary (Figs 15, 16). The same topography was observed in the specimens collected from *P. albicans*, *P. argenteus* and *P. maculatus* from Argentina, thus the conspecificity with *M. magna* was also confirmed.

In the genus *Monticellia*, only *M. spinulifera* has been partially examined with SEM (Rego, 1999). Even when this author studied the sucker at very low magnification, and the giant spiniform microtriches on the marginal ring of the sucker could be easily observed. However, from the photomicrograph it is not known if the spiniform microtriches are the only kind of microtriches on the marginal ring surface or if they are interspersed with other types of microtriches. Therefore, it is necessary to study in detail all the regions of the scolex proper to confirm the microthrix distribution of *M. spinulifera*. To date, in the Neotropical proteocephalids only *Nomimoscolex semenasae* Gil de Pertierra, 2002 (Monticelliidae, Zygobothriinae), and *M. magna* in this paper were completely analysed for the microthrix distribution with SEM.

Host-specificity varies widely among different taxa of fish helminths. Highly host-specific parasites are restricted to one host species and specificity declines as the number of suitable host species increases (Poulin, 1998). The South American proteocephalideans have been considered to be specific to one fish host species. In fact, a few examples of species having more than one final host were registered: (1) *Amazotaenia yvettae* de Chambrier, 2001 from *Brachyplatystoma filamentosum* Lichtenstein, 1819, and *B. vaillantii* Valenciennes, 1840; (2) *Choanoscolex abscissus* (Riggenbach, 1896) from *Zungaro zungaro* (Humboldt, 1821) [(= *Paulicea luetkeni* (Steindachner, 1876)], *Pseudoplatystoma corruscans* (Agassiz, 1829), *P. fasciatum* Linnaeus, 1766, and *Raphiodon vulpinus* Spix & Agassiz, 1829 (see Rego *et al.*, 1999); (3) *Harriscolex kaparari* (Woodland, 1934) from *P. corruscans*, and *P. tigrinum* (Valenciennes, 1840); (4) *Monticellia magna* from *Pimelodus albicans* (new record), *P. argenteus* (new record), *P. clarias*, and *P. maculatus*; (5) *M. ventrei* de Chambrier & Vaucher, 1999 from *Luciopimelodus pati* (Valenciennes, 1836) (new record), and *Pinirampus pirinampu* (Spix & Agassiz, 1829); (6) *Nomimoscolex microacetabula* Gil de Pertierra, 1995 from



Figs 15-16

Monticellia magna (Rego, dos Santos & Silva, 1974), transverse sections of proglottides drawn from holotype CHIOC 32715a, showing internal longitudinal musculature, and topography of the genitalia. 15. Transverse section anterior to ovary. 16. Transverse section at level of ovary. Scale-bar: 15, 16 = 500 µm.

P. albicans, and *P. maculatus*; (7) *N. suspectus* Zehnder, de Chambrier, Vaucher & Mariaux, 2000 from *B. filamentosum*, *B. vaillantii*, and *Z. zungaro* [(= *B. flavicans* (Castelnau, 1885)]; (8) *Nupelia tomasi* de Chambrier & Vaucher, 1999 from *Trachelyopterus galeatus* (=*Parauchenipterus galeatus*) (Linnaeus, 1766), and *T. cf. striatulus* (= *P. striatulus*) (Steindachner, 1877); (9) *Peltidocotyle rugosa* Diesing, 1850 (see Zehnder & de Chambrier, 2000) from *P. corruscans*, *P. fasciatum*, and *P. tigrinum*; (10) *Peltidocotyle lenha* (Woodland, 1933) (see Zehnder & de Chambrier, 2000) from *Z. Zungaro*, and *Sorubimichthys planiceps* (Spix & Agassiz, 1829); and (11) *Proteocephalus microscopicus* Woodland, 1935 from *Cichla monoculus* Spix & Agassiz, 1831, and *Cichla ocellaris* Bloch & Schneider, 1801.

Poulin (1992, 1997) stated that high host-specificity can be an artefact of inadequate sampling, and among species of parasites of freshwater fishes sampling effort explains much of the variability in host-specificity. The number of South American proteocephalid species known parasitising more than one fish host might be correlated with a larger sampling effort. Among the fishes mentioned previously 81% are commercially exploited (*Cichla*, 2 species; *Brachyplatystoma*, 2 species; *Luciopi-*

melodus pati; *Pimelodus*, 3 species; *Pinirampus pirinampu*; *Pseudoplatystoma*, 3 species; *Z. zungaro*)

M. magna is widespread within *Pimelodus* spp., these host species are very frequent, and is common food among people living nearby the Argentinian rivers.

In this study accurate drawings of the scolex, mature and gravid proglottides, transverse sections of the proglottides at different levels, detail of the vaginal sphincter, eggs are revisited for the first, and the types of microtriches and their distribution are presented for the first time, the ranges of measurements and the mean are in agreement with the values given by de Chambrier & Vaucher (1999), differences were registered only for the number of uterine branches (18-36 vs 37-57 in this paper), and cirrus length/cirrus pouch length (30% vs 30-62% in this paper).

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Austrolebias arachan (Cyprinodontiformes, Rivulidae), a new species of annual fish from northeastern Uruguay

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***Austrolebias arachan* (Cyprinodontiformes, Rivulidae), a new species of annual fish from northeastern Uruguay**. - The annual fish *Austrolebias arachan* is described from temporary ponds of Río Tacuarí (Los Patos-Merín system) and Río Negro (Río Uruguay drainage) basins. *Austrolebias arachan* is easily distinguished from other *Austrolebias* species by the combination of the following characters: body of males dark brown to black, with light narrow yellow vertical bands, dorsal fin dark brown with vertically elongated light yellow dots in the proximal half, pectoral fin light grey with margin black; females with anterior anal fin rays elongated, forming a triangular-shaped fin. Both sexes with pelvic fins joined to each other in different degrees; two to four parietal neuromasts; three pectoral radials in most individuals. The new species is closely related to *A. adloffi* species group and to *A. viarius*.

Key-words: Cyprinodontiformes - Rivulidae - *Austrolebias* - Uruguay basin - Los Patos System.

INTRODUCTION

At least seven species of the annual fish genus *Austrolebias* (Rivulidae) are endemic of the Los Patos-Merín system, southern Brazil and eastern Uruguay (Costa & Cheffe, 2001; García *et al.*, 2000). Most of them are distributed in lowlands and wetlands associated to that drainage (Costa & Cheffe, 2001; Azpelicueta & García, 2001), between 0 and 50 meters above sea level. However, at least two species, *A. cyaenus* (Amato, 1987) and *A. vazferreirai* (Berkenkamp *et al.*, 1994), inhabit "highland" localities of that system, between 50 and 100 meters above sea level. Furthermore, they can also be found in temporary ponds of the Río Negro drainage, Uruguay (Berkenkamp *et al.*, 1994; Azpelicueta & García, 2001).

In the present article, we describe a new species of *Austrolebias* with a disrupted distribution that includes "highland" localities from both drainages, Laguna Merín and Río Negro (Río Uruguay basin). We also perform chromosomal studies to contribute with the diagnosis of the populations under study.

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MATERIAL AND METHODS

Measurements were taken with digital calliper following Costa (1988), except peduncle length that was measured from the vertical through last anal fin ray to posterior margin of hypural plate and snout length which was measured from anterior tip of upper lip to a vertical through anterior eye margin.

Measurements were expressed as percentages of SL, or other lengths as indicated. Vertebral counts included the composed caudal centrum as one element. Cephalic neuromasts nomenclature followed Costa (2001). Osteological preparations were made following Dingerkus & Uhler (1977).

In the cytogenetics analysis, metaphases were studied following the protocols of Kligerman & Bloom (1977), with modifications by Bertollo *et al.* (1978). Better metaphase preparations of spleen, kidney, and gill epithelium were selected under a microscope Nikon Microphot-Fx with inmersion objective. Photographs were taken with Kodalith (25 asas). Chromosome nomenclature followed Levan *et al.* (1964) and Denton (1973) for fishes. Based on arm relation (AR), chromosomes were classified as metacentric (M), submetacentric (S), subtelocentric (ST) and acrocentric (A). The diploid number (2n) and the number of chromosome arms (FN) were also established. Nucleolar Organizer Regions (NORs) were identified with silver-staining method by Howell & Black (1980) and constitutive heterochromatic C-band regions were detected according to Sumner (1972). Meiotic studies were performed in male individuals to corroborate haploid number (N) following standard protocols (Kligerman & Bloom, 1977).

The examined specimens were deposited in Muséum d'histoire naturelle de Genève (MHNG) and Vertebrate Collection of Facultad de Ciencias, Montevideo, Uruguay (ZVC-P). Tissues and voucher of *A. arachan* used for chromosomic analysis are deposited in the Sección Genética Evolutiva Facultad de Ciencias, Montevideo, Uruguay (FCMVD-GP) with the numbers 657-661, 775-781, and 1130-1132 (all from Departamento de Cerro Largo, Parque Municipal, Melo city).

COMPARATIVE MATERIAL (SL in mm). *Austrolebias adloffi* Ahl: ZVC-P 724, 25 ex., (8 C&S), 30.75-38.26 mm, Brazil, Rio Grande do Sul, Niteroi, pond into the town; ZVC-P 747, 25 ex., 26.46-29.55 mm, Brazil, Rio Grande do Sul, pond close to Rio Gravataí; ZVC-P 854, 16 ex., 26.00-35.10 mm, Brazil, Rio Grande do Sul, Niteroi, pond close to Rio Gravataí; ZVC-P 855, 13 ex., 27.85-33.70 mm, Brazil, Rio Grande do Sul, Niteroi, Villa Rio Branco; MCP 10288, 12 ex., 38.95-54.29 mm, Brazil, Rio Grande do Sul, Canoas, Rio dos Sinos; MCP 15040, 2 ex., 32.00-39.00 mm, Brazil, Rio Grande do Sul, Rio Gravataí; MCP 10933, 20 ex., 29.37-36.92 mm, Brazil, Rio Grande do Sul, Alvorada, rio, Rio Gravataí; UMMZ 168844, 4 ex., 37.25-50.75 mm, Brazil, Canoas; UMMZ 181681, 13 ex., 37.50-44.55 mm, Brazil, vicinity of Porto Alegre; UMMZ 181682, 11 ex., 32.60-40.70 mm, Brazil, vicinity of Porto Alegre. *Austrolebias bellottii* Steindachner: ZVC-P 876, 61 ex. (19 C&S), 25.20- 46.93 mm, Uruguay, Colonia, Carmelo, pond close to Río Uruguay. *Austrolebias melanoorus* Amato: ZVC-P 4322, 10 ex. (2 C&S), 29.82-38.00 mm, ZVC-P 4323, 10 ex., 26.74-44.64 mm, Uruguay, Tacuarembó, Pueblo Ansina, pond close to Río Tacuarembó 10 ex. (2 C&S). *Austrolebias vandenbergi* Huber: ANSP 175282, 16 ex., 28.73-47.71 mm, Paraguay, Boquerón, pond along road Filadelfia-Teniente Montaña; ANSP 175289, 20 ex., 37.30-55.10 mm, Paraguay, Boquerón, pond along road Filadelfia-Teniente Montaña; ANSP 175290, 25 ex., 24.88-47.44 mm, Paraguay, Boquerón, pond along road Filadelfia-Teniente Montaña. *Austrolebias viarius* Vaz-Ferreira, Sierra & Paulette: ZVC-P 525, 50 ex. (8 C&S), 28.63-49.63 mm, Uruguay, Rocha, pond in the vicinity of A° Valizas; ZVC-P 596, 14 ex. (2 C&S), 27.57-41.67 mm. Uruguay, Rocha, pond next to A° Valizas.

RESULTS

Austrolebias arachan sp. n. Figs 1, 2, Tables I, II

Cynolebias uruguayensis Nion *et al.*, 1994, *nomen nudum.*

Holotype. ZVC-P 4336, male, 38.6 mm SL, Departamento de Cerro Largo, pond close to Route 7 and Arroyo Chuy, Laguna Merín basin, Uruguay, col. M. Loureiro, F. Teixeira, A. D'Anatro, L. Bocardi, September 2000.

Paratypes. ZVC-P 4574, 6 males (1 C&S), 31.9-43.7 mm SL, 8 females (1 C&S), 24.8-31.3 mm SL, collected with the holotype. ZVC-P 4314, 2 males, 22.9-24.9 mm SL, 1 female 21.6 mm SL, Departamento de Cerro Largo, pond close to Melo city, road to the airport, Uruguay, coll. M. Loureiro, F. Teixeira, A. D'Anatro, L. Bocardi, September 2000. ZVC-P 4317, 4 males (2 C&S), 26.0-29.5 mm SL, 4 females (2 C&S), 23.2-28.3 mm SL, Departamento Cerro Largo, pond at Parque Municipal, Melo city, Uruguay, coll. M. Loureiro, F. Teixeira, A. D'Anatro, L. Bocardi, September 2000. ZVC-P 4329, 4 males (all C&S), Departamento de Cerro Largo, pond close to Route 26 and Negro River, Uruguay, coll. M. Loureiro, G. Yemini, C. Hernández, October 1999. ZVC-P 4331, 14 males (3 C&S), 26.9-33.8 mm SL, 7 females, 24.7-33.0 mm SL, Departamento de Cerro Largo, pond close to Route 26 and Río Negro, Uruguay, coll. M. Loureiro, F. Teixeira, A. D'Anatro, L. Bocardi, September 2000. ZVC-P 4332, 10 males, 23.6-28.2 mm SL, 5 females, 16.4-22.7 mm SL, Departamento de Cerro Largo pond close to Melo city, road to the airport, Uruguay, coll. M. Loureiro, F. Teixeira, A. D'Anatro, L. Bocardi, September 2000. ZVC-P 4333, 5 males (3 C&S) 28.5-35.6 mm SL, 14 females (5 C&S), 24.5-35.6 mm SL, Departamento de Cerro Largo pond close to Melo city, road to the airport, Uruguay, coll. M. Loureiro, G. Yemini, C. Hernández, October 1999. ZVC-P 4335, 2 males, 30.95-32.45 mm SL, 4 females, 26.3-31.9 mm SL, Departamento de Tacuarembó, Route 26, km 331 pond next to the road, Uruguay, coll. M. Loureiro, F. Teixeira, A. D'Anatro, L. Bocardi, September 2000. ZVC-P 4528, 3 males (1 C&S), 25.0-29.4 mm SL, 3 females (1 C&S), 23.6-25.9 mm SL, Departamento de Cerro Largo, a pond at Parque Municipal, Melo city, Uruguay, coll. G. García, July 2000. MHNG 2641.88, 3 males, 30.58-33.89 mm SL, 3 females, 24.53-29.38 mm SL, Departamento de Cerro Largo, pond close to Route 26 and Río Negro, Uruguay, coll. M. Loureiro, F. Teixeira, A. D'Anatro, L. Bocardi, September 2000.

Diagnosis. Austrolebias arachan is distinguished by the following combination of characters: medium size body (no more than 45.8 mm SL); dorsal-fin insertion anterior to anal-fin origin; long dorsal- and anal-fin bases; male body dark brown to black with light yellow narrow vertical bands, dorsal fin dark brown with vertically elongated light yellow dots on basal half, yellowish brown without dots on distal half; proximal half of anal fin dark brown with vertically elongated light blue dots, distal half light blue without dots; caudal fin light blue with light yellow dots proximally, hyaline on distal fourth; pectoral fin light grey with the ventral margin black. Males with contact organs on scales of flanks, specially distributed over anal fin and around pectoral-, pelvic-, and caudal-fin bases; contact organs on distal third of second to fifth anal fin rays and on three or four uppermost pectoral fin rays distally. Anal fin of females with anterior rays elongated, forming a triangular-shaped fin. Pelvic fins joined to each other at their bases or by an epithelial membrane covering completely or partially (one third) of inner edge in both fins. Two to four parietal neuromasts, sometimes continuous with supra-orbital series. Three pectoral radials in 92 % of individuals examined, four radials in the remaining 8 %.

Description. Meristic and morphometric values are presented in tables I and II respectively. Dorsal profile of head straight or slightly concave; dorsal profile strongly convex from rear of head to dorsal-fin origin, less convex in females; straight below dorsal fin, and straight or scarcely concave on caudal peduncle. Ventral profile arched from tip of lower jaw to end of anal-fin. Maximum body depth at pelvic-fin origin (Fig. 1); females with lower body.

Dorsal fin with 21-26 rays in males; in females, 16-20. Dorsal-fin tip of males rounded, acute in females. Second proximal pterygophore of dorsal fin through a vertical between vertebrae 7 and 8 in males; through vertebrae 9 and 11 in females. Anal fin with 22-27 rays in males, 17-22 in females. Anal-fin tip rounded in males; anterior rays elongated, forming a triangular fin in females, ratio between longest anal-fin ray/anal-fin base 0.76-1.21 (mean 0.94). Anal-fin origin through a vertical between 2nd to 5th dorsal-fin rays in males and females. Caudal fin with distal margin slightly rounded in males, with 20-29 rays; caudal fin rounded with 20-26 rays in females. Caudal-fin skeleton supported by last three or four vertebrae. Pectoral fin with 11-13 rays in males, 10-14 in females; pectoral-fin margin rounded, with middle rays longer; tip of pectoral fin reaching bases of 2nd to 6th anal-fin rays in males, and half or two thirds of pelvic-fin length of females. Pelvic fin with 4-7 rays, covering urogenital papilla and surpassing 3 to 5 anal-fin ray bases in males, scarcely surpassing anal-fin origin in females; distal fin margin rounded. Pelvic fins joined to each other at their bases or joined by an epithelial membrane covering completely or partially (one third) of inner edge in both fins.

Total number of vertebrae 27-30, number of precaudal vertebrae 11-13; second vertebrae pre-zygapophysis poorly developed; post-temporal ventral process variably developed, process reduced or absent in 47 % of the individuals, in rest process moderate or well developed.

Scales cycloid, 27-34 on lateral series; transverse scales 11-18; scales around caudal peduncle 14-20; 1-3 series over caudal fin. Suborbital and postorbital regions scaled.

Contact organs on scales placed over anal-fin base, many contact organs distributed around pectoral and pelvic fin bases, peduncular area completely covered by contact organs. Contact organs on distal half of uppermost pectoral fin rays 1-3 and on distal third of anal fin rays 2-6.

Supraorbital neuromasts 13-22, parietal neuromasts 2-4. Ventral gill rakers 7-11, dorsal gill rakers 2-4. Basihyal slightly widened, basihyal cartilage 50-60 % of total basihyal length. Two to 4 teeth in second pharyngobranchial. Fourth ceratobranchial with 1 or 2 series of teeth mono-, bi- or multicuspidate. Dermosphenotic absent.

Coloration in life: Male*:* Body dark brown with transverse well defined narrow light yellow bands, between those bands may appear some poorly defined bands with the same coloration. Opercular region bluish. Suborbital and supraorbital bands black. Dorsal fin dark brown with vertically elongated light yellow dots in the proximal half, yellowish brown without dots in the distal half; proximal half of anal fin dark brown with vertically elongated light blue dots, distal half light blue without dots; caudal fin light blue with light yellow dots proximally, hyaline in distal fourth; pectoral fin grey with lower margin black; pelvic fin bluish.

Female: Pale brown body, with darker brown irregular dots or stripes on flanks. Dorsum darker than rest of body. Opercular region yellowish green iridescent. Suborbital band faint, supraorbital absent. Dorsal and anal fins proximally covered by

FIG. 1

Austrolebias arachan, female and male, non-preserved specimens collected in a pond at Parque Municipal, Melo city, Uruguay (one of the paratypes localities).

FIG. 2

Karyogram of *Austrolebias arachan*, somatic cells stained with Giemsa. Diploid number 2n= 48, NF= 60. Scale= 10 mm.

irregular black to brown dots or diffuse vertical bands or completely hyaline; most specimens with dots on basal one third of caudal fin; a few specimens, more or less one third of them, without dots on caudal fin. Pectoral fin hyaline; pelvic fin light grey.

Cytogenetic analysis. The mitotic metaphase studies from 15 individuals (ten males and five females) showed 2n=48, NF=60 and gonial meiotic cells from testis N=24. All individuals with following chromosome formula: three pairs of biarmed chromosomes of submetacentric (SM) type, and 23 pairs of ST-A chromosomes (Fig. 2); three pairs of large acrocentric chromosomes; two Ag-NORs placed at terminal position in small arms of first SM chromosome pair (see arrows, Fig. 2). C-bands lo-

TABLE I. Meristic data of *Austrolebias arachan* from Laguna Merín and Río Negro basins. Holotype and minimum, maximum, and mean of 90 paratypes.

		Males (n= 45)		Females (n= 45)	
	Holotype	min-max	mean	min-max	mean
Dorsal fin rays	22	21-26	23.6	16-20	18.0
Anal fin rays	23	22-27	24.1	17-22	19.8
Caudal fin rays	23	20-29	23.4	20-26	23.3
Pectoral fin rays	13	11-13	12.1	10-14	12.1
Pelvic fin rays	6	4-6	5.4	5-7	5.6
Lateral scales	31	27-34	30.4	28-34	30.5
Transverse scales	14	11-18	14.5	12-16	13.3
Peduncle scales	18	14-20	16.8	14-18	16.2
Predorsal scales	19	14-24	19.9	19-30	22.0
Supraorbital scales	4	0-4	1.8	0-4	20.7
Supraorbital neuromast series	21	13-24	20.7	15-27	2.0

TABLE II. Morphometrics of *Austrolebias arachan* from Laguna Merín and Río Negro basins. Holotype and maximum, minimum, and mean of 86 paratypes in percentage of SL.

		Males (n= 39)		Females (n= 47)	
	Holotype	min-max	mean	min-max	mean
Standard length	38.6	22.9-45.8	30.2	16.4-42.4	26.7
Predorsal length	49.9	47.5-54.1	50.3	51.8-62.0	58.4
Basidorsal length	43.3	38.3-48.1	43.2	25.9-35.7	29.4
Preanal length	51.2	49.3-59.0	53.2	55.2-65.9	60.2
Basianal length	38.2	33.8-48.0	41.4	21.5-31.0	24.9
Prepelvic length	49.6	43.5-49.6	46.9	46.9-57.8	51.8
Body depth	39.0	30.6-42.1	35.2	25.6-37.1	31.0
Peduncle depth	13.6	11.2-15.9	13.5	9.4-14.2	12.3
Peduncle length	12.7	7.7-15.3	10.4	14.9-22.6	18.6
Pectoral fin length	23.9	10.2-27.9	23.6	20.9-30.1	25.4
Pelvic fin length	9.1	7.9-13.3	9.8	9.4-14.0	11.7
Head length	34.2	28.9-34.5	32.2	28.4-36.9	32.4
Head width	59.4	49.7-65.7	57.3	50.2-70.5	59.0
Head depth	93.9	79.5-106.1	88.7	71.9-98.7	81.5
Eye diameter	24.1	23.8-32.9	27.8	23.9-37.9	28.8
Interorbital length	41.7	37.7-50.4	44.3	35.0-48.7	41.9
Snout length	19.7	15.9-24.3	19.9	11.6-23.3	19.1

cated at centromeric and telomeric positions in some chromosome pairs. Large heterochromatic blocks of C-bands occuring at interstitial regions of extra large ST-A type.

Etymology. The name *arachan*, originally refers to native inhabitants from the vicinity of Porto Alegre city and Laguna de los Patos system (Brazil). At present, it refers to people from Departamento de Cerro Largo (Uruguay), where several populations of the new species of *Austrolebias* occur.

Distribution. The new species is known from localities of the upper Río Tacuarí drainage (Laguna Merín basin), and upper Río Negro drainage (Río Uruguay basin); all localities are between 50 and 100 meters above sea level (Fig. 3).

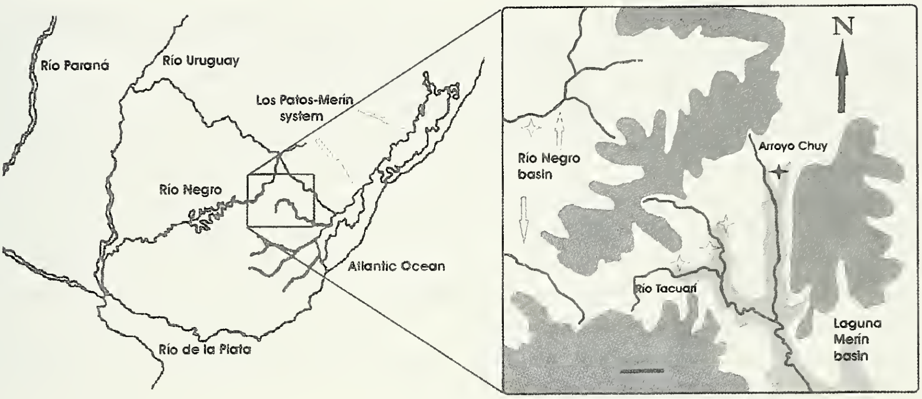

FIG. 3

Geographical distribution of *Austrolebias arachan*. Black star: type locality; white stars: paratypes localities. Dark grey areas represent Cuchilla Grande (more than 150 m above sea level), white areas represent land between 150 and 100 m above sea level, ligth grey areas represent land between 100 and 50 m above sea level. Scale bar= 10 km.

DISCUSSION

Nion *et al.* (1994), in a meeting occurred in Montevideo (Uruguay), presented an abstract entitled "Dos nuevas especies del género *Cynolebias* Steindachner, 1876 (Actinopterygii, Aplocheilidae) del Uruguay". Those authors recognized two new species but they never described them, neither in the abstract nor in other subsequent paper. Therefore, the name *Cynolebias uruguayensis*, used in that abstract for a taxon with similar distribution of the new species here described, became a *nomen nudum*. Furthermore, the material used for that record is lost and this taxon was never described until the present paper.

Austrolebias arachan is related to a group of medium size species that present the anterior anal-fin rays of females elongated (Costa, 2002), pelvic fins joined to each other in different degrees, and two to four parietal neuromasts. The species included in this group are: *A. bellottii*, *A. melanoorus*, *A. vandenbergi*, *A. viarius*, and the *A. adloffi* species group, in which *A. adloffi*, *A. charrua*, *A. minuano*, *A. nigrofasciatus* are included (Costa & Cheffe, 2001; Costa, 2002). *Austrolebias arachan* also shares with all the species mentioned, except *A. viarius*, the presence of pectoral fin with ventral margin black. The pigmentation pattern in the body male of *A. arachan* easily distinguishes it from most of the species aforementioned, except from *A. viarius*. However, *A. viarius* is distinguished from males of *A. arachan* by the darker coloration of body and fins (body dark brown to black vs. brown orange, Vaz Ferreira *et al.*, 1964), a relatively larger dorsal fin base (mean 43.2 vs. 38.8 % of SL), and a relatively narrower head (mean 57.3 vs. 62.2 % of HL); both sexes of *A. arachan* and *A. viarius* are also differentiated by the absence in the former of black dots on the flanks. *Austrolebias arachan* is further distinguished from *A. adloffi* species group by the absence of vertically arranged black dots in the caudal peduncle. Furthermore, the proportion of individuals with reduced postemporal process is higher in *A. arachan* (45 %) than in all species abovementioned (less than 30 %).

Parsimony analysis based on 27 data set of cyt-b sequence including eighteen species of *Austrolebias* and six other Rivulidae genera (García *et al.*, 2002) confirmed that *A. arachan* (*C.* sp GG-661, in that article) is closely related to the *A. adloffi* species group, and to *A. viarius*. Also, cytogenetic data revealed that *A. arachan* presents a generalized karyotype composed by 48 chromosomes of predominantly ST-A chromosome type as was reported for other Cyprinodontiforms groups (Ebeling & Chen, 1970) and other taxa within *Austrolebias* (García *et al.*, 1993, 1995, 2002). However, *A. arachan* has distinctive karyological characters from those of *A. adloffi*, and *A. viarius*. *Austrolebias arachan* has three pairs of SM chromosome type, while *A. adloffi* bears one pair of biarmed chromosomes and *A. viarius* one or two pairs. Furthermore, *A. arachan* presents three extra-large ST-A chromosomes as markers. This type of chromosomes were found in species included in other clades of *Austrolebias* such as *A. alexandri* and *A. gymnoventris* but they were not found in *A. viarius* and *A. adloffi* (García *et al.*, 1995).

Austrolebias arachan shows two NORs at terminal positions of the first biarmed chromosomes. The variability in number and position of NOR regions observed in this taxon is very low in comparison with the high variability detected in previous studies within the genus *Austrolebias* and among sister taxa of the clade (García *et al.*, 1993, 1995, 2001). Peculiar large heterochromatic blocks of C-bands were detected at interstitial regions of the extra large ST-A type; this is an additional different cytogenetic character in *A. arachan*, not found in *A. viarius* and *A. adloffi*.

Austrolebias arachan, together with *A. vazferreirai,* has a unique geographical distribution within the genus, because no other species is found in localities of the two different drainages of the Río Negro and the Laguna Merín. In addition, both drainages belong to different ichthyogeographical regions such as the Río de la Plata basin and the Coastal Atlantic rivers (Ringuelet, 1975). The distribution pattern of the new species could be an indicator of an ancient connection between both systems and regions. The Río Negro basin is separated from the Laguna Merín basin by the Cuchilla Grande (up to 300 m above sea level). However, this hills system is interrupted by an area between 150 and 100 meters above sea level, close to *A. arachan* distribution (Fig. 3). This distribution pattern would suggest a relatively ancient origin of these species and also the possibility of dispersion caused by birds (Santamaría & Klassen, 2002). Annual fish present drought resistant eggs which could rise the probability of successful dispersion by this way. However, this kind of phenomena has not been proved for these fish yet.

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Edaphus comellinii sp. n. aus Sri Lanka (Coleoptera: Staphylinidae)
88. Beitrag zur Kenntnis der Euaesthetinen

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Edaphus comellinii sp. n. from Sri Lanka (Coleoptera: Staphylinidae). 88th Contribution to the knowledge of Euaesthetinae. - Description of *Edaphus comellinii* sp. n. from Sri Lanka, a species of the group of *E. cribricollis* Schaufuss, which is now represented by 3 species in Sri Lanka.

Key-words: Coleoptera - Staphylinidae - *Edaphus* - new species - taxonomy.

EINLEITUNG

Unter den Paratypen des *Edaphus cinghalicus* Comellini fand sich im Muséum d'histoire naturelle de Genève (MHNG) eine neue Art der Gattung aus Sri Lanka, die ich hier beschreibe und zu Ehren von Monsieur André Comellini, der sich um die Erforschung der *Edaphus* von Sri Lanka verdient gemacht hat, benenne. Aus Sri Lanka sind bisher 18 Arten der weltweit verbreiteten Gattung bekannt, die meisten von A. Comellini beschrieben. Während der Revision des Artenkomplexes um *Edaphus cinghalicus* Comellini (Puthz, 2003) habe ich auch die Typen der genannten Art untersucht und dabei unter den Paratypen zwei Stücke der neuen Art entdeckt; ein weiteres Stück fand sich unter unbestimmtem Material.

Edaphus comellinii sp. n.

Material: ♂-Holotypus und 1 ♂-Paratypus: CEYLON (= SRI LANKA): Central, Matale, 400 m, 17.I.1970, Mussard, Besuchet & Löbl (7) (beide Stücke tragen auch die Paratypus-Etiketten von Comellini „E. cinghalicus n. sp.")(MHNG); 1 ♀-Paratypus: Polonuaruwa, 31.VI.1965, R. Mussard no. 5 (coll. Puthz).

Beschreibung: Länge: 1,0 mm (Vorderkörperlänge: 0,6 mm). Hell bräunlich, glänzend, Pronotum sehr fein und wenig dicht punktiert; Beborstung fein, anliegend. Stirn mit Seitenkielen.

Proportionsmaße des Holotypus: Kopfbreite: 27,4; Augenabstand: 19; Wangenlänge: 5; Schläfenlänge: 1,5; Augenlänge: 8; Pronotumbreite: 28,5; Seitenfaltenabstand: 18; Pronotumlänge: 26; größte Elytrenbreite: 39,5; größte Elytrenlänge: 33; Nahtlänge: 28.

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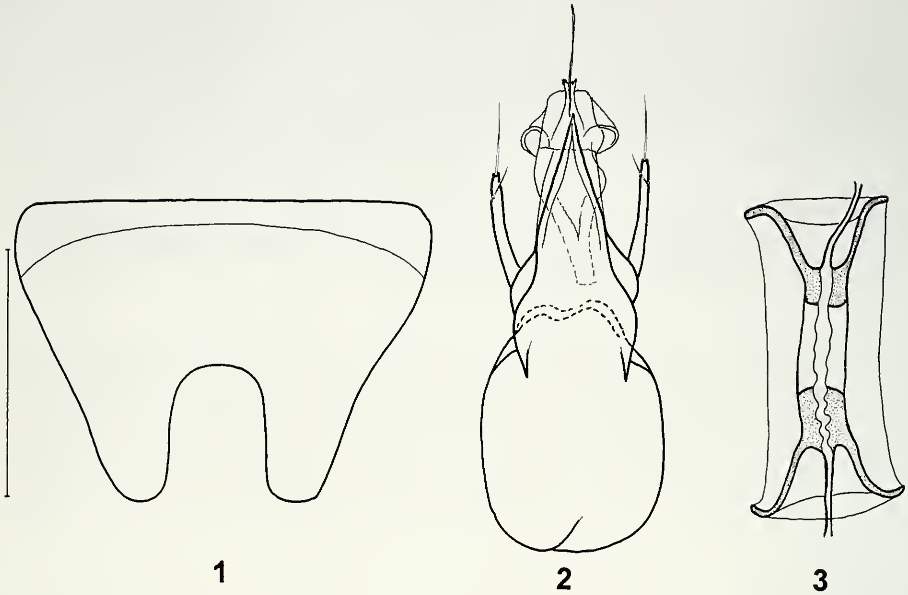

FIGS 1-3
Edaphus comellinii sp. n. (Holotypus): 8. Sternit (1), Aedoeagus, ausgestülpt (2) und Spermapumpe (3).- Maßstab = 0,1 mm.

Männchen: 8. Sternit (Fig. 1). Spermapumpe (Fig. 3). Aedoeagus (Fig. 2), ausgestülpt.

Kopf wenig schmäler als das Pronotum, Augen fein facettiert, vergleichsweise klein, Schläfen deutlich ausgeprägt, Stirn mit deutlichen Seitenkielen, hintere Querfurche und vordere Längsfurchen deutlich eingeschnitten, vorderer Mittelteil breiter als jedes der Seitenstücke, breitrund erhoben, unpunktiert, vom Clypeus durch eine schmale Querrandung abgesetzt, vordere Seitenteile mit wenigen winzigen Punkten. Fühler kurz, 7.-9. Glied fast so lang wie breit, Keule zweigliedrig, deutlich abgesetzt, vorletztes Glied etwa so lang wie breit. Pronotum wenig breiter als lang, hinten kräftig eingeschnürt, mit deutlichen Seitenfältchen, die durch eine feine Linie über die Pronotummitte hinaus nach vorn verlängert sind (dies wird besonders bei schrägem Lichteinfall erkennbar), Mittelfältchen bis zur Basis durchgehend, und mit 6 basalen Grübchen. Punktierung sehr fein, aber erkennbar und ziemlich weitläufig. Elytren trapezoid, erheblich breiter als lang, Schultern einfach, Punktierung undeutlich, sehr fein, flach und weitläufig. Abdomen zerstreut mit winzigen Punkten versehen, Mittelkiel des 3. Tergits gut bis zur Tergitmitte reichend.

Bemerkungen: Diese neue Art ist dem *E. sparsus* Puthz aus Malaysia zum Verwechseln ähnlich; sie unterscheidet sich aber von ihm durch längere Seitenfältchen des Pronotums, feinere Punktierung desselben und durch kleineren Aedoeagus. Von *E. cinghalicus* unterscheidet sie sich sofort durch fehlende lange Mittelfurche und kürzere Seitenfalten des Pronotums. In meiner Bestimmungstabelle (Puthz, 1979) muss die Art bei Leitziffer 13 eingefügt werden. Comellini nennt in seiner Arbeit bei *E. cinghalicus* 2 Paratypen von Matale, 1 ♂ und 1 ♀: beide Stücke sind jedoch Männchen und gehören zu der neuen Art.

LITERATUR

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Two new taxa of Leptodirini (Coleoptera: Leiodidae, Cholevinae) from the Cantabrian cornice (Asturias, Spain). Biogeographical observations

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Two new taxa of Leptodirini (Coleoptera: Leiodidae, Cholevinae) from the Cantabrian cornice (Asturias, Spain). Biogeographical observations. - *Quaestus (Asturianella) incognitus* subgen. n., sp. n, and *Quaestus (Speogeus) mermejaensis* sp. n. are described from caves located in the eastern foothills of the Sierra Mermeja (Asturias, Spain). Both taxa are included in the section *Quaestus* (sensu Salgado, 2000). Keys for a better, more precise placement of the new taxa are also given as well as biogeographical observations and a study on colonization by the species captured in the four caves examined in this paper, in comparison with other morphologically similar species or those living in neighbouring areas.

Key-words: Coleoptera - Leiodidae - Leptodirini - taxonomy - *Quaestus (Asturianella) incognitus* sp. n. - *Quaestus (Speogeus) mermejaensis* sp. n. - caves - colonization.

INTRODUCTION

One of the karstic areas with the largest troglobitic fauna stretches over a series of small mountain ranges situated towards the south of Asturias comprising the Crespón, Mermeja, Corteguero, Pintacanales, Ques and Giblaniella sierras. They cover an area of approximately 600 km^2 between the Ponga, Sella, Infierno, Marea, Nalón, S. Isidro and Aller river basins (fig. 27). Eleven species of troglobitic Leptodirini are known from this area. They have been described over the last 20 years (Salgado, 1982, 1984, 1985, 1988, 1989) and are at different stages of evolution, indicating that the caves were colonized during different glacial periods in the Pleistocene.

Undoubtedly, the presence of such a high number of species in such a small area is explained by the occurrence of great orogenic convulsions causing the formation of small mountain ranges and numerous faults, landslides, overthrusts, etc. Well-isolated areas were formed and this interrupted the genetic flow of the populations, the main reason for speciation, which in this case is clearly allopatric (Bellés & Martínez, 1980; Galán, 1993; Salgado, 1995; Peck, 1998).

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In one of the previously-mentioned mountain ranges, the Mermeja, various samplings were carried out intermittently in 4 caves. A known species, *Quaestus (Quaestus) longicornis* (Salgado, 1989) was captured together with one proximate to *Q. (Q.) jeannei* (Coiffait, 1965) and *Q. (Q.) recordationis* (Salgado, 1982), *Quaestus (Quaestus)* sp., this last species is still under study, due to the complexity of its structures and distribution. Two new taxa, *Quaestus (Asturianella) incognitus* subgen. n., sp. n. and *Q. (Speogeus) mermejaensis* sp. n. were also captured.

TAXONOMIC TREATMENT

DESCRIPTION OF THE NEW SUBGENUS OF THE GENUS *QUAESTUS*

Asturianella subgen. n.

Type species: *Quaestus (Asturianella) incognitus* sp. n.

Diagnosis. The basic distinguishing characters are: antennal segments of club longer than wide; pronotum strongly transverse, parameres with 4 apical setae; very long, robust stylet with subrectangular basal plate; spermatheca with small spherical apical lobe, basal lobe highly developed and oblong, spermathecal duct long and fine.

Description. Ovoide, anophthalmic; small, less than 3 mm (fig. 1). Antennae not surpassing half body length, all segments longer than wide (fig. 6). Elliptical elytra following curve of prothoracic sides. Mesosternal carina developed, with rounded tip and expanded ventral margin (fig. 9). Legs short. Male protarsi with 4 clearly dilated segments (fig. 7); females with gracile 4-segmented protarsi.

Aedeagus robust, weakly arcuate but with apex strongly curved towards ventral face. Ventral lamina of tegmen slightly wider than long. Parameres somewhat longer than median lobe, distally forming dilated club with 4 setae inserted. Internal sac with two bands almost the same length as sac; long developed stylet inserted in subrectangular basal plate, no other sclerotized pieces discernible, only scales in basal region and fine spines and pilosity near median region (figs 2, 3 and 5).

Apical lobe of spermatheca small and spherical, basal lobe expanded and long spermathecal duct weakly dilated along anterior region (fig. 4).

Etymology. The subgeneric name is a reference to Asturias, the region of Spain where the specimens belonging to this new taxon were captured. The name is of feminine gender.

Discussion. Some of the characters of the external morphology of the new taxon, including, 8th, 9th and 10th segments scarcely long; pronotum transverse with uniformly arcuate sides, elytra quite narrow in posterior region, and in particular, the genitalia, with a well-developed stylet and the spermatheca exhibiting an easily-distinguishable spherical apical lobe, are also observed in the genus *Quaestus*. However, there is one unique and completely distinguishing character in this new taxon, the 4 setae in the apical region of the parameres, which is only present in the genus *Speocharinus* Español & Escolà, 1997, as all the *Quaestus* have only 3. In exceptional cases some specimens may exhibit 4 setae, as indicated by Bellés (1977) in *Quaestus (Quaesticulus) minos* (Jeannel, 1909) and Salgado (1982) in *Quaestus (Quaestus) jeannei* (Coiffait, 1965), both species have a supernummary seta, but it is only present in one specimen and on one paramere.

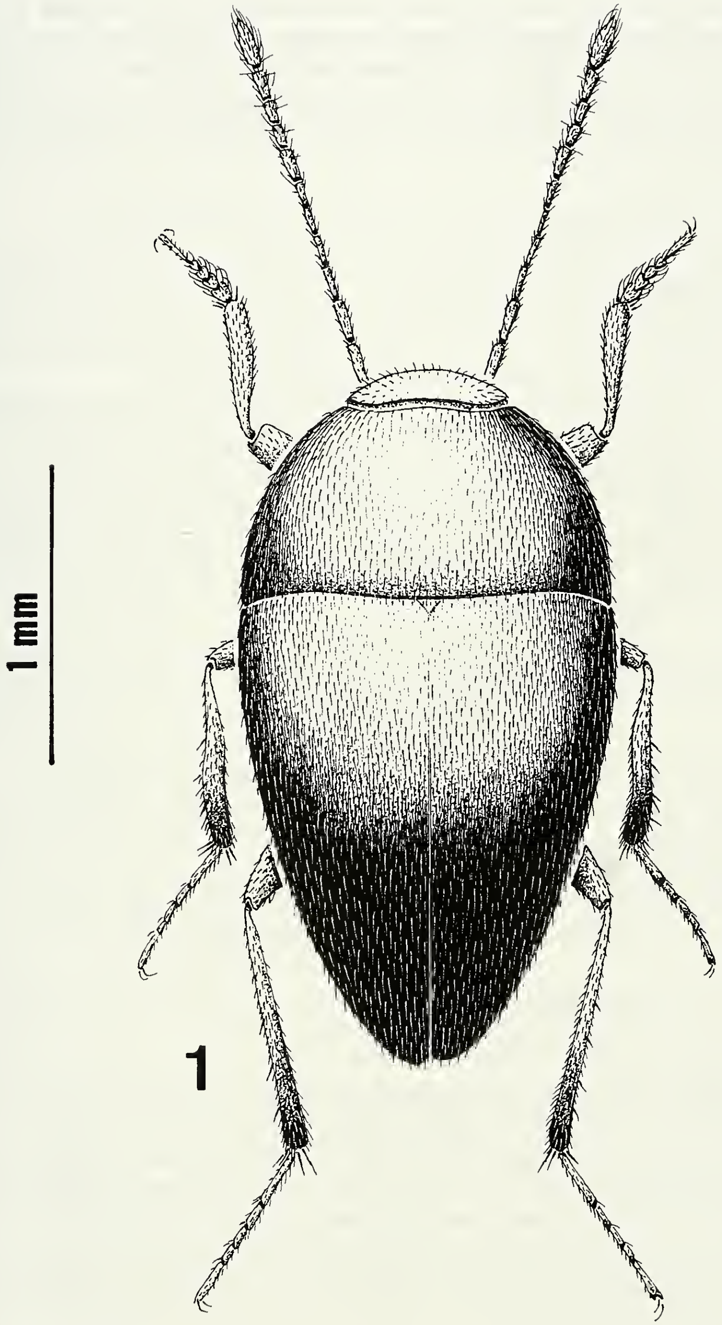


FIG. 1
Quaestus (*Asturianella* subgen. n.) *incognitus* sp. n. (paratype, male), habitus.

Considering the importance of this character, 4 setae in the parameres, with 3 setae never being observed in any specimen, and considering that the aedeagus and spermatheca are quite similar to those in specimens belonging to *Quaestus*, especially the group *jeannei* (Salgado, 1982), the category of genus should not be assigned to this new taxon. The category of monospecific subgenus is sufficient to establish its taxonomic independance.

TAXONOMY AND KEY OF THE SUBGENERA BELONGING TO THE GENUS *QUAESTUS*

The section *Quaestus* (Salgado, 2000) includes the following valid genera: *Breuilia* Jeannel, 1909; *Breuilites* Salgado, 1980; *Cantabrogeus* Salgado, 2000; *Espanoliella* Guéorguiev, 1976; *Leonesiella* Salgado, 1996; *Quaestus* Schaufuss, 1861; *Oresigenus* Jeannel, 1948 and *Speocharinus* Español & Escolà, 1997.

The genera belonging to this section are characterized by the long elevated or low mesosternal carina (short in the subgenus *Speogeus* only). Internal sac of aedeagus with pilosity, scales, spinules, spines, sclerotised plates or generally long stylet, or a combination of all these structures. Spermatheca with generally discernible basal lobe, more developed than spherical apical lobe. The species belonging to these genera are found along the Cantabrian cornice, except for *Quaestus (Quaesticulus) cisnerosi* (Pérez-Arcas, 1872) which inhabits the Central Mountain Range of the Iberian Peninsula.

Using studies by Salgado (1985, 1993, 2000), Newton (1998) and Perreau (2000) as a basis, the genus *Quaestus* includes 6 subgenera.

1 Elytra lacking sutural striae or with very rudimentary weakly discernible stria, only visible in anterior region of elytrum. Stylet of internal sac of aedeagus bearing plate or basal bowl. Spermatheca with small apical lobe and generally long, fine spermathecal duct 2

1’ Elytra with sutural stria along all the elytrum, usually easily discernible. Sylet of internal sac of aedeagus lacking plate or basal bowl. Spermatheca with big or small apical lobe and short spermathecal duct 4

2 Parameres bearing 4 setae in apical region . . . . *Asturianella* subgen. n.

2’ Parameres with 3 setae in apical region 3

3 Mesosternal carina short, if the apophysis is near the end of the metasternum, the carina is always low. Angle of carina strongly obtuse. Ventral edge of carina always narrow. Mid posterior region of metasternum often bearing small fovea . . . . *Speogeus* Salgado, 1985

3’ Mesosternal carina long and elevated, apophysis always reaching metasternum. Angle of carina just over 90°. Ventral edge narrow or wide. Mid posterior region of metasternum lacking fovea . *Quaestus* Schaufuss, 1861

4 Apical region of elytra pointed and diverging. Median lobe of aedeagus strongly expanded in mid region, with carina in ventral face. Internal sac lacking fanerae, only stylet present . . . . *Samanolla* Salgado, 2000

4’ Apical region of elytra rounded and not diverging. Median lobe of aedeagus not strongly expanded in mid region, lacking carina in ventral face. Internal sac with fanerae and stylet 5

5 Male metafemur with small denticle on posterior margin. Internal sac of aedeagus with robust teeth and spines, spinules or both .... *Amphogeus* Salgado, 2000

5’ Male metafemur lacking denticle in posterior margin. Internal sac of aedeagus with more or less developed spiny formations .... *Quaesticulus* Schaufuss, 1861

DESCRIPTIONS OF THE NEW SPECIES

Quaestus (Asturianella) incognitus sp. n.

Type material. Holotype, ♂, Cave of Julió, Caleao, T. M. de Caso (Asturias), 31-VII-2002, J.M. Salgado leg., in Muséum d’histoire naturelle de Genève. Paratypes: 48 ♂♂ and 74 ♀♀, same data as Holotype. Cave of the Prau, Puente de Piedra-Buspriz, T. M. de Caso (Asturias), 17-VI-1989, 60 ♂♂ and 96 ♀♀; 28-X-1989, 68 ♂♂ and 73 ♀♀; 31-VII-2002, 3 ♂♂ and 10 ♀♀, J.M. Salgado and D. Rodríguez leg. Cave of Carretera, Puente de Piedra-Buspriz, T. M. de Caso (Asturias), 28-X-1989, 2 ♂♂ and 3 ♀♀, J.M. Salgado and D. Rodríguez leg. Cave of Rearco, Coballes, T. M. de Caso (Asturias), 22-IV-1989, 33 ♂♂ and 50 ♀♀; 15-IV-2003, 45 ♂♂ and 41 ♀♀, J.M. Salgado and D. Rodríguez leg. Muséum d’histoire naturelle de Genève; J.M. Salgado Coll., Dpto. de Biología Animal, Universidad de León (Spain); J. Fresneda Coll., Lleida (Spain); P.M. Giachino, Museo Regionale di Scienze Naturali, Torino (Italy); Museo de Zoología de Barcelona (Spain); Muséum National d’Histoire Naturelle, Paris (France); Field Museum of Natural History, Chicago (USA).

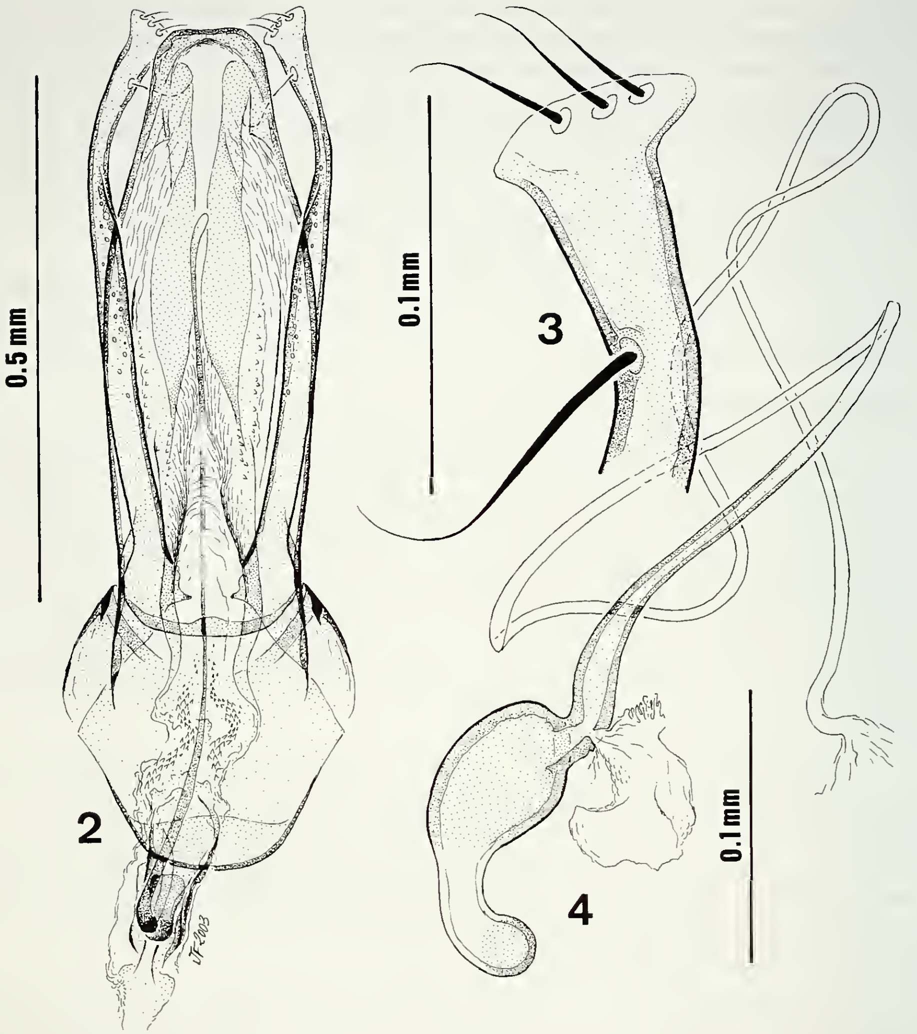
Diagnosis. 11th antennal segment twice the length of 10th; 8th, 9th and 10th segments slightly longer than wide; male protarsi as wide as maximum width of tibia; aedeagus with tip of median lobe curved towards ventral face; parameres somewhat longer than median lobe, with 3 short apical setae and one longer preapical seta; internal sac of aedeagus exhibiting pilosity, scales and very long robust stylet with subrectangular basal plate; spermatheca with small spherical apical lobe, and wide oval basal lobe, spermathecal duct very long.

Description. MALE. Holotype ♂, 2.56 mm (paratypes: 2.53-2.70 mm). Elongate, elliptic body, not very narrow posteriorly (fig. 1). Uniformly reddish-brown. Shiny tegumenta. Antennae not surpassing half the body length, segments noticeably expanded from 7th (fig. 6). Of particular interest is the 11th segment which is twice the length of 10th; 8th, 9th and 10th segments slightly longer than wide; 3rd and 5th segments equal and slightly longer than 4th and 6th, which are the same (Table I).

Pronotum strongly transverse (maximum width/maximum length relationship: 2.05), sides uniformly arcuate and widest at base. Elytra elongate, less than one and a

TABLE I. Maximum lengths (L) and widths (W) of antennal segments (1 mm = 50 units).

Segments	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
L	6.5	7.0	5.0	4.0	5.0	4.0	5.5	3.2	4.1	3.9	8
W	2.5	2.7	2.0	2.0	2.0	2.0	2.8	2.4	3.1	3.3	3.6



Figs 2-4

Quaestus (A.) incognitus sp. n.: (2) aedeagus, dorsal view; (3) apical region of the paramere; (4) spermathecal complex.

half times width of pronotum, margins continuous, gradually narrowing towards tip. Sutural stria absent. Mesosternal carina elevated, apophysis reaching metasternum; obtuse angle with rounded tip and ventral margin wide (fig. 9). Legs slender, moderately long, with first segment of protarsi as wide as maximum width of protibiae (fig. 7).

Aedeagus robust and long (0.77 mm), in dorsal view, median lobe with sides almost parallel as far as apical fourth then narrowing progressively, apical area weakly truncate (fig. 2). In lateral view distal region in extended pointed tip and curved towards ventral part (fig. 5). Parameres just surpassing tip of median lobe, apical region expanded, resembling an axe, with 4 setae inserted, 3 short equal ones in apical margin, a more robust one in club base near internal margin (fig. 3). Long robust stylet of internal sac with subrectangular basal plate, flanked by two thin very weakly sclerotized plates; scales near basal region set out in shape of an arch, fine spinules and pilosity in two narrow rows near median region. Two reinforcement bands almost as long as sac (fig. 2).

FEMALE. As robust as male, with shorter antennae and proportionally thicker segments (Table II). Protarsi not expanded and tetramere. Eighth urite with short, narrow spiculum ventrale, twice as short as length of sternite (fig. 8). Spermathecal complex showing a spermatheca with very small spherical apical lobe, basal lobe twice as wide and almost three times longer than apical lobe; the joining between these lobes short, narrow and not sclerotized; spermathecal duct long, approximately 9 times as long as spermatheca which is slightly expanded in one third of its anterior length (fig. 4).

TABLE II. Maximum lengths (L) and widths (W) of antennal segments (1 mm = 50 units).

Segments	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
L	5.7	6.2	4.0	3.7	4.0	3.7	5.0	2.7	4.0	3.8	7.5
W	2.5	2.7	2.0	2.0	2.0	2.0	2.7	2.3	3.0	3.2	3.6

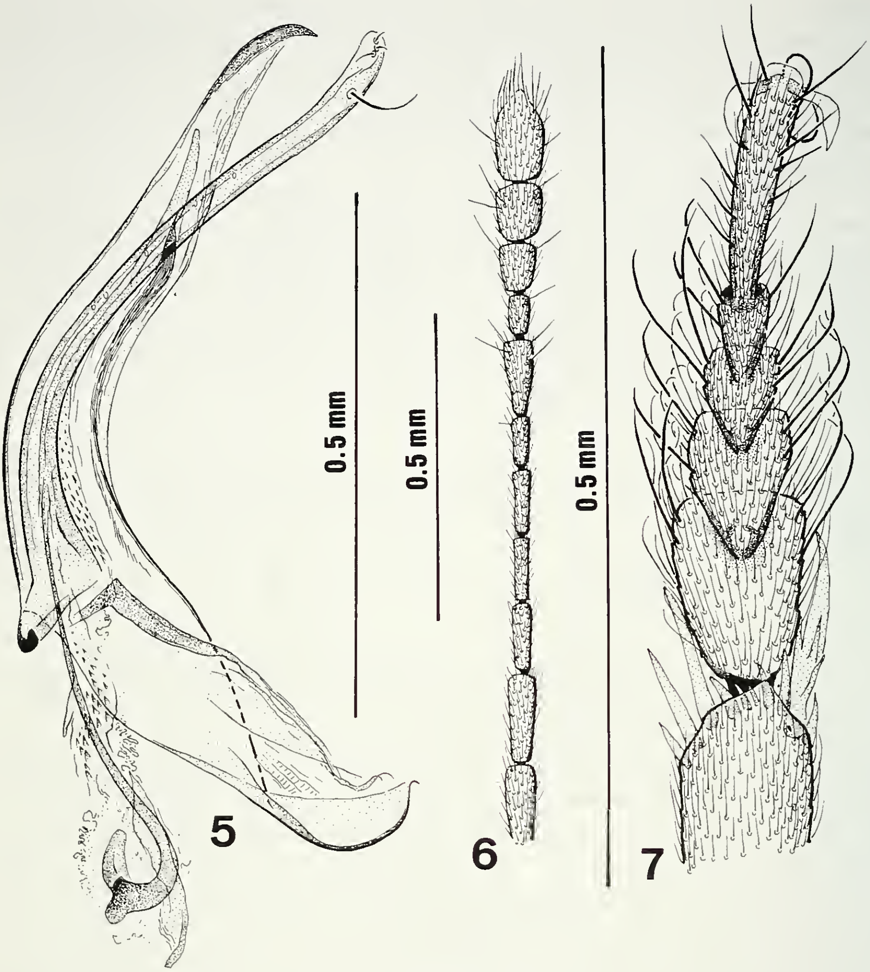
Etymology. "Incognitus=unknown" refers to the long period of time that passed from when this new species was first captured (22-IV-1989) until it was described.

Discussion. This new taxon shows certain similarities to two species in the group *jeannei*, *Quaestus (Quaestus) jeannei* Coiffait, 1965 and *Q. (Q.) recordationis* Salgado, 1982, in their external morphology, shape of the median lobe, structures of the internal sac of the aedeagus and shape of the spermatheca (figs 10-17). *Q. (Asturianella) incognitus* sp. n. is differentiated from the two previously-mentioned species by the more slender antennal segments, all of which are longer than wide, and a more transverse pronotum; also, the median lobe of the aedeagus is more robust and has a slightly truncate apical area, more parallel sides in the median region and the apical curvature more pronounced. However, two characters make this new species unmistakeable and clearly distinguish it from any other species in the genus *Quaestus*, the shape of the club of the parameres and the 4 setae inserted.

Finally, it should be mentioned that the antennal segments of the specimens captured in the Rearco cave are slightly longer than those of the specimens captured in the other three.

Quaestus (Speogeus) mermejaensis sp. n.

Type material. Holotype, ♂. Cave of the Prau, Puente de Piedra-Buspriz, T. M. de Caso (Asturies, Spain), 17-VI-1989, J.M. Salgado leg., in Muséum d'histoire naturelle de Genève. Paratypes: Cave of the Prau, Puente de Piedra-Buspriz, T. M. de Caso (Asturies, Spain), 17-VI-1989, 35 ♂♂ and 47 ♀♀; 31-VII-2002, 10 ♂♂ and 10 ♀♀, J.M. Salgado and D. Rodríguez leg. Cave of the Carretera, Puente de Piedra-Buspriz, T. M. de Caso (Asturies, Spain), 28-X-1989, 2 ♂♂ and 4 ♀♀, J.M. Salgado and D. Rodríguez leg. Cave of Rearco, Coballes, T. M. de Caso (Asturies, Spain), 22-IV-1989, 2 ♂♂ and 2 ♀♀; 15-IV-2003, 4 ♂♂ and 12 ♀♀, J.M.



Figs 5-7

Quaestus (A.) incognitus sp. n.: (5) aedeagus, lateral view; (6) antenna; (7) protarsum, dorsal view.

Salgado and D. Rodríguez leg. Muséum d'histoire naturelle de Genève; J.M. Salgado Coll., Dpto. de Biología Animal, Universidad de León (Spain); J. Fresneda Coll., Lleida (Spain); P.M. Giachino, Museo Regionale di Scienze Naturali, Torino (Italy); Museo de Zoología de Barcelona (Spain); Muséum National d'Histoire Naturelle, Paris (France); Field Museum of Natural History, Chicago (USA).

Diagnosis. A species of the tribe Leptodirini characterized by: elongate weakly convex body; 8th antennal segment transverse, 9th and 10th segments slightly longer than wide; elytral margins parallel along mid region; mesosternal carina low and short with narrow ventral edge and strongly obtuse angle; parameres clearly surpassing tip of median lobe, dilated club with 3 setae and one or two easily discernible piliferous pores.

Description. MALE. Holotype ♂, 2.62 mm (paratypes: 2.58-2.82 mm). Body elongate, elliptical weakly convex, reddish-brown and covered in short laid back yellowish pilosity. Antennae quite long, clearly surpassing half body length (fig. 23); 11th segment three times longer than wide and three times as long as 10th segment; 8th segment transverse; 3rd to 6th segments similar in length (Table III).

TABLE III. Maximum lengths (L) and widths (W) of antennal segments (1 mm = 50 units).

Segments	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
L	7.2	8.0	5.1	4.9	5.0	5.0	6.4	3.0	4.1	4.0	11.7
W	2.7	2.4	2.0	2.0	2.0	2.0	3.4	3.0	3.7	3.8	4.0

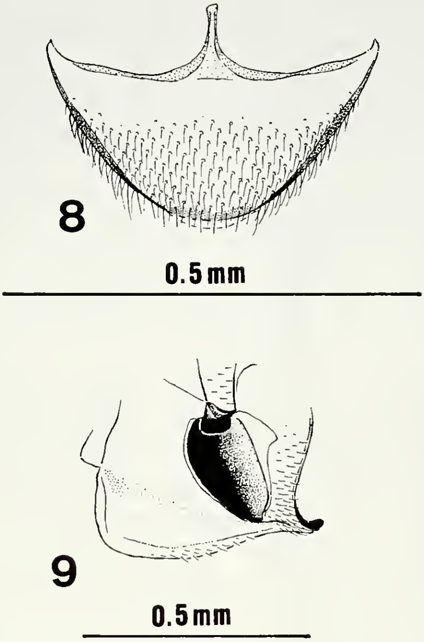
Pronotum transverse, almost twice as wide as long (1.88), sides uniformly curved, attenuated towards front and weakly narrow towards back; basal area as wide as elytra. Elytra elongate,1.65 times longer than wide, with parallel margins along two thirds of their length, gradually narrowing to the tip. Sutural stria not discernible. Mesosternal carina low, with very obtuse angle and very rounded tip; ventral margin narrow, apophysis slightly surpassing mesosternum (fig. 21). Legs slender and quite long, protarsi dilated, the first being wider than the maximum width of the protibiae (first protarsi/protibiae ratio = 1.25).

Aedeagus weakly wide and quite long (0.60 mm) in lateral view, with uniformly arcuate median lobe and curved pointed tip (fig. 22). In dorsal view, tip of median lobe truncate and slightly arcuate inwards in median region (fig. 18). Parameres clearly surpassing tip of median lobe, with expanded shovel-like club, internal margin pointed, resembling a peak; of the three setae inserted in the club, the lower one is long and inserted in the base, fairly distant from the two small apical ones, with insertion pores close together and one or two pores above the apical setae which have no setae (fig. 19). Internal sac with numerous weakly-sclerotised scales scattered in mid basal region; stylet very long and fine, almost as long as median lobe, with well-developed subrectangular insertion plate. Two reinforcement bands as long as internal sac (fig. 18).

FEMALE. Generally a little more robust than male, with elytra slightly more convex. Antennae somewhat shorter and segments comparatively thicker than in male (Table IV). Spiculum ventrale of 8th urite very short and narrow, 3 times shorter than length of sternite. Spermathecal complex with spermatheca quite rectilinear, apical lobe small and spherical, basal lobe much longer than wide, both well-sclerotised, the joining region more narrow and translucent; spermathecal duct fine, just over 4 times as long as spermatheca, and slightly more expanded along anterior fifth (fig. 20).

TABLE IV. Maximum lengths (L) and widths (W) of antennal segments (1 mm = 50 units).

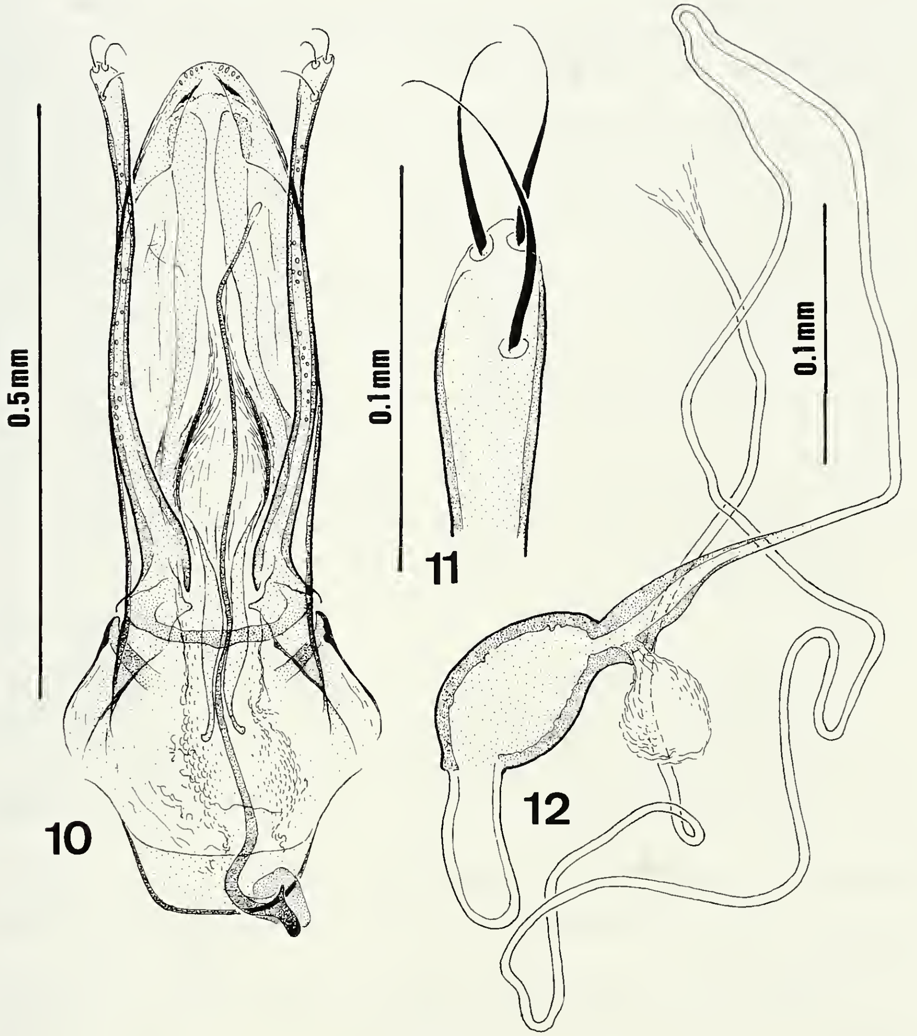
Segments	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
L	6.9	7.8	5.0	4.7	5.0	4.8	6.0	2.8	4.0	4.0	9.0
W	2.7	2.5	2.1	2.1	2.1	2.1	3.5	2.8	3.7	3.8	4.0



Figs 8-9
Quaestus (A.) incognitus sp. n.: (8) urite female, ventral view; (9) mesosternal carina, lateral view.

Etymology. The name refers to the caves situated in the foothills of the Sierra Mermeja where specimens belonging to this new species were found.

Discussion. The only species that *Quaestus (Speogeus) mermejaensis* sp. n. could be mistaken for is *Q. (S.) nietoi* (Salgado, 1988) as they are similar morphologically. There are, however, constant and significant differences in some external morphological characters and in the genitals. These differences are: 8th antennal segment in *Q. (S.) mermejaensis* transverse, 9th and 10th slightly longer than wide; apophysis of mestosternal carina only just surpassing mesosternum; parameres widely surpassing median lobe, insertion pores of both apical setae more separated, pore of basal seta at a considerable distance. Whilst all the antennal segments in *Q. (S.) nietoi* are clearly longer than wide, the apophysis of the mesosternal carina almost reaches the metasternum, the club of the parameres has a different shape and only just surpasses the tip of the median lobe, the insertion pores of the apical setae are closer together and the insertion pore of the basal seta is slightly separated (figs 24, 25); finally, the area joining the spermathecal lobes is shorter and the spermathecal duct is clearly longer (fig. 26). Added to all this, the populations of these species are isolated by barriers such as overthrusts and sandstone areas separating them, as can be seen on the distribution map (fig. 27).



Figs 10-12

Quaestus (Quaestus) jeannei (Coiffait, 1965): (10) aedeagus, dorsal view; (11) apical region of the paramere; (12) spermathecal complex.

KEY TO THE SPECIES OF THE SUBGENUS *SPEOGEUS*

1 Basal plate of stylet of internal sac rounded 2
1' Basal plate of stylet of internal sac subrectangular 3

2 Male protarsi more narrow or slightly wider than maximum width of protibiae; 11th antennal segment 3 times or just over 3 times as long as 10th; parameres narrow, with tip in the shape of an oblong club . . . . *Q. (S.) amicalis* (Salgado, 1984)

2' Male protarsi almost twice as wide as maximum width of protibiae; 11th antennal segment at most 2.5 times as long as 10th; parameres wide, tip curved and club barely differentiated . . . . *Q. (S.) littoralis* Salgado, 1999

3 Parameres longer than median lobe, with club flattened and more or less pointed towards inner side 4
3' Parameres as long as or slightly shorter than median lobe, with tip rounded and lacking distinguishable club 5

4 8th, 9th and 10th antennal segments clearly longer than wide; apophysis of mesosternal carina reaching or just surpassing mid region of mesosternum; parameres slightly surpassing tip of median lobe; distance between the two apical setae of club of parameres less then three times the distance between them and insertion point of lower seta
. . . . *Q. (S.) nietoi* (Salgado, 1988)
4' 8th antennal segment transverse, 9th and 10th segments slightly longer than wide; apophysis of mesosternal carina not reaching mid region of mesosternum; parameres widely surpassing tip of median lobe; distance between the two apical setae of club of parameres almost 5 times the distance between them and insertion point of lower seta
. . . . *Q. (S.) mermejaensis* sp. n.

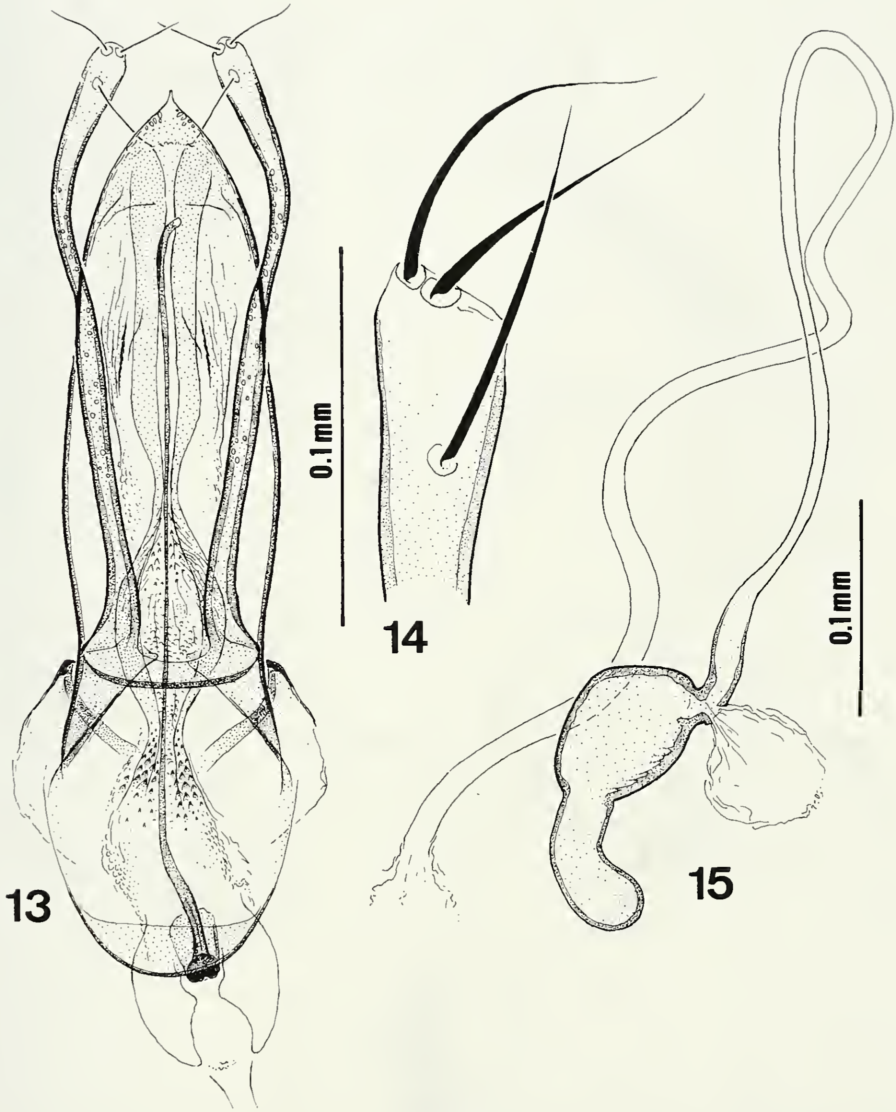
5 3 setae of parameres inserted in apical region of club; mid-apical region of internal sac lacking developed fanerae . . . *Q (S.) avicularis* (Salgado, 1985)
5' 3 setae of parameres not inserted in apical region of club, one inserted near base; mid apical region of internal sac with two or three groups of well-developed fanerae . . . . *Q. (S.) diegoi* (Salgado, 1989)

BIOLOGICAL AND ECOLOGICAL OBSERVATIONS

The following is a description of some of the characteristics of the four caves sampled in this study.

Julió cave (UTM: 30TUN023803). This cave is situated 1000 m. in a limestone area from the Carboniferous period. It is surrounded by *Corylus avellana* L. and *Fagus sylvatica* L. as the predominating plant species, with a rocky area nearby. It is 800 m long and easy to enter and walk through. The first 50 m are highly eroded and there is a large clay substrate. Facing south-east, the temperature inside is 12° C (summer) with 97-98% relative humidity above the first 50 m. Most of the catches were carried out randomly at between 50 and 150 m in heaps of organic plant material and scattered bat faeces and using attraction traps (cheese, fruit, liver). *Q. (A.) incognitus* sp. n. cohabits with *Q. (Q.) longicornis*. The populations of the latter species are also found in caves in the bordering area of the Sierra del Crespón.

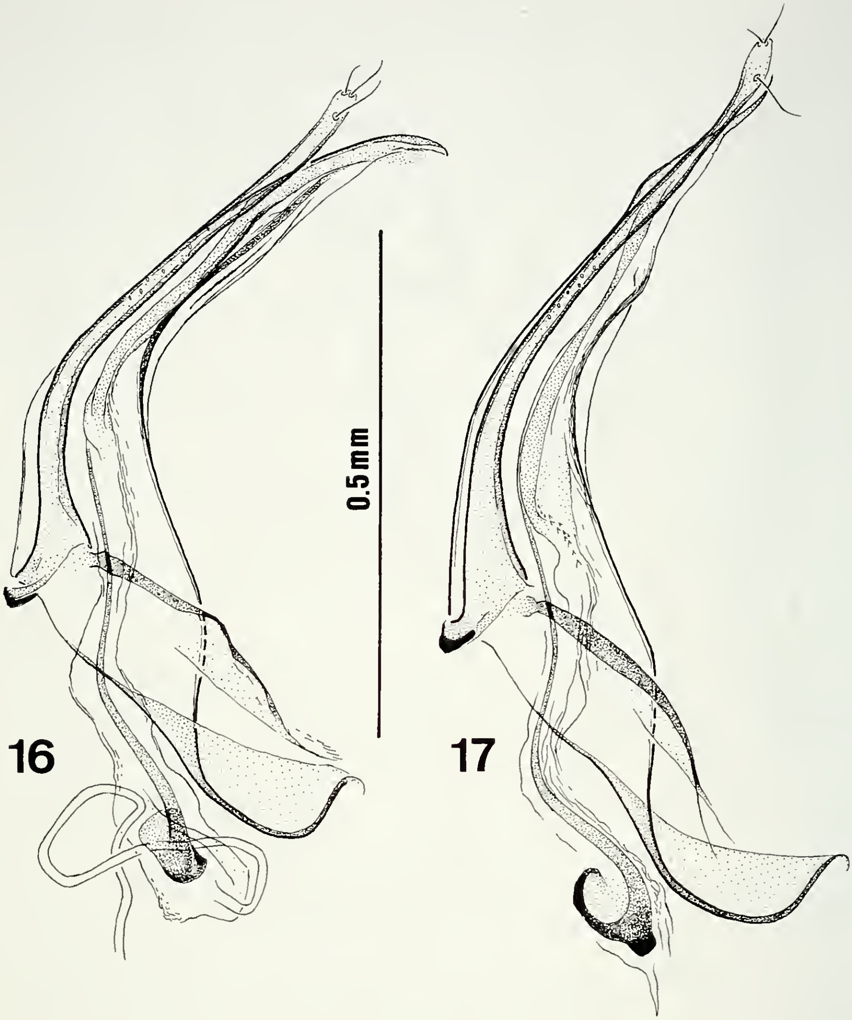
Prau cave (UTM: 30TUN055824). Situated at 815 m., also in limestone areas from the Carboniferous period. The mouth of the cave faces south and the surrounding area is predominated by *Quercus robur* L., *Alnus glutinosa* (L.) Gaertn. and *Corylus avellana* L. It is an active cave still in the process of formation and approximately 200



Figs 13-15
Quaestus (Q.) recordationis (Salgado, 1982): (13) aedeagus, dorsal view; (14) apical region of the paramere; (15) spermathecal complex.

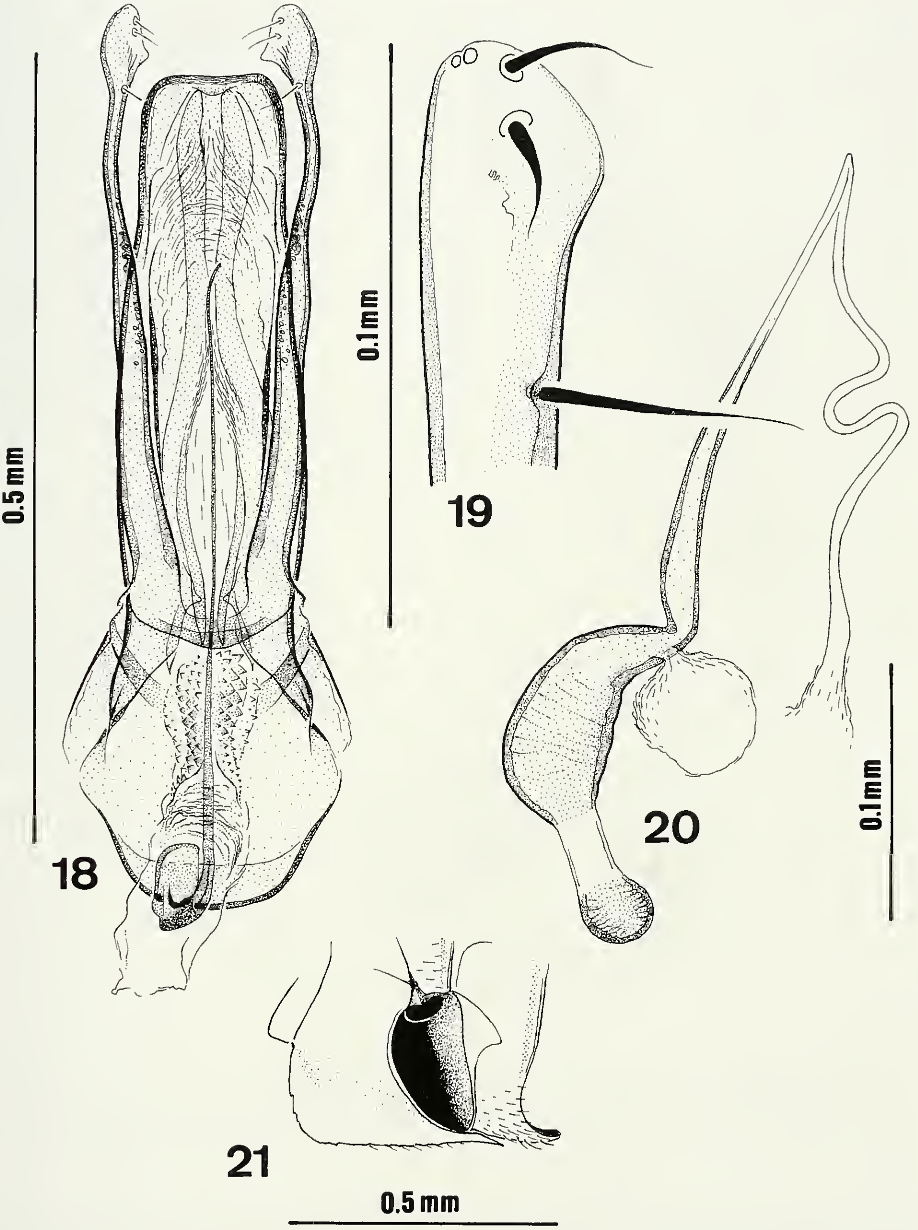
m long. A number of stalactites, stalagmites and outflows can be seen inside. The temperature is between 8° C (winter) and 11° C (summer), with 98.5% constant relative humidity.

As the ground is free from organic material and there are a number of gours, catches were only possible using attraction and pit fall traps, especially in the centre of



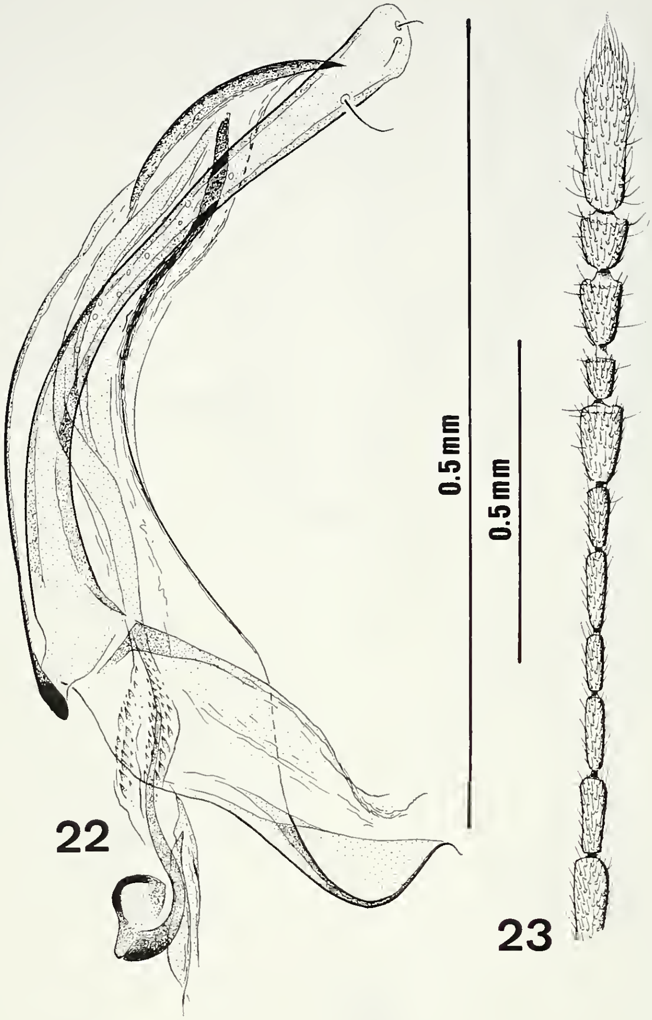
Figs 16-17
Lateral view of the aedeagus: (16) *Quaestus (Q.) jeannei* (Coiffait, 1965); (17) *Quaestus (Q.) recordationis* (Salgado, 1982).

the cave. From the biological perspective, this cave is of great interest as three troglobitic species of Leptodirini cohabit there: *Q. (Q.) longicornis*, *Q. (A.) incognitus* sp. n. and *Q. (S.) mermejaensis* sp. n., as well as *Notidocaris franzi* Jeannel, 1956, a musiculous species captured at the entrance. A very interesting member of the family Trechinae, *Apoduvalius* sp., morphologically very close to *A. espanoli* Salgado, 1996, is also found there.



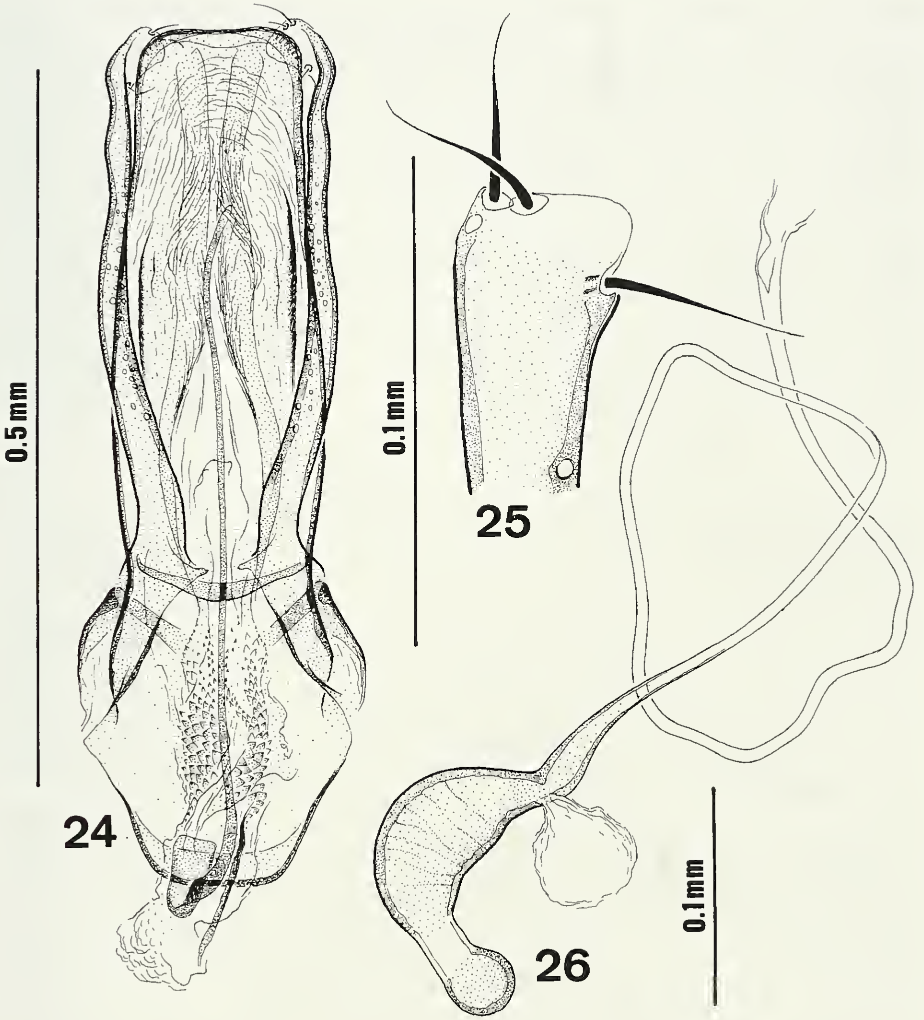
Figs 18-21

Quaestus (Speogeus) mermejaensis sp. n.: (18) aedeagus, dorsal view; (19) apical region of the paramere; (20) spermathecal complex; (21) mesosternal carina.



FIGS 22-23
Quaestus (S.) mermejaensis sp. n.: (22) aedeagus, lateral view; (23) antenna.

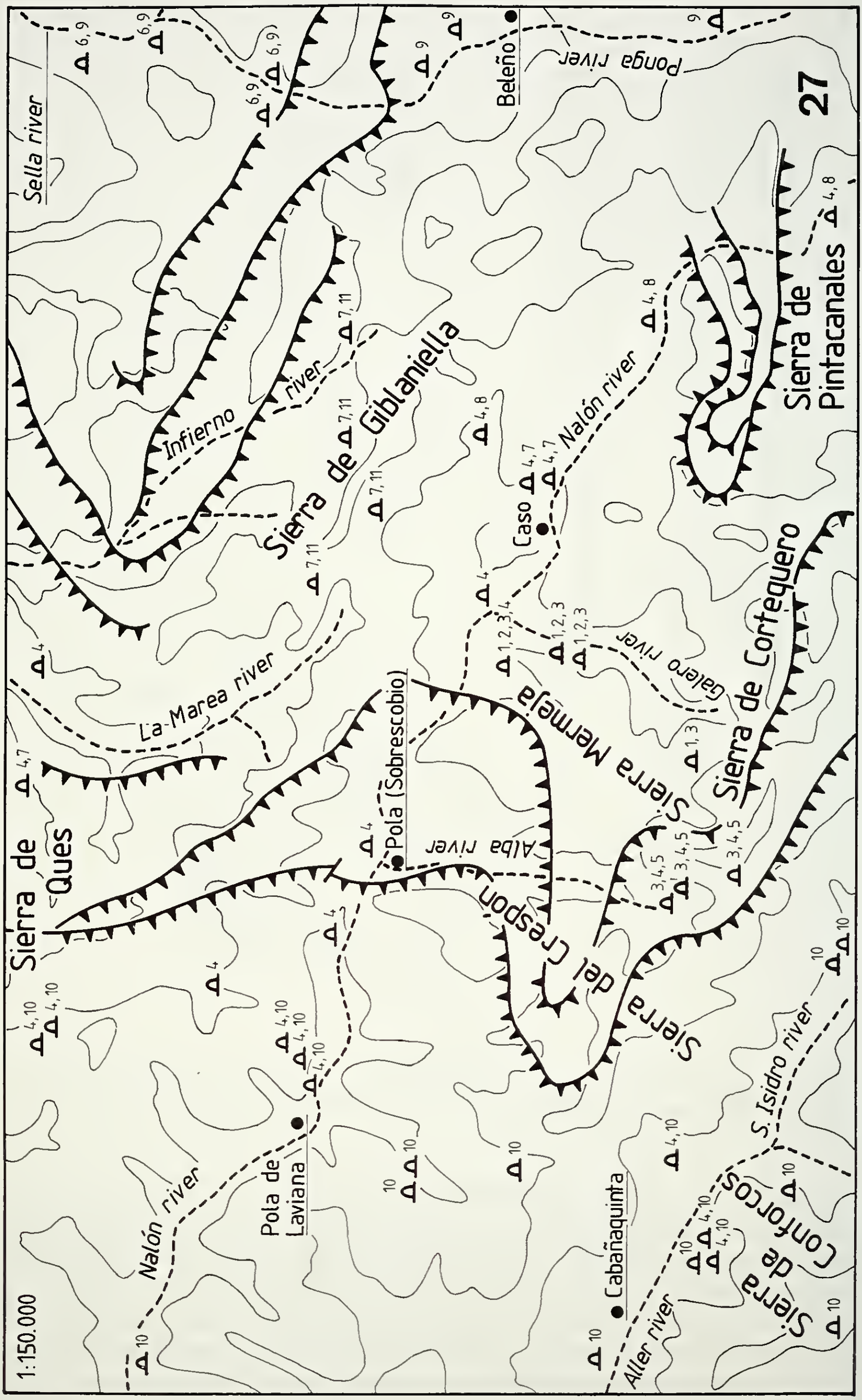
Carretera Cave (UTM: 30TUN056830). This cave is 400 m from the cave of the Prau. It is a small, very narrow gallery less than 25 m long. It is situated at 800 m alt. in limestone areas from the Carboniferous period. The entrance faces south-east, and is hidden mainly by *Sambucus nigra* L. and *Quercus robur* L. brambles and shrub branches. Because of its short length it is strongly influenced by atmospheric changes, so only a few specimens of *Q. (A.) incognitus* sp. n., *Q. (S.) mermejaensis* sp. n. and *Q. (Q.) longicornis* were captured using traps in the deepest parts.



Figs 24-26

Quaestus (Speogeus) nietoi (Salgado, 1988): (24) aedeagus, dorsal view; (25) apical region of the paramere; (26) spermathecal complex.

Rearco cave (UTM: 30TUN054846). Of all the caves, this one is situated furthest north at an altitude of 650 m. As in the previous cases the limestone area where the cave was formed belongs to the Carboniferous period. The surrounding vegetation is *Crataegus monogyna* Jacq., *Corylus avellana* L., *Castanea sativa* L. and *Quercus robur* L. The cave was formed from a joint, producing a very narrow gallery leading into a larger chamber, 2 m high at the most and from which a network of very narrow low galleries lead off. The accessible area is approximately 175 m long. As the cave


27
1:150.000
Sella river
Ponga river
Beleño
Infierno river
Sierra de Giblaniella
Nalón river
Caso
Sierra de Pintacanales
Sierra de Cortequero
Galero river
La-Marea river
Pola (Sobrescobio)
Alba river
Sierra Mermeja
Sierra de Ques
Sierra del Crespón
Pola de Laviana
Nalón river
Cabañaquinta
Aller river
S. Isidro river
Sierra de Conforcos

entrance is very small, the physical factors are constant all the way through, with a temperature of 12° C and 98% relative humidity.

The fauna were captured in the first few meters inside the cave in organic plant matter, and in the rest of the cave in small heaps of organic animal material, especially bat faeces. The cave is of great biological interest because, to date, it is the only one in the world where 4 troglobitic species belonging to the same genus, *Quaestus (Q.) longicornis*, *Q. (Quaestus)* sp., *Q. (A.) incognitus* sp. n. and *Q. (S.) mermejaensis* sp. n. have been located, which is possible because they are all at different stages of evolution and have different microniches; for example, the two species belonging to the subgenus *Quaestus*, *Q. (Q.) longicornis* and *Q. (Quaestus)* sp., besides having completely different genitalia, the first species has clearly evolved more than the second because the appendices, legs and antennae are much longer and much more slender.

GEOGRAPHICAL DISTRIBUTION

As already pointed out the two new taxa *Q. (A.) incognitus* and *Q. (S.) mermejaensis* are found in caves in the eastern foothills of Sierra Mermeja and cohabit in the Prau, Carretera and Rearco caves. The two new species also cohabit with *Q. (Quaestus)* sp. and *Q. (Q.) longicornis* which is more widespread, though the morphological differences amongst them are very evident. Also, *Q. (S.) mermejaensis* has similar morphological characters to *Q. (S.) nietoi*, which inhabits a nearby karstic region and is much more widely distributed. It would be interesting to carry out a biogeographical analysis to obtain a better understanding of their genetic and geographical isolation in relation to the present distribution of the different species (fig. 27).

The various degrees of evolution may be considered as multistage processes in which several events occurred and gave rise to non-allopatric and allopatric speciation. Non-allopatric speciation occurred as a result of a diverging process of adaptation during the colonization of hypogeous environments by a population via gradual steps or stages with changes brought about by very different factors (Wilson, 1989; Bush, 1994). In the case of allopatric speciation, reproductive isolation was possible as a result of great climatic changes such as glaciation during the Pleistocene (Jeannel, 1942; Galán, 1993; Trajano, 1995) and the search for shelter (Bellés, 1987; Haffer, 1994), or the fragmentation of the habitat in isolated karstic areas (Bellés & Martínez, 1980; Reveillet, 1980; SALGADO, 1995), which obviously occurred in this study area.

An examination of the species cohabiting in the caves described in this study, or morphologically proximate species inhabiting neighbouring areas, revealed that *Q. (Quaestus)* sp., which is very widespread, cohabits with *Q. (Speogeus) nietoi*, *Q. (S.)*

FIG. 27

Distribution map of the species: 1, *Quaestus (Asturianella) incognitus* sp. n.; 2, *Quaestus (Speogeus) mermejaensis* sp. n.; 3, *Quaestus (Quaestus) longicornis* (Salgado, 1989); 4, *Quaestus (Quaestus)* sp.; 5, *Quaestus (Speogeus) avicularis* (Salgado, 1985); 6, *Quaestus (S.) amicalis amicalis* (Salgado, 1984); 7, *Quaestus (S.) amicalis dilatatus* (Salgado, 1984); 8, *Quaestus (Q.) luctuosus* (Salgado, 1984); 9, *Quaestus (Q.) jeannei* (Coiffait, 1965); 10, *Quaestus (S.) nietoi* (Salgado, 1988); 11, *Quaestus (Q.) recordationis* (Salgado, 1982).

avicularis, Q. (S.) amicalis dilatatus, Q. (Quaestus) longicornis, Q. (Q.) luctuosus, and now with *Q. (S.) mermejaensis* sp. n. and *Q. (A.) incognitus* sp. n. in various caves. Of all the species mentioned, *Q. (Quaestus)* sp. is the least evolved, as shown by its morphological characters; the differentiating characters and genetic isolation may have occurred because the hypogeous environment was colonized in more recent periods. This theory is supported by the fact that the species is much more dispersed in karstic areas isolated by existing barriers which can be reached through the superficial underground compartment (MSS or Milieu Souterrain Superficiel, Juberthie *et al.*, 1981) as demonstrated by 3 catches recently made on the upper karst of Muñera (12-IX-1999), Pandanes (29-VI-2001) and Coballes (31-VII-2002).

Q. (Q.) longicornis is only known from the deep underground environment. Data on 3 caves in the Sierra del Crespón (Salgado, 1989) already existed and the 4 new ones from the Sierra Mermeja can now be added. Catches made in the caves show that there must have been a connection between the populations of these mountain ranges via fissures in the deep underground environment, the only way of establishing links between the populations of these fairly or very evolved species before the present barriers became established. The species cohabits with *Q. (S.) avicularis* and *Q. (Quaestus)* sp., in the Sierra del Crespon, with no impediments as they belong to different evolutionary stages, and in Sierra Mermeja with the two new taxons studied in this paper, and *Q. (Quaestus)* sp.

With regard morphological characters and proximity of colonization area, *Q. (S.) nietoi* is closest to *Q. (S.) mermejaensis* sp. n. Both belong to the same evolutionary stage and are therefore not found in the same area or cave. *Q. (S.) nietoi* is much more widely distributed than *Q. (S.) mermejaensis*, and is known from various caves in the karstic area between the Aller and Nalón river basins but limited by the Crespón, Mermeja and Ques sierras. At present both species are found in the deep underground compartment as they have never been located in the superficial underground environment through which they could migrate. Differentiation therefore occurred as a result of isolation by deep sandstone strata barriers and overthrusts which stopped the gene flow.

ACKNOWLEDGEMENTS

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Description of the first apterous genus of Sciomyzidae (Diptera), from Nepal

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Description of the first apterous genus of Sciomyzidae (Diptera), from Nepal. - *Apteromicra* gen. n. (type species *A. parva* sp. n.) is described and illustrated from Nepal. This is the first known apterous species within Sciomyzidae, its systematic position is discussed in detail.

Key-words: Diptera - Sciomyzidae - Sciomyzini - *Apteromicra* - taxonomy - apterous flies - Nepal.

INTRODUCTION

Reduction and loss of wings among the dipterous flies are rather common and those species have always provoked interest among dipterists. Hackman (1964) referred to aptery as "...known from more than 20 dipterous families" but since then such reduced-winged or apterous species have been discovered in additional families [e.g. Drosophilidae, Papp (1979)]. When discussing the environments in which short-winged or apterous Diptera are found, Hackman (1964) referred principally to high altitude Diptera. Other environments (and congruent Diptera groups) are: Diptera in arctic, subarctic and subantarctic mainland habitats; nival Diptera; Diptera of oceanic islands; Diptera on sea shores; marine Diptera; Diptera in various terricolous and hypogeous habitats; Diptera in nests of Hymenoptera and termites; and parasites on warm-blooded animals.

In the course of my visit to the Muséum d'histoire naturelle Genève in 1986 I found a small apterous fly among extensive collections, which coleopterists of the museum had made by sieving and subsequent funnelling in the Oriental region. I borrowed that fly but it was untouched for years. When I decided to study it early in 2002, immediately I found it peculiar, and its family relegation questionable, although it is obviously an "acalyptrate" fly.

Keys to families of adult Diptera employ characteristics of wings extensively. Consequently, reduced-winged or apterous flies have to be dealt with separately. In the key for the Palaearctic Diptera families, Papp & Schumann (2000) keyed 23 families of those flies in the last part of the key. Among the 23 families there are only six families of the "acalyptrates". Our fly does not belong to any of them. I also failed to

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identify it to a family with the aid of general or regional keys. Of course, the reason is rather simple: all of those keys are for families where wing reduction already has been known. I had to use only body characteristics other than those of wings to judge its relegation among higher flies. My conclusion was that this small fly is the first apterous representative of the family Sciomyzidae.

The type specimen is deposited in the Muséum d'histoire naturelle Genève, Switzerland (MHNG).

TAXONOMY

Apteromicra gen. n.

Type species: *Apteromicra parva* sp. n.

Diagnosis. Small apterous species with extremely long dorsal pre-apical setae on each tibia (Fig. 1) and with extremely long postocellar seta.

Frons only slightly narrowed apically. Face nearly straight in lateral view, eyes ovoid. No fronto-orbital spot. Ptilinal suture normal (slightly open with a herniated part of ptilinal sack on the holotype of the only known species). Genal height 0.24 mm, height of eye 0.30 mm, ratio 0.815. Two pairs of latero- and reclinate fronto-orbitals: anterior pair almost completely lateroclinate, posterior pair's direction is less than 45° to the longitudinal body axis. Short fronto-orbital setulae from medial vertical seta to antennal bases: 1 +2 + 3 (1 short fronto-orbital between medial vertical and posterior fronto-orbital; 2 setulae between the two fronto-orbitals and 3 setulae between anterior fronto-orbital and antennal base). No true interfrontal setulae, 8 frontal setulae anterior to anterior fronto-orbital seta. Midfrontal area anterior to ocelli not separable from other parts of frons and bare. Postocellar pair extremely long, slightly divergent, in occipital position. No vibrissa. Clypeus narrowly U-shaped, not concealed but small and broadly separated from other sclerotized parts of head. Proboscis medium long, not strongly sclerotized (proboscis not folded).

Thorax much reduced in volume, probably not more than the volume of head, since definitely narrower than head. Both pro- and metathorax relatively enlarged, probably due to the loss of wings, and proportional reduction of mesothorax. Mesonotal suture present as a black line from behind posterior notopleural seta (from level of posterior margin of anepisternum) as far as medially to presutural seta; metapleural callus weak but discernible. Prosternum subtriangular, bridging the proepisterna. Pro-episternum with a medium long pro-episternal seta above the base of fore coxa. Anepisternum and anepimeron separated by a membraneous area. Posterior spiracle behind level of postalar seta. One shorter postpronotal, 2 notopleural, an extremely strong presutural, 2 pairs of dorsocentral and 1 pair of probably strong postalar setae (postalar broken off on both sides on the holotype but on its right side also a setal base of a supra-alar is discernible). Two pairs of scutellars, apical pair dorsally directed and cruciate (Fig. 1), basal pair is very long and is in lateral position. A distinct pro-epimeral seta and a large katepisternal present, otherwise pleura bare.

Hind coxa bare posterodorsally. Mid and hind femora each with a large anterodorsal seta at apical 5/6. All tibiae with very long dorsal preapicals, mid tibia with 1 anterior and posterior short apical each and 2 large thick ventroapical pairs.

Wings reduced to minute processes (tegula), this tegula with 1 minute setula.

Abdominal spiracles 2-5 in membrane (Fig. 1). Female postabdomen simple (Figs 3-4). Terga and sterna 7 and 8 are small but not telescoped. Epiproct and hypoproct are small, cerci normal without any peculiar armature. Two pairs of globular spermathecae (Fig. 5).

Etymology. The new genus does not belong to the close relatives of *Pteromicra*. Its apterous state and its relegation to the Sciomyzini are the reasons why I name it so.

Discussion. Of course, one may question the relegation of this wingless fly to the family Sciomyzidae. If this is a sciomyzid, its pro-episternal seta designates its position definitely as a member of the tribe Sciomyzini. However, this seta is reduced in two genera of Sciomyzini (*Atrichomelina* Cresson and *Pseudomelina* Malloch) and distinctly present in three genera of Tetanocerini (*Eutrichomelina* Steyskal, *Perilimnia* Baker, and *Shannonia* Malloch). Nearly the full complement of head and thoracic setae found in most plesiomorphous Sciomyzidae are present in this species. The presence of long and thick pre-apical dorsal setae on all tibiae, which might be shorter in the ancestor, reduces strongly the possible number of the families, where it may belong to. Again, it has no vibrissal angle or vibrissae, which character excludes a number of families with strong dorsal preapicals on the tibiae. The shape of the prosternum (abridging the pro-episterna) and the 2 globular spermathecae seem to be strong synapomorphies, when searching for its true relatives. The male genitalia would have provided more evidence. However, the female postabdomen (Figs 3-4) does not show any true differences from that of the Sciomyzidae (cf. e.g. Rozkošný, 1998: fig. 35.36 for *Tetanocera*): characteristics of the postabdomen exclude a relationship to the Tephritoidea (with their ovipositor) and to a number of families (or even superfamilies), where the postabdomen is telescopized. Contrary to the Heleomyzoidea (and allies, like the Chyromyidae), vibrissae are absent. In any case, it falls into the group with strong dorsal preapicals on the tibiae *and* without vibrissae. Contrary to the Dryomyzidae and allies (where the clypeus is large and prominent), its clypeus is narrowly U-shaped, small and broadly separated from the other sclerotized parts. Unlike Lauxaniidae, the postocellar setae are divergent and *Apteromicra* has only two spermathecae instead of three or four as in the Lauxaniidae).

Diagnostic remarks. There are only two genera of Sciomyzini known in the Oriental region, *Pherbellia* Robineau-Desvoidy and *Pteromicra* Lioy. None of them is closely related to the new genus (cf. Rozkošný & Knutson, 1970). In the key Rozkosny (1998) published for the Palaearctic genera, one cannot find a closely related genus. *Sciomyza* Fallén with its double pre-apical setae on fore tibia (exception *S. sebezhica* Przhiboro, 2001), *Ditaeniella* Sack with its single fronto-orbital pair, haired prosternum and setulose anepisternum cannot be close relatives. The structure and armature of head of *Colobaea* Zetterstedt are strikingly different. I think the strength and position (direction) of the anterior fronto-orbital, the arrangement of setae on the mesonotum and also the direction of the apical scutellars are features, which will be distinctive for this fly as a genus even after further studies and morphological comparisons.

This discovery of an apterous Sciomyzidae suggests that, although few sciomyzids have been found in pitfall traps, such collections may indeed produce other new species of apterous Sciomyzidae.

Apteromicra parva sp. n. Figs 1-5

Holotype female (MHNG): Nepal, W Thorong Pass, 4450-4350 m, sous les pierres [= under stones], 29. IX. 1983, leg. I. Löbl & A. Smetana, No. 19.

Remarks. The specimen was kept in 70 % ethanol for 20 years. I judge the loss of colours rather moderate. The postabdomen was removed and treated with 10 % sodium-hydroxide. After washing in water and alcohol, it was placed in a plastic microvial with glycerine. This microvial contains also the spermathecae, which were removed from the abdomen during the preparation. The specimen itself is still preserved in alcohol.

Description. Body length 2.37 mm, length of head 0.385 mm, length of thorax 0.51 mm.

Body dark grey, head greyish yellow, legs black, lateral part of abdominal sclerites light.

Head as described in generic diagnosis, but in addition: 3 pairs of setulae between ocellar and postocellar; postgena with 2 pairs of long setae. Facial plate (praefrons) comparatively narrow, less broad than both cheeks. No vibrissa, genal bristles not well arranged, 1 peristomal row of ca. 7 pairs (back to the postgenal seta) plus other 6 genal setulae more dorsally on gena. Antennae black, decumbent (Fig. 2). Scape reduced to a short ring with minute setulae. Pedicel 0.06 mm long dorsally, with short setulae only. First flagellomere longer than high, broadly rounded apically. Arista subbasal, 0.3 mm long, with minute dark cilia. Basal aristomere very short, hardly discernible, second aristomere short, as broad as basal 1/3 of third aristomere. Palpus yellowish, normal, i.e. not thickened, with 1 long subapical ventral seta and other 5

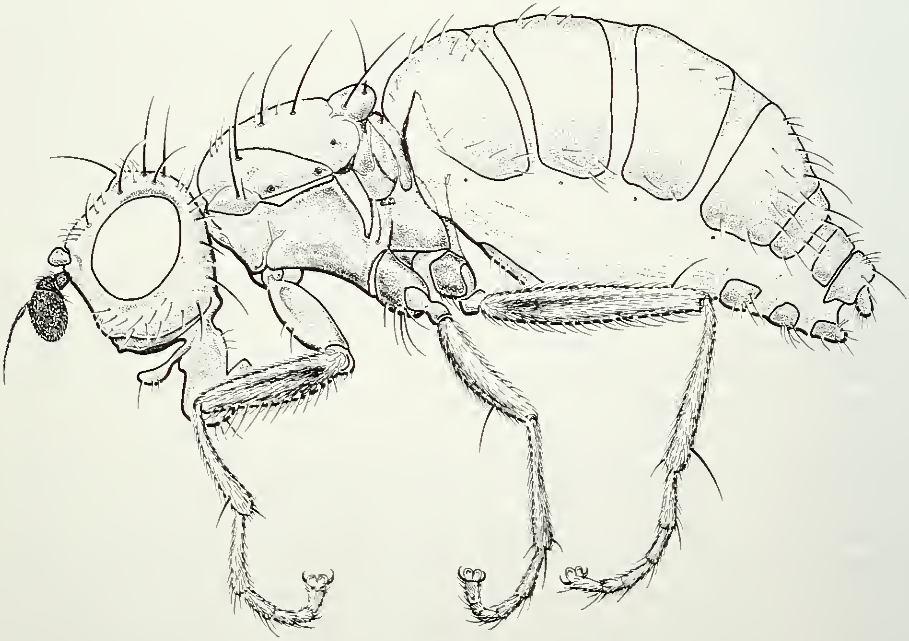
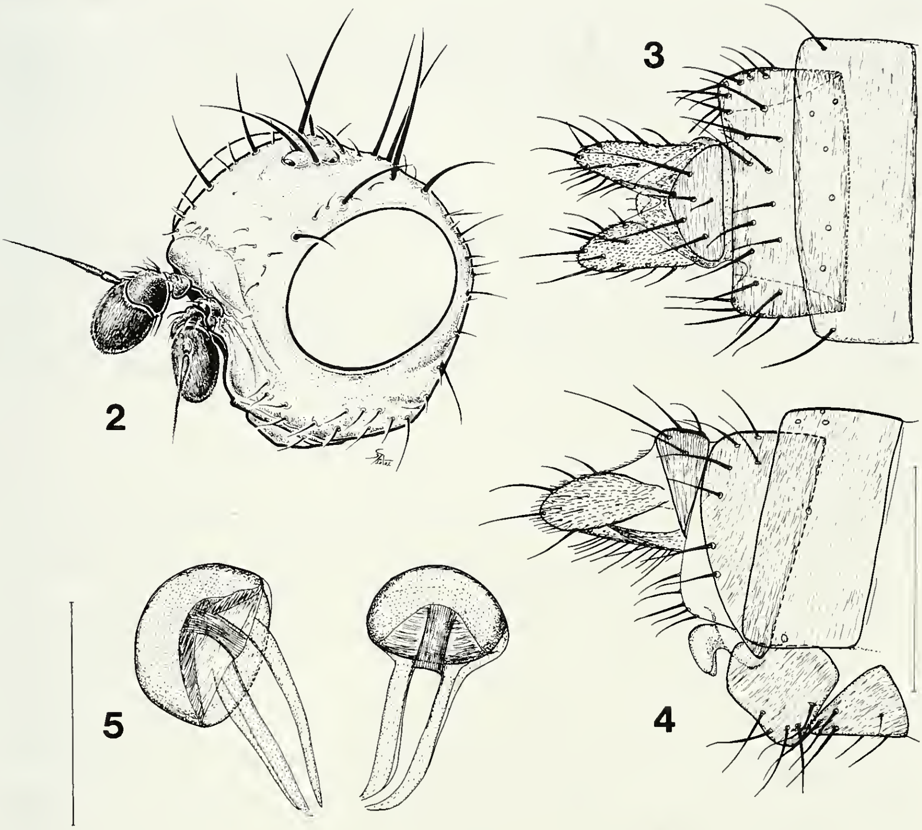


FIG. 1
Apteromicra parva sp. n., holotype female (del. A. Szappanos)



FIGS 2-5

Apteromicra parva sp. n., holotype female. 2, head, semilateral view (del. A. Szappanos). 3, postabdomen, dorsal view. 4, same, lateral view. 5, spermathecae (drawn in water). Scale bars: 0.1 mm (Fig. 5), 0.2 mm (Figs 3-4).

shorter setulae. The specimen has the ptilinium partly exposed (most probably an individual abnormality, depicted also on Figs 1-2).

Thorax dark grey, wholly microtomentose. Prosternum bare. Mesonotal setulae not arranged, 1 short intra-alar setula lateral to dorsocentral line, other short setulae on presutural mesonotum: 1 beside postpronotal, ca. 9 within the dorsocentral lines and 5 lateral to that lines. Notopleura and prescutellar area bare.

Pre-apical seta on hind tibia 0.17 mm long, anterodorsal seta on hind femur 0.19 mm.

Abdominal setae mostly broken off on the holotype but marginal setae are not particularly strong (not much longer than discal ones). Abdominal spiracles 2-5 in membrane. Setae on epiproct asymmetrically placed. Hypoproct covered by dense short setulae. Cerci of normal size, simple, without any longer setulae (Fig. 3). Also a pair of internal sclerites present, supporting gonopore at their mesal ends [these are probably the subgenital sclerites of Rivosecchi (1992)]. Two spermathecae (Fig. 5); they are unequal in size, both are globular, central part involuted even in water (when functioning, probably their shape is actually globular). Spermathecal duct thick, thick-walled but not sclerotized (pigmented).

ACKNOWLEDGEMENTS

I would like to thank Dr Albert Szappanos for his excellent habitus figure. I am grateful to the former curators of the Geneva Museum (Dr Claude Besuchet and Dr Ivan Löbl) as well as to the present curator, Dr Bernhard Merz, for loan of the specimen. I gratefully thank Dr Merz and the three reviewers of the manuscript for invaluable comments and suggestions, as well as Dr Lloyd V. Knutson for linguistic revision.

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Specie nuove o poco note di Homalotini, Silusini, Bolitocharini, Diestotini e Autaliini della Cina e della Thailandia (Coleoptera, Staphylinidae)*

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New or little known species of Homalotini, Silusini, Bolitocharini, Diestotini and Autaliini from China and Thailand (Coleoptera, Staphylinidae). - In this paper are listed twenty-two species of the subfamily Aleocharinae, of which nine are described as new for the science. The species belong to the genera *Stenomastax* (1 species), *Coenonica* (3), *Linoglossa* (1), *Neosilusa* (2), *Silusa* (6), *Leptusa* (3), *Neoleptusa* (1), *Phymatura* (1), *Pseudatheta* (1), *Diestota* (1) and *Autalia* (2). Each new species is illustrated and compared to the related close species, on the basis of the form of aedeagus or spermatheca. The figures of the unpublished aedeagus of *Linoglossa chinensis* are given.

Key-words: Coleoptera - Staphylinidae - Aleocharinae - taxonomy - China.

INTRODUZIONE

Le tribù, i generi e alcune specie compresi nel presente lavoro sono già noti per la Cina. Sono specie fitodetriticole e fungicole, prevalentemente predatrici di larve. Dato che le raccolte di Aleocharinae effettuate nel lontano passato in Cina sono state assai rare, le specie riportate dalle recenti missioni entomologiche in Cina dell'insigne studioso di Staphylinidae Dr. Aleš Smetana di Ottawa e del collega Michael Schülke di Berlino, come prevedibile, sono in buona parte costituite da specie nuove per la scienza. A queste specie cinesi sono aggiunte due specie della Thailandia.

Gli olotipi delle nuove specie sono conservati nel Museo di Storia Naturale di Ginevra (MHNG), nel Museo Zoologico dell'Università Humboldt di Berlino (MZB) e nel Museo di Storia Naturale di Londra (NHML). Paratipi e altri esemplari si conservano in collezione Michael Schülke di Berlino e del Museo Regionale di Scienze Naturali di Torino.

METODO

Il riconoscimento delle varie specie della sottofamiglia Aleocharinae, nel presente lavoro, come in altri di questa serie, è effettuato mediante l'esame della forma dell'edeago e della spermateca, senza dimenticare i caratteri esterni dell'esoscheletro. Poiché le specie del genere *Silusa* Erichson, 1837, presentano un edeago di forma

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* 182° Contributo alla conoscenza delle Aleocharinae.

Manoscritto accettato il 04.12.2002

piuttosto uniforme, le specie di questo genere sono distinte soprattutto per la forma dell'armatura interna dell'edeago, nella sua porzione sporgente dall'orifizio apicale. Le lamine laterali sono nettamente differenti da specie a specie.

ELENCO DELLE TRIBÙ, GENERI E SPECIE

HOMALOTINI

Stenomastax platygaster (Kraatz, 1859)

Homalota platygaster Kraatz, 1859: 33
Stenomastax platygaster: Cameron, 1939: 172; Pace,1992: 120
19 es., Thailand, Chumphong prov., 27.III-14.IV.1996, Pha To env., P. Prüdek leg.

DISTRIBUZIONE. Sri Lanka, India, Bengala, Vietnam, Bali, Australia. Già nota per la Thailandia.

Coenonica ming Pace, 1993

Coenonica ming Pace, 1993: 80
2 es., China, Sichuan, Qingchong Shan, NW Chengdu, 650-700 m, 3-4.VI.1997, leg. M. Schülke; 1 ♂, Sichuan, Gongga Shan, Moxi, 1300 m, 11.VII.1996, leg. A. Smetana.

DISTRIBUZIONE. Specie finora nota solo dello Yunnan.

Coenonica schuelkei sp. n. (cf. Descrizioni)

Coenonica rugosissima sp. n. (cf. Descrizioni)

Linoglossa (Axinocolya) chinensis Pace, 1998 Figg. 8-9

Linoglossa (Axinocolya) chinensis Pace, 1998: 202
1 ♂, China, Sichuan, Gongga Shan, Hailuogou, for. above Camp 2, 2800 m, 5.VII.1998, leg. A. Smetana.

DISTRIBUZIONE. Il ♂ di questa specie è stato raccolto nella località tipica, il Monte Gongga, unica località nota della specie. Viene qui data l'immagine dell'edeago finora sconosciuto, figg. 8-9.

Neosilusa ceylonica (Kraatz, 1857)

Stenusa ceylonica Kraatz, 1857: 8
Plagiusa ceylonica: Cameron, 1939: 167
Neosilusa ceylonica: Pace 1984: 15; Pace 1993: 71
12 es., China, Sichuan, Qingcheng Shan, NW Chengdu, 650-700 m, 18.V-3-4.VI.1997, leg. M. Schülke.

DISTRIBUZIONE. Mascarene, India, Malesia, Cina, Giappone e Borneo.

Neosilusa moultoni Cameron, 1920

Neosilusa moultoni Cameron, 1920: 233; Pace, 1992: 235; Pace, 1998: 142
Plagiusa moultoni: Bernhauer & Scheerpeltz, 1926: 540
3 es., China, Sichuan, Qingcheng Shan, NW Chengdu, 650-700 m, 18.V-3-4.VI.1997, leg. M. Schülke.

DISTRIBUZIONE. Singapore, Thailandia, Cina, Vietnam.

SILUSINI

Silusa smetanai Pace, 1998

Silusa smetanai Pace, 1998: 179

1 ♂, China, W Sichuan, 20 Km N Sabdê, 3200 m, 13.VII.1998, leg. A. Smetana.

DISTRIBUZIONE. Finora nota solo in Cina, Gongga Shan.

Silusa bodemeyeri (Eppelsheim, 1883)

Leptusa bodemeyeri Eppelsheim, 1883: 252
Silusa bodemeyeri: Pace 1989: 24

1 ♂, China, Sichuan, Qingcheng Shan, Rückseite, 650-700 m, 18.V.1997, leg. M. Schülke.

DISTRIBUZIONE. Romania e Cina.

Silusa shaanxiensis sp. n. (cf. Descrizioni)

Silusa leptusoides sp. n. (cf. Descrizioni)

Silusa schuelkei sp. n. (cf. Descrizioni)

Silusa sichuanensis sp. n. (cf. Descrizioni)

BOLITOCHARINI

Leptusa (Aleteleptusa) chinensis Pace,1997

Leptusa (Aleteleptusa) chinensis Pace,1997:753

32 es., China, Sichuan, Gongga Shan, Hailuogou, for. above Camp 3, 3000 m, 6.VII.1998, leg. A. Smetana; 1 ♀, China, Sichuan, Gongga Shan, Hailuogou, in front of glacier, 3000 m, 6.VII.1998, leg. A. Smetana; 1 ♀, China, N Yunnan, Xue Shan, nr. Zhongdian, 4000-4100 m, 23.VI.2850, leg. A. Smetana; 6 es., China, Sichuan, Emei Shan, 3000 m, 17.VII.1998, leg. A. Smetana.

DISTRIBUZIONE. Finora nota solo del Monte Gongga.

Leptusa (Aleteleptusa) xiahensis Pace,1997

Leptusa (Aleteleptusa) xiahensis Pace, 1997: 755

1 ♀, China, W Sichuan, 20 Km N Sabdê, 3200 m, 13.VII.1998, leg. A. Smetana; 4 es., China, W Sichuan, 15 Km W Kanding, 3250 m, 19.VII.1998, leg. A. Smetana.

DISTRIBUZIONE. Finora nota solo del Monte Gansu.

Leptusa (Drepanoleptusa) sichuanensis Pace, 1997

Leptusa (Drepanoleptusa) sichuanensis Pace, 1997: 757

1 ♂, China, Sichuan, Gongga Shan, Hailuogou, Lake above Camp 2, 2700 m, 4.VII.1998, leg. A. Smetana; 1 ♀, China, Sichuan, Gongga Shan, Hailuogou, for. above Camp 3, 3000 m, 6.VII.1998, leg. A. Smetana; 1 ♂, China, N Yunnan, Xue Shan, nr. Zhongdian, 4050 m, 24.VI.1996, leg. A. Smetana.

DISTRIBUZIONE. Finora nota solo del Monte Gongga.

Neoleptusa schuelkei sp. n. (cf. Descrizioni)

Phymatura sichuanensis sp. n. (cf. Descrizioni)

Pseudatheta thailandensis Pace, 1992

Pseudatheta thailandensis Pace, 1992: 239
1 ♀, China, Shaanxi, Qin Ling Shan, Hua Shan Mt., Valley 1200-1400 m, 118 Km E, Xian, sifted, 18-20.VIII.1995, leg. M. Schülke.

DISTRIBUZIONE. Finora nota solo della Thailandia, provincia di Chiang Mai. Nuova per la Cina.

DIESTOTINI

Diestota ming sp. n. (cf. Descrizioni)

AUTALIINI

Autalia rivularis (Gravenhorst, 1802)

Aleochara rivularis Gravenhorst, 1802: 73
Autalia rivularis : Thomson, 1859: 30
1 es., China, Sichuan, Kanding, 2900 m, 2.VII.1996, leg. A. Smetana.

DISTRIBUZIONE. Olartica.

Autalia limata Assing, 2001 Figg. 34-35

Autalia microptera Pace, 1998, in litteris
Autalia limata Assing, 2001: 912
1 ♀, China, Sichuan, Emei Shan, 3000 m, 17.VII.1996, leg. A. Smetana.

DISTRIBUZIONE. Finora nota solo del Sichuan. La forma della spermateca di questo esemplare coincide con quella figurata da Assing. Poiché questo autore non dà la figura dell'habitus e la sua descrizione è incompleta, viene qui data la figura «in toto» dell'esemplare. La specie è microttera, non atta al volo.

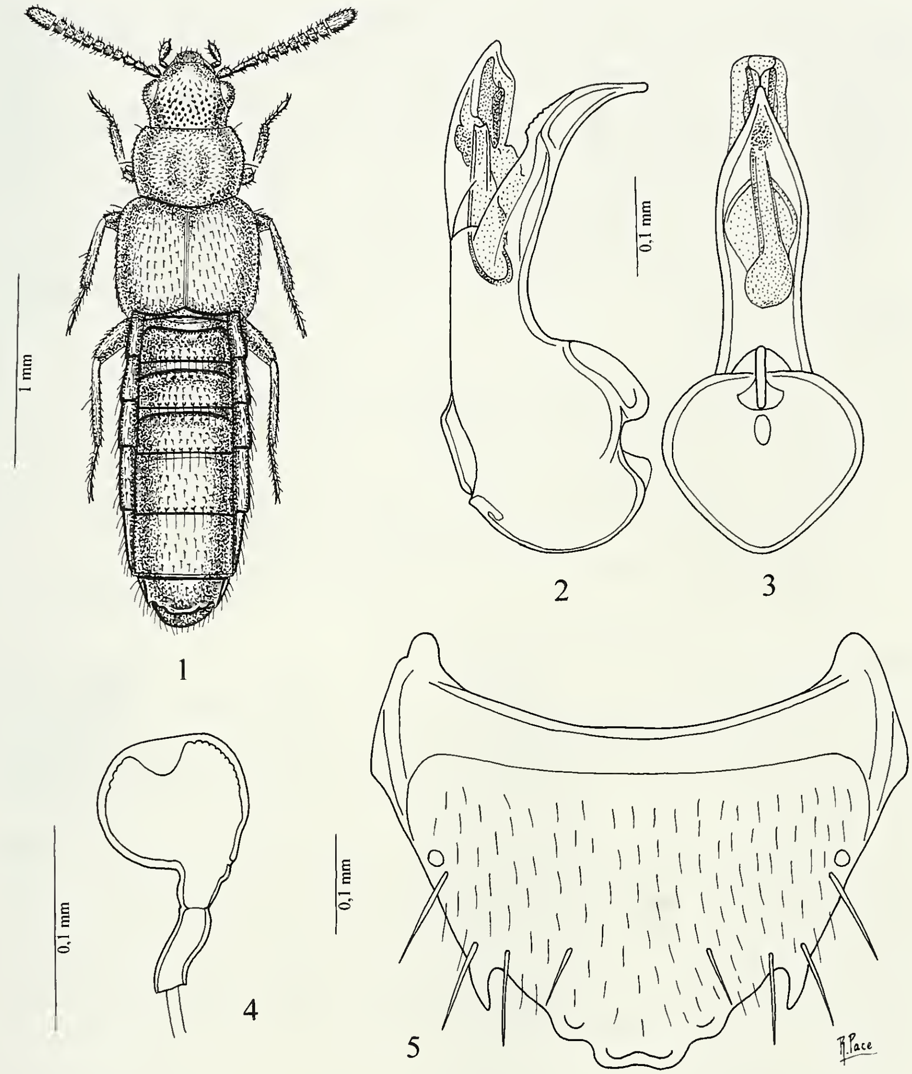
DESCRIZIONI

Coenonica schuelkei sp. n. Figg. 1-5

Holotypus ♂, Thailand, Chumphong prov., 27.III-14.IV.1996, Pha To env., P. Prüdek leg.(MZB).
Paratypi: 3 ♂♂ e 1 ♀, stessa provenienza.

DESCRIZIONE. Lungh. 2,9 mm. Avancorpo debolmente lucido, addome lucido. Corpo nero; antenne nere con i due antennomeri basali e l'undicesimo nero-bruni; zampe bruno-rossicce con femori neri. La punteggiatura del capo è netta, ma sul disco è fine e molto superficiale. La punteggiatura del pronoto è indistinta. La granulosità delle elitre è superficiale, quella dell'addome è fitta. La reticolazione del capo è netta, quella del pronoto vigorosa e quella delle elitre e dell'addome è superficiale. Edeago figg. 2-3, spermateca fig. 4, sesto urotergo libero del ♂ fig. 5.

COMPARAZIONI. La forma dell'edeago della nuova specie è molto simile a quella dell'edeago di *C. malayana* Cameron, 1936, della Malaysia (holotypus ♂ esaminato). L'apice dell'edeago, infatti, è molto protratto nelle due specie, ma quello della nuova è ricurvo e non rettilineo come in *malayana*. L'armatura interna dell'edeago è notevolmente differente nelle due specie: più sviluppata nella nuova specie che in *malayana*. Più netti sono i caratteri differenziali esterni: corpo nero della nuova specie e in *malayana* bruno-rossiccio con elitre giallo-rossicce orlate posteriormente di bruno.



FIGG. 1-5

Habitus, edeago in visione laterale e ventrale, spermateca e sesto urotergo libero del ♂. 1-5: *Coenonica schuelkei* sp. n.

ETIMOLOGIA. La nuova specie è dedicata allo studioso di Staphylinidae Michael Schülke di Berlino, per avermi affidato in esame la nuova specie.

Coenonica rugosissima sp. n. Figg. 6-7

Holotypus ♀, China, SE Sichuan, Jinfo Shan, 29°01'N/107°14'E, 1750 m, 27.VI.1998, leg. A. Smetana, 1998 China Expedition J. Farač, D. Král, J. Schneide + A. Smetana (MHNG).

DESCRIZIONE. Lungh. 2,8 mm. Capo e pronoto opachi, elitre debolmente lucide, addome lucido. Corpo nero pece, con margine posteriore degli uroterghi, tranne il quarto libero, bruno-rossiccio; antenne brune; zampe gialle. La granulosità del capo e del pronoto è fitta, quella delle elitre è fittissima. Il pronoto presenta un largo solco mediano sui due terzi posteriori. La reticolazione sull'addome è assente, tranne sugli uroterghi liberi quarto e quinto, dove le maglie di reticolazione sono molto trasverse ed estremamente superficiali. Spermateca fig. 7.

ETIMOLOGIA. L'aspetto rugoso dell'avancorpo dà il nome alla nuova specie.

COMPARAZIONI. La nuova specie per la forma della spermateca si presenta affine a *C. mutata* Pace, 1984, del Nepal. Se ne distingue per i caratteri dati nella seguente chiave.

1 Corpo bruno-rossiccio, con capo e quarto urotergo libero bruni; occhi molto più corti delle tempie; capo coperto di granulosità grossolana; appendice prossimale della spermateca, rettilinea. Lungh. 2,2 mm. Nepal .... *C. mutata* Pace

\- Corpo nero pece, con margine posteriore degli uroterghi, tranne il quarto libero, bruno-rossiccio; occhi più lunghi delle tempie; capo coperto di granulosità fine; appendice prossimale della spermateca, ricurva. Lungh. 2,9 mm. Cina .... *C. rugosissima* sp. n.

Silusa shaanxiensis sp. n. Figg. 10-13

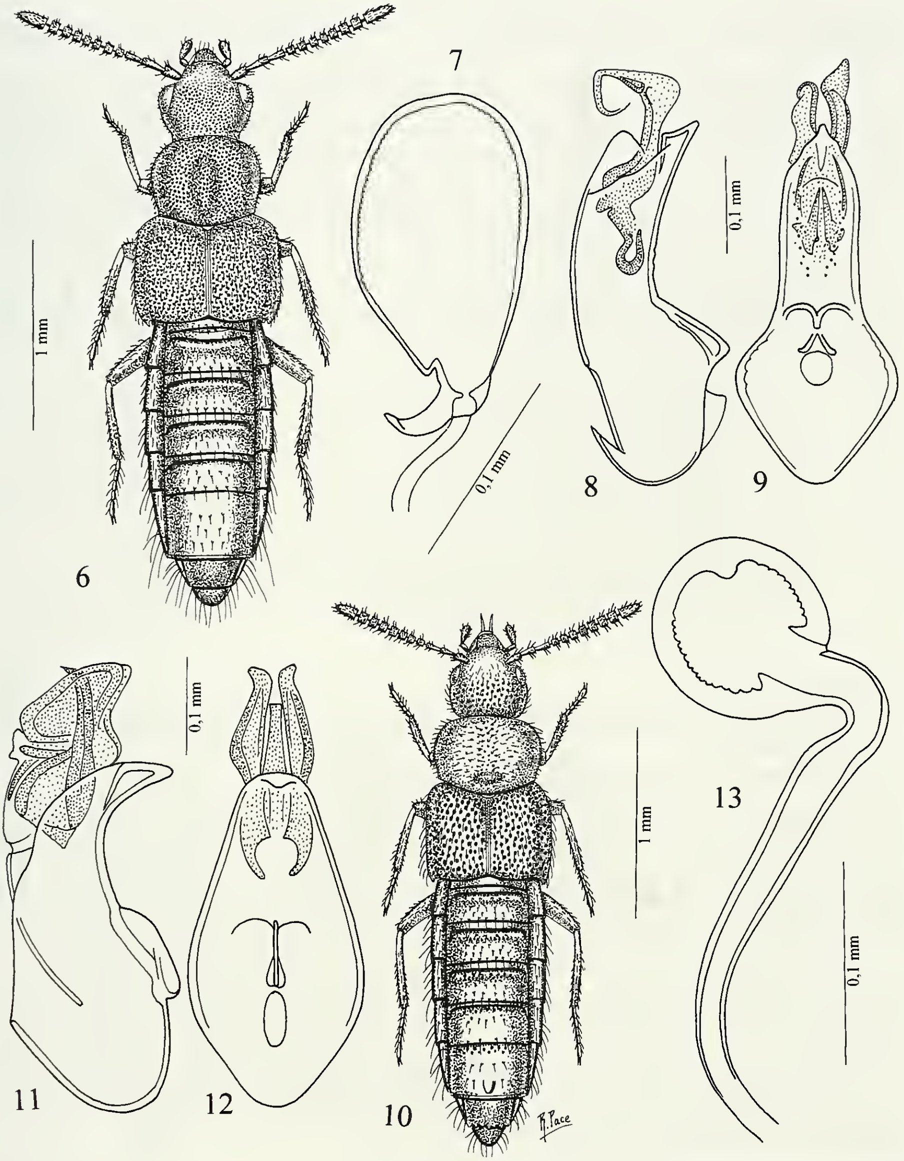
Holotypus ♂, China, Shaanxi, Qin Ling Shan, Hua Shan, Mt.-top, 1960-2000 m, forest, sifted, 19.VIII.1995, leg. M. Schülke (MZB).

Paratypi: 4 ♂♂ e 2 ♀♀, stessa provenienza; 1 ♂, China, Shaanxi, Qin Ling Shan, Autoroute Km 93, S of Zhouzhi, 108 Km SW Xian, mountain forest, sifted, 1650 m, 1-2.IX. 1995, leg. M. Schülke.

DESCRIZIONE. Lungh. 2,8 mm. Corpo lucido e bruno-rossiccio, con uriti liberi quarto e tre quarti basali del quinto bruni; antenne bruno-rossicce, con i due antennomeri basali rossicci; zampe rossicce. La punteggiatura del capo e dei solchi trasversi basali degli uroterghi liberi quarto e quinto, è netta, quella delle elitre è profonda. La granulosità del pronoto e dell'addome è saliente e più fitta sulla fascia longitudinale mediana del pronoto, che presenta un'impressione mediana anteriore e una fossetta mediana trasversa basale. Assente è la reticolazione del corpo. Edeago figg.11-12, spermateca fig. 13.

COMPARAZIONI. La nuova specie presenta una fossetta mediana posteriore del pronoto, come in *S. cooteri* Pace, 1998, pure della Cina, ma della provincia dello Zhejang. Tuttavia, la punteggiatura delle elitre della nuova specie è profonda, mentre è superficiale in *cooteri*. Evidenti sono le differenze nella forma dell'edeago. Apice spesso e corto nella nuova specie, sottile e lungo in *cooteri*, armatura laterale interna dell'edeago, sporgente esternamente, irregolarmente ovale nella nuova specie, mentre in *cooteri* è appuntita e profondamente incisa.

ETIMOLOGIA. La nuova specie prende nome dallo Shaanxi.



FIGG. 6-13

Habitus, spermateca ed edeago in visione laterale e ventrale. 6-7: *Coenonica rugosissima* sp. n.; 8-9: *Linoglossa chinensis* Pace; 10-13: *Silusa shaanxiensis* sp. n.

Silusa leptusoides sp. n. Figg. 14-17

Holotypus ♂, China, W Sichuan, 20 Km N Sabdê, 29°35'N/102°23'E, 3200 m, 13.VII.1998, leg. A. Smetana, 1998 China Expedition J. Farač, D. Král, J. Schneide + A. Smetana (MHNG).

Paratypi: 1 ♂ e 2 ♀♀, stessa provenienza, ma anche in data 11 e 14.VII.1998; 1 ♂ e 1 ♀, China, Sichuan, Gongga Shan, Hailuogou, for. above Camp 3, 3000 m, 6.VII.1998, leg. A. Smetana.

Descrizione. Lungh. 2,8 mm. Corpo lucido e bruno, con margine posteriore dei tre uriti basali, bruno-rossiccio; antenne e zampe rossicce. La punteggiatura ombelicata del capo è superficiale. La granulosità del pronoto è distinta, quella delle elitre è saliente. Assente è la reticolazione del corpo. Spermateca fig. 15, edeago figg. 16-17.

Etimologia. Il nome della nuova specie significa «dall'aspetto di *Leptusa*», perché a prima vista sembra una specie di *Leptusa.*

Comparazioni. Per la forma dell'armatura interna dell'edeago, la nuova specie si presenta affine a *S. cooteri* Pace, 1998, pure della Cina, ma della provincia dello Zhejang. Se ne distingue per i caratteri dati nella seguente chiave.

1 Quarto antennomero nettamente trasverso; occhi molto più corti delle tempie; elitre lunghe quanto il pronoto; piastre sporgenti dell'armatura interna dell'edeago poco profondamente incise e divise in un lobo stretto e uno tozzo. Lungh. 2,8 mm. Zhejang . . . . *S. cooteri* Pace

\- Quarto antennomero debolmente trasverso; occhi poco più corti delle tempie; elitre più lunghe del pronoto; piastre sporgenti dell'armatura interna dell'edeago molto profondamente incise e divise in un lobo largo e uno stretto e lungo. Lungh. 2,8 mm. Sichuan . . . . *S. leptusoides* sp. n.

Silusa schuelkei sp. n. Figg. 18-21

Holotypus ♂, China, W Sichuan, Erlang Shan, E Sutao-Kiao Pass, 3000 m, 19.V.1997, leg. M. Schülke (MZB).
Paratypi: 23 es., stessa provenienza.

Descrizione. Lungh. 2,1 mm. Corpo lucido e bruno-rossiccio, con pigidio rossiccio e quarto urite libero bruno; antenne e zampe rossicce. La punteggiatura del capo e la granulosità del pronoto e dell'addome sono distinte. La granulosità delle elitre è saliente. La reticolazione del capo, del pronoto e delle elitre è netta e quella dell'addome è distinta. Edeago figg. 19-20, spermateca fig. 21.

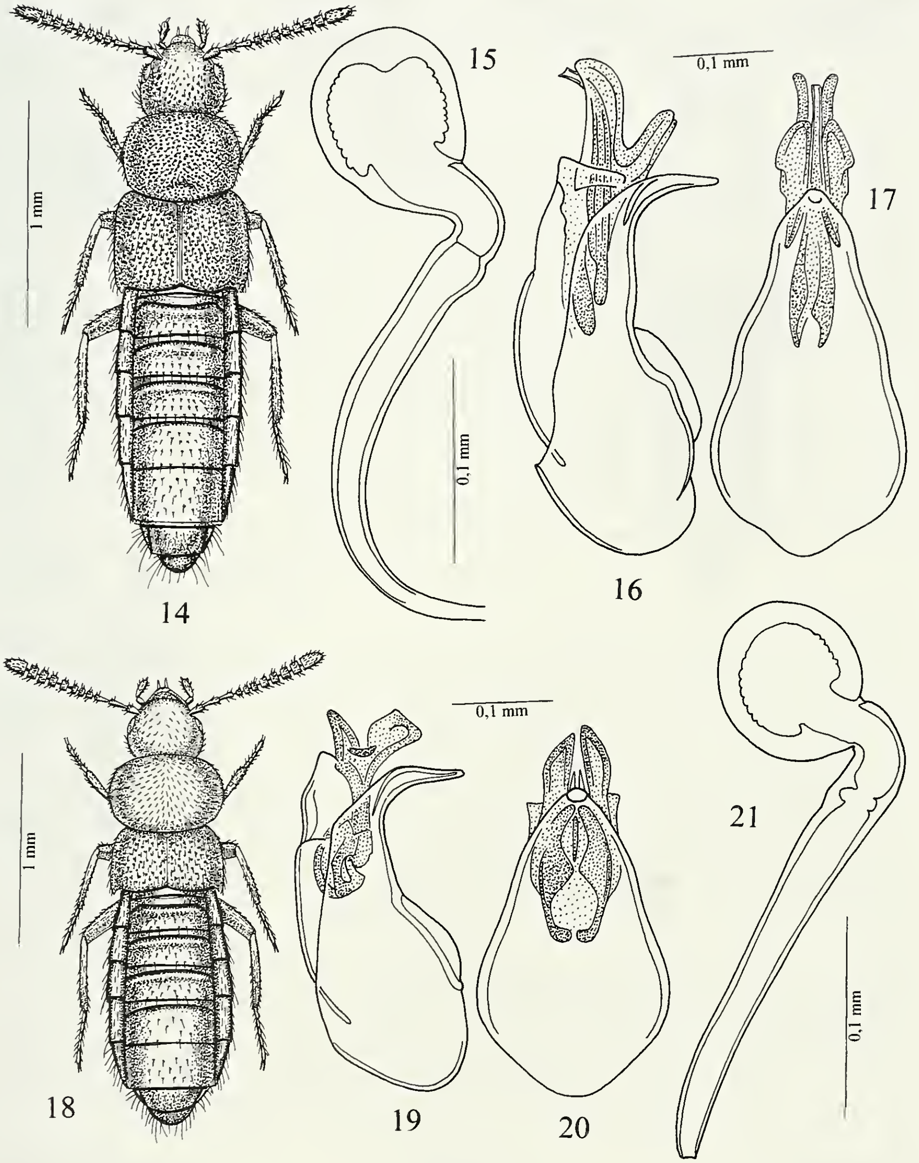
Comparazioni. La nuova specie, per avere le elitre più corte del pronoto, è nettamente distinta da tutte le specie del genere *Silusa* della Cina e delle regioni vicine. In base alla forma della parte sporgente dell'armatura interna dell'edeago, la nuova specie si presenta affine a *S. cooteri* Pace, 1998 e a *S. leptusoides* sp. n, sopra descritta.

Etimologia. La nuova specie è dedicata al suo abile raccoglitore, lo studioso di Staphylinidae Michael Schülke di Berlino.

Silusa sichuanensis sp. n. Figg. 22-26

Holotypus ♂, China, W Sichuan, 20 km N Sabdê, 3200 m, 29°35'N/102°23'E, 15.VII.1998, leg. A. Smetana, 1998 China Expedition J. Farač, D. Král, J. Schneide + A. Smetana (MHNG).
Paratypi: 8 es., stessa provenienza, ma anche in data 11-13-14.VII.1998.

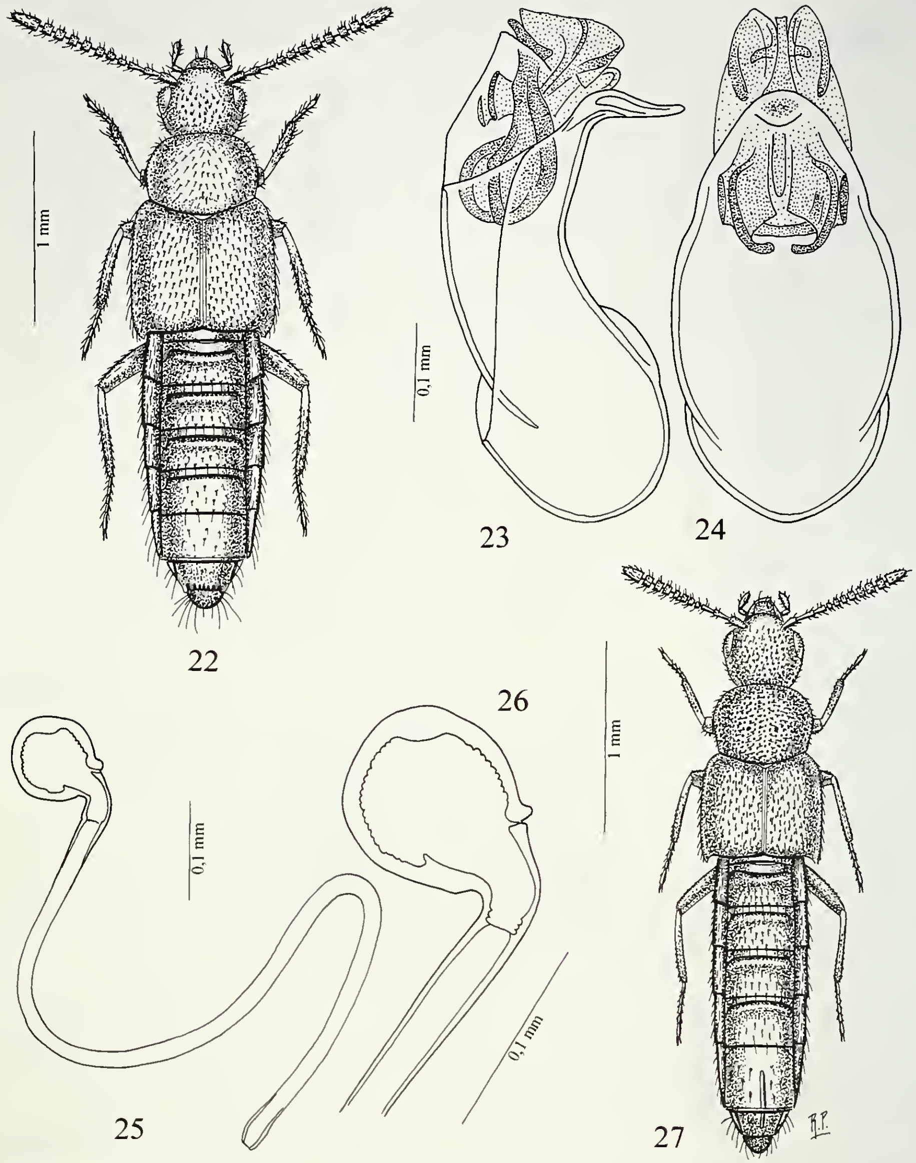
Descrizione. Lungh. 2,9 mm. Corpo lucido e bruno-rossiccio, con capo, lato esterni delle elitre, uriti liberi terzo, quarto e base del quinto bruni, uriti basali e pigidio giallo-rossicci; antenne brune, con i due antennomeri basali e la base del terzo rossicci



Figg. 14-21

Habitus, spermateca ed edeago in visione laterale e ventrale. 14-17: *Silusa leptusoides* sp. n. ; 18-21: *Silusa schuelkei* sp. n.

e metà apicale dell'undicesimo giallo-rossiccia; zampe giallo-rossicce. La punteggiatura del capo è poco profonda. La granulosità del pronoto è superficiale, quella delle elitre è poco saliente. La reticolazione del capo è distinta, quella del pronoto è netta sulla fascia longitudinale mediana, ai lati è estremamente superficiale. La retico-



FIGG. 22-27

Habitus, edeago in visione laterale e ventrale e spermateca a ingrandimento minore e maggiore. 22-26: *Silusa sichuanensis* sp. n.; 27: *Neoleptusa schuelkei* sp. n.

lazione delle elitre e dei quattro uroterghi basali è assente, quella quinto urotergo libero è molto trasversa ed estremamente superficiale, quella sul sesto urotergo libero è pure molto trasversa, ma distinta. Edeago figg. 23-24, spermateca fig. 25-26.

COMPARAZIONI. L'edeago della nuova specie è simile a quello di *S. bodemeyeri* (Eppelsheim, 1883), presente anche in Cina. Se ne distingue per la sua armatura interna molto più robusta di quella della specie in comparazione, con parte apicale poco dilatata (molto dilatata in *bodemeyeri*).

Neoleptusa schuelkei sp. n. Figg. 27-29

Holotypus ♂, China, Shaanxi, Qin Ling Shan, Hua Shan, Mt.-S top, 1950-2000 m, 19.VIII.1995, leg. A. Pütz (MZB).

DESCRIZIONE. Lung. 2,8 mm. Corpo lucido e bruno, con elitre, margine posteriore dei tre uroterghi basali e pigidio rossicci; antenne brune, con i due antennomeri basali e la base del terzo rossicci; zampe giallo-rossicce. La punteggiatura dell'avancorpo è distinta. La reticolazione del capo e del pronoto è molto svanita, quella delle elitre e dell'addome è superficiale. Edeago figg. 28-29.

COMPARAZIONI. Per la forma dell'edeago, la nuova specie è più simile a *N. rugosa* Pace, 1985, del Nepal, che a *N. brunnea* Cameron, 1939, dell'India (tipi esaminati), che mostra una lamina ventrale dell'edeago. In visione ventrale l'apice dell'edeago della nuova specie è acutissimo, mentre quello di *rugosa* è assai largo.

ETIMOLOGIA. La nuova specie è dedicata allo studioso di Staphylinidae Michael Schülke di Berlino, che me l'ha affidata in esame.

Phymatura sichuanensis sp. n. Figg. 30-31

Holotypus ♀, China, Sichuan, Gongga Shan, Hailuogou, for. above Camp 2, 2800 m, 29°35'N /102°00'E, 5.VII.1998, leg. A. Smetana, 1998 China Expedition J. Farač, D. Král, J. Schneide + A. Smetana (MHNG).

DESCRIZIONE. Lungh. 2,9 mm. Corpo debolmente lucido e bruno, con pronoto bruno-rossiccio dal margine laterale e posteriore rossicci, con base delle elitre giallo-bruna e con i due uriti basali liberi e il pigidio rossicci; antenne rossicce con i tre antennomeri basali giallo-rossicci; zampe giallo-rossicce con femori bruni. La granulosità del capo è fine, quella del pronoto è distinta. La punteggiatura delle elitre è ben visibile. La reticolazione dell'avancorpo è distinta, quella dell'addome è molto superficiale. Spermateca fig. 31.

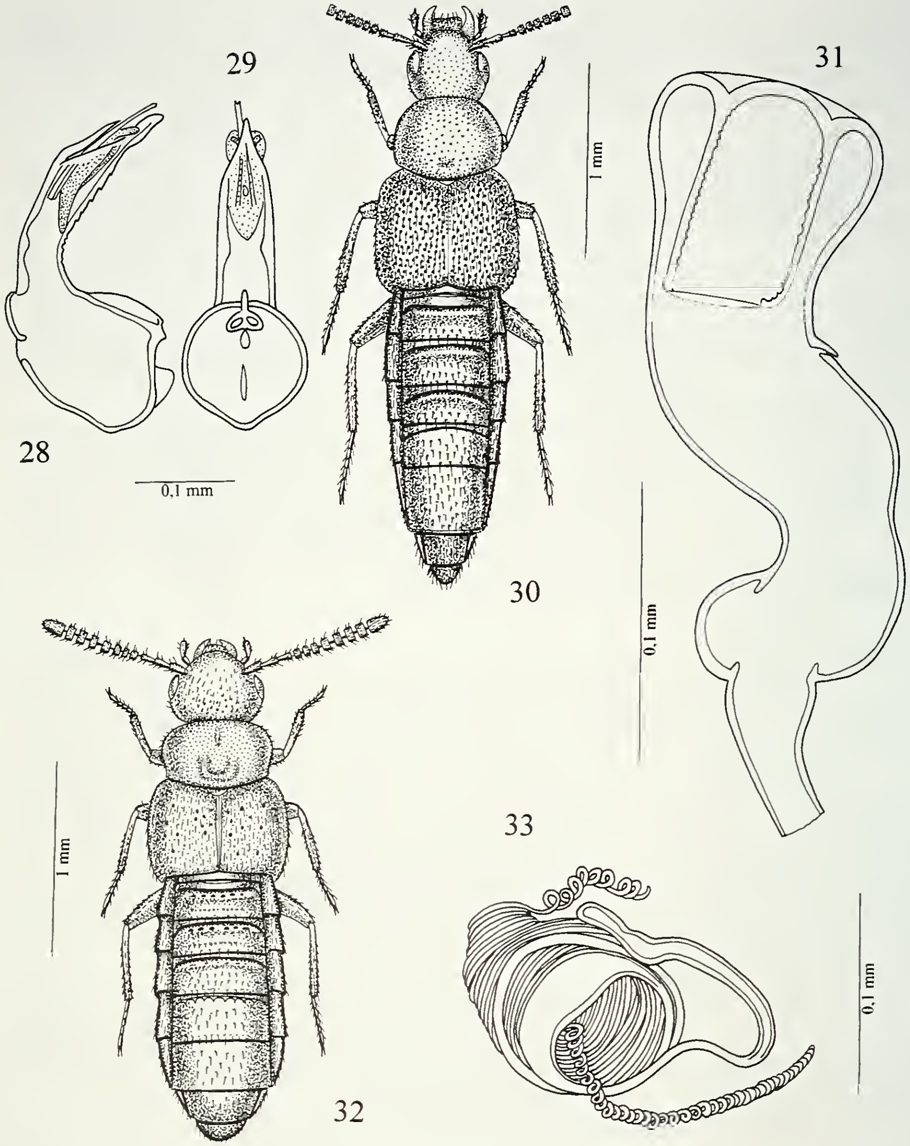
COMPARAZIONI. Per la forma della spermateca, la nuova specie si presenta affine a *P. smetanai* Pace, 1998, pure delle Cina. Se ne distingue per gli occhi più sviluppati, per la presenza di una fossetta mediana posteriore del pronoto e per la profondissima introflessione apicale del bulbo distale della spermateca.

ETIMOLOGIA. La nuova specie prende nome dal Sichuan.

Diestota ming sp. n. Figg. 32-33

Holotypus ♀, China, Bowring, 63-47, 541, 16.VI.1950 (NHML).

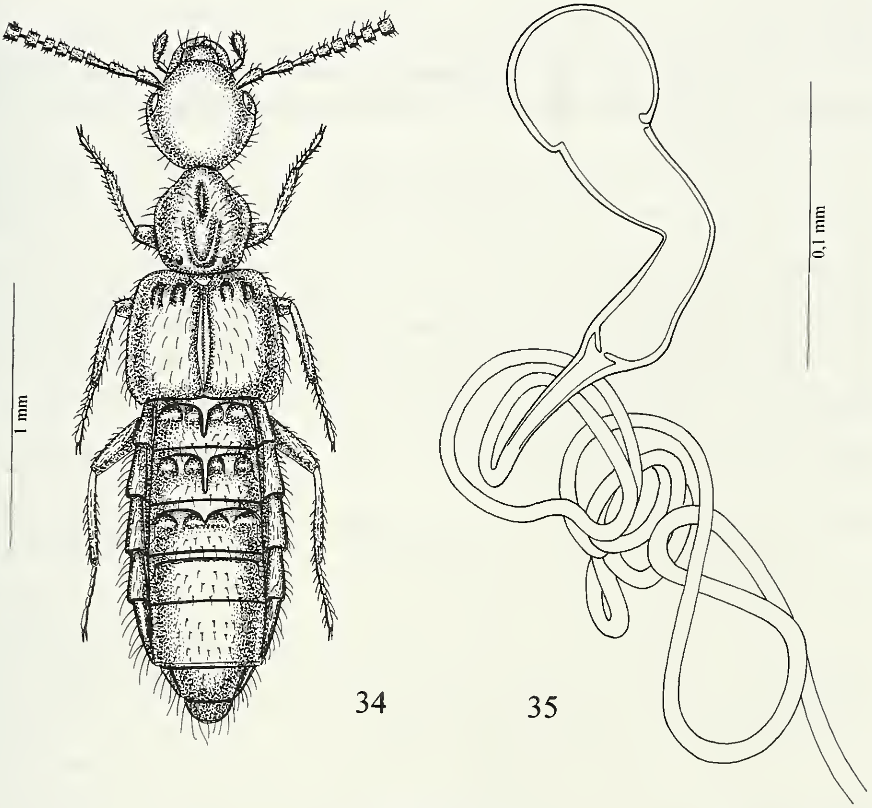
DESCRIZIONE. Lungh. 2,1 mm. Corpo lucido e bruno-rossiccio; antenne brune con i tre antennomeri basali rossicci; zampe giallo-rossicce. La punteggiatura del capo è ombelicata e netta e sta solo sulla metà posteriore, in avanti la superficie è coperta di granulosità. Il pronoto presenta una netta granulosità, in avanti sta un debole e largo solco mediano, all'indietro due solchi uniti posteriormente da uno trasverso. Le elitre



Figg. 28-33

Edeago in visione laterale e ventrale, habitus e spermateca. 28-29: *Neoleptusa schuelkei* sp. n.; 30-31: *Phymatura sichuanensis* sp. n.; 32-33: *Diestota ming* sp. n.

presentano alcuni punti profondi sparsi su un fondo superficialmente punteggiato. I due uriti basali mostrano file trasverse di granuli. Solo il quarto urotergo libero presenta carene basali. Assente è la reticolazione del corpo. Spermateca fig. 33.



FIGG. 34-35

Habitus ed edeago. 34-35: *Autalia limata* Assing, 2001 (= *Autalia microptera* Pace, 1998, in litteris).

COMPARAZIONI. Per la forma della spermateca e per alcuni caratteri esterni, la nuova specie si presenta affine a *D. castanea* (Cameron, 1920), di Singapore (tipo ♀ esaminato). La parte mediana della spermateca della nuova specie è avvolta a matassa con ampie spire, mentre la porzione mediana della spermateca di *castanea* è avvolta a matassa con spire strette. Il pronoto della nuova specie è sinuato davanti agli angoli posteriori, mentre non lo è quello di *castanea*.

ETIMOLOGIA. La nuova specie prende nome dalla dinastia cinese Ming, che regnò dal 1368 al 1644.

RINGRAZIAMENTI

Per avermi affidato in studio il materiale oggetto del presente lavoro rivolgo i miei più cordiali ringraziamenti ai colleghi Dr. Aleš Smetana di Ottawa, Michael Schülke di Berlino e Guillaume de Rougemont di Londra. Per il prestito di tipi ringrazio il Dr. P. M. Hammond del Museo di Storia Naturale di Londra, il Dr. Lothar Zerche del D.E.I di Eberswalde, e il Dr. Manfred Uhlig del Museo Zoologico dell'Università Humboldt di Berlino.

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REVUE SUISSE DE ZOOLOGIE 111 (1): 77-101; mars 2004

Pauropoda (Myriapoda) from Vietnam (Pauropoda and Symphyla of the Geneva Museum XIII)

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Pauropoda (Myriapoda) from Vietnam (Pauropoda and Symphyla of the Geneva Museum XIII). - Eight species of Pauropoda are reported from and near limestone hills in south Vietnam. Seven species from four genera are new to science and are described here: *Allopauropus* (*D.*) *leptotarsus* sp. n., *A.* (*D.*) *linguatulus* sp. n., *A.* (*D.*) *barbatulus* sp. n., *A.* (*D.*) *absimilis* sp. n., *Pauropus asiaticus* sp. n., *Samarangopus campanulatus* sp. n. and *Sphaeropauropus lecongkieti* sp. n.

Key-words: Myriapoda - Pauropoda - taxonomy - new species - Vietnam - biogeography - soil fauna - limestone.

INTRODUCTION AND BACKGROUND

As far as I know only one pauropod species has previously been recorded from Vietnam, viz. *Pauropus dawydoffi* Remy. A single specimen was reported (Remy, 1933) from central Vietnam (Dalat, in the tableland Lang Biang, alt. 1500 m a.s.). The species has not been found again either in Vietnam or elsewhere.

The ecosystem of the limestone hills in the Hon Chong area is seriously threatened by irreversible damages caused by intensive limestone exploitation linked to the recent development of large cement plants. Though these hills and their fauna and flora certainly have a biological originality of high value they were till recently virtually unknown to science. The first results of a soil and cave fauna survey have shown that several endemic species of Collembola and Coleoptera are living there (Deuve, 1996; Deharveng & Bedos, 1995,1996; Bedos & Deharveng, 2000).

Now data on Pauropoda can be added. Though it was not the primary aim of collecting to obtain pauropods, Drs Deharveng's and Bedos' material is of greatest value. The present study shows that the pauropods too have developed several endemic species there. Among 8 species reported, no less than 7 are new to science and one can hardly believe that they have a much wider distribution outside the area of these limestone hills. No comparable ecosystems exist neither in the neighbourhood nor elsewhere in Vietnam, where the next significant karstic area is located 750 km north-east of Hon Chong. Scattered limestone hills of the same type can be found 30-40 km further north near the border in Ha Tien and in Cambodia (near Kompong Trach). Calcareous areas with similar climatic conditions also exist in Thailand, but they are

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lying in a different geographic area and support a largely different wildlife. The Hon Chong limestone hills are small and isolated, and evidence is growing that their litter and soil fauna contains endemic taxa of great interest.

MATERIAL

In 1995, 2000 and 2001 Drs Louis Deharveng and Anne Bedos, Université Paul Sabatier, Toulouse (now Muséum National d'Histoire Naturelle, Paris), assisted by Professor Le Cong Kiet from the University of Ho Chi Minh City (Department of Botany and Ecology), made Berlese extractions of litter and soil samples in south-western Vietnam. Their interest was focused on the Ha Tien – Hon Chong limestone hills in the Kien Giang Province. From the collected material 45 specimens of Pauropoda were sorted out, among which 8 species could be identified, 7 of them as new to science. 5 species belong to the Pauropodidae (genera *Allopauropus* and *Pauropus*) and 3 species to the Eurypauropodidae (genera *Samarangopus* and *Sphaeropauropus*). The species new to science are described below: *Allopauropus* (*D.*) *leptotarsus* sp. n., *A.* (*D.*) *linguatulus* sp. n., *A.* (*D.*) *barbatulus* sp. n., *A.* (*D.*) *absimilis* sp. n., *Pauropus asiaticus* sp. n., *Samarangopus campanulatus* sp. n. and *Sphaeropauropus lecongkieti* sp. n.

Unless stated otherwise, all material was collected by Drs Louis Deharveng and Anne Bedos. The material is deposited in the collections of the Department of Arthropods and Entomology I, Natural History Museum of Geneva.

ABBREVIATIONS AND MEASUREMENTS

Abbreviations: ad. ..., subad. ... and juv. ... = an adult, a subadult or a juvenile specimen with the number of pairs of legs indicated.

Measurements: length of the body in mm and range of variation in adult paratypes given in brackets. Indication of absolute lengths are generally used only in the description of Eurypauropodidae and always applicated with µm. Otherwise the text refer the reader to relative lengths.

SYSTEMATICS

Order TETRAMEROCERATA

PAUROPODIDAE

One described species in the Pauropodidae, *Pauropus dawydoffi* Remy, was previously known from Vietnam (Remy, 1933). Five additional species, all new to science, with a total of 19 specimens, are here added. The high number of undescribed species in comparison with the low number of collected specimens indicates a very diversified fauna. These 6 species belong to the genera *Allopauropus* and *Pauropus*, 2 of the most widespread genera in Pauropoda. Future collecting will certainly increase considerably the number of species in these genera, particularly in *Allopauropus*, but I suppose that not only many species will be discovered there, but also some additional genera to the list of Vietnam, e.g. *Scleropauropus*, *Stylopauropus*, *Hemipauropus*, *Rabaudauropus*, *Cauvetauropus*. Thus, those 6 species now known from Vietnam are only a small part of an expected rich fauna of Pauropodidae.

In the studied collection another Pauropodidae species was found, which, however, could not be described. A single ad. 9(♂), of a species close to *Allopauropus* (*D.*) *chichinii* Remy, was collected from a limestone hill at Mo So near Hon Chong.

Genus ***Allopauropus*** Silvestri, 1902
Subgenus ***Decapauropus*** Remy, 1957 (Remy, 1957a)

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

Type material. **Holotype:** ad. 9(♀), VIETNAM, Ken Giang Province, Kien Luong, Hon Chong, Nui Binh Tri, secondary forest, Berlese extraction, 19.I.2000 (Loc. VIET-861). **Paratypes:** 2 ad. 9(♀), same data as holotype (Loc. VIET-858).

Other material. VIETNAM, Ken Giang Province, Kien Luong, Hon Chong, Nui Son Cha, under bush on limestone, litter, Berlese extraction, 1 ad. 9(♀), 18.I.2000 (Loc. VIET-840).

Total number. 4 specimens.

Diagnosis. A. (*D.*) *leptotarsus* sp. n. is well delimited from all other species of *Decapauropus* by the following combination of distinctive characters: anal plate rhombic, with two straight parallel posterior appendages close to each other; pygidial tergum subrectangular, with a small median lobe above anal plate; tarsi of posterior legs very slender and setae of the pygidial tergum long, pointed, glabrous and directed posteriorly. From the above characters *A.* (*D.*) *leptotarsus* sp. n. seems to be close to species in the subgenus *Allopauropus* s. str., but the absence of the pygidial setae b_3 assigns it to the subgenus *Decapauropus*.

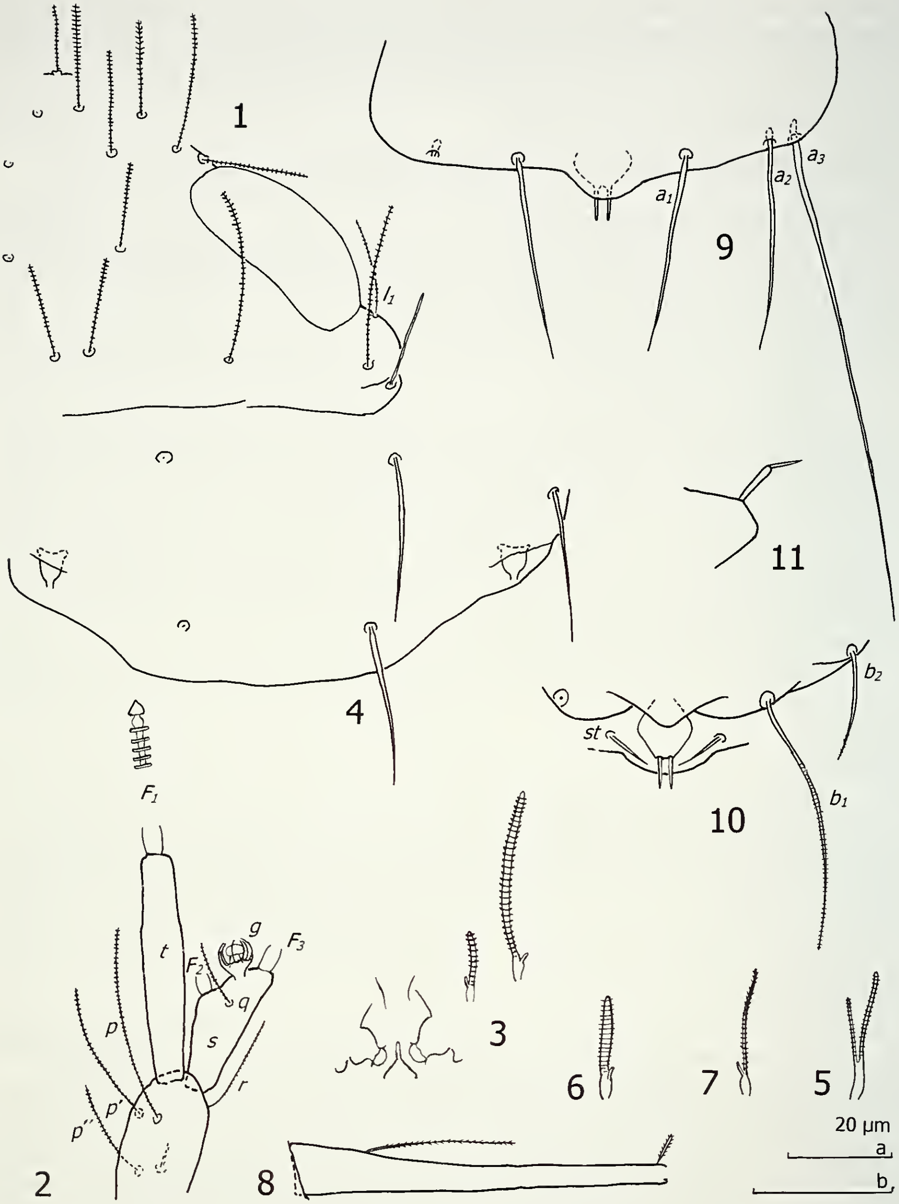
Etymology. From Greek leptos = thin, fine, slender (referring to the tarsi of the last pair of legs).

DESCRIPTION

Length. (0.88-) 0.92(-0.94) mm.

Head. Tergal setae mostly lacking, those present showing thin cylindrical or subcylindrical setae of medium length or fairly long ones. Relative lengths of setae (paratype specimen), 1st row: $a_1 = 10$, $a_2 = 9$; 2nd row: $a_1 = 10$, $a_2 = 13$, $a_3 = 11$; 3rd row: $a_1 = 9$, $a_2 = ?$; 4th row: $a_1 = a_4 = 10$, $a_2 = a_3 = 17$; lateral group of setae: $l_1 = l_3 = 15$, $l_2 = ?$. Length of temporal organs somewhat shorter than shortest interdistance. Head cuticle glabrous.

Antennae. Segment 4 with 5 setae, all thin, cylindrical, distally tapering, densely striate. Relative lengths of setae: $p = 100$, p' = (67-)73(-75), p'' = (48-)50(-52), p''' = (12-)13, r = 13(-14). Tergal branch *t* thin, slender, (5.2-)6.0(-6.1) times as long as greatest diameter and (1.3-)1.6(-1.7) times as long as sternal branch *s*, which is 2.2(-3.1) times as long as its greatest diameter; anterior corner strongly truncate. Seta *q* similar to seta *r* of 4th segment, with high insertion point, almost straight, (0.5-)0.6 of length of *s*. Relative lengths of flagella (base segments included) and base segments alone: $F_1 = 100$, $bs_1 = 4$; F_2 = 30(-33), $bs_2 = 2$; F_3 = (78-)80(-81), $bs_3 = 4$. F_1 3.4(-3.5) times as long as *t*, F_2 and F_3 1.1(-1.2) and (2.9-)3.0(-3.1) times as long as *s* respectively. Distal calyces of F_1 conical, those of F_2 and F_3 very small and not examined in detail. Distal part of flagella axes somewhat widened but only just below calyx. Globulus *g* only very little longer than wide, capsule flattened; width of *g* 0.8 of greatest diameter of *t*. Antennae glabrous.



FIGS 1-11

Allopauropus (*D.*) *leptotarsus* sp. n., holotype, ad. 9(♀). 1, head, median and right part, tergal view; 2, right antenna, tergal view; 3, collum segment, median and left part, sternal view; 4, tergite VI, posterior part; 5, seta on coxa of leg 9; 6, seta on coxa of leg 8: 7, seta on trochanter of leg 8; 8, tarsus of leg 9; 9, pygidial tergum, tergal view; 10, pygidium, posteromedian part, sternal view; 11, anal plate, lateral view. Scale a: Figs 4-8; b: Figs 1-3, 9-11.

Trunk. Setae of collum segment furcate. Primary branch thick, cylindrical, densely annulate; secondary branch rudimentary and glabrous. Sublateral seta 2.7(-2.8) times as long as submedian one; sternite process in anterior part very narrowly rod-shaped and without apical incision. Appendages much wider in proximal than in distal half, distal caps hemispherical. Process and appendages glabrous.

Setae on tergite I as on head, on II similar but somewhat tapering, on VI pointed and glabrous. 4+4 setae on tergite I, 6+6 on II-IV, 6+4 on V and 4+2 on VI. Submedian posterior setae on tergite VI (0.8-)0.9 of their interdistance.

Bothriotricha. Relative lengths of bothriotricha: $T_1 = 100$, $T_2 = (110\text{-})113(\text{-}114)$, $T_3 = 108(\text{-}119)$, $T_4 = ?(124\text{-}128)$, $T_5 = 168(\text{-}181)$. Axes thin, simple, straight, those of T_3 only a little thicker than the others. Pubescence very short depressed-oblique.

Legs. Setae on coxa and trochanter of leg 9 similar to each other, furcate, branches cylindrical, striate, blunt; secondary branch somewhat shorter than primary one. These setae on legs 1-8 with rudimentary glabrous secondary branches, setae on coxa thicker than those on trochanter. Tarsus of leg 9 very slender, (6.2-)7.3(-7.4) times as long as greatest diameter, distal half subcylindrical. Proximal seta thin, pointed, with short oblique pubescence, its length 0.4 of length of tarsus and (4.0-)4.3 times as long as distal seta; the latter cylindrical, blunt, with short oblique pubescence. Cuticle of tarsus almost glabrous.

Pygidium. Tergum. Almost rectangular with small semicircular lobe between *st* just above anal plate. Relative lengths of setae: $a_1 = 10$, $a_2 = (10\text{-})11$, $a_3 = (22\text{-})24$, $st = 2(\text{-}3)$. All these setae almost straight, tapering, pointed, glabrous; a_1 and a_2 somewhat converging, a_3 somewhat diverging, *st* strongly converging. Distance a_1 - a_1 0.8 of length of a_1; distance a_1 - a_2 3.0 times longer than distance a_2 - a_3; distance *st* - *st* 2.3(-2.4) times as long as *st* and 0.7 of distance a_1 - a_1. Cuticle glabrous.

Sternum. Posterior margin between b_1 indented and with a broad triangular lobe projecting backwards below anal plate. Relative lengths of setae ($a_1 = 10$): $b_1 = 12(\text{-}13)$, $b_2 = 5$. These setae thin, tapering, distally striate; b_1 (1.2-)1.3 times as long as interdistance, b_2 1.1 times as long as distance b_1 - b_2.

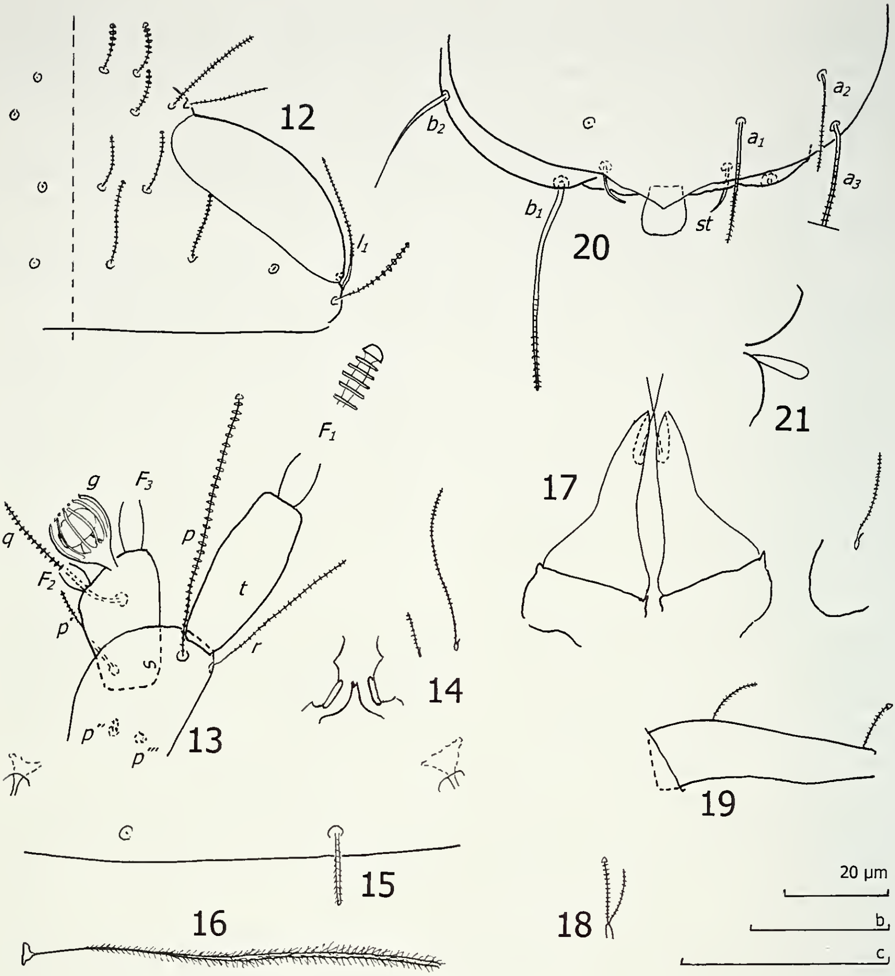
Anal plate directed upwards-backwards, rhombic, somewhat longer than wide, lateral corners rounded, 2 thin posteromedian, parallel appendages close to each other. The latter tapering, directed posteriorly, their length 0.7 of length of plate. Plate and appendages glabrous.

2. ***Allopauropus* (*D.*) *linguatulus*** sp. n. Figs 12-21

Type material. **Holotype:** ad. 9(♀), VIETNAM, Kien Giang Province, Kien Luong, Hon Chong, Nui Hang Tien, under bush on limestone, soil sample, Berlese extraction, 19.I.2000 (Loc. VIET-864). **Paratypes:** 3 ad. 9(1♂, 2♀), 1 juv. 3, same data as holotype. Kien Giang Province, Kien Luong, Hon Chong, Nui Son Cha, under limestone rock shelter, soil sample, Berlese extraction, 1 ad. 9(♂), 18.I.2001 (Loc. VIET-840).

Total number. 6 specimens.

Diagnosis. Only a few species in *Allopauropus* have a linguiform anal plate without appendages. Among them, *A. linguatulus* sp. n. may be closest to *A. ligulosus* Hagino from Japan (Hagino, 1991), *A. andriai* Remy and *A. palifer* Remy, both from Madagascar (Remy, 1956a). Distinctive characters in relation to *A. ligulosus* are the shape of the bothriotricha (e.g. T_3 with thin subcylindrical axis in *A. linguatulus* sp. n.,



FIGS 12-21

Allopauropus (*D.*) *linguatulus* sp. n.: 12-16, 18-21, holotype, ad. 9(♀), 17, paratype, ad. 9(♂). 12, head, median and right part, tergal view; 13, right antenna, tergal view; 14, collum segment, median and left part, sternal view; 15, tergite VI, posteromedian part; 16, T_3; 17, genital papillae and seta on coxa of leg 2, anterior view; 18, seta on coxa of leg 9; 19, tarsus of leg 9; 20, pygidium, posterior part, tergal view; 21, anal plate, lateral view. Scale a: Fig. 16; b: Figs 12, 14, 15, 17-20; c: Figs 13, 21.

proximal 2/3 of axis club-shaped in *A. ligulosus*) and the *st* (thin and tapering in *A. linguatulus* sp. n., not clavate in *A. ligulosus*). *A. linguatulus* sp. n. is distinguished from *A. andriai* Remy by the shape of the bothriotrix T_3 (axis thin and tapering in *A. linguatulus* sp. n., with distal end widened in *A. andriai*) and by the dissimilar margins of the anal plate (glabrous, not with fringe of distinct pubescence hairs). The new species is well delimited from *A. palifer* Remy too.

The anal plate has a glabrous margin in *A. linguatulus* sp. n., but a fringe of distinct pubescence hairs in *A. palifer* and the *st* are thin and cylindrical, not clavate. Moreover is the shape of the setae a_1 on the pygidial tergum thin and tapering in *A. linguatulus* sp. n., and short and clavate in *A. palifer*.

Etymology. From Latin lingua = tongue (referring to the tongue-like shape of the anal plate).

DESCRIPTION

Length. (0.65-)0.89 mm.

Head. Tergal setae of medium length, median ones subcylindrical, annulate, blunt; a_3 in 2nd row and lateral group of setae striate, pointed. Relative lengths of setae, 1st row: a_1 = 10, a_2 = 10(-11); 2nd row: a_1 = 11, a_2 = 23(-25), a_3 = 17(-20); 4th row: a_1 = (13-)16, a_2 = 14(-19), a_3 = ?(19), a_4 = 17; lateral group of setae: l_1 = 27, l_2 = 20, l_3 = 19. Temporal organs about 0.8 of shortest interdistance; small aperture at posterior margin. Head cuticle glabrous.

Antennae. Segment 4 with 5 setae, all but *r* and *p'''* subcylindrical, annulate; *r* straight, thin, cylindrical, striate; *p'''* a rudimentary knob only. Relative length of setae (paratype): *p* = 100, *p'* = 36, *p''* = 40, *p'''* = 1, *r* = 68. Tergal branch *t* somewhat fusiform, (2.5-)2.6 times as long as greatest diameter and (1.0-)1.2 times as long as sternal branch *s*, which is 1.7(-1.8) times as long as greatest diameter; anterior corner distinctly truncate. Seta *q* cylindrical, annulate-striate, pointed, (1.1-)1.3(-1.5) times as long as *s*. Relative lengths of flagella (base segments included) and base segments alone: F_1 = 100, bs_1 = 6; F_2 = 36(-37), bs_2 = 4; F_3 = (85-)88, bs_3 = 6. F_3 thinner than F_1, F_2 thinner than F_3. F_1 5.3 times as long as *t*, F_2 and F_3 (1.9-)2.3 and 4.7 times as long as *s*, respectively. Distal calyces somewhat flattened. Distal part of flagella axes only slightly widened. Globulus *g* 1.2(-1.3) times as long as greatest diameter, with (10-)11bracts, capsule flattened; width of g 0.9(-1.0) of greatest diameter of *t*. Antennae glabrous.

Trunk. Setae of collum segment simple or with minute rudimentary secondary branch. Primary branch very thin, striate. Sublateral seta (3.3-)3.4 times as long as submedian one; sternite process anteriorly narrow, with small incision. Appendages obliquely conical, caps flat; process and appendages almost glabrous.

Tergal setae similar to median setae on tergal side of head; 4+4 setae on tergite I, 6+6 on II-IV, 6+4 on V and 4+2 on VI. Submedian posterior setae on VI almost 0.4 of their interdistance.

Bothriotricha. Relative lengths of bothriotricha: T_1 = 100, T_2 = 83(-88), T_3 =117(-123), T_4 = 126(-133), T_5 = ?(193). Their axes thin, simple, straight, those of T_3 only a little thicker than the others. Pubescence almost erect, strongest on T_3.

Genital papillae (paratype). Base wide, distally strongly tapering, distal half narrow, subcylindrical; they are 1.8 times as long as widest part, seta 0.4 of length of papilla. Seta on coxa of leg 2 similar to other coxal setae on anterior legs.

Legs. Setae on coxa and trochanter of leg 9 similar to each other, furcate, branches subcylindrical, striate-annulate, blunt; secondary branch somewhat shorter and thinner than primary one. These setae seem to be simple on legs 1-8 and without rudimentary secondary branch. Tarsus of leg 9 slender, tapering, somewhat curved, (3.5-)3.7 times as long as greatest diameter. Proximal seta thin, cylindrical, striate, blunt, length 0.2(-0.3) of length of tarsus and 1.2(-1.3) times as long as distal seta; the latter cylindrical, striate, blunt. Cuticle of tarsus glabrous.

Pygidium. Tergum. Posterior margin rounded, with triangular lobe between *st* just above anal plate. Relative lengths of setae: $a_1 = 10$, $a_2 = 6$, $a_3 = ?(8\text{-}9)$, $st = 4(\text{-}5)$. a_1, a_2 and a_3 almost straight, thin, tapering, striate distally; *st* glabrous, tapering, curved inwards and converging; a_2 thinnest and inserted almost straight anterior of a_3. Distance a_1 - a_1 0.9 of length of a_1; distance a_1 - a_2 twice longer than distance a_2 - a_3; distance *st* - *st* 2.6(-3.1) times as long as *st* and 0.8(-0.9) of distance a_1 - a_1. Cuticle glabrous.

Sternum. Posterior margin between b_1 with broad and low lobe below anal plate. Relative lengths of setae ($a_1 = 10$): $b_1 = 17(\text{-}18)$, $b_2 = 8(\text{-}9)$. These setae thin, tapering, striate distally. b_1 1.1(-1.2) times as long as their interdistance, b_2 0.8 of distance b_1 - b_2.

Anal plate directed backwards-downwards, narrowest anteriorly, linguiform, 1.1 times as long as wide, glabrous; no appendages.

3. ***Allopauropus* (*D.*) *barbatulus*** sp. n. Figs 22-31

Type material: **Holotype:** ad. 9(♀), VIETNAM, Kien Giang Province, Kien Luong, Hon Chong, Nui Binh Tri, secondary forest in area without limestone, soil sample, Berlese extraction, 19.I.2000 (Loc. VIET-853).

Total number. 1 specimen.

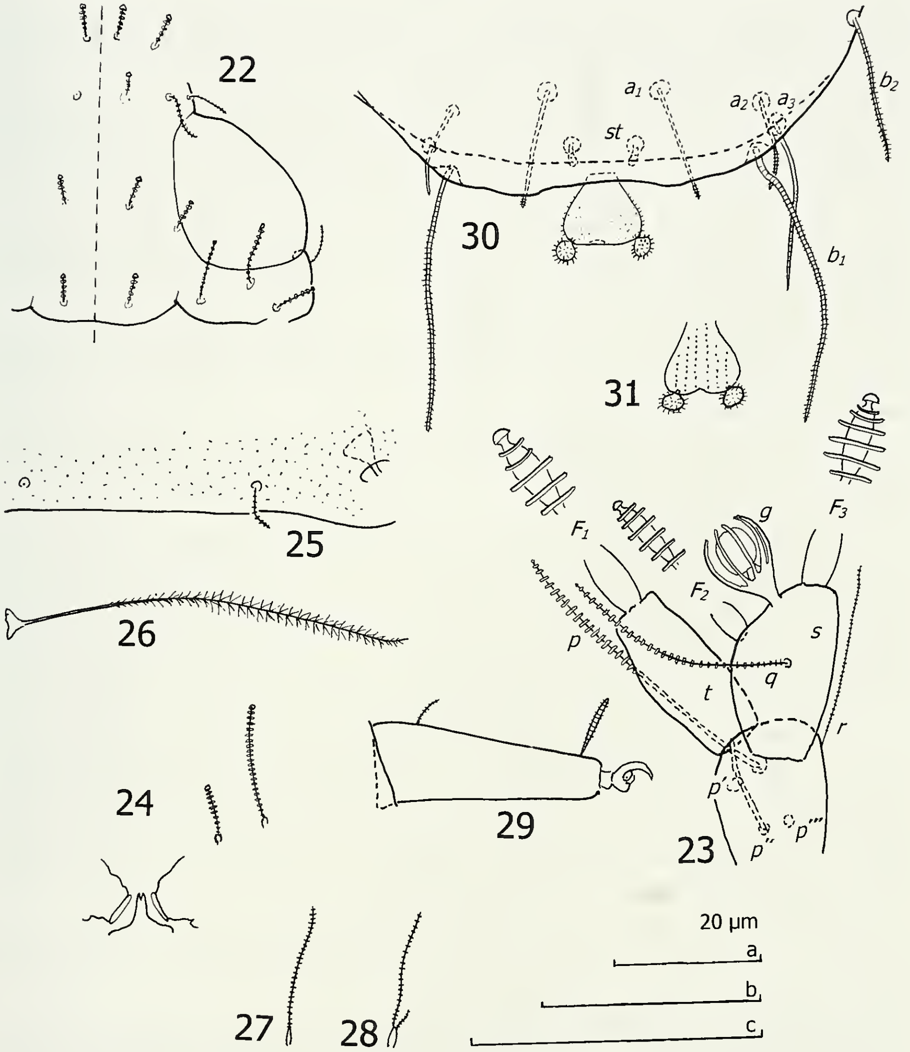
Diagnosis. A. barbatulus sp. n. is well defined by the following combination of characters: 1. anal plate almost cordate, with two short-stalked and ball-shaped appendages, one at each posterolateral corner; 2. distal seta on tarsus of leg 9 much longer than proximal seta; 3. pygidial tergum with thin subsimilar *a*-setae and short clavate *st*. This new species may be related to *A. rhopalophorus* Remy from Algeria (Remy, 1947) by the shape of the anal plate and some of the setae of the pygidial tergum. The two species are easily distinguishable by the shape of the pygidial setae a_1 (long and thin in *A. barbatulus* sp. n., short and blunt in *A. rhopalophorus* Remy) and by the shape of the appendages of the anal plate (ball-shaped and with short pubescence, versus not subcylindrical with a few long pubescence hairs only). More distant relationships presumably exist with the following species, e.g., *A. compatruelis* Remy & Rollet from Madagascar (Remy & Rollet, 1960), *A. scitulus* Remy from Madagascar too (Remy, 1956a) and *A. chartoni* Remy from Réunion (Remy, 1956b).

Etymology. Diminutive of Latin barbatus = bearded (referring to the hairy anal plate).

DESCRIPTION

Length. 0.76 mm.

Head. Tergal setae short or of medium length. Relative lengths of setae, 1st row: $a_1 = 10$, $a_2 = 11$; 2nd row: $a_1 = 9$, $a_2 = 23$, $a_3 = 14$; 3rd row: $a_1 = 11$, $a_2 = 16$; 4th row: $a_1 = 11$, $a_2 = 22$, $a_3 = 26$, $a_4 = 20$. Lateral group of setae: $l_1 = 20$, l_2 and l_3 not studied. Temporal organs 1.2 times as long as their shortest interdistance; small aperture close to posterior margin. Head cuticle glabrous.



FIGS 22-31

Allopauropus (*D.*) *barbatulus* sp. n., holotype, ad. 9(♀). 22, head, median and right part, tergal view; 23, left antenna, sternal view; 24, collum segment, median and left part, sternal view; 25, tergite VI, right posterior part; 26, T_4; 27, seta on coxa of leg 9; 28, seta on trochanter of leg 9; 29, tarsus of leg 9; 30, pygidium, posterior part, sternal view; 31, anal plate, tergal view. Scale a: Figs 22, 24-26; b: Figs 27-31; c: Fig. 23.

Antennae. Segment 4 with 4 setae, *p*' not studied, *p* subcylindrical, tapering distally, annulate, *p*" cylindrical, striate, *p*"' a rudimentary knob, relative lengths of setae: *p* = 100, *p*' = ?, *p*" = 33. Tergal branch *t* somewhat fusiform, 2.2 times as long as greatest diameter and 1.2 times as long as sternal branch *s*. The latter 1.4 times as long as greatest diameter, anterodistal corner truncated. Seta q as seta p of 4th segment but much thinner, 1.6 times as long as s. Relative lengths of flagella (base segments included) and base segments alone: $F_1 = 100$, $bs_1 = 8$; $F_2 = 27$, $bs_2 = 4$; $F_3 = 77$, $bs_3 = 6$. F_1 5.1 times as long as t, F_2 and F_3 1.7 and 4.8 times as long as s respectively. Distal calyces low, distal part of flagella axes widened, fusiform. Globulus g 1.2 times as long as greatest diameter, ≈ 9 bracts, capsule somewhat longer than wide; width of g 0.9 of greatest diameter of t. Antennae glabrous.

Trunk. Setae of collum segment simple, cylindrical, blunt, densely annulate. Sublateral seta twice longer than submedian seta; sternite process narrow anteriorly and with small V-shaped anterior incision. Appendages wide, obliquely subcylindrical, caps flat. Process and appendages glabrous.

Setae on tergites thin, short, similar to those on tergal side of head, 4+4 setae on tergite I, probably 6+6 on II-IV, 4+2 on VI. Posteromedian setae on tergite VI pointed, annulate, 0.2 of their interdistance.

Bothriotricha. All bothriotricha except T_4 lost or broken. $T_4 = 55$ µm, with thin, simple, straight axes, pubescence of straight, simple, almost erect hairs, which are longest just outside the middle.

Legs. Seta on coxa of leg 9 very thin, simple, cylindrical, striate; seta on trochanter furcate, main branch as on coxal seta, secondary branch very short and thin, striate. These setae simple on legs 1-8. Tarsus of leg 9 tapering, 2.5 times as long as greatest diameter. Proximal seta very thin, cylindrical, blunt, striate, curved inwards. Distal seta somewhat clavate, striate, its length 0.3 of length of tarsus and 1.9 times as long as proximal seta. Cuticle of tarsus glabrous.

Pygidium. Tergum. Posterior margin rounded, but with slight indentation below setae a_1. Relative lengths of setae: $a_1 = 10$, $a_2 = 7$, $a_3 = 15$, $st = 2$. a_1, a_2 and a_3 very thin, tapering, striate distally, diverging; st short, somewhat clavate, curved inwards and converging. Distance a_1 - a_1 almost as long as a_1 and somewhat longer than distance a_1 - a_2, which is twice longer than distance a_2 - a_3; distance st - st 3 times longer than st and 0.6 of distance a_1 - a_1. Cuticle glabrous.

Sternum. Posterior margin between b_1 almost straight. Relative lengths of setae ($a_1 = 10$): $b_1 = 23$, $b_2 = 13$. These setae thin, tapering, striate distally. b_1 0.9 of their interdistance, b_2 as long as distance b_1 - b_2.

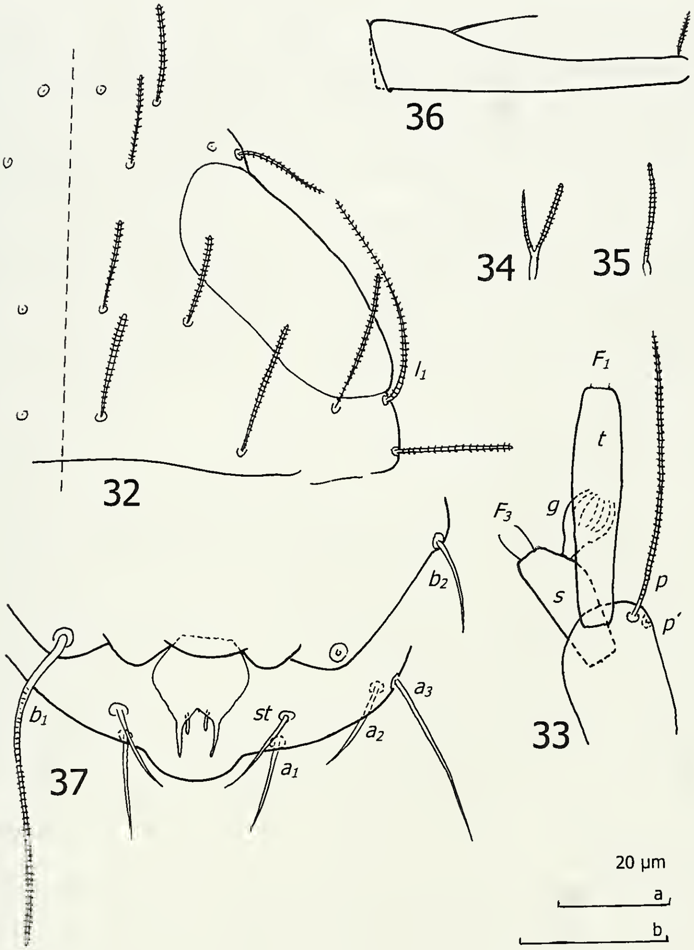
Anal plate narrow at base, broadly spatulate with rounded posterolateral corners. Posteromedian margin almost straight but with small indentation on tergal side, somewhat cordate in dorsal view. Plate 1.1 times as long as wide, posterolateral corners each with a short-stalked subspherical appendage. Appendages diverging, 1/3 of length of plate. Plate with short pubescence, indistinct and irregular on sternal side, arranged in 6 distinct longitudinal rows on tergal side; pubescence longest and erect on appendages.

4. *Allopauropus* (*D.*) *absimilis* sp. n. Figs 32-37

Type material: **Holotype:** ad. 9(♀), VIETNAM, Kien Giang Province, Kien Luong, Hon Chong, Nui Hang Tien, under bush on limestone, soil sample, Berlese extraction, 19.I.2000 (Loc. VIET-868).

Other material. Same data as holotype, 1 juv. 3.

Total number. 2 specimens.



FIGS 32-37

Allopauropus (*D.*) *absimilis* sp. n., holotype, ad. 9(♀). 32, head, median and right part, tergal view; 33, left antenna, tergal view; 34, seta on coxa of leg 9; 35, seta on trochanter of leg 9; 36, tarsus of leg 9; 37, pygidium, posteromedian and left part, sternal view. Scale a: Figs 34-36; b: Figs 32, 33, 37.

Diagnosis. A. absimilis sp. n. may be a close relative to Remy's *A. consociatus* from Madagascar (Remy, 1956a). The anal plates have the same groundplan and the antennal globuli are similar in both species. They can be distinguished by the shape of the posterior processes of the anal plate (0.5 of the length of plate in *A. absimilis* sp. n., as long as plate in *A. consociatus* Remy), by the shape of the seta on trochanter of leg 9 (simple, not furcate) and by some setae on the pygidial tergum ($a_1 > a_1 - a_1$, not $a_1 < a_1 - a_1$; *st* pointed, not blunt).

Etymology. From Latin absimilis = unlike (referring to the processes and appendages of the anal plate).

DESCRIPTION

Length. 0.81 mm.

Head. Most setae cylindrical, striate; all of those studied blunt, except a_3 in 2rd tergal row and l_1 which are tapering. Relative lengths of setae (a_2 in 1st row = 10, a_1 lacking,): 2nd row: $a_1 = 9$, $a_3 = 10$; 3rd row: $a_1 = a_2 = 9$; 4th row: $a_1 = a_4 = 11$, $a_2 = a_3 = 14$; lateral group of setae: $l_1 = 21$. Temporal organs 1.4 times as long as their shortest interdistance. Head cuticle glabrous.

Antennae. Antennae in bad condition. Seta *p* cylindrical, tapering distally, striate, l = 40, *p*" = 10 µm. Tergal branch *t* thin, slender, 5.3 times as long as greatest diameter and 1.8 times as long as sternal branch *s* which is about 2.4 times as long as its greatest diameter; anterior corner distinctly truncate. Flagellum F_3, l = 83 (base segment included), base segment alone l = 4 µm. F_3 4.6 times as long as *s*. Globulus *g* 1.5 times as long as greatest diameter; width of *g* 1.6 times as long as greatest diameter of *t*. Antennae glabrous.

Trunk and *bothriotricha* not available for study.

Legs. Seta on coxa of leg 9 furcate, branches similar to each other, cylindrical, blunt, striate; seta on trochanter simple, similar to main branch of coxal seta. These setae on legs 1-8 simple, seta on coxa thickest, seta on trochanter longest. Tarsus of leg 9 4.5 times as long as greatest diameter, very slender in distal 2/3. Proximal seta thin, tapering, pointed, with minute pubescence in distal half; proximal seta 0.3 of length of tarsus and twice longer than distal seta; the latter subcylindrical, tapering, pointed, striate. Cuticle of tarsus faintly granular.

Pygidium. Tergum. Posterior margin evenly rounded, but with distinct semicircular lobe between *st* above anal plate. Relative lengths of setae: $a_1 = 10$, $a_2 = 11$, $a_3 = 17$, $st = 9$. These setae tapering, pointed, almost glabrous; a_1, a_2 and *st* converging, a_3 diverging. Distance a_1 - a_1 1.4 times as long as a_1; distance a_1 - a_2 3.8 times as long as distance a_2 - a_3; distance *st* - *st* 1.8 times as long as *st* and 1.1 times as long as distance a_1 - a_1. Cuticle glabrous.

Sternum. Posterior margin between b_1 with 3 inner lobes, median one lowest and situated below anal plate. Relative lengths of setae ($a_1 = 10$): $b_1 = 30$, $b_2 = 8$ and 9. These setae thin, tapering, striate distally. b_1 1.2 times as long as their interdistance, b_2 0.7 of distance b_1 - b_2. Cuticle glabrous.

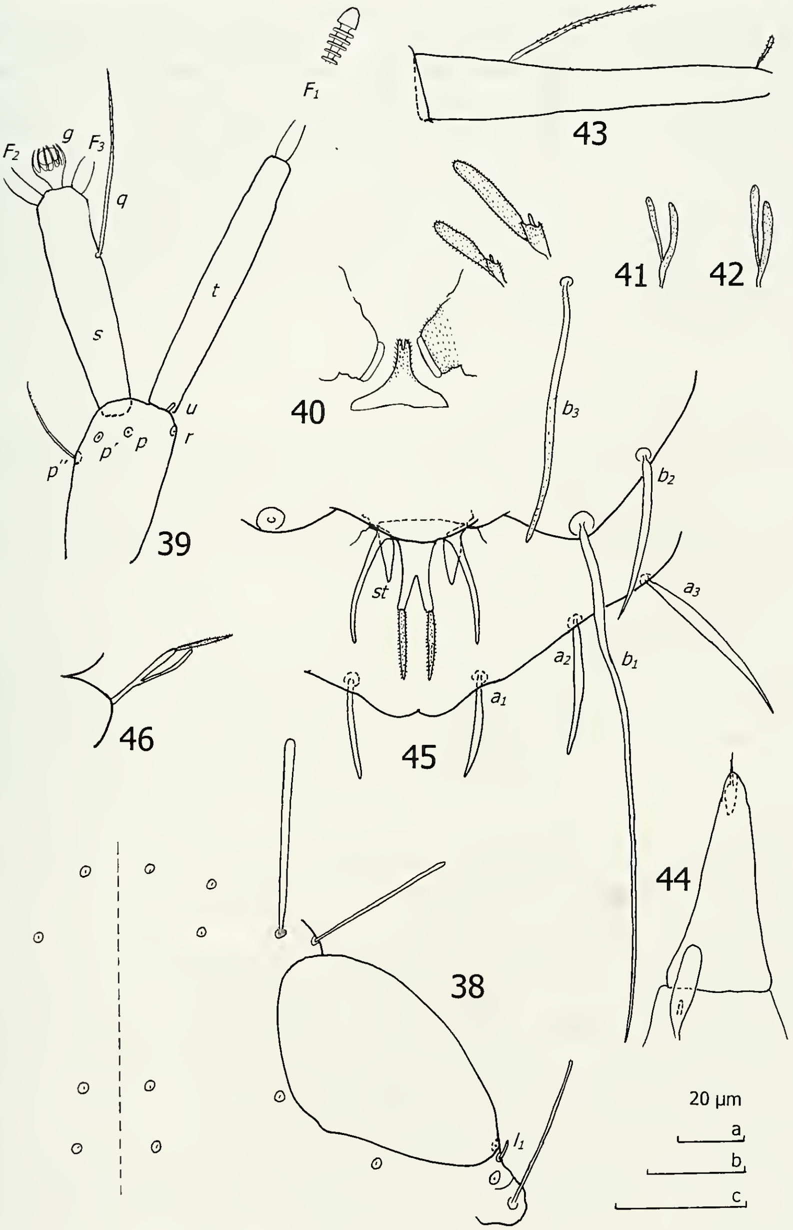
Anal plate 1.1 times as wide as long, narrowest anteriorly, with convex lateral margins and two posterior triangular lobes separated by a broadly V-shaped incision. Each lobe with a subcylindrical and tapering process protruding backwards, processes almost 0.5 of length of plate. Besides, two short subparallel appendages protruding backwards-downwards from inner sternal side of posterior lobes; length of appendage 0.5 of length of posterior processes. Plate and appendages glabrous.

Genus ***Pauropus*** Lubbock, 1867

5. ***Pauropus asiaticus*** sp. n. Figs 38-46

Type material. **Holotype:** ad. 9(♀), VIETNAM, Kien Giang Province, Kien Luong, Hon Chong, Nui Hang Tien, under bush on limestone, litter, Berlese extraction, 19.I.2000 (Loc. VIET-865). **Paratypes:** Same data as holotype, 1 ad. 9(♀) (Loc. VIET-863). Ibidem, soil sample, Berlese extraction, 3 ad. 9(♂), 1 subad. 8(♀), 19.I.2000 (Loc. VIET-864).

Total number. 6 specimens.



FIGS 38-46

Pauropus asiaticus sp. n., holotype, ad. 9(♀). 38, head, median and right part, tergal view; 39, right antenna, tergal view; 40, collum segment, median and left part, sternal view; 41, seta on coxa of leg 9; 42, seta on trochanter of leg 9; 43, tarsus of leg 9; 44, right genital papilla, outer lateral view; 45, pygidium, median and left side, sternal view; 46, anal plate, lateral view. Pubescence only partly drawn in Fig. 40. Scale a: Figs 41-43; b: Figs 39, 40, 44; c: Figs 38, 45, 46.

Diagnosis. *P. asiaticus* sp. n. closely resembles *P. forficularis* Scheller from Sri Lanka (Scheller, 1970). Distinctive characters are e.g. the shape of both the lateral branches and the posteromedian appendages of the anal plate (the former subcylindrical and long in *P. asiaticus* sp. n., tapering and short in *P. forficularis* Scheller; the latter lanceolate in *P. asiaticus* sp. n., claw-like in *P. forficularis*). The setae of the pygidial tergum are glabrous in *P. asiaticus* sp. n., but with a distinct pubescence in *P. forficularis*, and the pygidial setae a_3 are 1.5 times as long as the a_2 in *P. asiaticus* sp. n., almost of the same length in *P. forficularis*. The new species may also be close (but to a less degree) to *P. wieheorum* Remy from Mauritius (Remy, 1959) and to *P. difficilis* Remy from Pondichéry (Remy, 1961).

Etymology. Latinized adjective of Asia.

DESCRIPTION

Length. (0.98-)1.02(-1.42) mm.

Head. Most tergal setae lacking, those studied indicating long blunt glabrous setae. a_2 in 1st and 2nd rows and a_1 in 3rd row somewhat clavate; a_3 in 2nd row and a_4 in 4th row cylindrical. Temporal organs covering almost whole the posterior half of lateral side of head, their length 0.8 of their shortest interdistance. A very small pore in posterior part of temporal organ close to insertion point of l_1. Head cuticle and temporal organs glabrous.

Antennae. Segment 4 with 6 cylindrical setae, most of them lacking. In a paratype specimen p'' = 13 µm, p''' = 2 and u = 1 µm. Tergal branch t very slender, subcylindrical, 7.0(-7.1) times as long as its greatest diameter and (1.2-)1.3 times as long as sternal branch s which is very little clavate, (3.9-)4.3 times as long as its greatest diameter. Seta q cylindrical, tapering distally, indistinctly striate, 0.9 of length of s. Relative lengths of flagella (base segments included) and base segments alone: F_1 = 100, bs_1 = 6(-7); F_2 = (63-)79(-82), bs_2 = 6; F_3 = (78-)86, bs_3 = 6(-7); F_1 2.3(-2.5) times as long as t, F_2 and F_3 (2.2-)2.4 and (2.6-)2.7 times as long as s respectively. Globulus g 1.5 times as long as wide, with 9(-11) bracts, capsule with flattened bottom, width of g 0.9 of greatest diameter of t. Antennae glabrous.

Trunk. Setae of collum segment furcate, both branches with minute pubescence; primary branch foliform, (6.5-)6.6 times as long as broad, secondary branch rudimentary, subcylindrical. Sublateral setae 1.4(-1.5) times as long as submedian ones. Sternite process with narrow anterior part with distal incision; appendages low with flat caps; process and appendages with distinct pubescence.

Setae on tergite I lanceolate, glabrous; 4+4 setae on I, 6+6 on II-IV, ? on V and VI.

Bothriotricha. Most bothriotricha lost or broken. Relative lengths of them: T_1 = 100, T_2 = 101, T_3 = (107-108), T_4 = (156), T_5 = ?. Bothriotricha with thin straight axes with short pubescence, for the greatest part oblique but distally erect.

Genital papillae (paratypes). Genital papillae with almost straight sides, narrowly conical, 2.1-2.2 times as long as greatest diameter, glabrous. Apical seta short, 0.1-0.2 of length of papilla. Seta on coxa of leg 2 as coxal setae on other anterior legs.

Legs. Posterior legs long. Setae on coxa and trochanter of leg 9 furcate, with minute pubescence, main branch thickest, fusiform; secondary branch somewhat clavate (or cylindrical), blunt, protruding from a point 1/4 above the base of seta; secondary branch 0.8 of length of primary branch. More anteriorly these setae with a rudimentary cylindrical glabrous secondary branch. Tarsus of leg 9 strongly tapering, slender, 5.5(-6.0) times as long as greatest diameter. Setae with short oblique pubescence, proximal seta tapering, pointed; distal seta somewhat clavate, blunt. Proximal seta 0.4 of length of tarsus and 4.4 times as long as distal seta. Cuticle of tarsus with minute pubescence.

Pygidium. Tergum. Posterior part broadly triangular, between a_1 a small lobe with median incision. Relative lengths of setae: $a_1 = 10$, $a_2 = 12(-13)$, $a_3 = 17(-18)$, $st = 6$. All setae glabrous, all but *st* lanceolate, somewhat curved inwards, *st* broadly lanceolate, bent outwards and converging; a_1 and a_2 directed posteriorly, a_3 diverging. Distance a_1 - a_1 1.2 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* (1.4-)1.5 times as long as *st* and 0.8 of distance a_1 - a_1.

Sternum. Posterior margin between b_1 broadly indented and with low rounded median bulge below anal plate. Relative lengths of setae ($a_1 = 10$): $b_1 = 47$, $b_2 = 15$, $b_3 = 24$. b_1 tapering, pointed, glabrous; b_2 lanceolate, somewhat curved inwards, glabrous; b_3 subcylindrical and with minute pubescence most distally. b_1 1.7 times as long as their interdistance, b_2 2.0(-2.1) times as long as distance b_1 - b_2; b_3 0.9 of distance b_3 - b_3.

Anal plate broadest anteriorly, this part with two posterolateral branches directed backwards-outwards and somewhat curved inwards, their length 0.7 of total length of plate with appendages. Posteromedian part of plate subrectangular, with posterior V-shaped cleft separating two branches, each with a distal, posteriorly directed, somewhat lanceolate appendage with short erect pubescence. Length of appendages almost 0.5 of length of lateral branches.

EURYPAUROPODIDAE

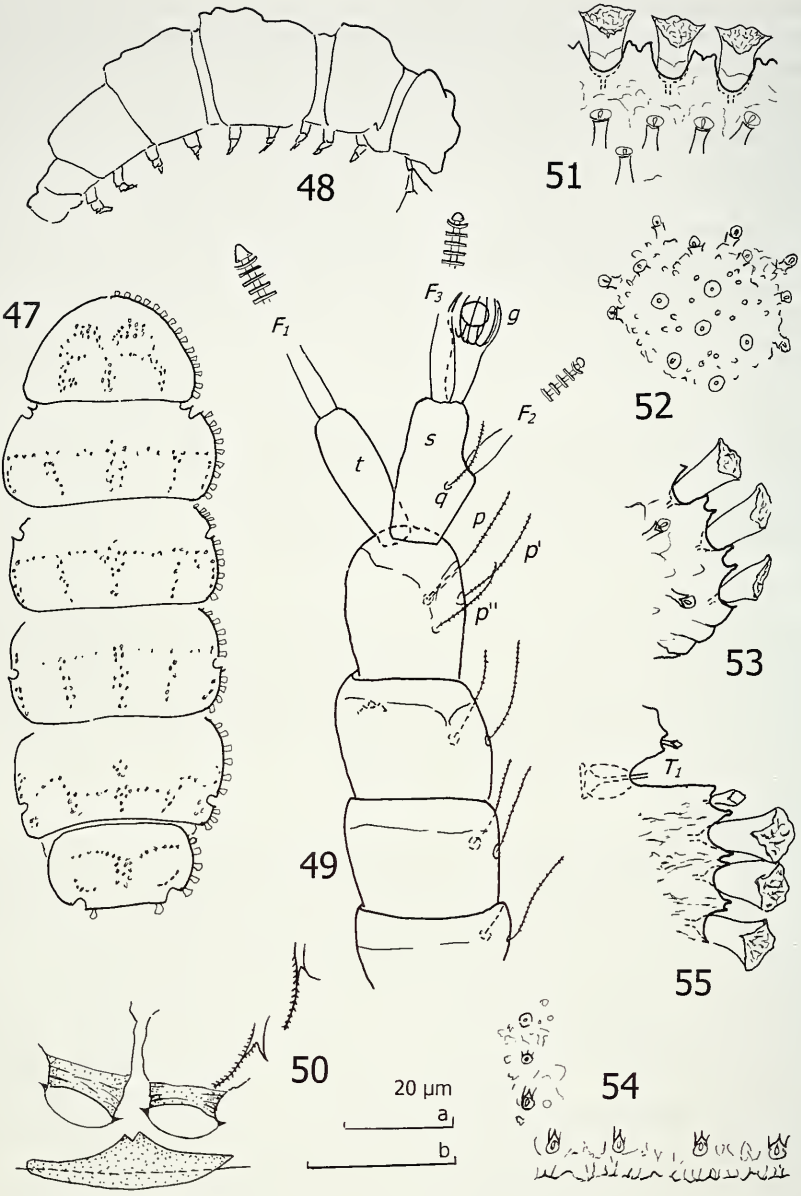
In most collections of Pauropoda Eurypauropodidae are poorly represented. The occurrence of 3 species, 2 of them new to science, in this material from Vietnam, indicates a proportionally high species diversity. This is in accordance with previous reports from south Asia, from Thailand (Scheller, 1995) and from Nepal (Scheller, 2000), which show that Eurypauropodidae, at least locally, may be almost as diverse as Pauropodidae. A further indication in this direction are two other *Samarangopus* species occurring in this collection which are unfortunately not in the best condition and therefore not described. One, 1 ad. 9(♂) and 1 juv. 5, from a limestone hill at Hon Chong, Nui Hang Tien, (Loc.VIET-866), is close to *S. longipenes* Scheller from Borneo (Scheller, 2001). The other, a juv. 6 specimen, from Hon Chong, Mo So, (Loc. VIET-014), is close to *S. segniter* Scheller (Scheller *et al.*, 1994) from Borneo.

Eurypauropodinae

Genus ***Samarangopus*** Verhoeff, 1934

6. ***Samarangopus campanulatus*** sp. n. Figs 47-64

Type material. **Holotype:** ad. 9(♀) VIETNAM, Kien Giang Province, Kien Luong, Hon Chong, Mo So, under bush on limestone, humus on rock, Berlese extraction, 18.XII.1994 (Loc. VIET-018, leg. Deharveng & Le Cong Kiet). **Paratypes:** Same data as holotype, 6 ad. 9(2♂,4♀), 1 subad. 8(♀).



FIGS 47-55

Samarangopus campanulatus sp. n., holotype, ad. 9(♀). 47, body, tergal view, tergites I-VI showing the symmetric pattern of depressions surrounded by raised cuticle; 48, body, lateral view; 49, right antenna, sternal view; 50, collum segment, median and left part, sternal view; 51, tergite I, part of anterior margin, tergal view; 52, tergite I, central part; 53, tergite I, right posterolateral corner; 54, tergite I, median part of posterior margin; 55, tergite II, right anterolateral corner, tergal view. Scale a: Figs 51-55; b: Figs 49-50.

Other material. VIETNAM, Kien Giang Province, Kien Luong, Hon Chong, Mo So, under bush on limestone, soil sample, Berlese extraction, 1 ad. 9(♂), 18.XII.1994 (Loc. VIET-013, leg. Deharveng & Le Cong Kiet). Ibidem, Hon Chong, Batai hill, under bushes, soil sample, Berlese extraction, 1 ad. 9(♀), 1 juv. 3, 21.XII.1994 (Loc. VIET-028, leg. Deharveng & Le Cong Kiet). Ibidem, Hon Chong, Nui Son Cha, under bush on limestone, litter, Berlese extraction, 1 ad. 9(♂), 1 juv. 5, 18.I.2000 (Loc. VIET-836). Ibidem, Hon Chong, Nui Hang Tien, under bush on limestone, soil sample, Berlese extraction, 1 ad. 9(♂), 1 juv. 5, 19.I.2000 (Loc. VIET-866).

Total number. 15 specimens.

Diagnosis. *S. campanulatus* sp. n. is most similar to the Bornean *S. segniter* Scheller (Scheller *et al*., 1994) and to *S. doiinthanonaeus* Scheller from north-western Thailand (Scheller, 1995). Distinctive characters in relation to *S. segniter* Scheller are: the shape of the pygidial setae *st* (straight and longer than a_1 in *S. campanulatus* sp. n., curved outwards and very short in *S. segniter* Scheller), the shape of the posterior margin of the pygidial sternum (straight in *S. campanulatus* sp. n., with posteromedian lobe with median incision in *S. segniter*) and the shape of the pygidial setae b_2 (thin tapering in *S. campanulatus* sp. n., broad lanceolate in *S. segniter*). Distinctive characters in relation to *S. doiinthanonaeus* are: the number of large protuberances on the posterior margin of tergite VI (one protuberance behind the pit of bothriotrix T_5 in *S. campanulatus* sp. n., two in *S. doiinthanonaeus* Scheller), the shape and pubescence of the bothriotrix T_3 (proportionally large distal swelling with minute pubescence in *S. campanulatus* sp. n., indistinct swelling and distinct pubescence in *S. doiinthanonaeus*) and the length of the pygidial setae *st* (about half of the length of the anal plate in *S. campanulatus* sp. n., as long as the anal plate in *S. doiinthanonaeus*).

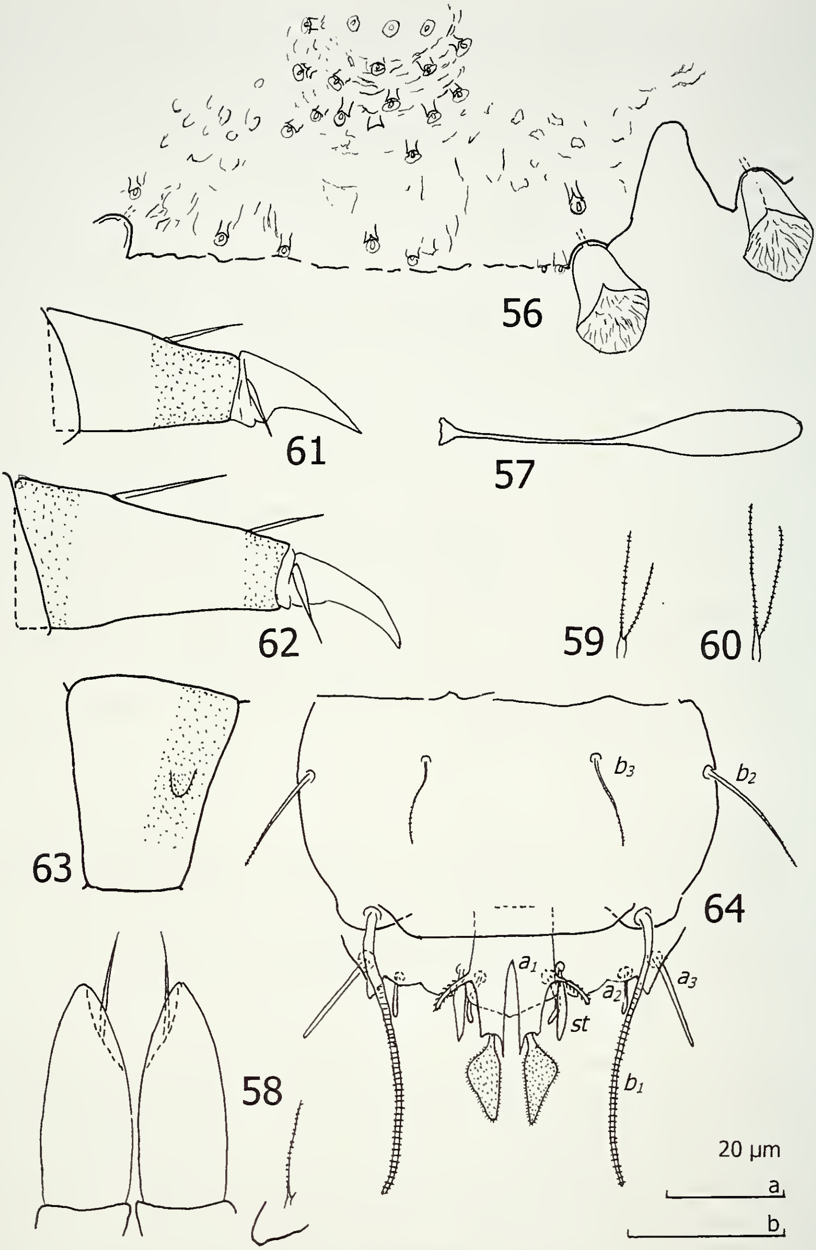
Etymology. From Latin campana = bell (referring to the shape of the large marginal setae on the anterior tergites).

DESCRIPTION

Length. (0.74-)0.84(-0.90) mm.

Head (holotype only). *Vertex*: no setae. *Tempus*: not studied. Index of setae, lateral row, 3 setae, lp_1 = ?, $lp_2 = 20$, $lp_3 = 14$, lp_1 - lp_2 =?, lp_2 - lp_3 = ?, $lp_1 - lp_1 = 16$; anterior row, 3 setae, $la_1 = 8$, $la_2 = 17$, $la_3 = 21$, $la_1 - la_2 = 7$, $la_2 - la_3 = la_1 - la_1 = 13$ µm. Distance $la_1 - la_1/la_1 - la_2 = 1.9$. Peristomal setae: *ipe* not ascertained, $pe_1 = 9$, $pe_2 = 14$, $pe_3 = 13$, $pe_4 = 14$, $pe_5 = 20$, $pe_1 - pe_2 = 3$, $pe_2 - pe_3 = 2$, $pe_3 - pe_4 = 5$, $pe_4 - pe_5 = 11$, $pe_1 - pe_1 = 16$ µm.

Antennae. Antennae almost glabrous; chaetotaxy of segments 1-4: 2/2/2+g'/3; setae thin, cylindrical, striate, their lengths on segment 4: p = 18(-20), p' = (15-)16, p'' = 13(-16) µm; no p''', u and r. Sternal branch s with distinct anterior indentation at level of F_2, anterior margin = (11-)13, posterior margin = (19-)20(-21), Ø of base = 6(-7), maximum Ø = 11(-12), q thin, cylindrical, annulate-striate, l = 10(-16) µm. Posterior margin/length of g 1.3(-1.7), posterior margin/maximum Ø = 1.8(-1.9), maximum Ø/Ø of base = (1.7-)1.8. Tergal branch fusiform, widest in distal half, l = 20 (-24), Ø of base = 5, maximum Ø = 7(-8) µm; pore not ascertained; length of t/maximum Ø = (2.5-)2.7. Globulus g, l = (12-)14(-15), maximum Ø = 7(-8) µm; length /maximum Ø = (1.8-)2.0; number of bracts (10-)13, their length = 7, capsule spherical, Ø = 3 µm. Relative lengths of flagella (base segments included): $F_1 = 100$, F_2 = 42(-49), F_3 = (79)82(-85). Lengths of base segments: bs_1 = 10(-13), bs_2 = 7(-8), bs_3 =



FIGS 56-64

Samarangopus campanulatus sp. n.: 56-57, 59-64, holotype, ad. 9(♀), 58, paratype ad. 9(♂). 56, tergite VI, median and right posterolateral part; 57, T_3; 58, genital papillae, anterior view; 59, seta on coxa of leg 9; 60, seta on trochanter of leg 9; 61, tarsus of leg 1; 62, tarsus of leg 9; 63, femur of leg 1 with appendage; 64, pygidium, sternal view. Pubescence only partly drawn in Figs 61-63. Scale a: Figs 56-58; b: Figs 59-64.

11(-12) µm. F_1 (3.6-)4.1 times as long as *t*, F_2 and F_3 (1.8-)2.1 and (3.3-)3.4 times as long as *s*, respectively. F_2 thinner than F_1 and F_3. Calyces of F_1 largest, conical, those of F_2 and F_3 smaller, subhemispherical.

Trunk. Setae of collum segment similar to each other, furcate. Branches tapering, pointed; main branch, striate; secondary branch rudimentary, glabrous; both setae l = 13(-14) µm. Sternite process broad and low, with anterior V-shaped incision. Appendages directed posteriorly, barrel-shaped, caps flat and with collar. Process and appendages with minute pubescence, caps glabrous.

Tergites. A single row of campanulate protuberances on anterior and lateral margins of tergite I, on lateral margins of II-V and on posterior margin of VI. Central part of all tergites with small cylindrical cuticular structures with distal candleflame-like vesicle surrounded by circular, funnel-shaped, transparent collar. Surface between these organs coarse.

Tergites I-VI with a symmetric pattern of depressions surrounded by raised cuticle with the above mentioned subcylindrical structures (Figs 47, 52, 54, 56). Number of campanulate marginal protuberances: I (27-)31; II, 1 small - T_1 - 1 small + (8-) 9; III, 5(6) - T_2 - 1 small + (6-)7; IV, 5(-6) - T_3 - (4-)5; V, 7 - T_4 - 4; VI, (5-)6 - T_5 - 1. Length/width ratio of tergites: I = (0.5-)0.6, II and V = 0.4(-0.5), III and VI = 0.5, IV = 0.5(-0.6).

Bothriotricha. All bothriotricha but T_3 curled distally and with very thin axes; these glabrous except for a minute pubescence on their distal third. T_3 with thicker axes and distal 2/5 increasing in width, forming a clavate distal end-swelling with minute pubescence. Relative lengths of bothriotricha: T_1 = 100, T_2 = 62(-105), T_3 = 28(-53), T_4 = ?(72-82), T_5 = (72-)81(-100).

Genital papillae. Base segments cylindrical. Length of papillae = 39(-48) µm, greatest Ø = 16(-20) µm, length of seta = 20 µm. Proximal part of genital papillae subcylindrical, distal part conical, seta (0.4-)0.5 of length of papilla, which is 2.4 times as long as greatest diameter. Cuticle glabrous. Coxal seta of leg 2 as on leg 1, length = 17(-20) µm.

Legs. All legs 5-segmented. Seta on coxa and trochanter of leg 9 subsimilar to each other, very thin, furcate, striate, with glabrous base; length of secondary branch 0.7-0.8 of primary one. More anteriorly these setae with rudimentary pointed glabrous secondary branches. Tarsi short, tapering, those of leg 9 1.8(-1.9) times as long as greatest diameter, with two tergal setae, both pointed and glabrous. Proximal seta (13-)15, distal one 9(-10) µm. Proximal setae 0.4(-0.5) of length of tarsus and (1.3-)1.7 times as long as distal seta. Cuticle of tarsus with minute pubescence. No proximal seta on tarsus of leg 1. All legs with large main claw and small setose anterior secondary claw; on leg 9 the former reaching 0.5 of the length of tarsus. On anterior side of femur of leg 1 a blunt appendage with short pubescence, length = 4(-5) µm.

Pygidium. Tergum. Posterior margin between the lateral digitiform appendages with 5 lobes, a triangular median one and two rounded ones on each side of it. Setae glabrous, a_1 and a_2 somewhat clavate, the former curved inwards and the latter almost straight; a_3 straight, cylindrical, somewhat tapering, diverging; *st* straight, lanceolate. Lengths of setae: a_1 = a_2 = (5-)6, a_3 = (10-)12(-14), *st* = 9(-12) µm. Distance a_1 - a_1 = 9(-11), a_2 - a_2 = (28-)29(-30), a_3 - a$_3$ = (34-)37(-39), a_1 - a_2 = 9(-10), a_2 - a_3 = 5, *st* - *st*

= 9(-12) µm. Distance a_1 - a_1 1.5(-2.0) times as long as a_1, distance a_1 - a_2 (1.8-)2.0 times as long as distance a_2 - a_3; distance *st* - *st* (1.1-)1.3 times as long as *st* and (1.1-)1.3 times as long as distance a_1 - a_1. Cuticle glabrous.

Sternum. Posterior margin with shallow indentations just inside b_1 and in between a broad low lobe with straight posterior margin. Setae thin, tapering, distally striate, b_2 and b_3 pointed. Lengths of setae: b_1 = (32-)37, b_2 = 15 and 17(-19), b_3 = (11-)12 µm . Distance b_1 - b_1 = (34-)36, b_2 - b_2 = (47-)50, b_3 - b_3 = (21-)22(-23), b_1 - b_2 = (18-)20, b_2 - b_3 = (13-)14 µm. Distance b_1 - b_1 (0.9-)1.0 of the length of b_1, b_2 0.7-0.8 of distance b_1 - b_2, b_3 0.5 of distance b_3 - b_3.

Anal plate twice as wider than long, widest in the middle, widest part about 1.5 times as wide as distal part; broadest part forming indistinct posterolateral corners, from there two short, thin, cylindrical, blunt, pubescent appendages protruding obliquely backwards; appendages 0.3 of length of plate; posterior 3/5 of plate divided into two tapering branches by a narrow V-shaped incision, each branch provided with two appendages: a submedian short straight tapering glabrous one and a stalked bladder of triangular shape in sternal view. Bladder-shaped appendages 0.6 of length of plate. Plate glabrous, bladder-shaped appendages with short erect pubescence.

Sphaeropauropodinae

Genus ***Sphaeropauropus*** Silvestri, 1930

7. ***Sphaeropauropus malayus*** Silvestri, 1930

Sphaeropauropus malayus Silvestri, 1930: 229-231, figs 3-4.

Material. VIETNAM, Kien Giang Province, Kien Luong, Hon Chong, Mo So, under bush on limestone, soil sample, Berlese extraction, 1 ad. 9(♀), 18.XII.1994 (Loc. VIET-014, leg. Deharveng & Le Cong Kiet).

Total number. 1 specimen.

General distribution. S. malayus has been reported from Java (Silvestri, 1930; Scheller, 1998), Réunion (Remy, 1956b) and the Philippines (Remy, 1957b). However, only on the base of the descriptions, none of the specimens reported by Remy seems to be completely identical with the type specimens from Java (Scheller, 1998) and only an examination of Remy's specimens can decide about their conspecificity with *S. malayus*.

8. ***Sphaeropauropus lecongkieti*** sp. n. Figs 65-84

Type material. **Holotype:** ad. 9(♂), VIETNAM, Kien Giang Province, Kien Luong, Hon Chong, Mo So, under bush on limestone, soil sample, Berlese extraction, 18.XII.1994 (Loc. VIET-020, leg. Deharveng & Le Cong Kiet). **Paratypes:** VIETNAM, Kien Giang Province, Kien Luong, Hon Chong, Batai, under bush on limestone, soil sample, Berlese extraction, 1 ad. 9(♀), 1 subad. 8(♀), 18.I.2000 (Loc. VIET-844).

Other material. VIETNAM, Kien Giang Province, Kien Luong, Hon Chong, Batai, under bushes,1 subad. 8(♀), 1 juv. 5, 21.XII.1994 (Loc. VIET-028, leg. Deharveng & Le Cong Kiet). Ibidem, same date, 1 subad. 8(♀) (Loc. VIET-029, leg. Deharveng & Le Cong Kiet). Ibidem, Hon Chong, near pagoda, under bushes, litter, Berlese extraction, 1 ad. 9(♀), 1 subad. 8(♂), 19.I.2000 (Loc. VIET-846).

Total number. 8 specimens.

Diagnosis. S. lecongkieti sp. n. is close to *S. breviglobulatus* Scheller from Nepal (Scheller, 2000) by similarities in the shape of the tuft-like setae and the pubescence on the tergites and in the general shape of the anal plate. Good distinctive characters are: the shape of the setae ipe_2 (simple and clavate in *S. lecongkieti* sp. n., thin and furcate distally in *S. breviglobulatus*), the proportion between the length of the base segment of the F_3 and the length of the sternal branch *s* (0.5, not 0.8), and the shape of the antennal globulus *g* (2.3 times as long as greatest width, not 1.2; 8-9 bracts, not 10-13; capsule spherical, not flattened). The two species may also be distinguished by the peculiar structure in the anterior part of the tergites V and VI (Figs 73-75), occurring in *S. lecongkieti* sp. n., but not in *S. breviglobulatus*.

Etymology. Dedicated to one of the collectors, Professor Le Cong Kiet (Ho Chi Minh City).

DESCRIPTION (holotype only)

Length. 0.85 mm.

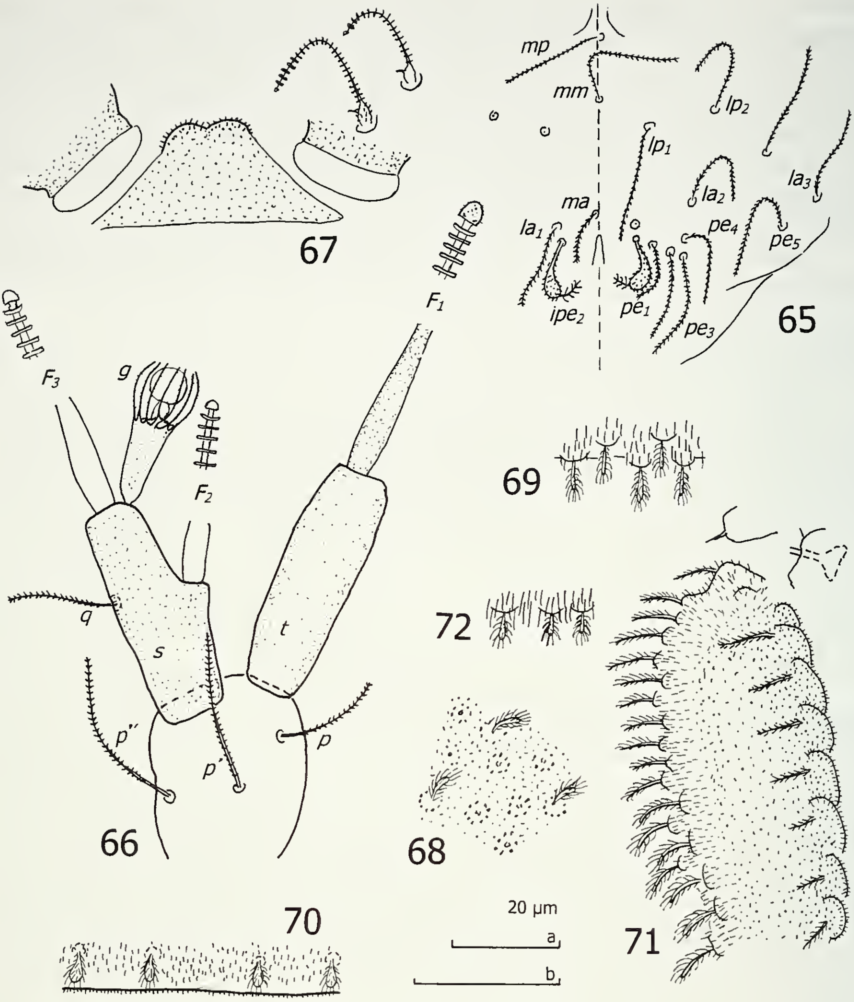
Head. All setae but ipe_2 cylindrical, thin, pointed, striate; ipe_2 clavate, bent inwards, with short pubescence. Vertex: no setae. Tempus: *te* not identified, no fungiform organ. Frons: frontal pore not identified. Index of frontal setae: median row, 3 setae, $mp = 20$, $mm = 25$, $ma = 10$, $mp - mm = 10$, $mm - ma = 21$ µm; lateral row, 3 setae, $lp_1 = 22$, $lp_2 = 20$, $lp_3 = 24$, $lp_1 - lp_2 = 12$, $lp_2 - lp_3 = 13$, $lp_1 - lp_1 = 19$ µm; anterior row, 3 setae, $la_1 = 16$, $la_2 = 19$, $la_3 = 17$, $la_1 - la_2 = 10$, $la_2 - la_3 = 22$, $la_1 - la_1 = 15$ µm. Distance $la_1 - la_1/la_1 - la_2 = 1.4$. Peristomal setae, ? in number, ipe_1 and *lb* not ascertained, $ipe_2 = 9$, $pe_1 = 13$, $pe_2 = 17$, $pe_3 = 20$, $pe_4 = 16$, $pe_5 = 25$, $pe_1 - pe_2 = 4$, $pe_2 - pe_3 = 2$, $pe_3 - pe_4 = ?$, $pe_4 - pe_5 = 18$, $pe_1 - pe_1 = 20$, $pe_5 - pe_5 = 68$ µm.

Antennae. Cuticle of segments 1-4 and branches *t* and *s* sparsely granular, *g* and flagella glabrous. Chaetotaxy of segments 1-4: 2/2/2/3. Setae subcylindrical, tapering, annulate; *g*' not ascertained, setae on segment 4, $p = 24$, $p' = 22$, $p'' = 16$ µm. Sternal branch with distinct anterodistal truncation at the level of F_2, anterior margin = 17, posterior margin = 26, Ø of base = 8, maximum Ø = 14, $q = 16$ µm. Anterior margin/length of $g = 0.9$; anterior margin/length of $q = 1.1$; anterior margin/posterior margin = 0.7; anterior margin/maximum Ø = 1.2; maximum Ø/Ø of base = 1.7. Tergal branch *t* fusiform, length = 33, Ø of base = 5, maximum Ø = 11 µm, length of t/maximum Ø = 3.0. Globulus *g* straight, l = 20, maximum Ø = 9 µm; with 8 or 9 bracts, their length = 9 µm; capsule subspherical, Ø = 5 µm. Relative lengths of flagella (base segments included): $F_1 = 100$, $F_2 = 49$, $F_3 = 83$. Length of base segments: $bs_1 = 22$, $bs_2 = 9$, $bs_3 = 16$ µm. F_1 3.2 times as long as *t*, F_2 and F_3 1.7 and 2.9 times as long as *s* respectively. Calyces helmet-shaped, those of F_1 largest.

Trunk. Setae of collum segment furcate; main branch cylindrical, striate-annulate, secondary branch rudimentary, conical, pointed, glabrous; length of submedian ones = 25, lateral ones = 20 µm; sternite process broad, anterior part divided into two rounded lobes separated by a shallow median incision; appendages short with thick round caps, Ø = 20 µm.

Tergites with tuft-like setae with clavate stalk. Cuticle between setae with very small sessile organs in the centre of round glabrous spots surrounded by sparse but distinct pubescence. Pubescence longest on lateral parts of tergites.

Setae on outer margin of laterosternal furrows resembling tuft-like setae but with thinner axes, some anterior ones even pointed. All setae in inner row pointed and with shorter oblique pubescence.

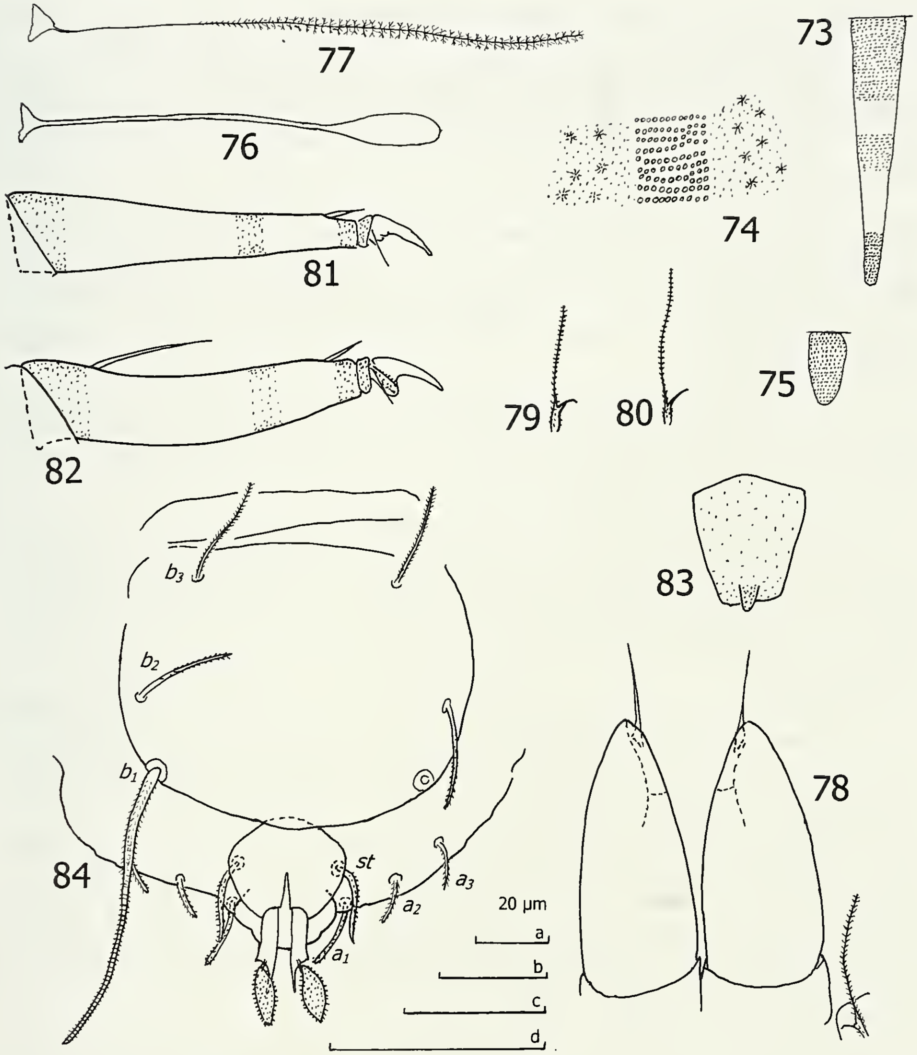


Figs 65-72

Sphaeropauropus lecongkieti sp. n., holotype, ad. 9(♂). 65, head, median and left part, tergal view; 66, left antenna, sternal view; 67, collum segment, median and left part, sternal view; 68, tergite I, central part; 69, tergite I, near posterolateral corner; 70, tergite I, posterior margin; 71, tergite II, right laterosternal furrow, sternal view; 72, tergite VI, posteromedian margin, tergal view. Scale a: Figs 65, 67, 71; b: Figs 66, 68-70, 72.

Anteromedian part of tergite V with wedge-shaped area, provided with densely packed transverse bands of small circular spots. A similar but smaller area on anterior part of tergite VI.

Bothriotricha. All but T_3 with very thin axes and distinct pubescence, the latter erect on distal halves, hairs branched at least on T_5. T_3 with thicker axes and distal ovoid swelling, its length 1/4 of length of bothriotrix; only distal part of T_3 with minute



Figs 73-84

Sphaeropauropus lecongkieti sp. n., holotype, ad. 9(♂). 73, tergite V, wedge-shaped cuticular pattern on anteromedian part; 74, detail of the cuticular pattern in Fig. 73 in higher magnification; 75, tergite VI, wedge-shaped cuticular pattern on anteromedian part; 76, T_3; 77, T_5; 78, genital papillae and seta on coxa of leg 2, anterior view; 79, seta on coxa of leg 9; 80, seta on trochanter of leg 9; 81, tarsus of leg 1; 82, tarsus of leg 9; 83, femur of leg 1 with appendage; 84, pygidium, sternal view. Pubescence only partly drawn in Figs 81 and 82. Scale a: Figs 73, 75; b: Figs 76-83; c: Fig. 84; d: Fig. 74.

but dense pubescence of oblique hairs. Relative lengths of bothriotricha: $T_1 = 100$, $T_2 = T_5 = 95$, $T_3 = 75$, $T_4 = 90$.

Genital papillae. Proximal half subcylindrical, distal half conical, length = 51, greatest Ø = 22 µm; length of seta = 20 µm. Papillae 2.6 times as long as greatest diameter, seta 0.4 of length of papilla. Cuticle glabrous. Coxal seta of leg 2 as on leg 1, length = 27 µm.

Legs. All legs 5-segmented. Setae on coxa and trochanter of leg 9 furcate. Main branch thin, striate-annulate, on coxa blunt and on trochanter pointed; secondary branch rudimentary, curved, pointed, glabrous. These setae on legs 1-8 of similar shape but coxal setae thinner.

Tarsi of leg 9 slender, tapering, somewhat bow-shaped, 4.1 times as long as greatest diameter, minutely pubescent; two tergal setae, both tapering, pointed, glabrous. Proximal seta = 22, distal seta = 8 µm, proximal seta 0.3 of length of tarsus and 2.8 times as long as distal seta. No proximal seta on tarsus of leg 1. On anterior side of femur of leg 1 a triangular blunt appendage with short pubescence; length of appendage = 5 µm.

All legs with almost straight main claw and small setose anterior secondary claw. Base of main claw with distinct pubescence, other parts glabrous. Main claw of leg 1 = 13, secondary claw = 8 µm; main claw of leg 9 = 14, secondary claw = 9 µm; main claw 0.2 of length of tarsus in all legs.

Pygidium. Tergum. Posterior margin rounded and with protruding lobe between a_1. Setae subsimilar to each other, subcylindrical, curved inwards, with very short pubescence. a_1, a_2 and a_3 cylindrical, blunt, converging; *st* tapering, directed posteriorly. Index of tergal setae: $a_1 = 9$, $a_2 = a_3 = 7$; $a_1 - a_1 = 16$, $a_2 - a_2 = 30$; $a_3 - a_3 = 50$, $st = 13$, $st - st = 14$ µm; $st - st/a_1 - a_1 = 0.9$, $a_1/a_1 - a_1 = 0.6$, $a_1/a_1 - a_2 = 1.1$, $a_1 - a_1/a_2 - a_3 = 2.0$. Tergum glabrous.

Sternum. Posterior margin between b_1 evenly rounded, setae tapering, with short oblique pubescence or striate distally. Index of sternal setae: $b_1 = 43$, $b_2 = 15$, $b_3 = 16$, $b_1 - b_1 = 38$, $b_2 - b_2 = 43$, $b_3 - b_3 = 28$, $b_1 - b_2 = 11$ µm; $b_1/b_1 - b_1 = 1.1$, $b_1/b_2 = 2.9$, $b_2/b_1 - b_2 = 1.4$, $b_3/b_3 - b_3 = 0.6$.

Anal plate pentagonal and with 2 cylindrical branches protruding backwards from posterior part of sternal side. Each branch with posterolateral-posterosternal truncation and two distal appendages: one of them tergal submedian and tapering, the other submedian and clavate. The latter 2.3 and 3.1 times as long as its greatest width and 1/3 of length of plate. Anal plate glabrous, clavate, with distinct erect pubescence.

ACKNOWLEDGEMENTS

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A re-evaluation of the generic assignment of *Bradypodion spinosum* (Matschie, 1892) and some considerations on the genus *Rhampholeon* Günther, 1874

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A re-evaluation of the generic assignment of *Bradypodion spinosum* (Matschie, 1892) and some considerations on the genus *Rhampholeon* Günther, 1874. - The generic assignment of the dwarfed African chameleon *Bradypodion spinosum* is re-evaluated with regard to phenotype, soft tissue morphology, cranial osteology and DNA analysis. All methods used indicate that the species is unequivocally a member of the genus *Rhampholeon* to which it is formally transferred here: *Rhampholeon spinosus* (Matschie) comb. nov. Comparison of DNA with other species of the genus indicates that the genus *Rhampholeon*, as currently composed, is not monophyletic and consists of at least two separate lineages.

Key-words: *Bradypodion spinosum* - *Rhampholeon* - Chamaeleonidae - taxonomy - molecular analysis - Usambara Mountains - Tanzania.

INTRODUCTION

Prior to 1892, only two species of *Rhampholeon* had been described viz. *kerstenii* (Peters, 1868) and *spectrum* (Bucholz, 1874). Although both were initially placed within the genus *Chamaeleo*, Günther erected the genus *Rhampholeon* in 1874 with *spectrum* as the type species for the genus. Both of these species have bicuspid claws. During a stay in the Eastern Usambara station of Derema in 1891, L. Conradt assembled a small collection of mammals and reptiles from which five new species of chameleons were described (Matschie, 1892) including two further new species of *Rhampholeon* named as *Chamaeleon (Brookesia) brevicaudatus* and *Chamaeleon (Brookesia) temporalis.* The latter, although possessing simple claws, has a typical Brookesiinae body habitus and it is not difficult to understand why it was allocated to *Brookesia.* Lastly there was a single specimen of a rather strange small chameleon with simple claws, an unusual ovo-globular rostral projection and prominent spines arranged in irregular rows along the dorsal keel and on the limbs. This chameleon was aptly named *Chamaeleon spinosus,* and all subsequent authors and taxonomists have treated it either as a member of the genus *Chamaeleo* (Werner, 1902; Mertens, 1966),

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or more recently as a member of the genus *Bradypodion* [as *B. spinosum*] (Broadley & Howell, 1991; Klaver & Böhme, 1986; Uetz, 2003). However, a number of observations made us question the generic allocation of this species. The available evidence, as well as new characters pertinent to this question, are reviewed below.

MATERIAL AND METHODS

Specimens of *B. spinosum* examined

[BMNH: The Natural History Museum (London, UK), MHNG: Muséum d'Histoire Naturelle de Genève (Geneva, Switzerland), MNHN: Muséum National d'Histoire Naturelle (Paris, France), PEM-R: Port Elizabeth Natural History Museum, (South Africa)].

BMNH 95.4.8.3	(FF), Usambara, Tanzania
BMNH 1974.522	(FF), Mazumbai Estate, Western Usambara, Tanzania
BMNH 1900.12.12.2	(MM), Ambangulu, Eastern Usambara, Tanzania
BMNH 1971.159	(FF), Amani, Eastern Usambara, Tanzania
MHNG 2609.067	(FF), Amani, Eastern Usambara, Tanzania
MHNG 2620.032	(FF), Eastern Usambara, Tanzania (skeleton prepared)
MHNG 2620.033	(FF), Eastern Usambara, Tanzania
MHNG 2620.034	(FF), Mazumbai Estate, Western Usambara, Tanzania
MHNG 2620.035	(MM), Mazumbai Estate, Western Usambara, Tanzania
MHNG 2620.036	(MM), Mazumbai Estate, Western Usambara, Tanzania
PEM-R 5738	(FF), Herkulu estate, Western Usambara Mtns, Tanzania

Material used for the molecular analysis and EMBL/Genbank accession numbers:

Bradypodion tavetanum (Steindachner, 1891)
MHNG 2612.095, Bundunki, Uluguru, Tanzania. (AJ609593)

Bradypodion oxyrhinum Klaver & Böhme, 1988
MHNG 2612.096, Bundunki, Uluguru, Tanzania. (AJ609594)

Bradypodion fischeri (Reichenow, 1887)
MHNG 2609.080, Amani, Eastern Usambaras, Tanzania. (AJ609592)

Bradypodion spinosum (Matschie, 1892)
MHNG 2609.067, Amani, Eastern Usambaras, Tanzania. (AJ609595)

Bradypodion spinosum
MHNG 2620.032, Eastern Usambara, Tanzania. (AJ609600)

Rhampholeon sp.
MHNG 2624.074, Kindoroko FR, North Pares, Tanzania. (AJ609601)

Rhampholeon spectrum (Buchholz, 1874)
MNHN 351I, Cameroon. (AJ609599)

Rhampholeon uluguruensis (Tilbury & Emmrich, 1996)
MHNG 2617.099, Mkungwe, Uluguru, Tanzania. (AJ609602)

Rhampholeon kerstenii (Peters, 1868)
MHNG 2611.010, Captive breeding. (AJ609598)

Rhampholeon brevicaudatus (Matschie, 1892)
MHNG 2609.064, Amani, Eastern Usambaras, Tanzania. (AJ609597)

Sceloporus undulatus (Bosc & Daudin, 1801) (L28075)

For osteological observation, the skeleton of a female specimen from the Museum of Natural History of Geneva (MHNG 2620.032) was cleaned by *Dermestes* sp. larvae for one week, then whitened with H_2O_2.

DNA extractions were made out of liver or muscle samples with the DNeasy Tissue kit (Qiagen) according to the manufacturer instructions. A 0.56kbp fragment of the 16S rDNA was amplified using the universal primers L2510 and H3059 designed by Palumbi *et al.* (1991). PCR conditions were as follows: Initial denaturation 94° for 3 minutes, then (93°, 45 seconds; 55°, 45 seconds; 72°, 1 minute) x 37 cycles, and final extension 72° for 5 minutes. PCR products were checked for size on 1% agarose gel and purified on QIAquick columns (Qiagen). PCR fragments were directly sequenced for both strands using the BigDye cycle sequencing kit (Applied Biosystems), and an ABI 377 automated sequencer. Sequences were aligned with Sequencher^{TM} v4.1.2 (Gene Codes Corp.), and minor corrections were done by hand. The final matrix was analyzed with PAUP* v4.0b10 (Swofford, 2002). Base composition heterogeneity was tested with the same software. Exhaustive parsimony analyses were performed on the whole matrix, and on a reduced dataset comprising the Chamaeleonidae only (without *Sceloporus*) with the following settings: Uninformative characters excluded, characters unordered and unweighted, gaps treated as missing, multistate treated as uncertainty. Branch support was estimated with 10'000 bootstrap pseudoreplicates.

RESULTS AND DISCUSSION

MORPHO-ANATOMICAL AND ECOLOGICAL OBSERVATIONS

Bradypodion spinosum is a dwarfed, short tailed, cryptically coloured, and rare inhabitant of the Afro-montane forests of the Eastern and Western Usambara Mountains of northern Tanzania (Fig. 1). The chameleons live in the lower strata of the deep forest biotope where they may be found at perch heights from a few cm to 3 meters elevation. Over part of their distribution (in the Eastern Usambaras) *B. spinosum* is sympatric with *Rhampholeon temporalis*. A superficial glance at this chameleon reveals some features that are not seen in the typical *Rhampholeon*. It has a network of interstitial skin that divides the flanks into clumps or islands of tubercles. In the genus *Rhampholeon*, this character is only seen in *R. gorongosae* Broadley, 1971. The tubercles on the flanks are not composed of sheets of stellate tubercles as is seen in other species of *Rhampholeon*, but rather of polygonal tubercles. The occiput of the skull has a rather prominent casque and the tail is relatively long for the typical *Rhampholeon*, averaging around 40% of the total length. It also has simple claws, a feature common to all species of the *Chamaeleo* and *Bradypodion* genera and to date only described in *Rhampholeon temporalis*.

FIG. 1

Rhampholeon spinosus comb. n., female. Herkulu Tea Estate, Western Usambaras, Tanzania. (Photo. C. Tilbury)

Bradypodion spinosum has however some morphological features unlike any seen in the genus *Bradypodion* (sensu lato) but reminding one of *Rhampholeon* (sensu lato). A clearly demarcated ridge of inter-orbital tubercles is present. In addition, the gular region is adorned with posteriorly diverging rows of low conical tubercles. Whilst there are a few species of *Chamaeleo* (e.g. *tempeli*, *laterispinis*) and one species of *Rhampholeon* (*kerstenii*) that demonstrate this gular arrangement, there are no members of the east African *Bradypodion* that have any trace of gular ornamentation. Closer examination of the scalation of the lower flanks shows that in areas there are small zones of stellate tubercles. In addition the rostral process is unlike any other rostral processes seen outside the *Rhampholeon* Type II group (Rieppel, 1987). Where they occur among the genus, the rostral process is formed by a cluster of small conical tubercles around a soft tissue cushion that projects forward off the snout as a flexible process. Occasional specimens of *spinosum* may also have weak axillary dermal dimples equivalent to the better formed mite pockets of other species of *Rhampholeon*, and finally all specimens examined have low palmar and plantar spines. These are only seen in the *Rhampholeon* type II species (sensu Rieppel, 1987).

Klaver (1979) provided a valuable insight into the relationship of *spinosum* to the Brookesiinae when he commented that the simple sac-like a-diverticulate lungs of *spinosum* were “truly *Rhampholeon* like”. A single male specimen of *spinosum* (MHNG 2620.036) was found with everted hemipenes. These demonstrate an acalyculate hemipenal truncus and a complete absence of any apical structures – a condition not described outside the Brookesiinae genera. It is possible that the hemipenes are not fully everted and so further comment on the apex is withheld.

OSTEOLOGICAL CHARACTERS

The skull of *Bradypodion spinosum* demonstrated the following osteological features. The nasals are paired and form the dorsal margin of the external nares. The nasal process of the pre-maxilla meets the frontal bone just anteriorly to the nasals. The external nares reach the frontal bone. There is no fontanelle between the nasal and the prefrontal. The parietal is triangular and resembles that of *Rhampholeon platyceps* as illustrated by Rieppel (1987, Fig. 9E). The latter bone clearly lacks a supratemporal process, but the squamosal presents a normal dorsal process closing the upper temporal fossa posteriorly. These characters were all used by Rieppel (1987) to define taxa of the *Rhampholeon* type II group. The supratemporal itself is absent from the specimen we observed. Although this bone is present in most of the *Rhampholeon* type II species, exceptions occur like in *R. spectrum* (Rieppel, 1987). The presence of the splenial could not be ascertained. Additionally it was observed that the orbitae are bordered by three bones (i.e. including the frontal), a character typical of the Brookesiinae according to Klaver & Böhme (1986).

MOLECULAR PHYLOGENY

Partial DNA sequences from the 16S mitochondrial rDNA were obtained for 10 taxa and aligned with an outgroup belonging to the Iguanidae (Phrysonomatinae). Out of 558 aligned characters, 62 were excluded for alignment difficulties and, among the 496 remaining ones, 82 were parsimony informative (70 when *Sceloporus* was excluded). No compositional bias was detected in the dataset. Pairwise uncorrected distances between the outgroup and ingroup taxa vary between 22.3 and 25.8%. Interspecific distances within the ingroup fluctuate between 4.3 and 13.7%. There are 5 substitutions (4 transitions and 1 transversion), representing 1% divergence between both *B. spinosum* samples. The parsimony analysis of the 10 chameleons sequences resulted in a single most parsimonious tree (Fig. 2) with a length of 158 (CI 0.601, RI 0.606). In this tree *B. spinosum* is the sister-group of *Rampholeon* sp. a new species from the neighbouring North Pare Moutains. This relationship is well supported. Both species forms a monophyletic group with two *Rhampholeon* (II) taxa although bootstrap support is much lower for this node. Interestingly this group of species includes *R. spectrum,* the type species of *Rhampholeon.* The other *Rhampholeon* (belonging to type I) group together, and so do the *Bradypodion* taxa, however all these nodes are weakly supported by bootstrap values. When the tree is rooted with the *Sceloporus* sequence, its topology remains the same and the root branches between the *Rhampholeon* (type II) and the *Bradypodion/Rhampholeon* (type I) clades (Fig. 2). However, because of saturation concerns with the use of the available outgroup we prefer to discuss our results on the basis of an unrooted tree. In any case this does not change the relationships of *B. spinosum* with *Rhampholeon.* Despite the obvious caution we should exercise because of the weak bootstrap support for some branches, these additional molecular results confirm the conclusions we derived from morpho-anatomical analyses. They allow us to obtain two important conclusions: a) *B. spinosum* is definitely more closely related to (some) *Rhampholeon* species than to other *Bradypodion*, therefore its transfer to *Rhampholeon* is fully justified; and b) The genus *Rhampholeon* is most probably not monophyletic and comprises at least 2 separate lineages concordant with the Type I and Type II groupings. This idea has already been suggested by several authors on the basis of diverse morphological characters (Bauer, 1997; Rieppel, 1987; Tilbury, 1992; Tilbury & Emmrich, 1996, Townsend & Larson, 2002), and is now supported by a new class of characters. The taxonomic decisions and corresponding nomenclatural acts needed to reflect this situation will be published elsewhere on the basis of a more comprehensive dataset (Matthee *et al.*, in prep), except for the new combination proposed below.

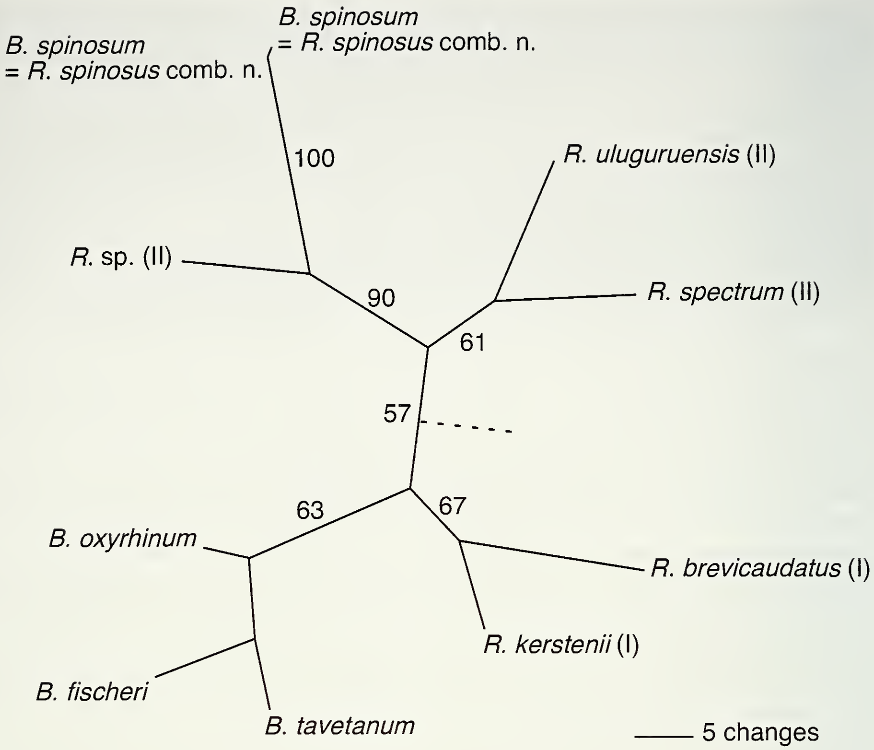

FIG. 2

Unrooted phylogram showing the phylogenetic relationships of *Rhampholeon spinosus* comb. n. based on a parsimony analysis of partial 16S rDNA sequences. Numbers on branches are bootstrap values (10'000 repeats). *B* = *Bradypodion*, *R* = *Rhampholeon*, (I)= *Rhampholeon* type I, (II)= *Rhampholeon* type II. The dotted line indicates the position of the root when *Sceloporus undulatus* is used as outgroup.

CONCLUSIONS

On the basis of its general phenotype, rostral process, simple lung morphology, presence of accessory palmar spines, row of enlarged inter-orbital tubercles, acalyculate hemipenal truncus, osteological skull structure, and particular DNA characteristics, *B. spinosum* clearly does not belong in the genus *Bradypodion* (sensu lato), but rather in the genus *Rhampholeon* [Type II (Rieppel, 1984; Tilbury, 1992)]. Whilst it is apparent that *spinosum* belongs within the Brookesiinae subfamily, its relationships within the genus *Rhampholeon* are by no means clear yet. By virtue of its acalyculate hemipenal truncus it is likely to be more closely related to the species around *R. boulengeri* and *uluguruensis.* Compared to the sympatric species *R. temporalis*, the exaggerated development of the rostral process, the small gular spines and the flank scalation of *spinosum*, more reminiscent of the other chameleon genera, may indicate differentiation due to character displacement (Brown & Wilson, 1956). The gular spines are very reminiscent of those found in *R. kerstenii.* The flank scalation, and simple claws of *spinosum* are morphological features that appear to bridge the generic gap between *Rhampholeon* and *Chamaeleo* and may be important clues in the complex evolutionary history of the Chamaeleonidae. The molecular data reported here do not allow us to confirm this assumption, however preliminary analyses of more complete molecular datasets tend to support this idea (JM, unpublished data).

We conclude with the transfer of *B. spinosum* to the genus *Rhampholeon* Günther, 1874, and propose the following new combination: *Rhampholeon spinosus* (Matschie, 1852) **comb. nov.**

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Redescription of *Brooksiella praeputialis* and *Goezeella siluri* (Eucestoda: Proteocephalidea), parasites of *Cetopsis coecutiens* (Siluriformes) from the Amazon and proposition of *Goezeella danbrooksi* sp. n.

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Redescription of *Brooksiella praeputialis* and *Goezeella siluri* (Eucestoda: Proteocephalidea), parasites of *Cetopsis coecutiens* (Siluriformes) from the Amazon, and proposition of *Goezeella danbrooksi* sp. n. - *Brooksiella praeputialis* (Rego, Santos & Silva, 1974) and *Goezeella siluri* Fuhrmann, 1916 from the Amazonian siluriform fish *Cetopsis coecutiens* (Siluriformes: Cetopsidae) are redescribed. *Goezeella piramutab* Woodland, 1933 is considered as a synonym of *Goezeella siluri*. *Goezeella siluri* sensu Brooks & Rasmussen, 1984 becomes *Goezeella danbrooksi* sp. n., differing from *G. siluri* by the vitelline follicles position (only dorsal, not lateral), size (much smaller in type material) and shape (slightly wider posteriorly); by the position of vaginal sphincter (which is terminal in *G. siluri*) and by the number of testes.

Key-words: Eucestoda - Monticelliidae - *Brooksiella praeputialis* - *Goezeella siluri* - *Goezeella danbrooksi* sp. n. - catfish parasites - taxonomy.

INTRODUCTION

Two proteocephalidean tapeworms, *Goezeella siluri* Fuhrmann, 1916 and *Brooksiella praeputialis* (Rego, Santos & Silva, 1974) have been described from the "candiru", *Cetopsis coecutiens* (Cetopsidae) from the Amazon River. During a field expedition to Amazonia conducted by the Natural History Museum, Geneva (MHNG) and the Institute Oswaldo Cruz (IOC), we were able to collect both cestodes species in excellent condition. Due to some confusion in citations or redescription of both species (Woodland, 1933; Freze, 1965; Rego *et al.*, 1974; Rego, 1975), we give here a brief redescription of *Brooksiella praeputialis* and *Goezeella siluri*, and clarify a number of issues linked to the synonymy of these taxa.

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MATERIAL AND METHODS

The hosts were collected by fishermen from the Amazon river near Itacoatiara, Brazil, in 1992 and 1995; they were dissected and examined for parasites immediately after death. The gut was dissected along its entire length. The worms were fixed immediately after dissection with hot 4% neutral formaldehyde solution, stained with Mayer's hydrochloric carmine solution, dehydrated in an ethanol series, cleared with eugenol (clove oil) and mounted in Canada balsam. Pieces of the strobila were embedded in paraffin wax, cross sectionned (thickness 12-15 µm), stained with Weigert's hematoxylin and counterstained with 1% eosin B (de Chambrier, 2001). Eggs were studied in distilled water. All measurements are given in micrometers (µm) unless otherwise stated.

Abbreviations used in descriptions are as follows: x = mean, n = number of measurements, CV = coefficient of variability, OV = ovary width versus proglottis width ratio (in %), PP = position of genital pore (cirrus pore) as % of proglottis length, PC = cirrus-pouch length versus proglottis width ratio (in %). CHIOC = the Helminthological Collection of the Institute Oswaldo Cruz; MHNG = Natural History Museum, Geneva, INVE = Geneva Museum Invertebrate Collection, USNM = U.S. National Museum.

RESULTS

Brooksiella praeputialis (Rego, Santos & Silva) Figs 1-5, 9-10

Amphoteromorphus praeputialis Rego, Santos & Silva, 1974: 200.
Amphoteromorphus praeputialis; Brooks & Rasmussen, 1984: 751.
Brooksiella praeputialis; Rego, Chubb & Pavanelli, 1999: 354.

Type-host: *Cetopsis coecutiens* Spix & Agassiz (Siluriformes: Cetopsidae); vernacular name : Candiru.

Other host: *Pseudocetopsis othonops* Eigenmann (Siluriformes: Cetopsidae).

Materiel studied: *Brooksiella praeputialis* (Rego, Santos & Silva, 1974), syntypes CHIOC 26.421, 31.047a-d, 31.048 a-c and 26.524.

Other material : Itacoatiara, Amazonas State, Brazil, MHNG INVE 19357 (14.09.1992); INVE 21875, 21876 (07.10.1995); INVE 22059, 22088, 21994, 21995, 21996 (16.10.1995).

Site of infestation: Intestine.

Type locality: Rio Amazonas, Maicuru, Pará State, Brazil.

Distribution: Amazon River.

REDESCRIPTION (based on 10 specimens)

Proteocephalidae, Zygobothriinae. Cestodes up to 12-22 mm long, 1,785 wide, with numerous transverse grooves in immature and mature proglottides, less marked in gravid proglottides. Strobila acraspedote, anapolytic, consisting of 46 to 51 (n = 7) proglottides : 25-36 immature (up to appearance of spermatozoa in vas deferens), 2-4 mature (up to appearance of eggs in uterus), 7-15 pregravid (up to appearance of hooks in oncospheres), and up to 8 gravid proglottides. Proliferation zone very short.

Immature, mature, pregravid proglottides wider than long (Fig. 3), gravid proglottides slightly wider than long or longer than wide. Metascolex slightly conical 910-1370 (x = 1145, n = 10) in diameter, much wider than neck (Figs 1, 9-10), with antero-laterally directed, embedded, uniloculate suckers, 275-395 (x = 325, n = 40, CV

= 9%) in diameter. Suckers with a well-developed circular musculature situated in upper marginal region (Fig. 1). External surface of metascolex bearing numerous wrinkles (Figs 9-10).

Internal longitudinal musculature weakly developed, represented by fine bundles of separated muscular fibres (Figs 4-5) forming anastomoses. Osmoregulatory canals overlapping vitelline follicles and testes (Figs 3-5). Ventral canals wider than dorsals. Presence of a posterior transverse canal and of secondary canals situated posteriorly and ending laterally beneath the tegument. Within scolex, canals form a dense network (Fig. 1).

Testes medullary, forming 2 compact fields in two or three layers, not overlapping cirrus sac, vagina and vas deferens (Fig. 3), numbering 193-292 (x = 244, n = 5, CV = 19%); aporal testes 98-150 in number (x = 123); 17-25 preporal testes (x = 21); 141 postporal testes 75-122 (x = 98). Testes spherical to oval, 45-60 in diameter, representing 2.5 - 4% of proglottis width. Testes reaching laterally almost the margin of proglottides, but not reaching not the posterior one (Fig. 3), overlapping vitelline follicles, present also in gravid proglottides.

Cirrus sac elongate to pyriform, with tapered distal part, thick-walled, 250-385 long and wide (Fig. 3); PC 15-23% (x =19 %, n = 36, CV = 11%). Cirrus up to 65% of cirrus pouch length. Vas deferens strongly coiled, situated between proximal part of cirrus sac and midline of proglottides, occupying up to 32 % of proglottis width, wider in its basal part (Fig. 3).

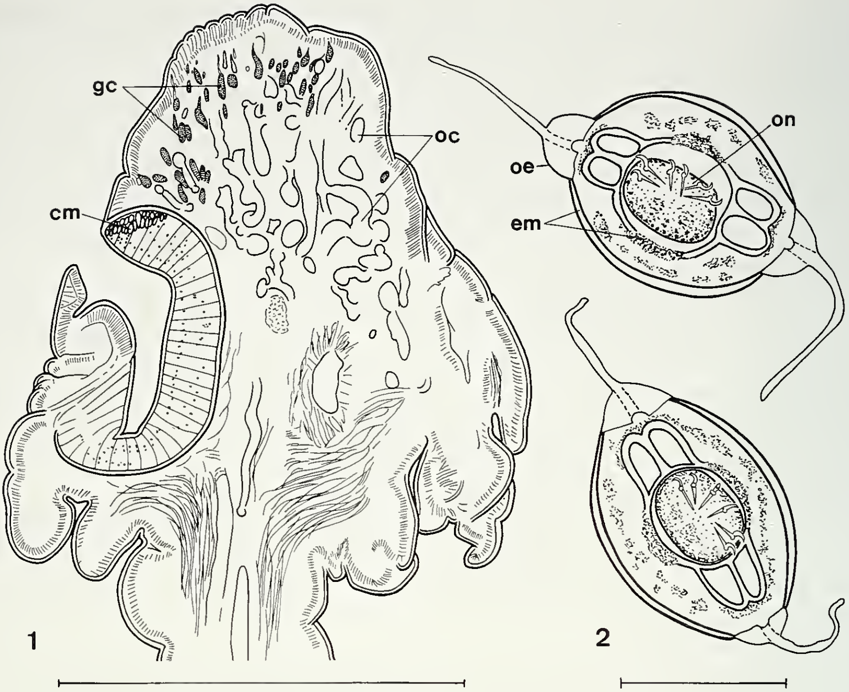
Genital atrium deep, pores alternating irregularly, situated anteriorly; PP = 12-26% (x = 18%, n = 24). Genital ducts passing between osmoregulatory canals.

Ovary medullary, bilobate, highly follicular in pre-gravid proglottides (Figs 3-4), with numerous dorsal and ventral outgrowths scarcely reaching dorsal cortex (Fig. 4), 880-1210 wide, OV =55-69 % (x = 59%; n = 34; CV = 7%). Mehlis' glands 100-150 in diameter (Fig. 3).

Vitelline follicles cortical, arranged in two lateral ventral field near margins of proglottides, more numerous posteriorly, occupying almost all proglottis length, not interrupted at level of cirrus sac ventrally, with some isolated follicles dorsal to cirrus sac. Vitelline fields of ventral follicles overlapping testes (Figs 3-5).

Vaginal canal forming small seminal receptacle antero-dorsal to ovarian isthmus, terminal part of vaginal canal (pars copulatrix vaginae) muscular (Fig. 3). Vagina anterior 26(%) or posterior 74(%) (n = 126) to cirrus-sac. Vaginal canal strongly curved before reaching seminal receptacle.

Primordium of uterine stem medullary, present in immature proglottides. Formation of uterus of type 1 (see de Chambrier *et al.,* 2004b): in immature proglottides, uterine stem straight, occupying entire length of proglottis, formed by longitudinal thick column of chromophilic cells along midline of proglottides. Lumen of uterus appearing in first mature proglottides (Figs 3-5); diverticula (lateral branches) formed before first eggs appear in uterine stem. In pregravid proglottides, eggs completely filling uterine stem and thick-walled diverticula. In gravid proglottides, diverticula occupying up to 62 % of proglottis width; 9-17 (n = 26) medullary lateral branches on each side. Longitudinal ventral uterine opening observable in some terminal proglottides.



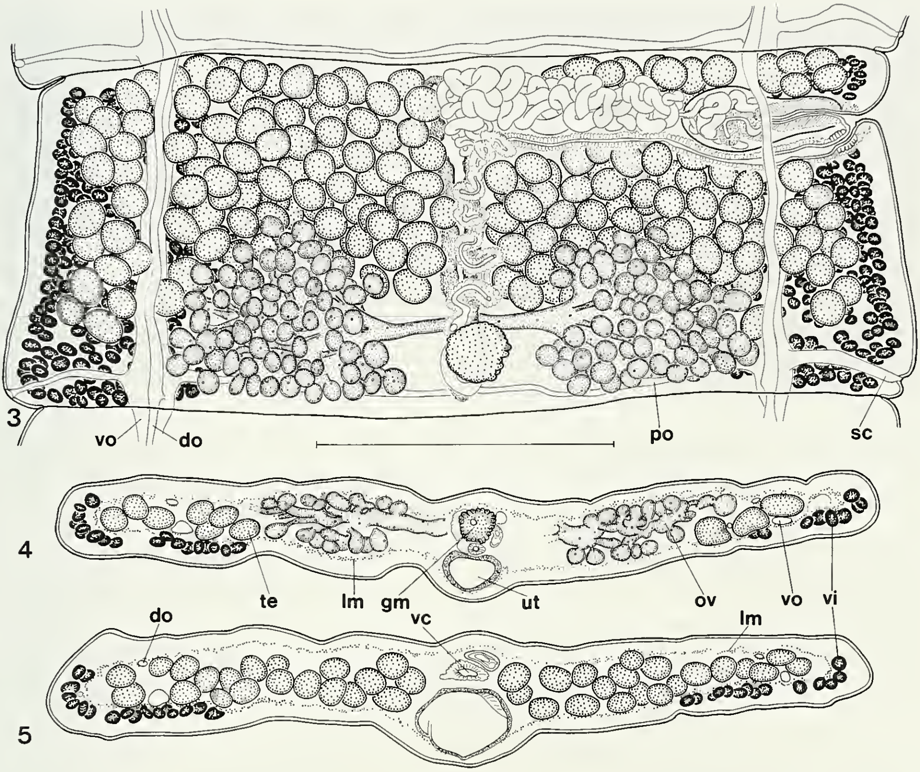
FIGS 1-2

Brooksiella praeputialis (Rego, Santos & Silva, 1974), INVE 22059. 1. Frontal section of the scolex, showing the concentration of gland(?) cells and dense network of osmoregulatory canals beneath the apical part. Note also the muscular fibres situated in the anterior part of the sucker. 2. Eggs drawn in distilled water. *Abbreviations*: cm, internal circular musculature; em, embryophore; gc, gland cells; oc, osmoregulatory canals; oe, outer envelope; on, oncosphere. Scale-bars: 1 = 500 µm; 2 = 20 µm.

Eggs with two polar projections 15- 20 long (Fig. 2). Embryophore spherical, bilayered, 25-29 x 22-24; internal layer containing granular material and paired polar chambers, 22-26 x 13-16; oncosphere spherical to oval, 10-13 in diameter, with 3 pairs of hooks, 4-5 long (Fig. 2).

REMARKS

Brooks & Rasmussen (1984) commented on the confusion of figures by Rego *et al.* (1974). We re-examined the original material and agree with Brooks & Rasmussen: figures 23, 24, 26 and 27 of Rego *et al.* (1974) are of *B. praeputialis* (No CHIOC 31047a, 31047d respectively) and not *Monticellia siluri* as stated. Figures 30-32 (CHIOC 31048a) and figure 33 (CHIOC 31048c) correspond to the syntype material of *B. praeputialis*.



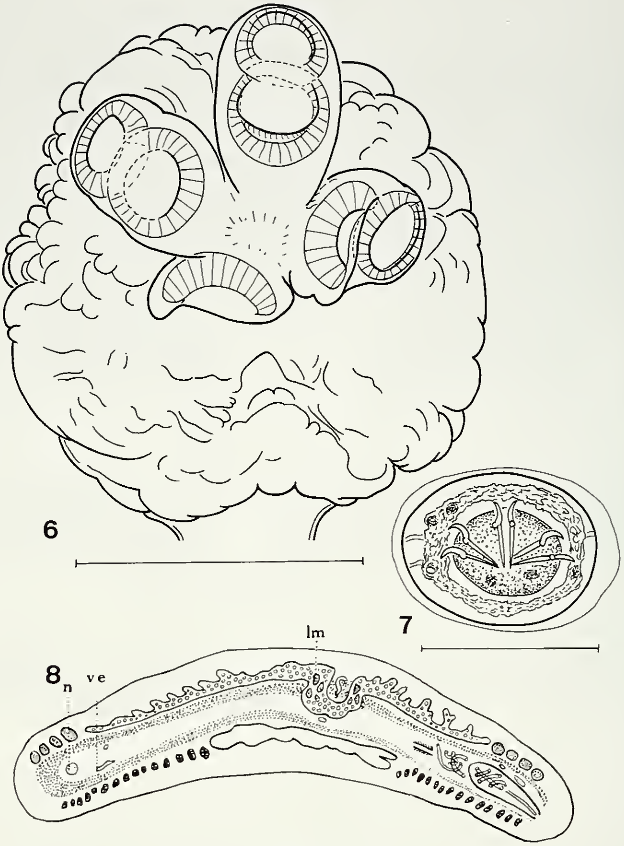
FIGS 3-5

Brooksiella praeputialis (Rego, Santos & Silva, 1974). 3. INVE 21996, mature proglottis, dorsal view. 4-5. INVE 22059, pregravid proglottis, cross sections at level of ovary and at level of middle of the proglottis. Note the follicular structure of ovary and the lateral and ventral position of vitelline follicles. *Abbreviations*: do: dorsal osmoregulatory canal; gm, Mehlis glands; lm, internal longitudinal musculature; ov: ovary: po : transverse osmoregulatory canal; sc : secondary canal; te: testes; ut: uterus; vc: vaginal canal; vi: vitellaria; vo: ventral osmoregulatory canal. Scale-bar: 500 µm.

Goezeella siluri Fuhrmann Figs 6-8

Goezeella siluri Fuhrmann, 1916: 386.
Goezeella piramutab Woodland, 1933: 488, **syn. n.**, see discussion below.
Monticellia siluri; Woodland, 1925: 714.
Goezeella siluri; Freze, 1965: 508.
Monticellia siluri; Rego, Santos & Silva, 1974: 195.
Goezeella siluri; Brooks & Deardorff, 1980: 15.
Goezeella siluri; Rego, Chubb & Pavanelli, 1999: 348.
[Not *Goezeella siluri*; Brooks & Deardorff, 1980: 15]. See *Goezeella danbrooksi* sp. n., described below.
[Not *Goezeella siluri*; Brooks & Rasmussen, 1984: 750]. See discussion below.

Type-host: *Cetopsis coecutiens* (Siluriformes: Cetopsidae).
Other host: *Pinirampus pirinampu* (Spix & Agassiz) (Siluriformes: Pimelodidae).



Figs 6-8

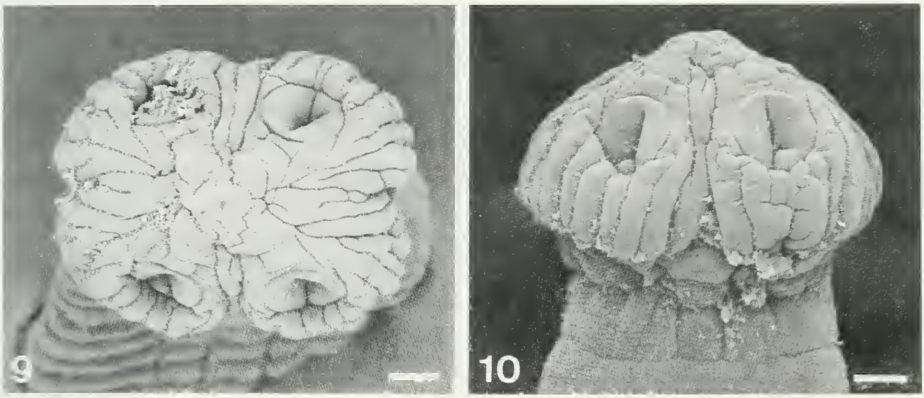
Goezeella siluri Fuhrmann, 1916. 6. Scolex, type material showing the biloculate suckers. 7. INVE 19858, egg drawn in distilled water. 8. Cross section at level of ovary, showing the ventral position of vitelline follicles, after Fuhrmann (1931, Fig. 275). *Abbreviations* (according to Fuhrmann)*:* lm, internal longitudinal musculature; n, longitudinal nerve; ve, ventral osmoregulatory canal. Scale-bars: 6 = 1000 µm: 7 = 20 µm (8 = no scale).

Materiel studied: *Goezeella siluri*, syntype material, 2 whole mount slides, 14 cross-sections slides, Coll. Institut de Zoologie, Neuchâtel. Other material: Itacoatiara, Amazonas State, Brazil, MHNG INVE 19858, 13.09.1992.

Site of infestation: Intestine.
Type locality: "Amazonas", Brazil.
Distribution: Amazon River.

DESCRIPTION

Strobila somewhat contracted, 77 mm long, 2025 in width. About 47 immature, 10 mature and 143 (pregravid and gravid) proglottides. Scolex with metascolex, 1825 in diameter, with biloculated suckers 435 long and 300 width (Fig. 6). Internal longitudinal musculature developed, represented by fine bundles of separated muscular fibres (Fig. 8) forming anastomoses.



Figs 9-10

Brooksiella praeputialis (Rego, Santos & Silva, 1974), INVE 22088. Scanning electron micrographs. 9. Scolex, apical view. 10. Scolex, lateral view. Scale-bar: 100 µm.

About 380-433 small testes in one cortical dorsal field and in one layer. Deep genital pore irregularly alternating, anterior, PP = 10-16%. Cirrus pouch elongated to pyriform, PC = 13-17% (x = 14%, n = 9), cirrus occupying between 30-50% of cirrus pouch length. Vagina always anterior to cirrus pouch (n = 36), with powerful muscular terminal sphincter. Ovary cortical, bilobate, follicular, with numerous dorsal outgrowths, OV = 75-79%.

Ventral cortical vitelline follicles lateral, occupying large triangular field, wider posteriorly, overlapping ovary and cirrus pouch, running from anterior to posterior margin of proglottis. Ventral cortical uterus of type 2 (see de Chambrier *et al.*, 2004b, for definition), with 14-21 thin digitate diverticula with thick walls. Eggs oval (in whole mounts), embryophore bilayered, about 20 x 16; oncosphere spherical to oval, about 10 in diameter (Fig. 7).

Goezeella danbrooksi sp. n.

Goezeella siluri; Brooks & Deardorff, 1980: 15.
[Not *Goezeella siluri* Fuhrmann, 1916: 386].

Type-host: *Ageneiosus cancanus* (Siluriformes: Ageneiosidae).

Holotype (examined): 1 unique specimen with some proglottides cut in serial sections, USNM Helminthological collection No. 74498 (2 slides), No. 74544, (19 slides, serial sections). In our knowledge, no other material of this species cited in literature.

Site of infestation: Small intestine near juncture of stomach and intestine.

Type locality: Magdalena River, vicinity of San Cristobal, Bolivar Province, Colombia.

REMARKS

Brooks & Deardorff (1980) studied, in a detailed description, *Goezeella siluri* in *Ageneiosus cancanus* Steindachner from Columbia. De Chambrier & Vaucher (1999, p. 184) noted that the species described by these authors apparently did not belong to *G. siluri*. When looking at figures 2 to 5 of Brooks & Deardorff (1980), we observed that their material differed from the type material of *G. siluri* (see Fig. 8, present work) in several aspects: the position of the vitelline follicles (only dorsal, not lateral), relative size (much smaller in type material), and shape (slightly wider posteriorly, see Fuhrmann, 1916, Fig. 4). *Goezeella siluri* sensu Brooks & Deardorff also differs in the position of vaginal sphincter (terminal in *G. siluri*), by the size of the cirrus / cirrus pouch ratio, and by the number of testes (183-380 versus 380-433). Furthermore, the taxon described by Brooks & Deardorff parasitizes a different family of hosts (Ageneiosidae).

In our opinion, *Goezeella siluri* sensu Brooks & Deardorff represents a distinct species and we name it *Goezeella danbrooksi* sp. n. in honour of Prof. Daniel R. Brooks from Toronto, Canada.

DISCUSSION

Fuhrmann (1916) in his description of *G. siluri*, observed oval eggs without polar projections. Woodland (1933) in his expedition in Amazonian river in 1931, found in the type host *Cetopsis coecutiens* (field number Amaz 174) twenty three worms he determined as *G. siluri*. He first thought that he had two different species, as six specimens fitted Fuhrmann's description (thick proglottides, similar transverse sections) but the remaining specimens included much thinner proglottides. He finally decided to consider that all the material belonged to a single species because the "eggs of both types are identical in shape and size". In fact, Woodland observed and drew only those from *B. praeputialis* (his Fig. 18, compare with Fig. 2, present work).

The material described by Woodland (1933) as *Goezeella siluri* (BMNH 1964.12.15.174-183) is in fact a mixture of two species: *G. siluri* Fuhrmann, 1916 with biloculate suckers (Fig. 6, present work) and *Brooksiella praeputialis* (Rego, Santos & Silva, 1974) with uniloculate suckers (Figs 1, 9-10, present work). The shape described by Woodland (1933) as "cobra like" due to the hood shaped neck (Woodland's Fig. 12) corresponds with *Brooksiella praeputialis* (Woodland's plate 30, Figs 10, 11, 12, 14, 17, 18) and the other figures correspond with *Goezeella siluri* (Figs 9, 13, 16). Of his six whole mounted slides, three are a mixture (slides number 1, 3, 6), one is *G. siluri* (slide number 4) and two are *B. praeputialis* (slides number 2, 5). The cross sections numbered G' 1-6 and G" 1-3 are of *G. siluri* (Woodland's Fig. 16) and those G 1-2, Gc 1-7 and G"' 1-2 correspond to *B. praeputialis* (Woodland's Fig. 17).

In the same paper, Woodland (1933) considered *Goezeella piramutab*, a parasite of *Brachyplatystoma vaillanti*, as a new species. He based his decision to separate *G. piramutab* from *G. siluri* only on the differences on eggs shape and size. He suggested that a complete diagnosis must await the examination of further material. In fact, Woodland equivocally compared eggs from *B. praeputialis* (Woodland's Fig. 18) and eggs of *G. piramutab* (Woodland's Fig. 22). In our opinion, the eggs figured by Woodland (Fig. 22) belong to *Goezeella siluri* (see Fig. 7, present work). The other eggs (Woodland's Fig. 18) are typical of *B. praeputialis* (compare with Fig. 2, present work). As the argument to separate *G. piramutab* from *G. siluri* by their eggs shape and size is no longer valid, we consider *Goezeella piramutab* as a synonym of *Goezeella siluri*.

Brooks & Rasmussen (1984) found a cestode they determined as *B. praeputialis* in a new host, *Pseudocetopsis othonops* in Venezuela but did not give a description.

Judging by their figures (5, 6, 7), we believe that it may correspond to another species : the diameter of scolex is smaller (705 µm versus 1145 µm in mean), the suckers seem to be deeply embedded and the testes are less numerous according to their figures (6-7, p. 751) (64-178 versus 205 - 342).

The shape of the ovary of *Brooksiella praeputialis* is particular. It is highly follicular and is similar to that of *Goezeella siluri*. This is an unusual observation for the Proteocephalidea, although this ovarian shape is also present in *Manaosia bracodemoca* Woodland, 1935 and *Electrotaenia malapteruri* (Fritsch, 1886) (see de Chambrier, 2003; de Chambrier *et al.*, 2004a).

Brooksiella praeputialis shows some similarities with the species of *Rudolphiella*: a metascolex, a wide band of ventral vitelline follicles, a follicular ovary, type 1 uterine formation and eggs with a similar structure including polar formations and bilayered embryophores. Furthermore, in a recent molecular analysis, two *Rudolphiella* species clustered with *Brooksiella praeputialis* in a strongly supported clade (see de Chambrier *et al.*, 2004b: fig. 1. *Rudolphiella* possesses cortical vitelline follicles and testes, and medullar ovary and uterus, whereas in *Brooksiella* only the vitelline follicles are cortical. Both genera belong to two different subfamilies, Rudolphielliinae and Zygobothriinae, which are characterised by a different arrangement of the genital organs relative to the internal longitudinal musculature. However we have recently expressed doubts about the importance of this type of character and have suggested that other characters may prove to be useful in suprageneric classifications of the Proteocephalidea (de Chambrier *et al.*, 2004b).

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Salaria economidisi, a new species of freshwater fish from Lake Trichonis, Greece, with comments on variation in *S. fluviatilis* (Teleostei: Blenniidae)

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Salaria economidisi, a new species of freshwater fish from Lake Trichonis, Greece, with comments on variation in *S. fluviatilis* (Teleostei: Blenniidae). - *Salaria economidisi*, new species, is distinguished from *S. fluviatilis*, its hypothesised closest relative, in having a longer head, more teeth in both jaws, a simple orbital cirrus, a much shorter lateral line, and a distinctive colour pattern of 3-5 rows of bold black dots on the cheek.

Key-words: Blenniidae - Salaria - Greece - Lake Trichonis - taxonomy.

INTRODUCTION

The family Blenniidae includes a large number of small benthic fishes. The vast majority are marine and occur in tropical areas. A few species are known to enter brackish or fresh waters in Southeast Asia (e.g. *Phenablennius heyligeri* (Bleeker, 1859); see Springer & Smith-Vaniz, 1972: 70), India, Africa (*Omobranchus* species; see Springer & Gomon, 1975), and South America (e.g., *Lupinoblennius paivai* (Pinto, 1958); see Sazima & Carvalho-Filho, 2003). The genus *Salaria*, as usually recognised, includes 3 species of which *S. fluviatilis* (Asso, 1801) is known only from freshwaters. It has been recorded under a variety of synonyms (e.g., *Blennius vulgaris* Pollini, 1816, *Salarias varus* Risso, 1827, *B. cagnota* Valenciennes, 1836, *B. lupulus* Bonaparte, 1840, *B. alpestris* Blanchard, 1866; see Kottelat, 1997) from drainages around the northern Mediterranean shore from Israel to Portugal and in Morocco and Algeria.

Salaria fluviatilis inhabits portions of streams with swift water and rocks varying in size from small stones to large boulders (Freeman *et al.*, 1990); it also occurs on rocky shores of lakes (Elmiger, 2002). It spawns under stones and the male defends the eggs (Wickler, 1957). The larvae are pelagic (as are those of marine blennies) and the young settle in benthic habitats when they reach about 15 mm. The pelagic larvae apparently are one of the factors limiting the distribution of the species. Larvae from riverine populations are drifted by the current and need to reach a quiet section of the stream or a lake where they can spend their pelagic time, and then need

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to be able to return to the riverine stretch. Although sometimes stated in the literature, there is no evidence that this pelagic period can be spent in estuaries or brackish water. In the Mediterranean climatic zone, streams and rivers severely shrink in summer, and many survive only as a succession of pools connected by trifles of water. Water in these pools is moving very slowly, probably providing suitable habitats for the larvae.

All freshwater populations of European blennies have been referred to *S. fluviatilis* (Kottelat, 1997; Perdices *et al.*, 2000), but they have rarely been compared. Examination of the population from Lake Trichonis (a large natural lake in western Greece) shows that it is a species with a distinctive morphology, colour pattern and ecology. The species is described here and some populations of *S. fluviatilis* are discussed.

The generic nomenclature of Bath (1977, 1996) is followed here. Bock & Zander (1986: 142) united the genera *Lipophrys* and *Salaria* and used *Lipophrys* Gill, 1896 as the valid name. As discussed by Kottelat (1997), *Salaria* Forsskål, 1775 is the oldest valid name. The argument of similarity of the generic names *Salaria* and *Salarias* Cuvier, 1816 is irrelevant to the discussion (ICZN art. 56.2 is explicit).

MATERIAL AND METHODS

All measurements were made point to point with a dial calliper. Standard length is measured from the tip of the upper lip to the end of the hypural complex, total length to the posteriormost point of the caudal fin, head length to the posterior most point of the opercle, pre-anal length to the origin of the first anal spine. Body depth is measured at the origin of dorsal fin, depth of caudal peduncle at the narrowest point of the caudal peduncle. Length of caudal peduncle is measured from the base of the last anal-fin ray to the end of the hypural complex, at mid-height. Snout length is measured from tip of upper lip to the nearest point of margin of orbit. Eye diameter is the greatest diameter of the eye ball. The eye-rictus distance is measured from the posterior extremity of upper lip to the nearest point of the orbit. Interorbital width is the width of the bony area. Terminology of cephalic lateral line canals is derived from that of Bath (1977). Lateral line pore count starts with the pore immediately posterior to the upper extremity of the gill opening. Sequence of description generally follows the template of Springer & Williams (1994). Notation for dorsal and anal fin ray counts follows Hubbs & Lagler (1947).

Examined material is in: MHNG, Muséum d'histoire naturelle, Genève; CMK, author's collection.

DESCRIPTION

Salaria economidisi sp. n. Figs 1-2

Holotype. MHNG 2641.89, 60.8 mm SL; Greece: Lake Trichonis east of Panetolio; 38°35'28.1"N 21°27'51.2"E; M. Kottelat & P. S. Economidis, 6-7 October 2001.

Paratypes. MHNG 2641.90, 10; CMK 16968, 158; 19.5-55.9 mm SL; same data as holotype. - CMK 13428, 5, 29.9-44.0 mm SL; Lake Trichonis; P. S. Economidis, 1 Nov 1996.

Diagnosis. *Salaria economidisi* is distinguished from the marine *S. pavo* (Risso, 1810) and *S. basilisca* (Valenciennes, 1836) in having XII-XIII,16-17 dorsal rays (vs. XII,22-25) and II,18-19 anal rays (vs. II,23-26; Bath, 1977; Whitehead *et al.*, 1986). It

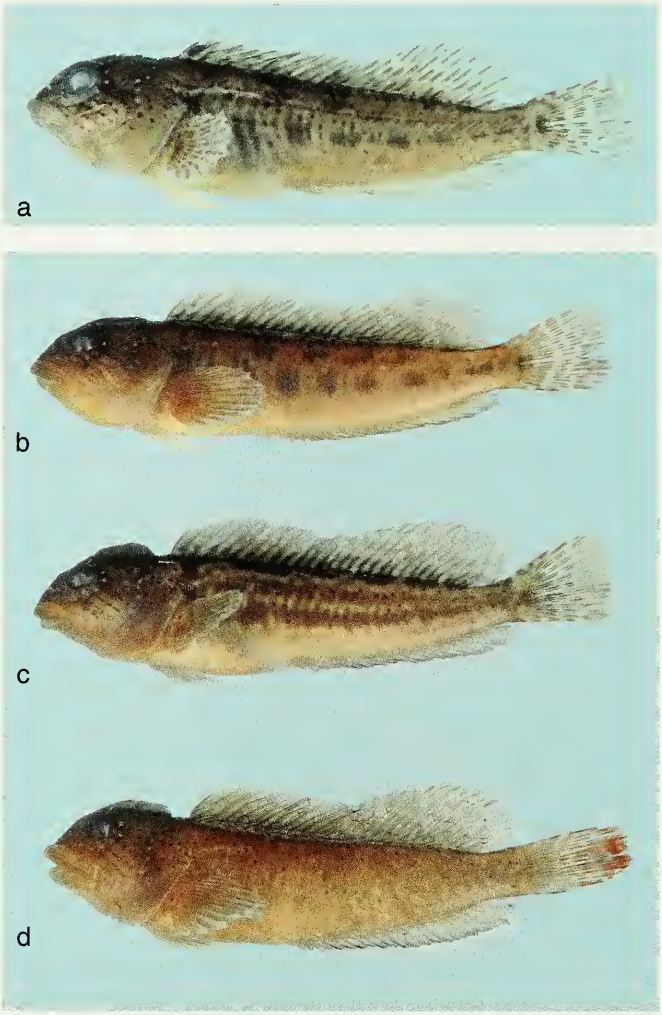


FIG. 1
Salaria economidisi; Greece: Lake Trichonis. a, paratype, female, 48.4 mm SL, CMK 16968; b, male, holotype, 60.8 mm SL, MHNG 2641.89; c, male, paratype, 50.9 mm SL, CMK 16968; d, male, paratype, 55.9 mm SL, CMK 16968.

FIG. 2
Salaria economidisi; Greece: Lake Trichonis, eastern end, at 2-3 m depth on gently sloping sand-gravel beach; August 1995 (photograph by U. Schliewen).

is distinguished from the freshwater *S. fluviatilis* in having a longer head (29.1-33.1 % SL, vs. 25.3-30.6), 25-30 teeth in the upper jaw (vs. 16-24), 20-27 in the lower jaw (vs. 16-20), orbital cirrus simple (vs. branched), anterior continuous canal of lateral line with 5-9 simple pores (vs. usually 12-22, rarely 6-8) continued by a series of 1-3 short bi-pore tubes (vs. 4-12), and a pattern of 3-5 rows of bold black dots on the cheek, running obliquely from eye backwards and downwards, the space between the lower two rows being greyish and spaces between the upper rows paler (vs. cheek with a broad diagonal band of tiny dots from lower edge of eye downwards backwards; Figs 3, 4a).

Description. Selected morphometric data of holotype and 9 paratypes in Table 1. Dorsal fin. XII-XIII,16-17 (XIII,16), modally XIII,16, total 28-30; XIV spines in a single specimen out of 31 specimens examined for this character. Spinous portion somewhat shallower than segmented-ray portion; posterior membranous attachment on dorsal edge of caudal peduncle anterior to caudal-fin base.

TABLE 1. Morphometric data of holotype (60.8 mm SL) and 9 paratypes of *Salaria economidisi*. M: males, F: females.

	M	M	M	M	M	M	M	M	F	F
SL (mm)	60.8	59.9	52.1	50.9	49.7	47.8	42.8	39.9	48.4	41.3
TL (mm)	73.7	69.2	63.4	62.4	60.2	59.0	52.0	43.9	58.5	50.7
in % of standard length										
Head length	29.1	29.4	30.5	31.0	30.0	33.1	32.7	32.3	31.2	29.5
Pre-Anal length	54.6	51.9	55.5	57.0	55.7	54.2	55.8	57.6	55.8	57.9
Body depth	24.3	23.0	25.5	26.3	23.1	22.6	24.5	23.1	24.8	23.7
Depth of caudal peduncle	9.4	9.7	10.4	9.6	8.2	9.2	8.9	8.8	9.7	11.4
Length of caudal peduncle	13.0	10.7	11.7	12.0	10.7	13.4	9.3	11.8	11.0	9.7
in % of head length										
Snout length	33.9	33.0	31.4	34.2	31.5	31.6	32.9	31.0	28.5	32.0
Eye diameter	22.6	21.6	20.1	24.7	23.5	18.4	25.7	22.5	23.2	24.6
Eye-rictus distance	22.6	22.7	22.6	22.8	23.5	22.8	20.7	22.5	21.9	25.4
Interorbital width	18.1	17.0	15.1	13.3	16.8	13.3	13.6	14.0	15.9	23.0

Anal fin II-III,17-19 (II,18), modally II,17, three spines in a single specimen. Posterior membranous attachment on ventral edge of caudal peduncle anterior to caudal-fin base. male with a large "ear or onion-like glandular formation" (sensu Bath, 1977: 208) on anterior face of each anal spine; "leaflet-shape" glands at tip of anal rays in specimens over 50-55 mm SL.

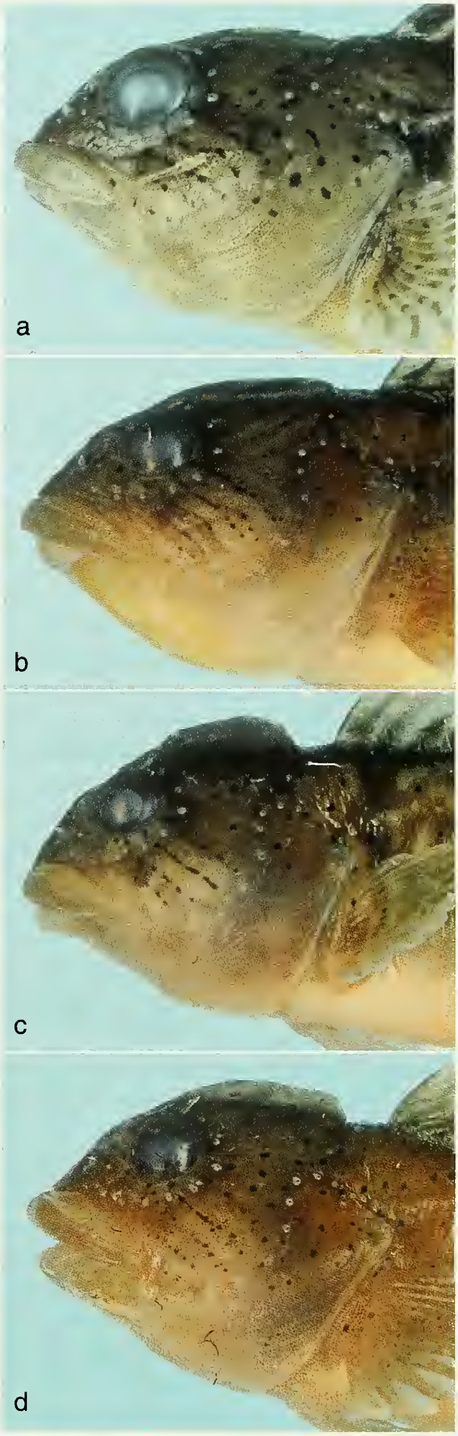
Pectoral-fin rays 13-14 (13), modally 14. Pelvic-fin segmented rays 3. Caudal-fin segmented rays 13, 9 branched.

Cirri. Orbital cirrus much shorter than eye diameter, simple (out of 40 specimens examined for this character, one 30 mm SL has a short side branch and one 36 mm SL has two short side branches); cirrus missing in specimens less than 30 mm SL. Anterior nostril with a short point along posterior margin, never developed as a cirrus.

Lateral line. Continuous canal anterodorsally with 5-9 simple pores, extending posteriorly to a point between vertical from bases of 3rd to 7th spine, then continuing posteriorly as a series of 1-3 short, disjunct, horizontally bi-pored tubes in skin; posteriormost tube in area between verticals from bases of 4th to 9th dorsal-fin spines.

FIG. 3

Salaria economidisi; Greece: Lake Trichonis. Head pattern; a, paratype, female, 48.4 mm SL, CMK 16968; b, male, holotype, 60.8 mm SL, MHNG 2641.89; c, male, paratype, 50.9 mm SL, CMK 16968; d, male, paratype, 55.9 mm SL, CMK 16968.



Cephalic pores. Supratemporal canal with 3 pores. Preoperculo-mandibular canal with 11 pores. Orbital canal with 8 infraorbital pores (9 in two specimens) and 5 supraorbital pores.

Upper jaw with 25-30 teeth, posterior 1-2 (modally 1) on each side caniniform. Lower jaw with 20-27 teeth, posterior 1 (rarely 2) on each side caniniform.

Both sexes show indication of fleshy crest development on head at 25 mm SL. Only a few males have a well developed crest; in most it remains very low. Highest development (about 2 mm) in 49.7 mm SL specimen. In females, only as sharp ridge.

Coloration (Figs 1-2). Background pale yellowish brown. A mid-lateral row of 7-8 dark brown blotches, more or less rectangular, horizontally elongated, irregularly shaped, alternating with 5-6 dark brown saddles along dorsal body contour and on base of dorsal fin. In some individuals, an intermediate row of horizontally elongated, irregular, dark brown spots or blotches; in a few individuals, blotches of three rows fused to form 3 stripes (Fig. 1c). Numerous small, black spots on side, variably distributed over whole body or only anteriorly or dorsally, almost missing in a few individuals. A single individual plain pale yellowish brown, except for black dots (Fig. 1d). Striped pattern present in both sexes, already distinct in specimens 28 mm SL.

In individuals larger than about 30 mm SL, head yellowish brown, darker on top, with numerous small, black spots, some surrounded by a paler area (Fig. 4a). 2-3 parallel rows of 2-6 black spots from eye to posterior corner of crest, sometimes fused to form short lines; 2 rows sometimes marking edges of a darker band. Usually 4 (3-5) oblique rows of 4-8 black spots on cheek, slanted posteroventrally, 3rd (counted from dorsalmost) originating at lower margin of eye; area above upper row dark brown, between rows 1 and 3 pale yellowish brown, between rows 3-4 dark brown, and below row 4 pale yellowish brown. Sometimes a short additional row starting at posterior extremity of upper lip. Throat uniformly yellowish brown.

In specimens less than about 30 mm SL, bands on top of head more contrasty and a faint pale stripe from eye to tip of snout. Dark band on cheek distinct, but rows of spots absent. A darker patch at tip of lower lip, and a diffuse darker triangular patch on each side of throat.

Dorsal fin with dark blotches or band along base; remainder of fin, in males more or less plain greyish brown, in females with 2-3 rows of dark brown spots on rays of segmented-ray portion. A black botch between anterior 2 spines, conspicuous in females and juveniles, faint to indistinct in males. Anal fin plain greyish brown, with a white distal and a dark brown subdistal bands. Caudal fin with a dark brown blotch continuing mid-lateral row on flank; 3-4 vertical rows of dark brown spots on rays, less contrasty in adult males. Pectoral-fin rays with several dark brown patches (tessellated) and a few black spots equivalent to those on head and flank. Pelvic hyaline.

Distribution. Definitively known only from Trichonis Lake (Fig. 5). The species possibly occurs in some or all of the other lakes of the Acheloos drainage (Lysimachia, Ozeros, Amvrakia), but this remains to be confirmed.

Habitat and biology. Lake Trichonis is 18.1 x 7.5 km large, up to 57 m deep, oligotrophic and drains to Acheloos River through lake Lysimachia. It has a late Pliocene origin (Economidis & Miller, 1990: 147, 166). The only other fish species endemic to Lake Trichonis is the miniature gobiid *Economidichthys trichonis* Econo-

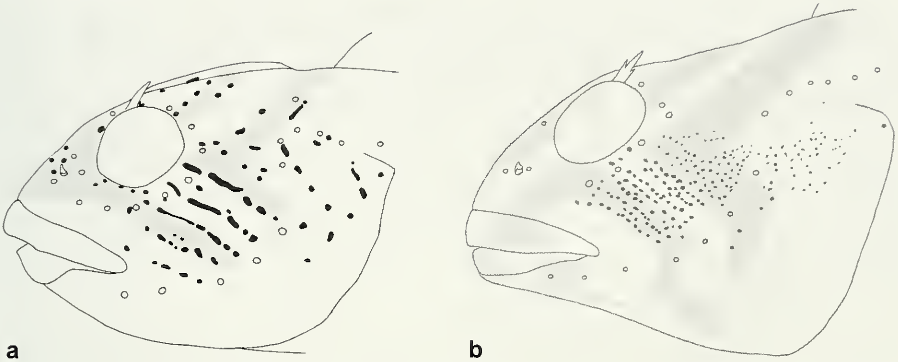


FIG. 4

Head pattern and cirrus of: a, *Salaria economidisi*, male, CMK 16968, 49.7 mm SL; b, *S. fluviatilis*, female, CMK 17000, 63.4 mm SL.

midis & Miller, 1990, but several other species are endemic to either the Acheloos drainage, or the lakes of the lower Acheloos drainage.

On 6-7 October 2001, I observed and collected the species in Lake Trichonis east of Panetolio. The species was not seen in a small stream entering the lake, neither on sandy-muddy nor on gravely to stony substrate. It was observed only in the lake itself, at depths of at least 0.4 m. The area was a shallow strand, mostly sandy, but with large patches of underwater vegetation (mostly clumps of *Sagittaria* (?) sp.). *Salaria economidisi* was observed only in these clumps; it was not seen over the sand or on or near stones even with the use of an electric fish-shocker. Other fish species collected in these clumps were the gobies *Knipowitschia* cf. *caucasica* (Berg, 1916), *Economidichthys pygmaeus* (Holly, 1929) and occasionally the loach *Cobitis trichonica* Stephanidis, 1974. However, P. S. Economidis informs me that he has observed the species on stony and gravel bottoms in other parts of the lake, especially at Pantanassa, about 10 km east of Panetolio.

The reproduction and larvae are described in Economou *et al.* (1994). Eggs are laid in May-July. Early larvae are planktonic and settle at 14-15 mm. In October 2001, I observed large numbers of individuals 15-30 mm SL, probably young of the year. The largest collected male is 60.8 mm SL and the largest female 48.4.

Etymology. Named for Panos Stavros Economidis, in appreciation for his help during several field trips in Greece, stimulating discussions, encouragement, and being a unique historical, gastronomic and oenological cicerone.

DISCUSSION

The blenny from Lake Trichonis has long been identified as *S. fluviatilis*, a species recorded from freshwaters all along the northern shore of the Mediterranean, from Israel to Portugal (Guadiana drainage) and Algeria and Morocco, including Sardinia, Corsica and Creta (Mouslih, 1984; Doadrio, 2001; Steinitz, 1950; Goren, 1974). When I first encountered it in the field, I immediately suspected *S. economidisi* was distinct from *S. fluviatilis* because of habitat, behaviour, general coloration and patterning on the head.

I have observed *S. fluviatilis* in riverine habitats in Greece and France, and it was always observed among stones, usually preferring the deepest parts with fast currents. This is also the habitat reported in the literature (e.g., Freeman *et al.*, 1990; Hernandez *et al.*, 2000). In lacustrine habitat, I observed it in Lake Maggiore, where it was found under stones, in at least 0.5 m depth. This is also the habitat described by Elmiger (2002). I have never observed the species over sandy bottom under vegetation, the habitat in which *S. economidisi* was collected in Lake Trichonis. The largest examined individual of *S. economidisi* is 60.8 mm SL, while the largest *S. fluviatilis* is 111.8 mm SL, and larger sizes are reported in the literature (up to 150 mm; Persat, in Keith & Allardi, 2001).

The colour pattern of *S. fluviatilis* varies, depending on sex, size, sexual activity and 'mood' of the individual fish (e.g., Wickler, 1957), but there is no published information on geographic variation. I have seen too few specimens (or more precisely, most samples I have seen include too few specimens) to venture into a detailed inter-population comparison, and such a comparison would probably better be based on live specimens observed over an extended period of time, in order to account for seasonal variation. It is a sad reality that research on European fishes is made very difficult if not impossible for reasons which have nothing to do with sciences (Kottelat, 1997) and that access to fresh material badly needed for taxonomic revisions often is simply impossible to competent taxonomists. But the following generalities can be made.

I have not seen geographic variation in the colour pattern of *S. fluviatilis*. The following common features are shared by the examined populations. In juveniles, females and small males, the body has a mid-lateral series of about 7-10 irregularly squarish dark blotches, more or less alternating or connected with similar blotches along the dorsum (e.g., Fig. 6b, f). Small black dots may be present on the body, usually on the dorsal half. In larger females (over 60 mm SL), the blotches tend to become more vertically elongated, more irregular, often dissociated to form a marmorated pattern. In larger males, the blotches become less contrasty, and the body might vary from marmorated to plain dark brown to black or plain olive brown (e.g., Fig. 6c, e). In *S. economidisi*, 7-8 squarish blotches are present in most adults. In some individuals, they may fade out or fuse to form midlateral stripes. I have not observed plain dark brown males. The general background colour is yellowish brown in all individuals, paler than in any *S. fluviatilis*.

Salaria fluviatilis exhibits a conspicuous and distinctive colour pattern on the head (Figs. 4b, 7), which typically includes: a) a dark brown band from eye to posterior extremity of the crest, margined anteriorly and posteriorly by pale grey to yellowish bands; b) a pale band from eye to tip of snout, margined posteriorly by a dark band; c) from the upper extremity of this last band (under the eye), a conspicuous dark band extends posteroventrally, margined above and below by pale bands, and below by a narrow dark line along the edge of the posterior part of the upper lip; d) ventral side of head with a blackish blotch at tip of lower jaw, an elongated blotch on each side of jaw, and an oblique band connected or not with band (c). These bands are usually filled with tiny black dots and are never margined by rows of larger black dots or black lines.

This pattern is variously developed in all examined specimens. It is often partly or wholly obscured, especially in large dark males. I have seen it in material from

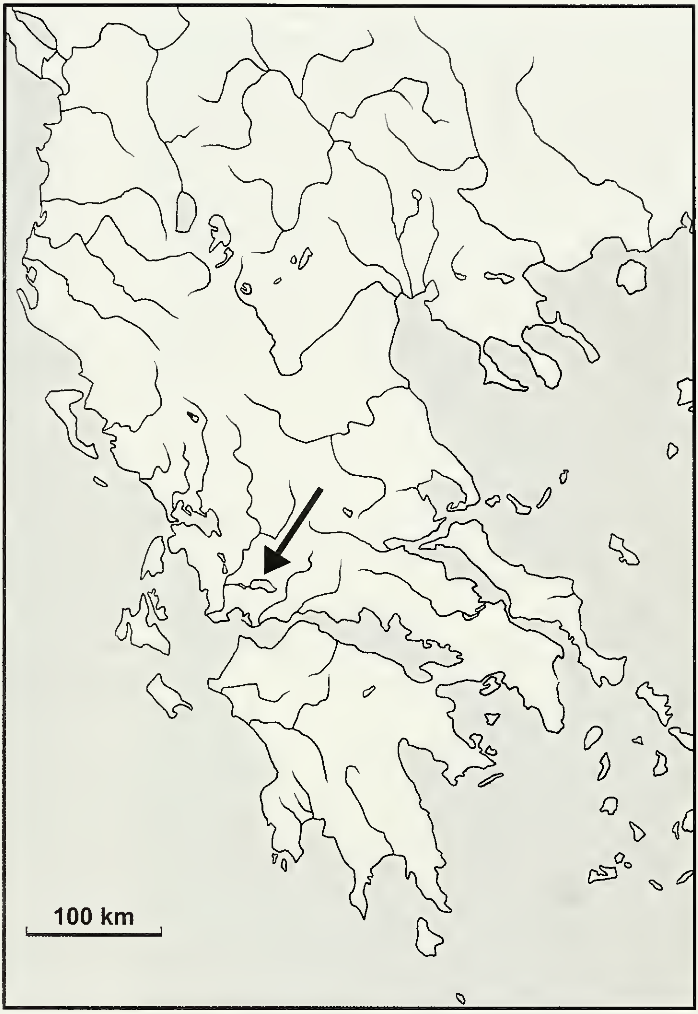


FIG. 5

Greece and western Balban Peninsula; arrow indicates Lake Trichonis, type locality of *Salaria economidisi*.

Spain (Ebro drainage), France (Tech, Rhône and Var) and Switzerland (Lake Maggiore). It is figured in material from France (Keith & Allardi, 2001), Sicily (Zava & Violani, 1991), Garda Lake (Wickler, 1957), Lake Maggiore (Elmiger, 2002), Spain (Doadrio, 2001) and Slovenia (Povz & Sket, 1990). This pattern is also obvious in photographs of live specimens from Turkey (from Kirandere near Iznik Lake [40°25'N 29°43'E], and from Aksu Köprüsu) provided by R. Wildekamp. From Greece, I have examined only 5 specimens from Pinios drainage (Peloponnese), which includes a large 111.8 mm SL black male in which no cephalic pattern can be distinguished any-more; in the four smaller specimens, only a faint indication of the dark cheek bar can be recognised. It is also present in material from Lake Kinneret (Israel) which is discussed below.

In *S. economidisi* over about 30 mm SL, elements (b) and (d) are missing. The throat is finely dotted by very regularly set melanophores. Elements (a) are very poorly contrasted; instead, there are 2-3 rows of black dots in positions corresponding to the limits between the pale and dark bands. Elements (c) are replaced by 3-5 (usually 4) rows of conspicuous black dots, with the space between the lower two rows usually slightly darker than between the other rows. In specimens less than about 30 mm SL, elements (b) are usually distinct, and the jaw markings of (d) are distinct; there are no rows of black spots in elements (a) and (c) which have an appearance similar to that of *S. fluviatilis* (suggesting that the *S. fluviatilis* pattern is probably the plesiomorphic condition).

Besides colour pattern, *S. economidisi* is distinguished from *S. fluviatilis* in having a longer head (29.1-33.1 % SL in specimens 39.9-60.8 mm SL, vs. 25.3-30.6 in specimens 37.8-111.8; Fig. 8), more and smaller teeth (25-30 in the upper jaw, vs. 16-24; 20-27 in the lower jaw, vs. 16-20; I have not observed variation associated with size or sex). The orbital cirrus is simple, while it is branched in most examined specimens of *S. fluviatilis* larger than 38 mm SL. The lateral line is much less developed, with only 5-9 pores (vs. usually 12-22, rarely 6-8, see below) in the continuous anterior canal, followed by 1-3 bi-pored tubes (vs. 4-12), the last one located between verticals through base of 4th to 9th dorsal-fin spine (vs. between vertical through base of 9th spinous to 13th segmented ray), on the anterior arched portion of the lateral line (vs. on the posterior horizontal portion).

The larvae of *S. economidisi* are described by Economou *et al.* (1994) who compared their observations with those of Cipria (1936) on the larvae of *S. fluviatilis* from northern Italian lakes. They report that *S. economidisi* differs from *S. fluviatilis* in the absence (vs. presence) of a large melanophore between the end of the ventral row of melanophores and the end of the notochord.

The synonymy of *S. fluviatilis* includes 12 nominal species (Kottelat, 1997) and the question arises whether some of these synonyms could be *S. economidisi* or could be valid species masquerading under the name *S. fluviatilis*.

Blennius fluviatilis Asso, 1801 was described from the river Ebro in Zaragoza (Spain) and *B. frater* Bloch, in Schneider, 1801 was based on an earlier description of Asso's Zaragoza material and thus represents the same species. *Blennius inaequalis* Valenciennes, in Cuvier & Valenciennes, 1836 was described on the basis of material from Sète (southern France), *B. cagnota* Valenciennes, in Cuvier & Valenciennes, 1836 on the basis of material from Toulon (southeastern France; type locality restricted by Kottelat, 1997, by lectotype designation) and *S. varus* Risso, 1827 on the basis of material from river Var (southeasten France). I have examined material from Ebro and Var drainages as well as from Tech drainage (in intermediate geographic position); I have not seen differences among these populations and conclude that they represent a single species.

I have not seen material from the Tyrrhenian coast of Italy, Sicilia, Sardinia and Corsica. *Blennius fluviatilis* Rafinesque Schmaltz, 1810 (an homonym of *B. fluviatilis*

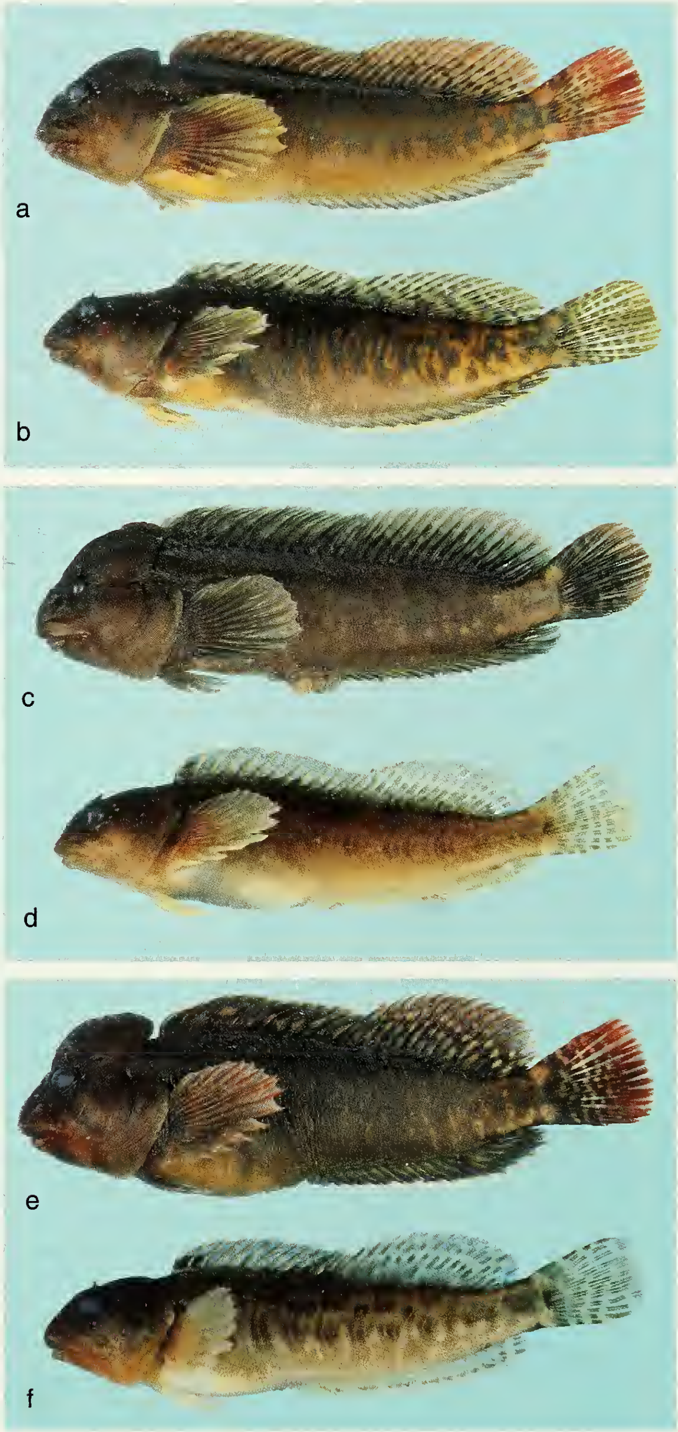


FIG. 6
Salaria fluviatilis; a-b, male 83.0 mm SL and female 71.2 mm SL, CMK 17568; France: River Tech; c-d, male 111.8 mm SL and female 53.1 mm SL, CMK 17305; Greece: Peloponnese: River Pinios; e-f, male 74.4 mm SL and female 37.8 mm SL, CMK 16844; France: stream Leysse.

Asso, 1801) was described from Sicilia, *B. lupulus* Bonaparte, 1840 from Toscana and Romana, and *B. anticolus* Bonaparte, 1840 from the surroundings of Roma. There does not seem to be differences between the fishes on the published photographs of populations from the Tyrrhenian basin (Zava & Violani, 1991) and the material I examined from Spain and southern France.

Blennius petteri Heckel & Kner, 1858 is a nomen nudum based on material from Split, Croatia. Besides the account and photograph in Povz & Sket (1990) there is no published information specifically dealing with the populations of streams draining to the Adriatic basin. Little can be said on the sole basis of a photograph.

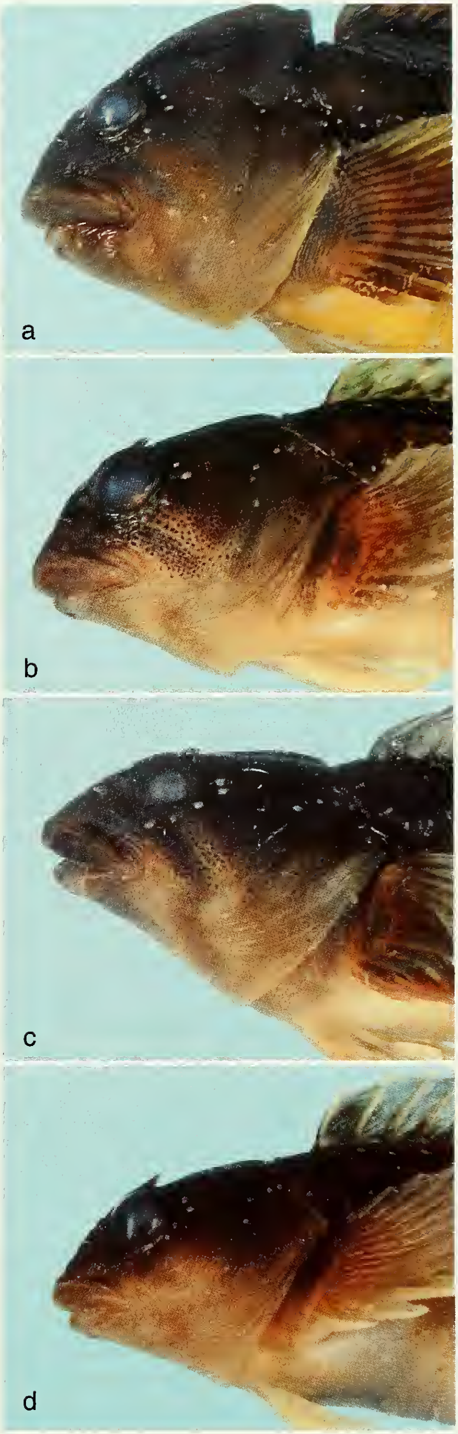
The situation with populations of subalpine lakes is different. South of the Alps, *S. fluviatilis* has long been known from Lake Garda, from where it was described as *B. vulgaris* Pollini, 1816 (*Ichthyocoris pollinii* Bonaparte, 1846 is an unnecessary replacement name); the species is also known at least from Lakes Maggiore and Lugano. North of the Alps, the species is known from Lake Bourget (from where it was described as *B. alpestris* Blanchard, 1866) and the Rhône drainage. As discussed below, there are slight morphological differences between the Bourget population and those from coastal drainages. Unfortunately, I have not been able to examine material from the Rhône mainriver and my sample from Lake Bourget is quite small.

I have not seen material from Lake Garda, but have examined material from Lake Maggiore. Here again, there are slight morphological differences between the Lake Maggiore population and those from coastal drainages of southern France and Spain. It need to be clarified whether these differences are shared with populations from other Insubrian lakes and those from peri-Adriatic coastal drainages. Interesting is that the morphological traits that distinguish the Lake Maggiore and Lake Bourget populations from the riverine ones are identical.

While all populations referred to *S. fluviatilis* apparently have the same head colour pattern, there is some variability in shape and development of the lateral line. The material from Lake Maggiore and Leysse have a longer head (27.7-30.6 and 28.6-29.6 % SL, respectively; Fig. 8) than those from the Ebro, Tech, Var and Pinios (25.3-28.6, with a single specimen 30.1) and the Leysse one has a deeper body (22.0-26.5 % SL, vs. 21.3-23.8 in Pinios, 21.4-24.4 in Tech, Var and Ebro, and 20.9-24.0 in Lake Maggiore). The sample sizes from the various localities are, however, too small to reach reliable conclusions on the value of these morphometric differences. The Lake Maggiore specimens have an unbranched orbital cirrus. The Leysse males have a much higher crest (Fig. 6e), even in a 37.8 mm SL male. Both Leysse and Lake Maggiore populations have about 1/3 of the specimens with 14 spinous dorsal rays, while specimens from all other samples have 13 (except one from Tech). In both Leysse (L) and Lake Maggiore (M), the lateral line is shorter, the anterior canal has 8-16 (L) and 6-8 (M) pores and extends posteriorly below base of 9-11th (L) and 3-6th (M) dorsal spine, continued by a series of 4-12 (L) and 5-8 (M) bi-pored tubes, extending to below base of 13th spine to 6th segmented (L) and 9-13th spine (M). Noteworthy is that the Lake Maggiore population is purely lacustrine and the Leysse population is from a tributary of Lake Bourget (the swiftest habitat where I collected blennies) about 2 km from the lake; these populations are possibly partly isolated from the riverine populations and occur in much colder habitats, at higher elevations.

FIG. 7

Salaria fluviatilis; head pattern; a-b, male 83.0 mm SL and female 76.6 mm SL, CMK 17568; France: River Tech; c, female 63.4 mm SL, CMK 17000; Spain: Ebro; d, female 53.1 mm SL, CMK 17305; Greece: River Pinios.



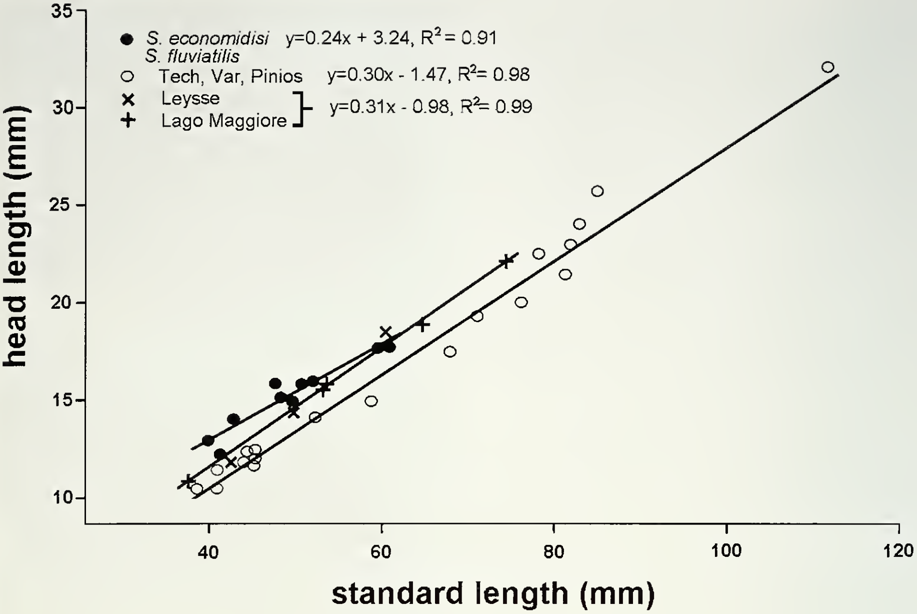


Fig. 8

Relationships between standard length and head length in *Salaria economidisi* and *S. fluviatilis*.

A population of *Salaria* has been known from Lake Kinneret (= lake Galilee or Tiberias) in Israel since Günther (1864; see also Lortet, 1883; Steinitz, 1950; Krupp & Schneider, 1989). Lake Kinneret is part of the endorheic Jordan drainage and the local population must have been isolated from the peri-Mediterranean ones since lower Pleistocene (Krupp & Schneider, 1989: 350), which creates a suspicion that it could be specifically distinct. Externally the Kinneret population is only minimally distinguished from the other populations I have examined. It has XIII-XIV dorsal spines (modally XIV, vs. XII-XIII, modally XIII) and usually a poorly contrasted cephalic colour pattern. But in individuals in which the pattern is contrasted, it is identical to what is observed in peri-Mediterranean coastal streams. The only difference possibly is the presence (vs. absence) of a blackish spot in juveniles at about 1/3 of length of pectoral fin and grayish lower fourth of pectoral.

A tentative conclusion is that the coastal populations are apparently all conspecific, while some of the lacustrine ones might represent distinct species.

Salaria economidisi is definititely recorded only from Lake Trichonis; it possibly also occurs in the other lakes of the lower Acheloos drainage. The presence of *S. fluviatilis* in riverine habitats of the Acheloos drainage should be expected; it might even be present in the lakes along rocky shores.

Perdices *et al.* (2000) investigated allozyme systems in 5 populations of *S. fluviatilis* from Spain and 3 from Greece. This limited sampling and the absence of geographic spectrum significantly reduces the significance of the conclusions derived from the study. But of interest here is that the authors probably included *S. economidisi* in their analysis (their Trichonis sample). All their phenograms show *S. economidisi* as the sister group to a cluster including all other Greek and Spanish populations, a pattern congruent with my conclusion that it is a distinct species.

Further, the two other Greek populations (Miras drainage and Doiran Lake) cluster together as sister group to all but one (Ruidera Lakes) Spanish populations. The Ruidera population comes out as sister group to all other *S. fluviatilis* populations. Perdices et al. do not mention any non-allozymic character. The branching sequence among their populations of *S. fluviatilis* is largely what is expected considering the vast geographic distance between the Spanish and Greek populations and the absence of material from intermediate areas. Inclusion of material from Mediterranean islands, various lacustrine populations, Turkey and North Africa would be a valuable addition to their study.

Nevertheless, the puzzling position of the Ruidera population would justify that its identity be critically re-examined. Ruidera Lake is a system of small lakes in the upper Guadiana drainage, one of the few Atlantic drainages where *S. fluviatilis* is recorded. Speculations on the evolution of the European freshwater blennies is premature before their diversity, variation and distribution are documented and a robust phylogeny has been hypothesised.

COMPARISON MATERIAL

Salaria fluviatilis: CMK 17305, 5, 44.7-111.8 mm SL; Greece: Peloponnisos: River Pinios at bridge 3 km west of Simopoulo, on road to Efira; 37°50'48"N 21°32'07"E; M. Kottelat, M. Stoumboudi & R. Barbieri, 14 May 2002. - CMK 5432, 9, 18.2-60.5 mm SL; Switzerland: Ticino: Lago Maggiore at Locarno; 46°09'30"N 8°48'20"E; M. Kottelat, 25 Aug 1985. - CMK 17648, 11, 58.8-85.0 mm SL; France: Alpes-Maritimes: River Var at Pont Napoléon III in Nice, about 1 km from sea; J.-M. Foissy & CSP team; 3 October 2002. - CMK 16844, 6, 37.8-74.4 mm SL; France: Haute-Savoie: stream Leysse (tributary of Lake Bourget) at bridge at Le Tremblay, west of Chambéry; M. Kottelat & H. Persat, 20 July 2001. - CMK 17568, 11, 38.6-83.0 mm SL; France: Pyrénées-Orientales: River Tech about 3 km upriver of bridge on road N114, south of Elne; 42°35'02"N 2°58'13"E; M. Kottelat & CSP team, 6 September 2002. - CMK 17000, 2, 53.2-63.4 mm SL; Spain: Ebro drainage; B. Elvira, October 2001.

Salaria pavo: CMK 16978, 2, 60.7-81.2 mm SL; Greece: Kleisova Lagoon at Mesologgi, east of port, at beginning of road to Turlida; 38°21'39.5"N 21°25'38.9"E; M. Kottelat & P. S. Economidis, 8 October 2001.

Salaria sp.: CMK 17016, 35, 21.0-70.9 mm SL; Israel: Lake Kinneret; M. Goren, 13 May 1993. - CMK 17017, 25, 20.4-70.8 mm SL; same locality; M. Goren, 10 June 1993.

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A taxonomic revision of the family Oncopodidae IV. The genus *Oncopus* Thorell (Opiliones, Laniatores)

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A taxonomic revision of the family Oncopodidae IV. The genus *Oncopus* Thorell (Opiliones, Laniatores). - The known *Oncopus* species are revised and their penis morphology is illustrated. Distinct sexual dimorphism in external characters of some species is pointed out. *Oncopus alticeps* Pocock is placed in the synonymy of *O. feae* Thorell and *O. acanthochelis* Roewer in the synonymy of *O. truncatus* Thorell. Four new species are described: *O. malayanus* sp. n. from Peninsular Malaysia, *O. tiomanensis* sp. n. from Tioman Island (Malaysia), *O. lingga* from two Indonesian islands in the Lingga Archipelago and *O. expatriatus* sp. n. seemingly from Thailand (dubious record; more likely occurring on Borneo). Nine valid species are recognized and placed in four species groups; relationships and zoogeography are discussed.

Key-words: Opiliones - Oncopodidae - *Oncopus* - new species - taxonomy - zoogeography - Southeast Asia.

INTRODUCTION

This is our fourth contribution in the course of a revision of the family Oncopodidae, completing the treatment of known species (see Martens & Schwendinger, 1998; Schwendinger & Martens, 1999, 2002). The present paper deals with the genus *Oncopus*, in which seven species were hitherto known [not including *O. cuspidatus* Schwendinger, which was only provisionally described in this genus (see Schwendinger, 1992: 197) and later transferred to *Caenoncopus* (see Martens & Schwendinger, 1998: 507)] and the taxonomy of which is in considerable confusion. As most previous authors were seemingly unaware of external sexual dimorphism in this genus (present also in some species of *Gnomulus*), did not take into consideration genital characters and described most species from single specimens (several of them ♀♀, one even a juvenile), species distinctions were by no means clear. No *Oncopus* species was hitherto known from both sexes, and only in *O. megachelis* was penis morphology described [the illustration of an *Oncopus* penis by Martens (1986: fig. 7) was not assigned to any species; it refers to *O. truncatus*]. Two species were described

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and named twice: *O. feae* Thorell (from Penang Island) originally from a ♀ and later again from a ♂ (described as *O. alticeps*) by Pocock; *O. truncatus* Thorell (from Singapore Island) originally from a juvenile and subsequently again from a ♀ (described as *O. acanthochelis*) by Roewer. The latter author caused further confusion by identifying a ♂, which clearly belongs to *O. doriae* (occurring in Sarawak, Borneo), as "*O. alticeps*" and giving Thailand as its country of origin (see Roewer, 1923: 60). Another ♂ in his collection (unpublished record; here described as *O. expatriatus* sp. n.) was identified as "*Pelitnus alticeps*", a species that was never formally described (probably a misunderstanding for *Oncopus alticeps*) and also referred to as originating from Thailand, but penis morphology suggests that this species probably occurs on Borneo as well.

MATERIAL AND METHODS

External structures were studied and drawn with a ZEISS SV11 stereomicroscope, the penes with a NIKON Optiphot compound microscope (each with a drawing tube). In contrast to other genera, the penes of *Oncopus* ♂♂ examined were often partly expanded, i.e. the glans raised from the proximad-directed resting position by about 30°. Drawings were made with the glans pressed back into its resting position by squeezing the apex of the penis between a microscopic slide with a well (filled with diluted glycerine) and a cover slide.

Body measurements refer to the dorsal scutum. Leg articles were measured on their dorsal side, from midpoint of anterior margin to midpoint of posterior margin. All measurements are given in mm. Terminology of penis morphology follows that of Martens & Schwendinger (1998: fig. 1).

Abbreviations used in the text. Fe - femur, Mt - metatarsus, Pa - patella, Ta - tarsus, Ti - tibia, Tr - trochanter.

CCD - collection of Christa Deeleman-Reinhold, Ossendrecht; MAR - collection of J. Martens, Mainz; MCZ - Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts; MHNG - Muséum d'histoire naturelle, Genève; MSNG - Museo Civico di Storia Naturale, Genova; NHML - Natural History Museum, London [formerly British Museum (Natural History)]; SMF - Naturmuseum und Forschungsinstitut Senckenberg, Frankfurt; ZMT - Zoological Museum, University of Turku; ZRC - Zoological Reference Collection of the Raffles Museum of Biodiversity Research, National University of Singapore.

TAXONOMY

Oncopus Thorell, 1876

Oncopus Thorell (1876: 134-135). - Thorell (1891: 99-100). - Loman (1902: 182). - Roewer (1923: 57). - Sørensen (1932: 210-211). - Martens & Schwendinger (1998: 552). - Schwendinger & Martens (2002b: 425-426).

Type species. Oncopus doriae Thorell, 1876 by original designation and by monotypy.

Diagnosis. Large to very large oncopodids (5.9-10.8 mm), characterized by only one tarsal article on all legs. Interocular area a low, forward-directed tubercle, a low rounded hump or not elevated; carapace region larger and more or less distinctly elevated in ♂♂; carapace-abdomen bridge indistinct, wide, undivided, never in the shape of two opposing teeth (as in *Gnomulus* and *Biantoncopus*); ventral scutal elevations of ♂♂ keeled, with transversal bands of white enclosures embedded in the cuticle; ventral side of leg coxa II usually with scale- or knob-shaped apophysis at its anteroproximal corner [indistinctly developed (as in *Gnomulus* spp.) only in *O. hosei* and *O. megachelis*]; stigmatic pit narrow, its posterior margin without tubercle; chelicerae robust (stronger in ♂♂ than in ♀♀), with anteriad-inclined prodorsal boss extending into more or less strongly developed dorsomedian boss on proximal article and with ventral process on proximal, median and often also on distal article (= mobile finger); palps with more or less pronounced ventral tubercles on coxa, trochanter, proximal and subdistal part of femur, proximal and distal part of tibia; some species also with wide proventral process on patella. Penis with one or several pairs of terminal setae on distal margin of truncus; glans proximad-directed, more or less distinctly narrower than truncus at that point, with U-, V- or W-shaped median plate, outwards-bent lateral sclerites, long membranous tubes and slender, tubular stylus with moderately bulbous base and with pair of subterminal teeth.

Remarks. Possible synapomorphies for the genus *Oncopus* are: 1) tarsalia reduced to a single article on all legs; 2) ventral process present on 3rd cheliceral article (mobile finger; Figs 77-85); 3) anteroproximal apophysis on ventral side of leg coxa II more strongly developed than in other genera, scale-like (Fig. 71) or (rarely) knob-like (Figs 24-26); 4) ventral scutal elevations in ♂♂ keeled, containing white enclosures (Fig. 27b); 5) distal margin of truncus penis carrying terminal setae (Figs 4-7); 6) sexual dimorphism in shape and size of carapace region and of chelicerae (see Figs 11, 12 and Figs 13, 14). The latter is also present in some *Gnomulus* species (e.g., *G. sumatranus* Thorell) and indicates (together with its proximad-directed, symmetrical glans penis) a close relationship between *Oncopus* and *Gnomulus* (see Schwendinger & Martens, 2002b).

Species account and distribution. Nine valid species are here recognized: *O. expatriatus* sp. n. allegedly from Thailand (dubious record; more likely occurring on Borneo); *O. feae* Thorell from Penang Island (W-Malaysia); *O. malayanus* sp. n. from central Peninsular Malaysia and from Pangkor Island off the west coast of the peninsula; *O. tiomanensis* sp. n. from Tioman Island off the east coast of Peninsular Malaysia; O. *truncatus* Thorell from Singapore Island and from the southernmost part of Peninsular Malaysia; *Oncopus lingga* sp. n. from two islands in the Lingga Archipelago (Indonesia); *Oncopus doriae* Thorell from western Sarawak; *Oncopus hosei* Pocock from eastern Sarawak; *Oncopus megachelis* Schwendinger from Sabah. Two presumably undescribed species occur in northern Sumatra and in southeastern Kalimantan, respectively (see "Unidentified material") (Fig. 1).

THE *FEAE*-GROUP

Diagnosis. Large species (5.9-9.7 mm body length) with more or less distinctly forward-inclined interocular area; paramedian processes on opisthosomal area VIII

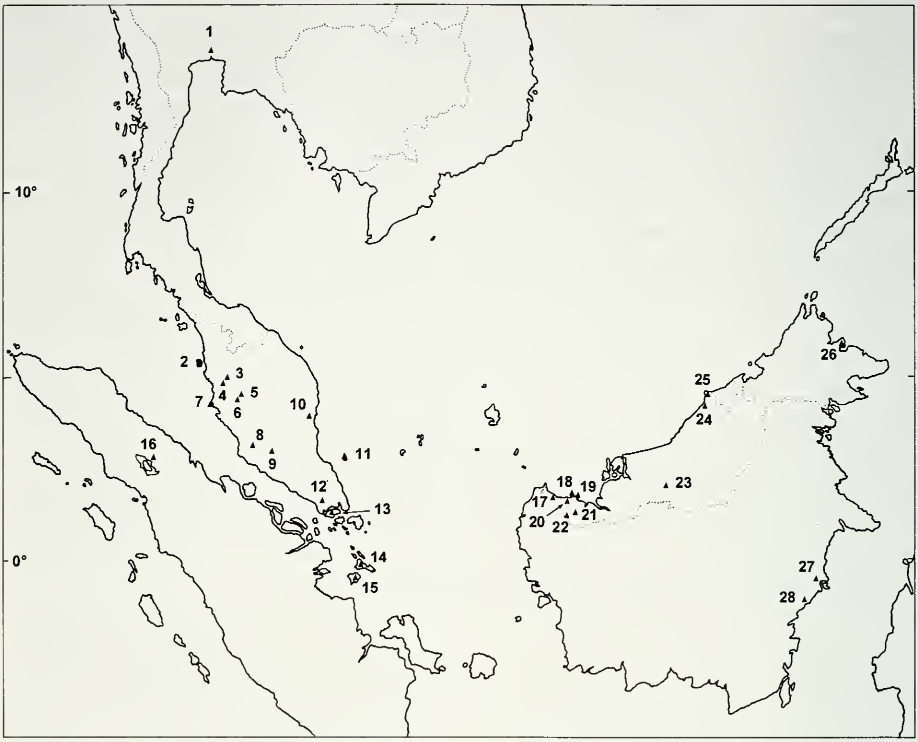


FIG. 1

Known records of *Oncopus* species. - 1 Bangkok (*O. expatriatus* sp. n.; dubious record), 2 Penang Island (*O. feae*), 3 Padang Gerus (*O. malayanus* sp. n.), 4 Maxwell Hill (*O. malayanus* sp. n.), 5 Cameron Highlands (*O. malayanus* sp. n.), 6 Chenderiang (*O. malayanus* sp. n.), 7 Pangkor Island (*O. malayanus* sp. n.), 8 Templer Park, Ulu Gombak, Kuala Lumpur (*O. malayanus* sp. n.), 9 Pasoh Forest (*O. malayanus* sp. n.?), 10 Bukit Charas (*Oncopus* sp.), 11 Tioman Island (*O. tiomanensis* sp. n.), 12 Gunung Pulai (*O. truncatus*), 13 Singapore Island (*O. truncatus*), 14 Lingga Island (*O. lingga* sp. n.), 15 Singkep Island (*O. lingga* sp. n.), 16 forest near Prapat (*Oncopus* sp.), 17 Batu Lundu, Gunung Gading (*O. doriae*), 18 Gunung Santubong (*O. doriae*), 19 Bako National Park (*O. doriae*), 20 Gunung Serapi (*O. doriae*), 21 Balai Ringin (*O. doriae*), 22 Gunung Penrissen (*O. doriae*), 23 Kapit (*Oncopus* sp.), 24 Lambir Hills National Park (*O. hosei*), 25 Kuala Baram (*O. hosei*), 26 Kabili-Sepilok Forest Reserve (*O. megachelis*), 27 Sangasanga Muara (*Oncopus* sp.), 28 Sepaku (*Oncopus* sp.).

projecting beyond posterior margin of dorsal scuta; penes slender, more or less gradually widening towards apex with almost straight distal margins carrying three to five terminal setae on each side.

This species group is close to the *truncatus*-group and contains two species (*O. feae* and *O. malayanus* sp. n.) from the northern and central parts of Peninsular Malaysia.

Oncopus feae Thorell, 1890 Figs 2-26

Oncopus feae Thorell (1890: 375-377); description of ♀. - Roewer (1923: 58). - Sørensen (1932: 211-213, figs 1-2). - Bristowe (1976: 7-11, figs 1-6, pl. 1-2). - Moritz (1993: fig. 299A); drawing. - Murphy & Murphy (2000: pl. 2.1); photo.

Oncopus alticeps Pocock (1897: 287, fig. 2), **syn. n.**; description of ♂. - Roewer (1923: 59-60, fig. 62); see also treatment of *O. doriae* in present paper.

Types. MALAYSIA (peninsula), Pulo Pinang (= Pulau Penang = Penang Island), 1 ♀, 4 juvenile syntypes (MSNG, examined), leg. L. Loria and L. Fea, 1889; ♀ here designated lectotype in order to preserve stability of nomenclature.

Other material. From Penang Island: 1 ♂ (holotype of *O. alticeps*), 1897.1.25.1 (NHML); Batu Feringgi, 20 m, 2 juveniles, leg. G. Cuccodoro & I. Löbl, 10.XI.1999; Batu Feringgi, 100 m, 1 ♂, 1 ♀, leg. G. Cuccodoro & I. Löbl, 13.XI.1999; forest above Botanical Garden, 250 m, 3 ♀, leg. G. Cuccodoro & I. Löbl, 12.XI.1999; Penang Hill (= Bukit Bendera), 650 m, 1 ♂, 5 ♀, 2 juveniles, leg. G. Cuccodoro & I. Löbl, 19.XI.1999; Penang Hill, 650-760 m, 1 ♂, leg. P.J. Schwendinger, 19.I.1995; Penang Hill, 710 m, 1 ♂, leg. P.J. Schwendinger, 8./9.XII.1997; all latter specimens deposited in MHNG.

Diagnosis. Distinguished by: interocular area more or less distinctly forward-inclined; pair of paramedian tubercles distinctly projecting beyond posterior margin of dorsal scutum; anteroproximal process on ventral side of coxa II developed as longitudinal bulge; second cheliceral article with ventroproximal hump; mobile cheliceral finger with ventroproximal boss; ventroproximal process on palpal tibia distinct; penis with three to five terminal setae on each side, lateral sclerites of glans distally wide, truncate.

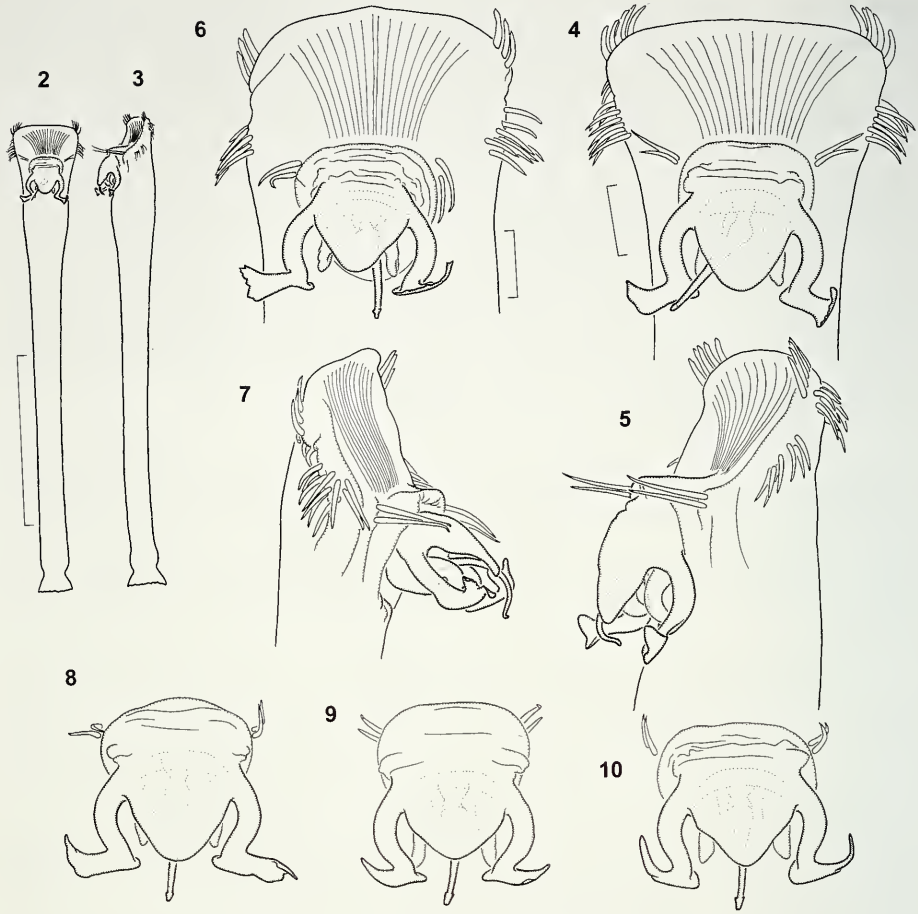
Redescription. Large species (8.7-9.7 mm long). Carapace region of dorsal scutum with more or less distinctly forward-inclined interocular area, low in ♀♀ (Figs 11, 18), arched and distinctly elevated above opisthosomal region in ♂♂ (Figs 13, 15-17); paramedian pairs of tubercles present on opisthosomal areas VI-VIII, the last one distinctly protruding beyond posterior margin of dorsal scutum (Figs 12, 14). Anteroproximal apophysis of coxa II knob-shaped in ♂♂ (Figs 24-26), scale-like in ♀♀ (Fig. 23); process posterior to apophysis of coxa II developed as longitudinal bulge, anteroproximal process on coxa III small (Figs 23-26).

Chelicerae robust, stronger in ♂♂ (Figs 14, 20) than in ♀♀ (Figs 12, 19), with pronounced ventral tubercle on first article; ventral side of second cheliceral article with distal process and proximal hump (indicated by arrow in Figs 19, 20); mobile finger of chelicera with distinct ventroproximal boss.

Pedipalps (Figs 21, 22) with distinct ventral process on trochanter, small ventroproximal process on femur and distinct ventroproximal process on tibia; no proventral process on palpal patella.

Legs: femur of leg II with small dorsoproximal tubercle, femur IV with indistinct ventroproximal tubercle.

Penis (Figs 2-10) fairly slender, with slightly rounded distal margin carrying three to five terminal setae on each side; glans about as wide as truncus at that point (wider when lateral sclerites are pressed sideward during examination on a temporary slide), flanked by two setae on each side; lateral sclerites slender at base, distally widening to truncate tips with more or less distinctly serrate terminal edge, bent outwards and away from truncus; median plate broadly V-shaped, distally rounded; membranous tubes long, protruding far beyond median plate.

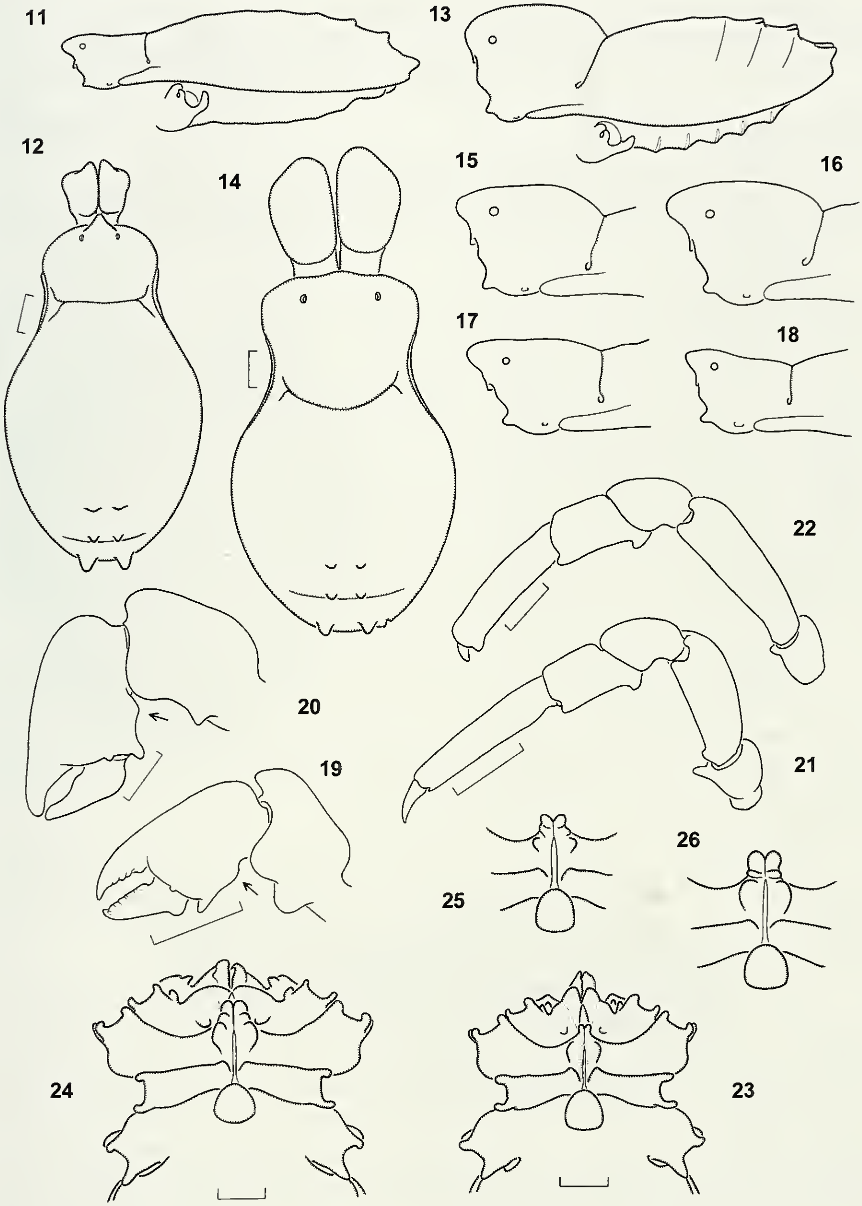


FIGS 2-10

Oncopus feae Thorell: ♂ holotype of *O. alticeps* (here placed in the synonymy of *O. feae*) (6, 7); 3 ♂ from Penang Hill (2-5, 8, 9); ♂ from Batu Feringgi, Penang (10). - Penis, dorsal (2) and lateral view (3); apex of penis, dorsal (6, 4) and lateral view (5, 7); glans penis, dorsal view (8-10). - Scale lines 1.0 mm (2, 3), 0.1 mm (4-10).

Variation. Measurements (♂, in parentheses ♀): body 8.67-9.67 (8.77-9.45) long, 4.80-5.98 (4.96-5.39) wide; carapace region 2.48-3.74 (2.08-2.39) long, 3.22-4.11 (2.91-3.16) wide; ♂ (n = 5), ♀ (n = 10). Variation in the shape of the interocular areas see Figs 11, 13, 15-18, of glans penis see Figs 4, 6, 8-10. In some ♂♂ the knob-shaped anteroproximal apophysis on coxa II is divided into two parts (Figs 24-26).

Remark. In 2 ♂ the penis is subdistally collapsed and its distal margin therefore looks more strongly rounded [Fig. 6 (holotype of *O. alticeps*, here placed in the synonymy of *O. feae*)] than in the other ♂♂ examined (Fig. 4).



FIGS 11-26

Oncopus feae Thorell: ♀ lectotype (11, 12, 19, 21, 23); ♂ holotype of *O. alticeps* (here placed in the synonymy of *O. feae*) (13, 14, 20, 22, 24); 3 other ♂♂ (15-17, 25, 26); other ♀ (18). - Body, lateral (11, 13) and dorsal view (12, 14); anterior part of body, lateral (15-18) and ventral view (23-26; 25, 26 showing only central portion); left chelicera (19, 20; arrows pointing to ventroproximal hump of second article) and left palp (21, 22), retrolateral view. - All scale lines 1.0 mm.

Relationships. *Oncopus feae* is externally similar to *O. doriae*, but genital morphology shows that the former is most closely related to *O. malayanus* sp. n.

Distribution. This species is known only from Penang Island [Fig. 1 (2)].

Oncopus malayanus sp. n. Figs 27-54

Oncopus alticeps Pocock. - Šilhavý (1974: 25); misidentification.
Oncopus cfr. *alticeps* Pocock. - Giribet *et al.* (2002); molecular study.
Oncopus feae Thorell. - Šilhavý (1974: 25; sub *O. feai*, incorrect subsequent spelling); misidentification.

Material. MALAYSIA (peninsula), Perak, Pangkor Island, forest near Kampung Sungai Cempedak, 30 m, ♂ holotype, 1 ♂, 7 ♀ paratypes (MHNG), leg. P.J. Schwendinger, 15./16.XII.1997; Padang Gerus, 200 m, 1 ♀ paratype (MHNG), leg. P.J. Schwendinger, 15.I.1995; Maxwell Hill (= Bukit Larut), 1100 m, 1 juvenile (MHNG), leg. G. Cuccodoro & I. Löbl, 21.XI.1999; Maxwell Hill, 1500 m, 1 ♀ paratype, 1 penis (MHNG; with label "*Oncopus alticeps*, det. Šilhavý, 1972"), leg. T. Jaccoud, 6.VIII.1969; Chenderiang, 290-330 m, 1 ♀ paratype (HMNG), leg. P.J. Schwendinger, 22.-31.I.1994; Perak, without exact locality and data, 1 ♂ paratype (SMF 299/2) with label "*Oncopus alticeps* Poc., 1 ♂, Roewer det. 1925", no name of collector, no date; Pahang, Cameron Highlands, Tanah Rata, Trail No. 9, 1400 m, 2 ♀ paratypes (MHNG), leg. Löbl & Calame , 27.III.1993; Templer Park (NW of Kuala Lumpur), 370 m, 1 juvenile (MHNG), leg. P.J. Schwendinger, 13.VII.2001; Selangor, Ulu Gombak, 200 m, 1 ♀ paratype, 1 juvenile (MHNG), leg. Agosti, 26.IX.1991; Ulu Gombak, 1 ♂ paratype (penis missing) (MAR), leg. Rohe & Maschwitz, XII.1988; 30 km N of Kuala Lumpur, 1 ♂ paratype (MAR), leg. A. Dorow, II.1986; Penchala, Kuala Lumpur, 2 ♀ paratypes (MHNG; with label "*O. feai*, det. Šilhavý, 1971"), leg. T. Jaccoud, 8.IX.1969.

Diagnosis. Similar to *O. feae*, distinguished by: paired paramedian tubercles on dorsal scutal area VIII smaller, only little protruding beyond scutal margin; ventral side of coxa II with scale-like anteroproximal apophysis in ♂♂, process posterior to it low, widely rounded, posteroproximal process present; chelicerae without subbasal ventral hump on second article and without subbasal boss on mobile finger; penis with narrower glans carrying distally pointed lateral sclerites.

Description. ♂ (holotype). Coloration: body amber, with dark reticulation on carapace, chelicerae and palps; dark margin on dorsal scutum and dark pattern on its opisthosomal part (Fig. 27a, c); legs dark, except for lighter distal portion of metatarsi, lighter tarsi III and IV, and cream tarsi I and II.

Carapace region of dorsal scutum large and moderately elevated, interocular area low, rounded, only slightly projecting beyond carapace front margin (Fig. 27c). Opisthosomal areas of dorsal scutum indistinctly elevated in posterior part, with pairs of small paramedian tubercles on areas VI-VIII, the last pair slightly protruding beyond posterior margin (Fig. 27a, c); ventral scutal areas keeled, with transversal bands of white enclosures (Fig. 27b, c). Palpal coxa with long, digitiform ventral process; ventral side of leg coxa I with conical anterolateral and knob-shaped central processes; coxa II with broad scale-like anteroproximal apophysis, with low, rounded process posterior to it, and with more pronounced, rounded posteroproximal process overlapping short anteroproximal process on coxa III. Genital operculum rounded, slightly longer than wide (Fig. 27b).

Chelicerae (Fig. 45) strong; proximal article with strong, rounded retroventral tubercle; second article with small ventrodistal process and with characteristic prodorsal subproximal hump (Fig. 45; see arrow); mobile finger without ventral process,

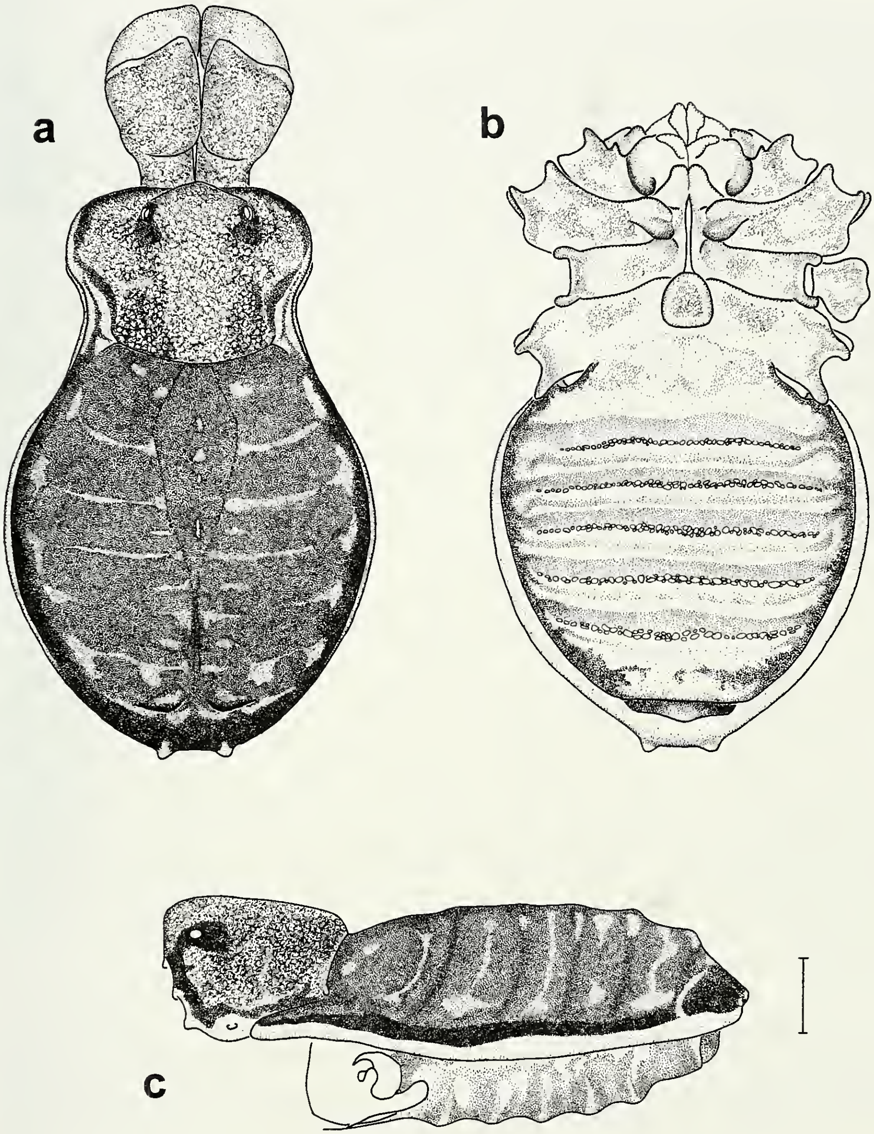


FIG. 27

Oncopus malayanus sp. n.: ♂ holotype. - Body, dorsal (a), ventral (b) and lateral view (c). - Scale line 1.0 mm.

its inner side with sharp, keel-shaped cutting edge only in distal half (worn in proximal half?).

Palps (Fig. 48): trochanter with small, slightly distad-inclined ventral process; femur unarmed; patella without proventral process; tibia with distinct retroventral proximal hump.

Legs 3124; femur II without dorsoproximal tubercle; only low rounded hump ventroproximally on femur IV.

Penis (Figs 28-31): truncus relatively slender, more or less continually widening from base to apex, slightly constricted at height of glans; distal margin slightly arched, with three and four lateral setae on each side. Glans penis much narrower than truncus at that point, flanked by two setae on each side; lateral sclerites slender, with pointed tips bent outwards and away from the truncus; median plate broadly rounded, almost semicircular; membranous tubes long, protruding far beyond median plate.

♀ (from the type locality). As the ♂ but carapace region of dorsal scutum less elevated in posterior part (Fig. 43); ventral scutal areas only slightly elevated, rounded; chelicerae much weaker but with more distinct dorsal hump on second article (Fig. 46); palps weaker, with small ventroproximal tubercle on femur (Fig. 53); coxa II with smaller anteroproximal apophysis, with conical process posterior to it, and with less pronounced posteroproximal process.

Measurements. ♂ holotype (♀ from the type locality in parentheses): body 7.50 (6.79) long, 4.81 (4.26) wide; carapace region 2.41 (1.67) long, 3.21 (2.53) wide. - Palp and legs:

	Tr	Fe	Pa	Ti	Mt	Ta	Total
Palp	1.11 (0.80)	1.94 (1.27)	1.11 (0.86)	0.86 (0.65)	- -	1.91 (1.54)	6.93 (5.12)
Leg I	0.86 (0.74)	2.65 (2.28)	1.14 (1.05)	1.14 (1.02)	2.28 (2.04)	0.43 (0.43)	8.50 (7.56)
Leg II	1.05 (0.86)	3.46 (2.96)	1.45 (1.33)	2.04 (1.70)	3.36 (2.90)	0.43 (0.43)	11.79 (10.18)
Leg III	0.86 (0.74)	2.25 (1.98)	1.17 (1.05)	1.11 (0.99)	2.47 (2.16)	0.43 (0.43)	8.29 (7.35)
Leg IV	1.11 (1.05)	2.90 (2.78)	1.60 (1.42)	1.98 (1.79)	3.95 (3.58)	0.46 (0.43)	12.00 (11.05)

Variation. Measurements (♂, in parentheses ♀): body 6.88-8.55 (5.90-9.10) long, 4.26-5.52 (3.46-6.08) wide; carapace region 1.76-2.93 (1.56-2.35) long, 2.59-3.61 (2.16-3.46) wide; ♂ (n = 5), ♀ (n = 15). Three to five terminal setae present on each side of distal penis margin. Variation in external morphological characters between and within different populations of *O. malayanus* sp. n. is more pronounced than in other species:

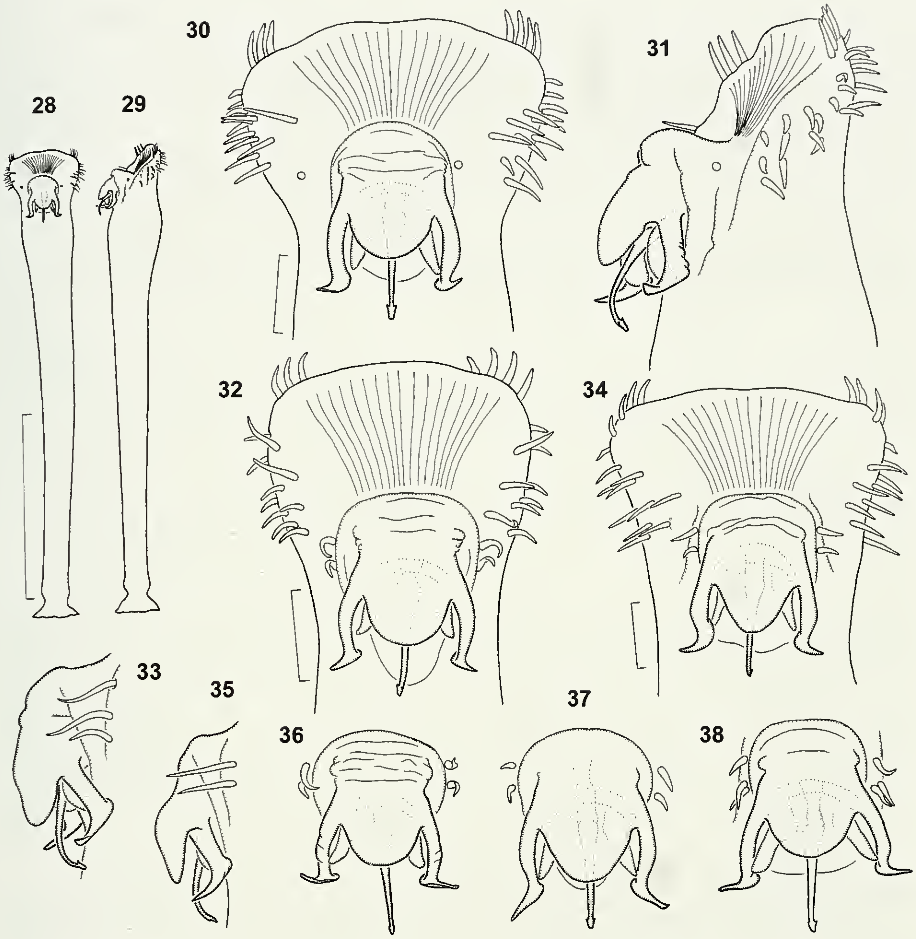
1 ♂ from the type locality has a low carapace region (Fig. 42), as otherwise only seen in ♀♀ (see Figs 43, 44).

The interocular area is moderately pointed and bent forward in the ♂ from Ulu Gombak (Fig. 40) and in the ♂ (Fig. 41) and ♀ from Kuala Lumpur, whereas it is rounded and not inclined in the other specimens examined (see Figs 27c, 39, 42-44).

The specimens from Pangkor Island possess a very strong and prominent retroventral process on the first cheliceral article (Figs 45, 46), in others this process is distinctly smaller (Fig. 47).

The characteristic dorsal hump on the second cheliceral article is distinct in specimens from the northern populations (including Pangkor Island; Figs 45, 46, see arrows), less pronounced in the ♀♀ from the Cameron Highlands and Ulu Gombak and in the ♂ from "Perak", and absent in specimens from near Kuala Lumpur (Fig. 47).

Some specimens possess a small ventroproximal process on palpal femur (Figs 49, 50, 53), others, even within the same population, lack it (Fig. 48).

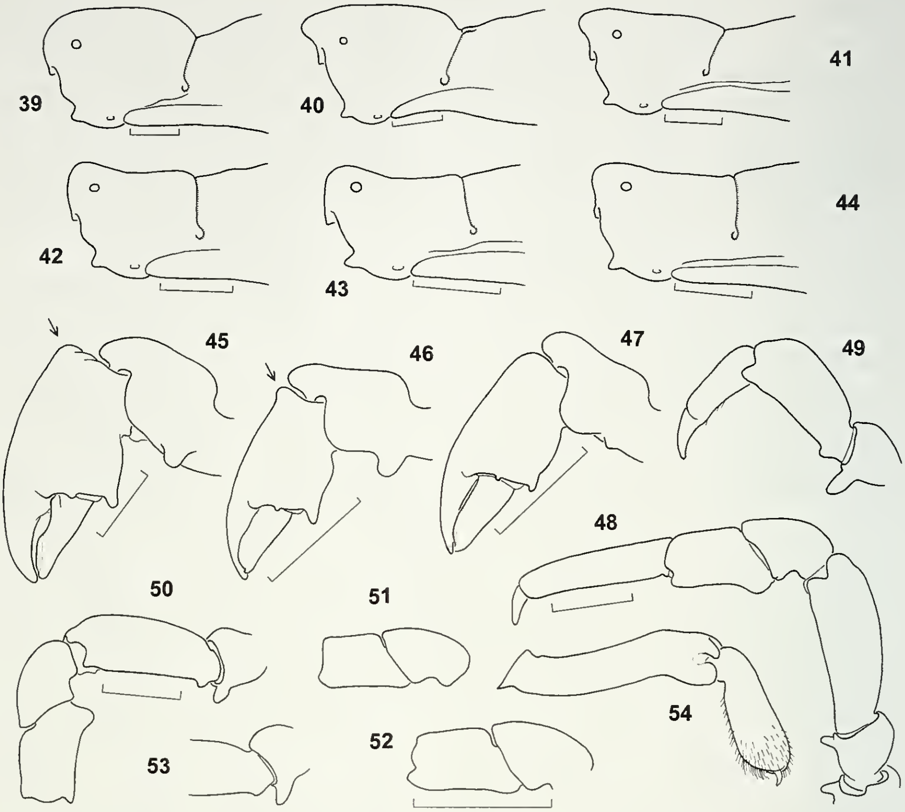


FIGS 28-38

Oncopus malayanus sp. n.: ♂ holotype from Pangkor Island (28-31); ♂ paratypes from Ulu Gombak (32, 33), Maxwell Hill (34, 35), Kuala Lumpur (36), Pangkor Island (37) and Perak (38). - Penis, dorsal (28) and lateral view (29); apex of penis, dorsal (30, 32, 34) and lateral view (31); glans penis, lateral (33, 35) and dorsal view (36-38). - Scale lines 1.0 mm (28, 29), 0.1 mm (30-38).

A retroventral proximal hump on the palpal tibia is distinct in most specimens (Figs 48, 50), less pronounced in the ♀ from Chenderiang, and indistinct in ♂♂ and ♀♀ from Kuala Lumpur and Ulu Gombak (Figs 51, 52).

The ♀♀ from Padang Gerus, Maxwell Hill and the Cameron Highlands, as well as the ♂ from "Perak" (without exact locality), are all more than 8 mm long and thus distinctly larger than the other specimens. Specimens of the northern populations appear to be generally larger in size than those of the southern populations.



FIGS 39-54

Oncopus malayanus sp. n.: ♂ holotype from Pangkor Island (45, 48); ♂ paratypes from Perak (39), Ulu Gombak (40), Kuala Lumpur (41, 51), Pangkor Island (42); ♀ paratypes from Pangkor Island (43, 46, 53), Cameron Highlands (44), Kuala Lumpur [1st ♀ (47, 52, 54), 2nd ♀ (49)], Maxwell Hill (50). - Anterior part of body, lateral view (39-44); left chelicera (45-47; arrows pointing to prodorsal subproximal hump of second article) and left palp (48, 49 deformed), retrolateral view; trochanter to tibia (50), patella and tibia (51), and trochanter and proximal part of femur (53) of left palp, retrolateral view; right leg III (deformed), retrolateral view (54). - All scale lines 1.0 mm.

Remark. The 2 ♀ from Kuala Lumpur possess crippled limbs: in one of them the right leg III has an elongated tarsus attached to the femur (Fig. 54), in the other ♀ the shortened palpal tarsus is joined directly to the palpal femur (Fig. 49).

Relationships. Oncopus malayanus sp. n. is most closely related to *O. feae*.

Distribution. This species has a relatively wide distribution in the western central part of Peninsular Malaysia [Fig. 1 (3-8)]. The immature specimens (not examined) recorded by Suzuki (1983: 2) from the Templer Park [near Kuala Lumpur; Fig. 1 (8)] and from the Pasoh Forest [near Simpang Pertang; Fig. 1 (9); Suzuki, 1976: 9-12, figs 1-2] presumably also belong to this species.

THE *TRUNCATUS*-GROUP

Diagnosis. Large to very large species (6.2-10.8 mm body length) with interocular areas not (or only slightly) forward-inclined and without paramedian tubercles on opisthosomal area VIII of dorsal scutum; palps characteristically modified: femora with more or less distinct subdistal ventral bulge, patellae with proventral process, tibiae very short; penes with widened apex (giving them the shape of a screwdriver) and one or two terminal setae on each side of straight distal margin.

This species group is close to the *feae*-group and comprises three species (*O. truncatus*, *O. tiomanensis* sp. n., *O. lingga* sp. n.) from southern Peninsular Malaysia, Singapore and from two Indonesian islands in the Lingga Archipelago.

Oncopus truncatus Thorell, 1891 Figs 55-91

Oncopus truncatus Thorell (1891: 764-765); description of juvenile. - Pocock (1897: 286, 288). - Roewer (1923: 58-59). - Roewer (1927: 267). - Sørensen (1932: 209). - Bristowe (1976: 9).

Oncopus acanthochelis Roewer (1915: 127, fig. 71), **syn. n.**; description of ♀. - Roewer (1923: 60, fig. 63). - Martens (1986: fig. 7); illustration of an oncopodid penis, without indication as to which species it belongs. - Schwendinger (1992: 194, figs 91-97, pl. 2).

Type. SINGAPORE, juvenile holotype of *O. truncatus* (MSNG, examined), leg. L. M. D'Albertis, IX.1874.

Other material. SINGAPORE: 1 ♀, holotypus of *Oncopus acanthochelis* (SMF 1256) with label "*Oncopus acanthochelis*, Type, 1 ♂", no name of collector, no date; 1 ♂, 1 ♀ (SMF 298/1) with label "*Oncopus truncatus*, 2 Exempl., Roewer det. 1926", no name of collector, no date; 1 ♂, 1 ♀ (SMF 2113/7) with label "*Oncopus acanthochelis*, 2 ♂, Roewer det. 1930", no name of collector, no date; 1 ♂ (MCZ 37715), 1 ♀ (MCZ 37716), leg. Y. M. Wang, VIII.1965; Bukit Timah Nature Reserve, 4 ♂, 4 ♀ (MAR 2140), leg. D. H. Murphy, III.-VIII.1967 (pitfall traps); 7 ♂, 7 ♀ (MAR 2141), leg. D. H. Murphy, XI.1965, III.-VIII.1967 (pitfall traps); 1 ♂, 1 ♀ (both fragmented, MAR), 1 ♀ (MHNG), leg. S. Huber, 1999; 1 ♀ (CCD), leg. C. Deeleman-Reinhold, 21.II.1983; SE Bukit Timah N. R., Rifle Range Road, 50 m, 1 ♂, 1 juvenile (MHNG SBH-96/3), 1 juvenile (MHNG SBH-96/2), 20.XI.1996, leg. B. Hauser; Labrador Hill, 40 m, 1 ♀, 1 juvenile (MHNG Sar-87/1), leg. B. Hauser, 21.XI.1987; NNW of MacRitchie Reservoir, 60 m, 1 ♀ (MHNG SBH-96/5), 21.XI.1996, leg. B. Hauser; Singapore Island Country Club, W of MacRitchie Reservoir, 20 m, 1 ♀, 2 juveniles (MHNG SL/SI-93/4), leg. B. Hauser, 23.VII.1993. MALAYSIA (peninsula), Johor, Gunung Pulai (SW of Kulai), 3 ♂, 1 ♀, 3 juveniles (RFS 2001.2241; 1 ♂ donated to the MHNG), no name of collector, 1935.

Diagnosis. Distinguished by: genital operculum with pronounced distal tubercle; mobile finger of chelicera with small ventroproximal process, large tooth on its cutting edge (if present) situated more proximally than tooth on cutting edge of fixed finger; palpal femur with subdistal bulge, palpal patella with wide proventral process, palpal tibia very short; ventroproximal process on palpal tibia distinct; penis with one terminal seta on each side, lateral sclerites of glans tapering.

Redescription. Very large species (7.5-10.8 mm long). Carapace region of dorsal scutum in ♂♂ (Figs 69, 70, 72-74) more elevated than in ♀♀ (Figs 75, 76), interocular area low, not or only slightly forward-inclined; low median longitudinal keel present on anterior areas of opisthosomal region and small paramedian pairs of tubercles present on areas V-VII (Fig. 70). Anteroproximal apophysis of coxa II scale-like, basally constricted; small process posterior to it and small anteroproximal process on coxa III. Genital operculum longer than wide, with distinct ventrodistad tubercle (Figs 71, 91).

Chelicerae robust, in ♂♂ (Figs 77-81) stronger than in ♀♀ (Figs 83, 84), with truncate or bifid retroventral tubercle and pointed, forward-inclined prolateral distal process on first article; ventral side of second cheliceral article with distal process; mobile finger of cheliceral hand with more or less pronounced subbasal process; cutting edge of each cheliceral finger in ♂♂ with strong tooth (worn in old ♂♂, Figs 77, 78; indistinct in ♀♀, Figs 83, 84), the one on the mobile finger situated at the same position as (Figs 79, 80), or more proximally than (Fig. 81) the one on the fixed finger.

Pedipalps (Figs 86-89) with short digitiform ventral process on trochanter, with more or less distinct ventroproximal process and distinct subdistal ventral transversal bulge on femur, and with pointed distad-inclined pro- and retrolateral distal processes and low rounded proximal retroventral hump on conspicuously short tibia (Fig. 86); palpal patella with wide proventral process in ♂♂ (Fig. 87; weaker in ♀♀).

Legs: femur of leg II with distinct dorsoproximal tubercle, femur IV with distinct ventroproximal one (see Schwendinger, 1992: figs 96, 97).

Penis (Figs 55-68) fairly slender, markedly widened between glans and apex, with straight or slightly rounded distal margin carrying one terminal seta on each side; glans narrower than truncus at that point (slightly wider when lateral sclerites pressed sideward on temporary slide; see Figs 57, 61), flanked by two to three setae on each side; lateral sclerites with wrinkles on lower side, tapering, slightly bent outwards and away from the truncus; median plate broadly V-shaped, distally rounded; membranous tubes long, protruding far beyond median plate.

Variation. Measurements (♂, in parentheses ♀): body 8.71-10.74 (7.42-9.11) long, 4.42-5.38 (4.39-5.32) wide; carapace region 2.29-3.12 (2.07-2.41) long, 2.60-3.06 (2.82-3.50) wide; ♂ (n = 19), ♀ (n = 21).

In most ♂♂ the teeth on the cutting edges of the cheliceral fingers are small or completely absent (Figs 77, 78). As all of them also show short and blunt (sometimes broken) palpal claws, whereas all ♂♂ with pronounced cheliceral teeth also have sharply pointed palpal claws, this is presumably due to wear.

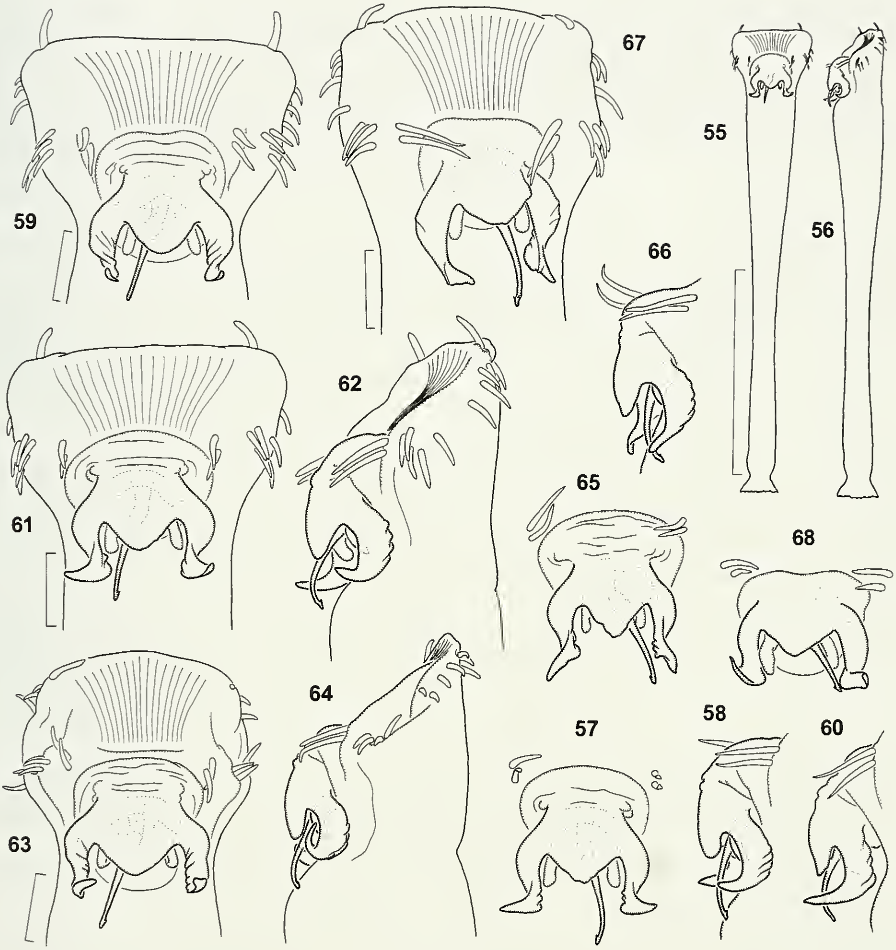
Penes have a straight or slightly arched distal margin (Figs 59, 61, 63, 67) and more or less strongly curved lateral glans sclerites (Figs 66, 60, 58, 62, 64). In most ♂♂ examined the glans penis is flanked by two setae on each side, in a single ♂ (from Singapore) by three setae (on both sides).

Remarks. The juvenile holotype (from Singapore) corresponds with *Oncopus* juveniles from the same island in all relevant characters [subbasal process on mobile cheliceral finger (Fig. 85), short palpal tibia (Fig. 90), dorso- and ventroproximal tubercle on femur II and IV, respectively]. Therefore we have no doubt that all *Oncopus* specimens from Singapore belong to the same species.

All 21 ♀ examined posses a small but distinct ventral tooth on the mobile cheliceral finger, which clearly distinguishes them from ♀♀ of the closely related *O. lingga* sp. n. (2 ♀ examined) and of O. *tioman* sp. n. (6 ♀ examined).

The larger tubercle on the genital operculum of *O. truncatus* (Fig. 91), in comparison with that of *O. lingga* sp. n., only becomes evident when specimens of both species are placed side by side.

Relationships. In its external morphology *O. truncatus* is most similar to *O. lingga* sp. n., but its penis morphology corresponds more with that of *O. tiomanensis*



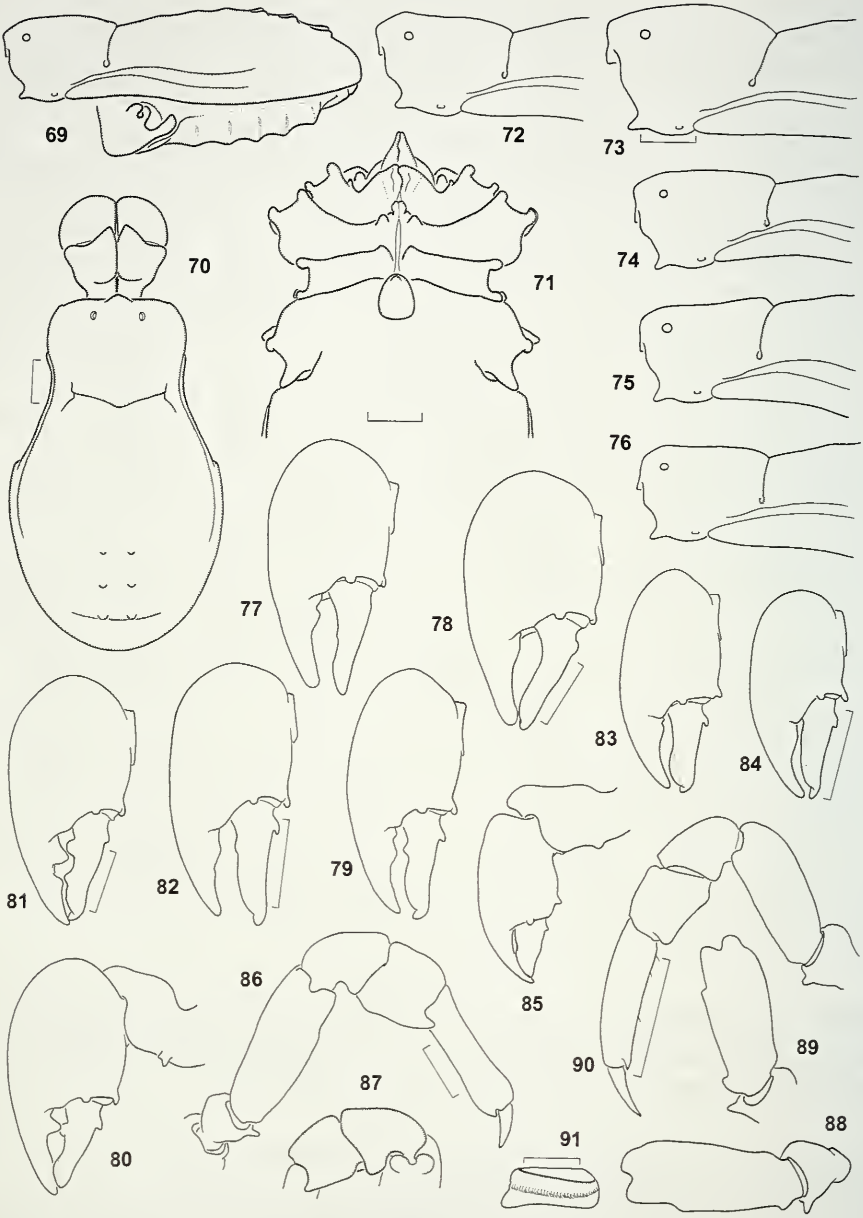
Figs 55-68

Oncopus truncatus Thorell: 5 ♂ from Singapore [1st (55-58), 2nd (59, 60), 3rd (61, 62), 4th (63, 64), 5th (65, 66)]; 2 ♂ from Gunung Pulai (67, 68). - Penis, dorsal (55) and lateral view (56); apex of penis, dorsal (59, 61, 63) and lateral view (62, 64); glans penis, dorsal (57, 65, 68) and lateral view (58, 60, 66). - Scale lines 1.0 mm (55, 56), 0.1 mm (57-68).

sp. n. Which of them are most closely related and sister to the third species remains to be established by a character analysis later on.

Distribution and bionomics. Known from several localities on Singapore Island [Fig. 1 (13)] and from a mountain in the south of Peninsular Malaysia [Fig. 1 (12)], about 25 km northwest of Singapore. This species appears to be fairly abundant in the leaf litter of moist forests; one specimen was even collected at the base of an isolated tree on a golf course (B. Hauser, pers. commun.).

According to a casual observation during night-time by S. Huber, *O. truncatus* mates in an upright position with the ventral sides of both partners facing each



FIGS 69-91

Oncopus truncatus Thorell: juvenile holotype (85, 90); ♂♂ from Singapore (69-74, 77-80, 86-88, 91); 2 ♂ from Gunung Pulai (81, 82); ♀♀ from Singapore (75, 76, 83, 84, 89). - Body, lateral (69) and dorsal view (70); anterior part of body, ventral (71) and lateral view (72-76); left cheliceral hand, retrolateral view (77-85), right (86) and left palp (90), retrolateral view; patella and tibia of right palp, prolateral view (87); trochanter and femur of left palp, retrolateral view (88, 89); genital operculum, lateral view (91). - Scale lines 1.0 mm (69-90), 0.5 mm (91).

other, similar to theraphosid spiders. This is the only existing observation on the mating behaviour of oncopodids. These animals are very sensitive to light and air movement, and either freeze or run for cover upon the slightest disturbance.

Oncopus truncatus (and other oncopodids as well) appears to be long-lived: a pair of mature specimens was fed with living termites and kept alive for more than two years (S. Huber, pers. commun.).

Oncopus tiomanensis sp. n. Figs 92-112

Material. MALAYSIA (peninsula), Pahang, Tioman Island, 2 km SE of Kampung Genting (2°47'N, 104°08'E), 50-100 m, ♂ holotype (MHNG), 6 ♀ paratypes, 15 juveniles (MHNG, MAR), 23.-28.VI.2001, leg. A. Schulz & K. Vock; Tioman Island, at the foot of Gunung Kajang (2°47.181'N, 104°07.892'E), 160 m, 1 ♂ (matured 10.VIII.2002), 1 ♀ paratypes (MHNG), 2.X.2001, leg. L. Monod.

Etymology. The specific epithet refers to the island where the new species was found.

Diagnosis. Similar to *O. truncatus*, distinguished by: smaller in size; no process on mobile finger of chelicerae; cutting edges of cheliceral fingers in ♂♂ without prominent teeth; palps with subdistal-ventral bulge of femur and proventral process of patella less developed; carapace region of ♂♂ not more elevated than in ♀♀, interocular area not directed forward; paramedian tubercles on dorsal scutal areas V-VII less pronounced; genital operculum much wider, without anterior tubercle; dorsoproximal tubercle on femur II and ventroproximal tubercle on femur IV much shorter; penis with almost quadrangular apex, separated from rest of truncus by a more abrupt constriction at height of glans.

Description. ♂ (holotype). Coloration: body reddish amber, carapace region, chelicerae and palps mottled with dark; dorsal scutum with dark margin and dark opisthosomal areas; proximal article of chelicerae and legs dark brown, except for light amber leg tarsi and distal portion of metatarsi; tarsi I and II cream. Ventral side of body and distal articles of chelicerae yellowish amber.

Carapace region of dorsal scutum fairly low, not arched, interocular area low, rounded, not projecting beyond carapace front margin (Fig. 98). Opisthosomal areas of dorsal scutum indistinctly elevated in posterior part, with pair of small paramedian tubercles on areas VI-VII (Figs 98, 99); ventral scutal areas moderately keeled, with transversal bands of white enclosures (Fig. 98). Palpal coxa with long, conical ventral process; ventral side of leg coxa I with small anterolateral process and knob-shaped central tubercle; coxa II with scale-like anteroproximal apophysis and with low, rounded process posterior to it; posteroproximal process of coxa II absent; anteroproximal process on coxa III indistinct. Genital operculum rounded, clearly wider than long, without distoventral tubercle (Fig. 100).

Chelicerae (Fig. 106) strong; proximal article with conical retroventral tubercle and with anteriad-inclined prodorsal boss extending into rounded dorsomedian boss; second article with small ventrodistal process; mobile finger without ventral process, its inner side with sharp cutting edge only in distal half (presumably worn in proximal half); both cutting edges of cheliceral hand without prominent teeth.

Palps (Figs 109, 110): trochanter with small, slightly distad-inclined ventral process; ventral side of femur with indistinct subdistal bulge and indistinct proximal process; patella with widely rounded proventral process (Fig. 110); tibia with low retroventral proximal hump.

Legs 3142; low rounded hump present dorsoproximally on femur II and ventroproximally on femur IV.

Penis (Figs 92-95): truncus fairly slender, more or less continually widening from base to height of glans, there abruptly widening to subquadrangular apex; distal margin almost straight, with single terminal seta on each side. Glans penis about as wide as truncus at that point (wider when lateral sclerites pressed sideward on temporary slide), flanked by two setae on each side; lateral sclerites slender, with pointed tips bent outwards and upwards; median plate broadly rounded, widely V-shaped; membranous tubes long, protruding far beyond median plate.

♀. As the ♂, but interocular area slightly more raised (Fig. 102), ventral scutal areas not elevated; chelicerae weaker (Fig. 108); palps weaker, subdistal bulge on ventral side of femur (Fig. 111) and proventral process on patella (Fig. 112) less developed.

Measurements. ♂ holotype (♀ in parentheses): body 6.25 (6.18) long, 3.56 (3.63) wide; carapace region 1.75 (1.53) long, 2.32 (2.15) wide. - Palp and legs:

	Tr	Fe	Pa	Ti	Mt	Ta	Total
Palp	0.74 (0.65)	1.63 (1.23)	1.01 (0.79)	0.64 (0.49)	- -	1.68 (1.38)	5.70 (4.54)
Leg I	0.67 (0.62)	2.03 (1.78)	1.04 (0.91)	0.89 (0.84)	1.80 (1.53)	0.49 (0.40)	6.92 (6.08)
Leg II	0.86 (0.79)	2.82 (2.47)	1.33 (1.19)	1.73 (1.51)	2.96 (2.42)	0.49 (0.40)	10.19 (8.78)
Leg III	0.69 (0.62)	1.75 (1.58)	1.01 (0.91)	0.89 (0.84)	1.88 (1.58)	0.49 (0.40)	6.71 (5.93)
Leg IV	0.89 (0.79)	2.47 (2.22)	1.43 (1.31)	1.63 (1.48)	3.06 (2.67)	0.59 (0.47)	10.07 (8.94)

Variation. Measurements of ♂ (of ♀ in parentheses): body 6.25-6.37 (5.88-6.67) long, 3.51-3.56 (3.41-3.98) wide; carapace region 1.75-1.78 (1.48-1.68) long, 2.17-2.32 (2.07-2.27) wide; ♂ (n = 2), ♀ (n = 7). The ♂ paratype has (like the ♀♀) a slightly more raised interocular area (Fig. 101) than the holotype. The cutting edges of its cheliceral hand appear less worn than in the holotype but they also carry no prominent teeth (Fig. 107).

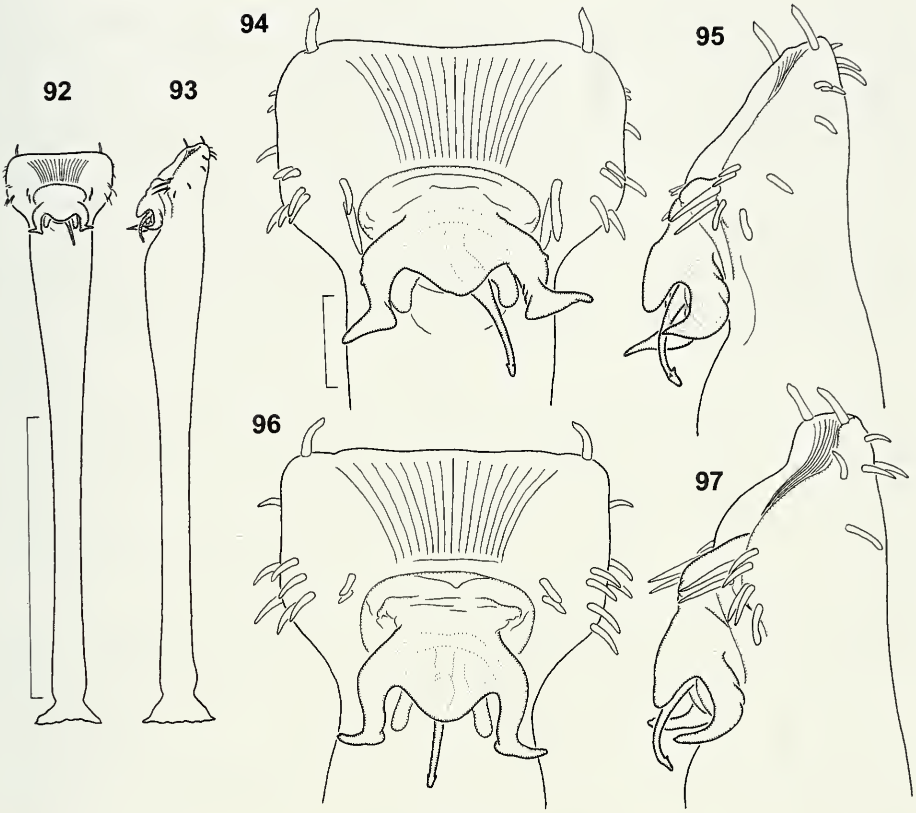
Remark. The right leg IV of the holotype is crippled; only a stump-like trochanter is present.

Relationships. External and genital characters show that *O. tiomanensis* sp. n. belongs to the *truncatus*-group and that it probably is more closely related to *O. truncatus* (more congruence in penis details) than to *O. lingga* sp. n.

Distribution. Known only from Tioman Island, off the southeastern coast of Peninsular Malaysia [Fig. 1 (11)].

Oncopus lingga sp. n. Figs 113-131

Material. INDONESIA, Riau Province, Lingga Archipelago, Lingga Island, near waterfall ca. 7 km N of Daik (0°08'53.3"S, 104°36'13.2"E), 60 m, ♂ holotype (MHNG), leg. P. J. Schwendinger, 15.VI.2001; Singkep Island, Batu Ampar Waterfall, ca. 10 km NW of Dabo (0°29'30.9"S, 104°28'31.4"E), 80 m, 2 ♀ paratypes, 2 juveniles (MHNG), leg. P. J. Schwendinger, 17./18.VI.2001.



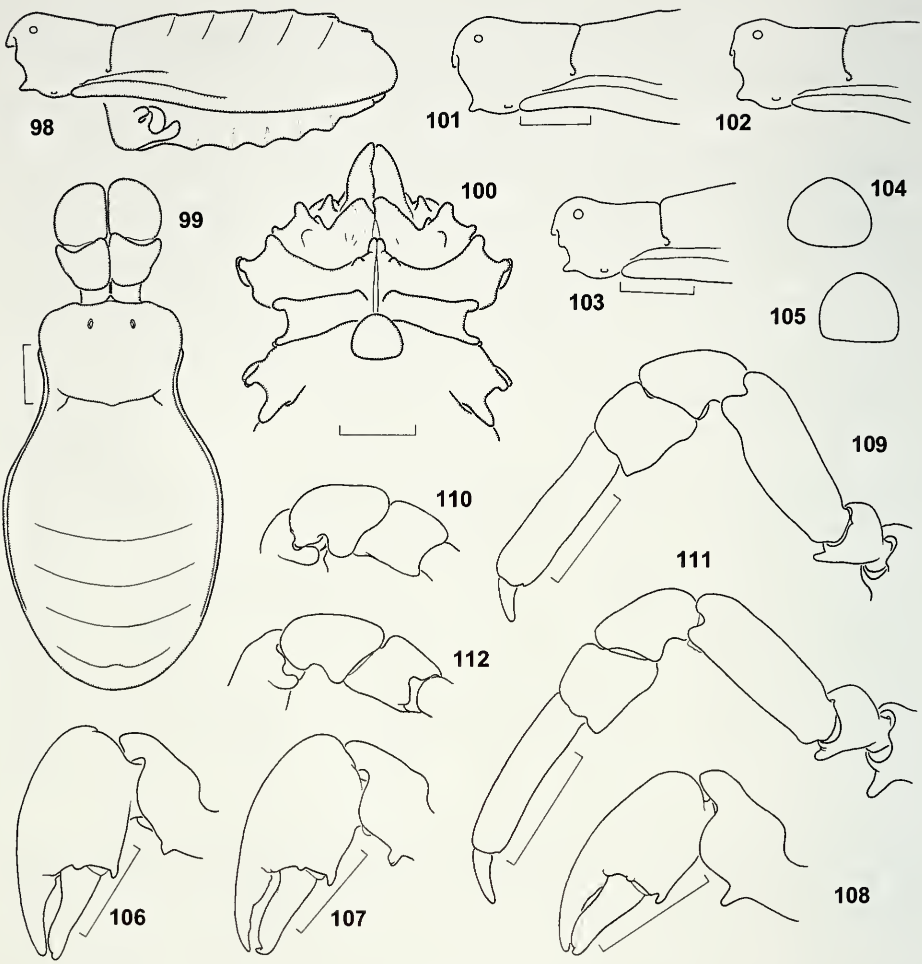
Figs 92-97

Oncopus tiomanensis sp. n.: ♂ holotype (92-95); ♂ paratype (96, 97). - Penis, dorsal (92) and lateral view (93); apex of penis, dorsal (94, 96) and lateral view (95, 97). - Scale lines 1.0 mm (92, 93), 0.1 mm (94-97).

Etymology. The specific epithet (a noun in apposition, hence invariable) refers to the archipelago in which the new species occurs.

Diagnosis. Close to *O. truncatus*, distinguished by: mobile finger of cheliceral hand ventrally with low mound instead of prominent tooth, dorsal and ventral proximal tubercles on leg II and IV smaller, tubercle near distal margin of genital operculum smaller. ♂ with more elevated interocular area, without subdistal ventral bulge on palpal femur, with stronger proventral process on palpal patella, and with large rounded tooth on cutting edge of mobile cheliceral finger situated more distally than tooth on cutting edge of fixed finger. Penis distinguished by two terminal setae on each side of distal margin; glans with wide, W-shaped median plate.

Description. ♂ (holotype). Coloration: body amber, with dark margin around dorsal scutum and dark transversal bands on its opisthosomal elevations (medially connected by dark transversal stripe); dark reticulations in carapace region and on chelicerae (proximal article darker than hand); legs and palps dark amber, except for light amber tarsi and distal part of metatarsi.



FIGS 98-112

Oncopus tiomanensis sp. n.: ♂ holotype (98-100, 106, 109-110); ♂ paratype (101, 104, 107); 2 ♀ paratypes (102, 103, 105, 108, 111, 112). - Body, lateral (98) and dorsal view (99); anterior part of body, ventral (100) and lateral view (101-103); genital operculum (104, 105); left chelicera, retrolateral view (106-108); left palp, retrolateral view (109, 111); patella and tibia of left palp, prolateral view (110, 112). - All scale lines 1.0 mm.

Carapace large and elevated, interocular area a low rounded hump (Fig. 117). Opisthosomal areas of dorsal scutum indistinctly keeled, with indistinct longitudinal median keel extending over anterior areas and with pair of paramedian tubercles on areas V-VII (increasing in size towards rear) (Fig. 118); areas of ventral scutum strongly keeled, with indistinct transversal bands of white enclosures (Fig. 117). Palpal coxa with large ventral process; ventral side of leg coxa I with anterolateral and central processes; coxa II with scale-like anteroproximal apophysis and rounded process posterior to it; coxa III with triangular anteroproximal process. Genital operculum distinctly longer than wide, with small tubercle near anterior margin (Fig. 119).

Chelicerae (Figs 124, 125) massive; proximal article with two-headed retroventral tubercle and anteriad-inclined prodorsal boss; second article with small ventrodistal tubercle, mobile finger with indistinct ventral hump on proventral face; large rounded tooth on cutting edge of mobile finger situated more distally than large conical tooth on cutting edge of fixed finger.

Palps (Figs 128-130) robust; trochanter with small ventral process; femur unarmed; patella with large subquadrangular proventral process (Figs 129, 130); tibia short, with low retroventral process near its base; tarsus subdistally widened (Fig. 128).

Legs 3142; femur II with dorsoproximal and femur IV with ventroproximal tubercle.

Penis (Figs 113-116): truncus fairly slender, with subbasal constriction, continually widening in distal half, slightly constricted at height of glans, widened at apex; distal margin straight, with two setae on each side. Glans penis narrower than truncus at that point; lateral sclerites pointed, bent outwards and away from the truncus; median plate wide, indistinctly W-shaped; membranous tubes long, distinctly protruding beyond median plate.

♀. As the ♂, but smaller, carapace region less elevated and shorter, ventral scutal areas less elevated (Figs 120, 123); chelicerae weaker, teeth on their cutting edges smaller (Figs 126, 127); ventral side of palpal femur with small proximal process and indistinct subdistal bulge, patella with smaller proventral process (Fig. 131); legs 3124.

Measurements. ♂ holotype (♀ in parentheses): body 7.93 (7.00) long, 4.75 (4.04) wide; carapace region 2.75 (1.98) long, 3.30 (2.47) wide. - Palp and legs:

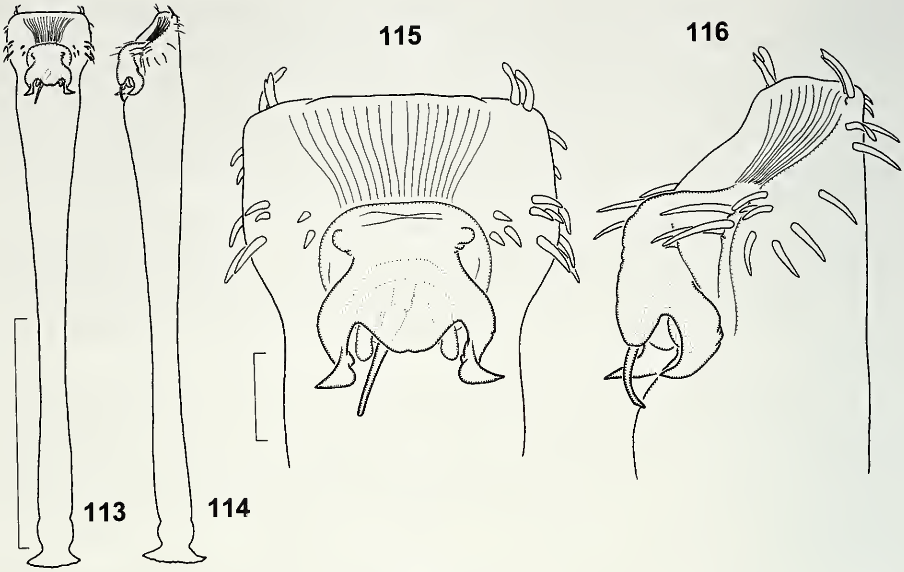
	Tr	Fe	Pa	Ti	Mt	Ta	Total
Palp	1.17 (0.80)	2.72 (1.54)	1.48 (0.93)	1.08 (0.68)	- -	2.28 (1.60)	8.73 (5.55)
Leg I	0.86 (0.68)	3.02 (2.10)	1.30 (1.64)	1.33 (1.64)	2.62 (1.82)	0.52 (0.40)	9.65 (8.28)
Leg II	1.17 (0.80)	3.95 (2.90)	1.73 (1.36)	2.41 (1.79)	4.01 (2.80)	0.49 (0.43)	13.76 (10.08)
Leg III	0.86 (0.74)	2.41 (1.88)	1.36 (1.08)	1.23 (0.99)	2.69 (1.94)	0.56 (0.52)	9.11 (7.15)
Leg IV	1.17 (0.93)	3.27 (2.59)	1.94 (1.48)	2.31 (1.82)	3.55 (3.15)	0.49 (0.56)	12.73 (10.53)

Variation. The second ♀ measures: body length 7.19, width 4.16; carapace length 1.98, width 2.59.

Remarks. As the ♀♀ examined are clearly smaller than the ♂ holotype and were collected from a different island, it is possible that they are not conspecific. On the other hand, they appear to be sufficiently distinct from ♀♀ of *O. truncatus* and therefore we regard them as belonging to *O. lingga* sp. n.

The ♂ holotype was collected immediately after its final moult (when the body was still unpigmented) and then kept in captivity for a few weeks; its cheliceral cutting edges and palpal claws therefore show no signs of wear.

Living mature specimens have a clearly visible white membrane dorsally between the proximal and second cheliceral article (Figs 118, 121), though this becomes less distinct in alcohol.



FIGS 113-116

Oncopus lingga sp. n.: ♂ holotype. - Penis, dorsal (113) and lateral view (114); apex of penis, dorsal (115) and lateral view (116). - Scale lines 1.0 mm (113, 114), 0.1 mm (115, 116).

Relationships. The new species is most closely related to *O. truncatus.* Both species share a similar penis morphology and a very similar external morphology (e.g., short palpal tibia; pronounced proventral process on palpal patella of males; subdistal ventral bulge on palpal femur of females; dorsoproximal and ventroproximal tubercle on femur of leg II and IV, respectively; anterior tubercle on genital operculum). *Oncopus tiomanensis* sp. n. is phylogenetically more distant from *O. lingga* sp. n.

Distribution. Known only from two islands (separated from each other by less than 10 km) south of the Malayan Peninsula [Fig. 1 (14, 15)]. This species and a presumably undescribed one from southern Kalimantan (see "Unidentified material") are the only *Oncopus* occurring south of the equator.

THE *DORIAE*-GROUP

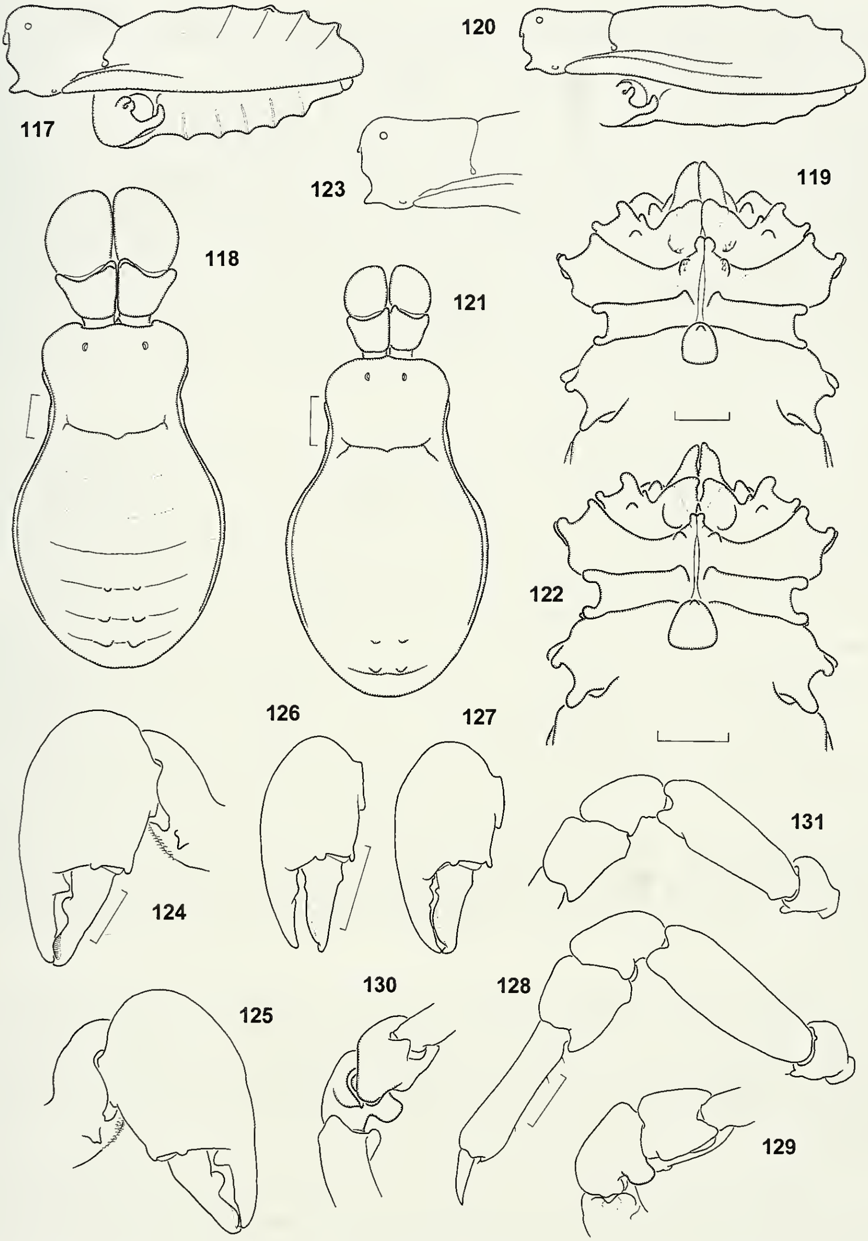
Diagnosis. See diagnosis of *O. doriae.*

At present this species group contains only a single species, *O. doriae*, from the western part of Sarawak. This species appears to be more closely related to the *feae*-group and the *truncatus*-group from the Malayan Peninsula and nearby islands than to congeners from northeastern Borneo.

Oncopus doriae Thorell, 1876 Figs 132-151

Oncopus doriae Thorell (1876: 135-138); description of ♀. - Thorell (1891: 764-765, figs 31-36). - Pocock (1897: 288). - Roewer (1923: 57-58, fig. 60). - Bristowe (1976: 9). - Sørensen (1932: 209). - Schwendinger (1992: 197).

Oncopus alticeps Pocock (= *O. feae* Thorell). - Roewer (1923: 60); misidentification of specimen SMF 1261.



FIGS 117-131

Oncopus lingga sp. n.: ♂ holotype (117-119, 124, 125, 128-130); 2 ♀ paratypes (120-123, 126, 127, 131). - Body, lateral (117, 120) and dorsal view (118, 121); anterior part of body, ventral (119, 122) and lateral view (123); left chelicera (124), right chelicera (125) and left cheliceral hand (126, 127), retrolateral view; left palp (128) and trochanter to tibia of left palp (131), retrolateral view; patella and tibia of left palp, prolateral view (129); patella and tibia of right palp, retroventral view (130). - All scale lines 1.0 mm.

Types. MALAYSIA (east), Sarawak, 1 ♀, 1 juvenile syntypes (MSNG, examined), leg. G. Doria & O. Beccari, 1866; ♀ here designated lectotype in order to preserve stability of nomenclature.

Other material. MALAYSIA (east), Sarawak, Santubong, 32 km N of Kuching, 0-100 m, 1 ♂, 1 ♀, 2 juveniles (MHNG), leg. I. Löbl & D. Burckhardt, 11.-16.V.1994; Gunung Santubong (south end), 1 ♀ (California Academy of Science), leg. J. E. Tobler, 15.IV.1970; Batu Lundu (presumably near Lundu), 1 ♀ (SMF 540/5) with label "*Oncopus doriae* Thorell, 1 Exempl., Roewer det. 1927", no name of collector, no date; Gunung Gading National Park, 300 m, NW of Lundu, 1 juvenile (MHNG), leg. S. Kurbatov, 18.X.2001; Gunung Serapi (near Matang), 320 m, 1 juvenile (MHNG), leg. B. Hauser, 9.XII.1987; Bako National Park, 2 juveniles (CCD), leg. C. Deeleman-Reinhold & P. Deeleman, 29./30.III.1985; Bako N. P., 1 juvenile (MAR), leg. A. Riedel, 27.III.1990; Balai Ringin, 40 km E of Serian, 1 juvenile (CCD), leg. C. Deeleman-Reinhold, 7.IV.1985; Gunung Penrissen, 1000 m, 2 juveniles (MHNG), leg. I. Löbl & D. Burckhardt, 23.V.1994. - THAILAND, without exact locality (dubious record), 1 ♂ (SMF 1261), fragmented specimen, with label "*Oncopus alticeps* Pocock, Siam, 1 ♂, Roewer det. 1914", no name of collector, no date.

Diagnosis. Distinguished by: interocular area forward-inclined; pair of paramedian tubercles projecting beyond posterior margin of dorsal scutum; palpal coxa with two ventral processes; mobile finger of chelicerae in ♂♂ with transversal ledge and wide ventroproximal boss; palpal femur with subdistal ventral process; penis with very large, paddle-shaped apex carrying two setae on each side of distal margin, lateral sclerites of glans distally widening, median plate long, V- or narrowly U-shaped.

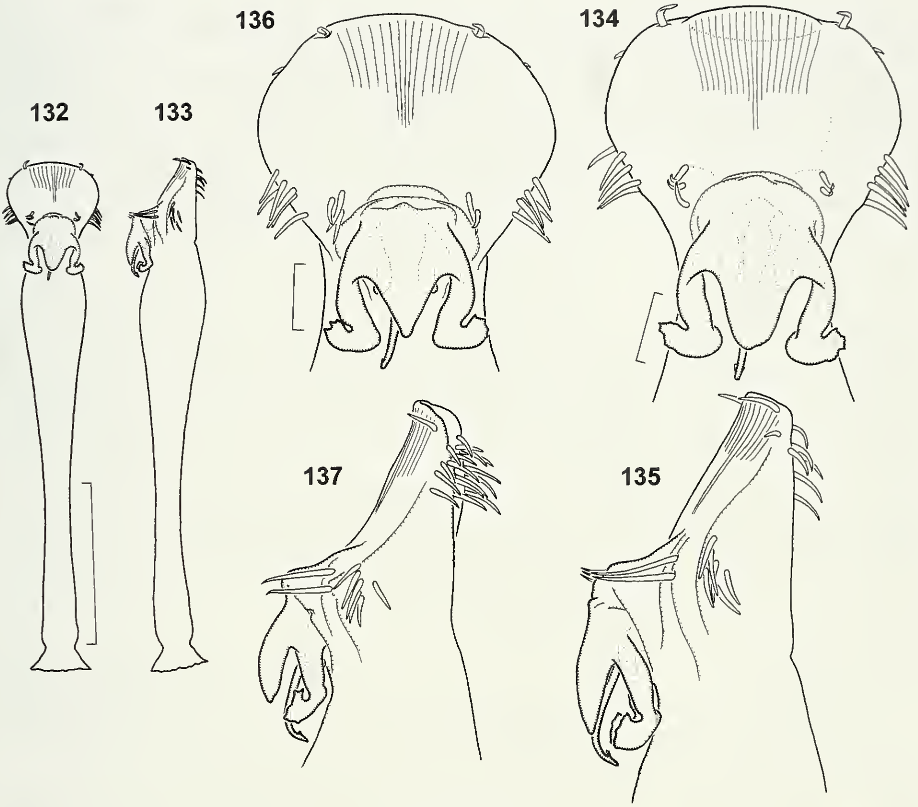
Redescription. Large species (7.1-8.4 mm long). Carapace region of dorsal scutum in ♂♂ (Fig. 138) arched and more elevated than in ♀♀ (Fig. 141), with forward-inclined interocular area, rounded in ♂♂ (Figs 138, 139), more pointed in ♀♀ (Figs 141-143); opisthosomal region of dorsal scutum with indistinct longitudinal median keel extending over areas I-III (Fig. 142) and with small paramedian pairs of tubercles on areas VI-VIII, the last pair clearly projecting beyond the posterior scutal margin (Figs 138, 139, 141, 143); palpal coxa with two pointed ventral tubercles on moderately developed common socket; leg coxa II with scale-like anteroproximal apophysis, process posterior to it developed as a hump (strongly elevated in ♂♂) gradually sloping down to the posteroproximal corner, the latter without process; anteroproximal process on coxa III indistinct; genital operculum longer than wide (Fig. 140).

Chelicerae robust, in ♂♂ (Figs 144, 145) stronger than in ♀♀ (Figs 146, 147), with rounded retroventral tubercle on first article; ventral side of second cheliceral article with strong distal process; mobile finger of chelicera in ♂♂ with broad ventral hump and with pronounced transversal ledge in proximal half of retrolateral side (Figs 144, 145; both characters absent in ♀♀); cutting edge of cheliceral fingers without marked teeth.

Pedipalps (Figs 148-151) with quite long, pointed ventral process on trochanter, with small proximal and small subdistal process on ventral side of femur (weaker in ♂♂, Figs 148, 149), and with small retroventral hump on tibia; no proventral process on palpal patella.

Legs: femur of leg II with small prodorsal proximal tubercle, femur IV without ventral tubercle.

Penis (Figs 132-137) fairly slender, gradually widening towards the apex, with constriction at height of glans; apex exceptionally long, widely paddle-shaped, with

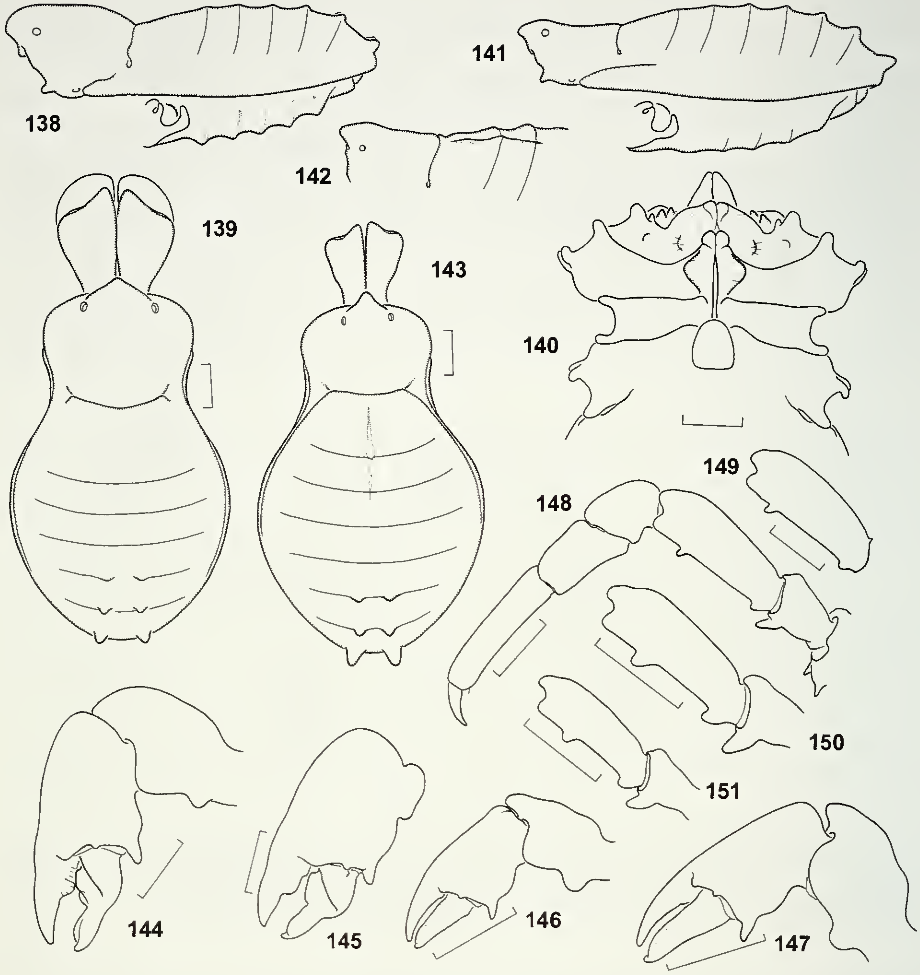


FIGS 132-137

Oncopus doriae Thorell: ♂ from Gunung Santubong (132-135); ♂ labelled as originating from Siam (136, 137). - Penis, dorsal (132) and lateral view (133); apex of penis, dorsal (134, 136) and lateral view (135, 137). - Scale lines 1.0 mm (132, 133), 0.1 mm (134-137).

broadly rounded distal margin carrying two setae on each side (distal seta arising from distal edge of truncus, more proximal seta originating from distoventral side close to edge; Figs 134, 136); glans about as wide as truncus at that point, flanked by two to three setae on each side; lateral sclerites broad, bent outwards and away from the truncus, with broadly truncate, dentate tips; median plate long and narrow, V-shaped (Fig. 136) or tongue-shaped (Fig. 134); membranous tubes short, not or only slightly protruding below median plate.

Variation. Measurements (♂, in parentheses ♀): body 7.92-8.39 (7.08-8.17) long, 4.88-5.25 (4.35-4.91) wide; carapace region 2.83-3.11 (1.93-2.27) long, 3.32-3.66 (2.48-3.07) wide; ♂ (n = 2), ♀ (n = 4). In 2 ♀ (including the lectotype) and both ♂♂ examined the median longitudinal keel on opisthosomal areas I-III is discernible in dorsolateral view (Fig. 142), in the other specimens it is not. The genital operculum of the ♀ lectotype and of one ♂ (Fig. 140) is slightly longer than wide, in the other specimens it is as wide as long or slightly wider than long. The proventral process on



FIGS 138-151

Oncopus doriae Thorell: ♀ lectotype (141-143, 147, 150); ♀ (146, 151) and ♂ (138-140, 144, 148) from Gunung Santubong; ♂ labelled as originating from Siam (145, 149). - Body, lateral (138, 141) and dorsal view (139, 143); anterior part of body, ventral (140) and dorsolateral view (142); left chelicera (144, 146, 147) and left cheliceral hand (145), retrolateral view; left palp (148), trochanter and femur (150, 151) of left palp, femur (149) of left palp, retrolateral view. - All scale lines 1.0 mm.

palpal coxa is either pointed and as long as the retrolateral one, or shorter and more rounded.

Relationships. O. doriae is very distinct from all other congeners and its relationships are not clear. Judging from penis morphology, it appears that this species is more closely related to the *feae*-group (closest to *O. feae*) and to the *truncatus*-group than to *O. hosei* and *O. megachelis*.

Distribution. This species is quite widely distributed in the western part of Sarawak [Fig. 1 (17-22)]. The types presumably originate from near Kuching. Beccari and Doria collected together in this area until Doria had to return to Italy (because of deteriorating health) in March 1866 (Beccari, 1904). The ♂ with the locality label "Siam" (written by Roewer) undoubtedly belongs to *O. doriae*, but it is very unlikely that this species occurs in western Sarawak and in Thailand and seemingly nowhere else in between. Therefore we assume that Roewer has added an incorrect label (see also the paragraph "Distribution" under *O. expatriatus* sp. n.).

THE *HOSEI*-GROUP

Diagnosis. Large species (7.0-9.5 mm body length) characterized by penis morphology: distal margin of truncus sinuate, with single terminal seta on elevated socket on each side; subdistal lateral setae arranged in one or two recurved rows; lateral sclerites of glans basally with knee-like lateral projections (as seen in dorsal view); median plate very wide.

This species group contains three species (*O. hosei*, *O. megachelis*, *O. expatriatus* sp. n.), presumably all from the northeastern part of Borneo (record of *O. expatriatus* sp. n. from Thailand dubious). Relationships remain unclear; in penis morphology these species are very distinct from all other congeners.

Oncopus hosei Pocock, 1897 Figs 152-158

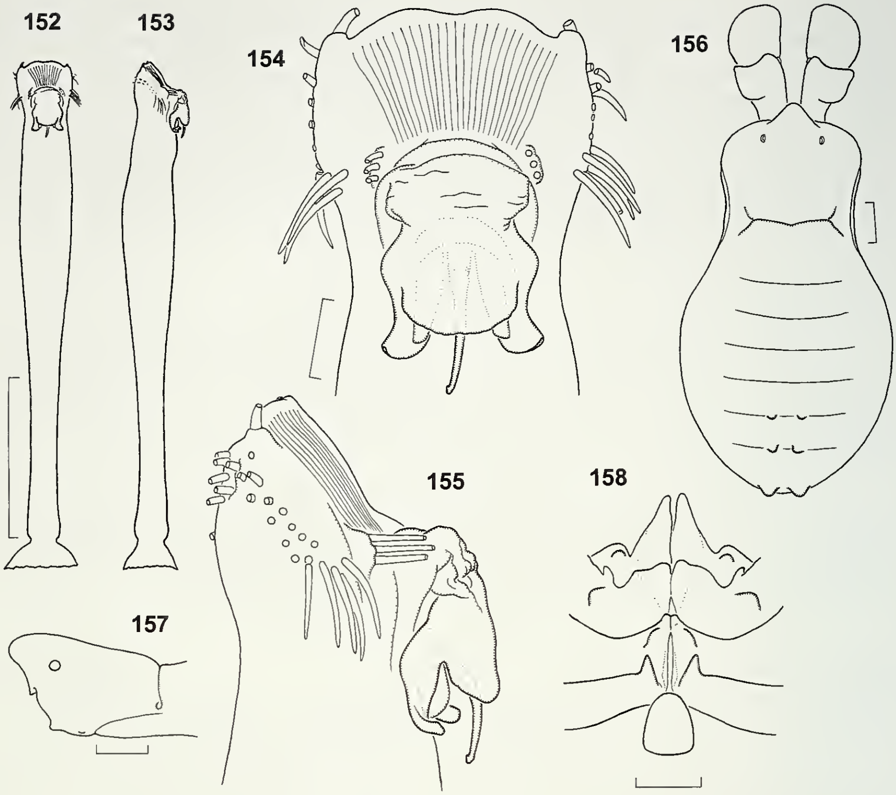
Oncopus hosei Pocock (1897: 285-287, fig. 1); description of ♂. - Roewer (1923: 59, fig. 61). - Bristowe (1976: 9). - Schwendinger (1992: 194-196, figs 98-101).

Type. MALAYSIA (east), Sarawak, Baram, ♂ holotype (NHML 1895.10.15, examined), leg. C. Hose, collected before 1895.

Other material. MALAYSIA (east), Sarawak, Lambir Hills National Park, south of Miri, 1 juvenile (MHNG), leg. S. Kurbatov, 11.-13.X.2001.

Diagnosis. Distinguished by: interocular area strongly forward-inclined; carapace region fairly low (clearly lower than in ♂♂ of *O. doriae*); paramedian tubercles on opisthosomal area VIII situated close to each other and projecting beyond posterior margin of dorsal scutum; anteroproximal process on coxa III long; mobile finger of chelicera without ventral tubercle; palpal femur without ventral process; truncus penis with one terminal seta on prominent socket on each side of distal margin, subterminal lateral setae arranged in two recurved rows; glans penis with widely rounded median plate and truncate lateral sclerites with bases bulged laterally.

Redescription. Large species (dorsal scutum of ♂ holotype 9.5 long, 5.2 wide; carapace region 2.8 long, 3.4 wide) with fairly slender body (Fig. 156). Carapace region only moderately raised, interocular area distinctly forward-inclined (Fig. 157); opisthosomal areas VI-VIII with paired paramedian tubercles, posterior ones largest, situated close to each other and projecting beyond posterior scutal margin (Fig. 156). Palpal coxa with low, rounded ventral process; leg coxa II with indistinct anteroproximal apophysis (as in *Gnomulus* species), process posterior to it developed as low bulge, posteroproximal process absent; anteroproximal process on coxa III long, pointed, triangular; genital operculum distinctly longer than wide (Fig. 158).



FIGS 152-158

Oncopus hosei Pocock: ♂ holotype. - Penis, dorsal (152) and lateral view (153); apex of penis, dorsal (154) and lateral view (155); body, dorsal view (156); anterior part of body, lateral view (157) and ventral view (158, showing only central portion). - Scale lines 1.0 mm (152, 153, 156-158), 0.1 mm (154, 155).

Chelicerae (see Schwendinger, 1992: fig. 100) robust, with low, domed retroventral process on proximal article, a small distoventral one on second article, none on mobile finger.

Palp (see Schwendinger, 1992: fig. 101) with small pointed ventral process on trochanter and with low ventroproximal hump on tibia, no process on femur.

Legs: femur of leg II with distinct dorsoproximal tubercle.

Penis (Figs 152-155): truncus fairly slender, with sinuate distal margin carrying one lateral seta on each side, each seta raised on small mound; subterminal lateral setae arranged in two more or less clearly outlined recurved rows; glans penis narrower than truncus at that point, its membranous base rounded, flanked by three setae on each side; median plate widely rounded, not covering tips of long membranous tubes; lateral sclerites with wide, rounded bases bulged sideward like “knees” and with truncate tips bent away from truncus.

Remarks. The holotype (with a pin running through its longitudinal axis) has a brittle cuticle and shows an unusually dark coloration (mentioned by Schwendinger, 1992: 194). This is possibly the result of an unusual preservation method.

The juvenile specimen is quite similar to the holotype (different only in interocular area less forward-inclined and anteroproximal process on coxa III shorter), but shows a normal (amber) coloration.

Relationships. Penis morphology shows a close relationship between *O. hosei* and *O. megachelis*. The penis of both species differ only in relatively minor details, i.e. *O. hosei* has a stouter truncus with a wider, laterally more rounded apex and narrower, distally more divergent, apically rounded lateral sclerites (Fig. 154, cf. Fig. 159).

Distribution. Known from the type locality, somewhere along the Baram River {possibly near Kuala Baram [Fig. 1 (25)]}, and from the Lambir Hills N. P. [Fig. 1 (24)], both in the northeastern part of Sarawak.

Oncopus megachelis Schwendinger, 1992 Figs 159-161

Oncopus megachelis Schwendinger (1992: 192-194, figs 81-90); description of ♂.

Types. MALAYSIA (east), Sabah, Sandakan Residency, Sepilok, Kabili-Sepilok Forest Reserve, 40 m, ♂ holotype, juvenile paratype (both in MHNG, examined), leg. B. Hauser, 10.V.1982.

Diagnosis. Large species (8.1 mm body length), similar to *O. hosei*, distinguished by: interocular area more rounded (Fig. 160); no paramedian tubercles on opisthosomal area VIII of dorsal scutum; genital operculum wider than long (Fig. 161); palpal femur with small ventroproximal process; penis stouter, its subterminal lateral setae mostly arranged in one recurved row (a few setae in the middle in two rows); lateral sclerites of glans penis narrower, more strongly bent outwards, distally rounded, bases more distinctly knee-shaped (Fig. 159).

Relationships. This species is most closely related to *O. hosei.*

Distribution. Known only from the type locality, in the eastern part of Sabah [Fig. 1 (26)].

Oncopus expatriatus sp. n. Figs 162-171

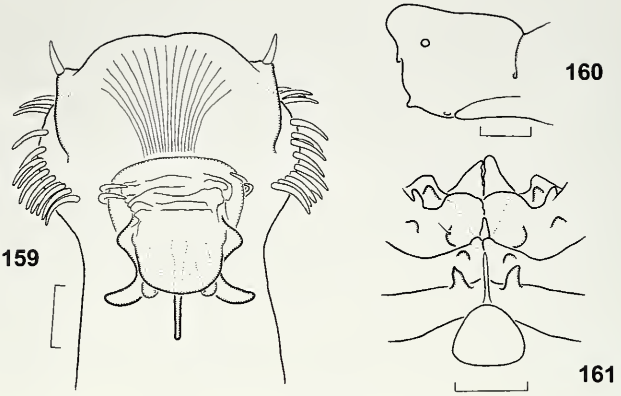
Material. THAILAND, near Bangkok (dubious record), ♂ holotype (SMF 8658/13) with label reading "*Pelitnus alticeps* Pocock, 1 ♂, Siam: bei Bangkok, Roewer det. 1940", no name of collector, no date.

Etymology. Latin participle: *expatriatus* = expatriate. The specific epithet refers to the questionable origin of the holotype.

Diagnosis. Similar to *O. megachelis*, distinguished by: interocular area less protruding; anteroproximal process of leg coxa III distinctly smaller; truncus penis stouter, slightly constricted in its middle portion, its subterminal lateral setae arranged in two rows; glans penis shorter, its lateral sclerites more strongly bent upwards and with more strongly bent knee-shaped lateral bases, its median plate with straight distal margin and strong lateral teeth.

Description. ♂ (holotype). Coloration (faded): body light amber throughout, with slightly darker markings on dorsal scutum.

Carapace region of dorsal scutum large and raised, interocular area a low rounded hump (Fig. 166). Opisthosomal areas of dorsal scutum indistinctly keeled,



Figs 159-161

Oncopus megachelis Schwendinger: ♂ holotype. - Apex of penis, dorsal view (159); anterior part of body, lateral (160) and ventral view (161, showing only central portion). - Scale lines 0.1 mm (159), 1.0 mm (160, 161).

with pairs of small paramedian tubercles on areas VII and VIII, posterior pair slightly protruding from posterior margin of scutum (Figs 166, 167); ventral scutal areas distinctly keeled, with transversal bands of white enclosures (Fig. 166). Palpal coxa with long, digitiform ventral process; ventral side of leg coxa I with distinct anterolateral and indistinct central processes; coxa II with small scale-like trapezoidal anteroproximal apophysis and with small conical process posterior to it; coxa III with small anteroproximal process. Genital operculum rounded, longer than wide (Fig. 168).

Chelicerae (Figs 169, 170) strong; proximal article with small, rounded retroventral tubercle and anteriad-inclined prodorsal boss (Fig. 170); second article with small ventrodistal tubercle, mobile finger without ventral process; cutting edge of mobile finger with conical tooth fitting between two teeth on cutting edge of fixed finger.

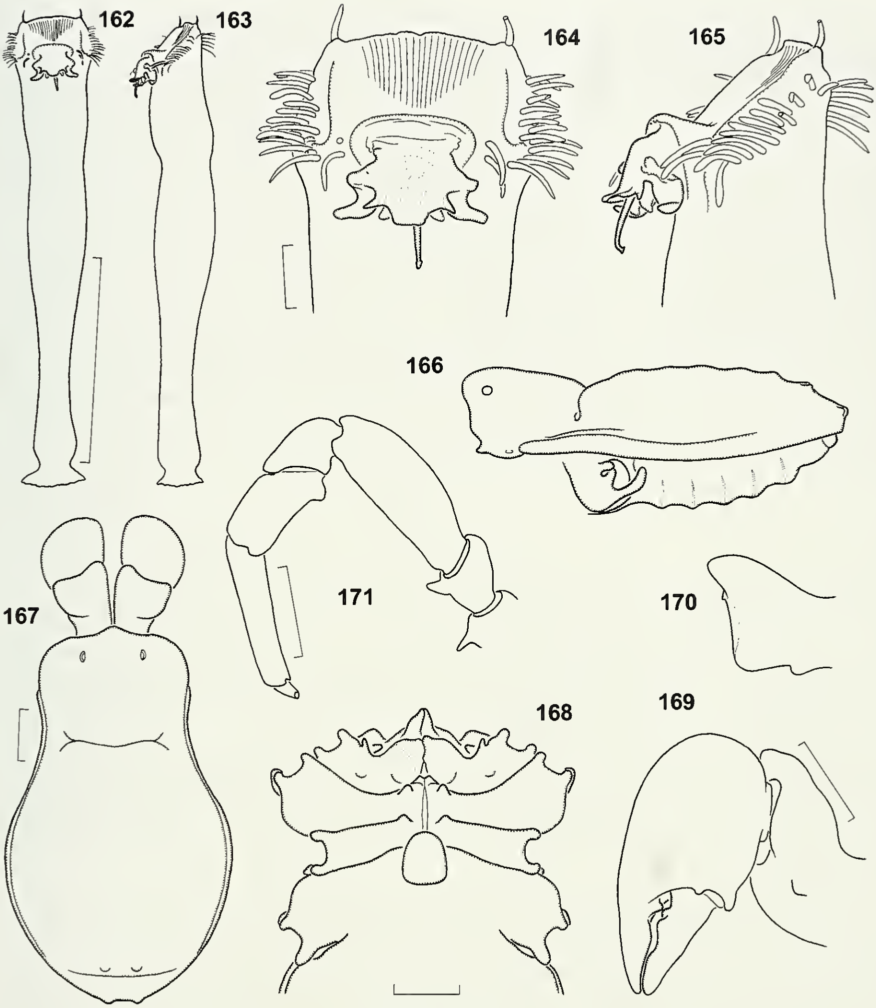
Palps (Fig. 171): trochanter with strong, distad-inclined ventral process; femur with only an indistinct ventrobasal hump, otherwise unarmed; patella without proventral process; tibia with quite large retroventral proximal process.

Legs 3124; femur II with dorsoproximal tubercle; only a low rounded hump ventroproximally on femur IV.

Penis (Figs 162-165): truncus remarkably stout, more or less continually widening from base to apex, slightly constricted after the proximal two-thirds, with subterminal lateral setae arranged in two irregular recurved rows; distal margin of truncus straight, each side with one terminal seta raised on low socket. Glans penis quite short, much narrower than truncus at that point, flanked by two setae on each side; lateral sclerites bent outwards and away from truncus, their wide bases strongly protruding laterally, their apices truncate; median plate with straight distal margin and with pair of strong lateral teeth; membranous tubes distinctly protruding beyond median plate.

♀. Unknown.

Measurements. ♂ holotype: body 7.04 long, 4.28 wide; carapace region 2.26 long, 2.83 wide. - Palp and legs:



FIGS 162-171

Oncopus expatriatus sp. n.: ♂ holotype. - Penis, dorsal (162) and lateral view (163); apex of penis, dorsal (164) and lateral view (165); body, lateral (166) and dorsal view (167); anterior part of body, ventral view (168); left chelicera (169) and left palp (171), retrolateral view; proximal article of left chelicera, retrodorsal view (170). - Scale lines 1.0 mm (162, 163, 166-171), 0.1 mm (164, 165).

	Tr	Fe	Pa	Ti	Mt	Ta	Total
Palp	0.89	1.77	0.93	0.79	-	1.77	6.15
Leg I	0.74	2.41	1.08	1.13	2.21	0.49	8.06
Leg II	0.93	3.20	1.43	1.87	3.27	0.34	11.04
Leg III	0.79	1.92	1.18	1.13	2.34	0.49	7.85
Leg IV	0.98	2.56	1.62	1.87	3.69	0.54	11.26

Remarks. The holotype has been pinned through its prosoma (not indicated in Fig. 167), but is otherwise in perfect condition.

According to Roewer's substitute label of 1940 (Roewer replaced many original labels in his collection), the holotype was collected near Bangkok, but we strongly doubt if this is correct. If so, this would be the only *Oncopus* specimen ever found in Thailand (not considering the obviously incorrectly labelled ♂ of *O. doriae* in Roewer's collection; see paragraph "Distribution" in the treatment of *O. doriae*), about 900 km away from the closest locality of another *Oncopus* (i.e. *O. feae* on Penang Island). No indication is given as to when the type was collected and by whom, and Roewer was notorious for giving inaccurate localities (see Helversen & Martens, 1972). On the other hand, strong similarities in the penes of *O. expatriatus* sp. n., *O. hosei* and *O. megachelis* indicate a close relationship between these three species, and therefore we assume that *O. expatriatus* sp. n. actually occurs in northern Borneo. We speculate that Roewer possibly has received the type from the collection of Stanley Flower, who was working at the Royal Museum of Bangkok and who also collected the type of *O. alticeps* (here placed in the synonymy of *O. feae*) (see Pocock, 1897: 287). No confirmation of this was found among Roewer's documents in the SMF (P. Jäger, pers. commun.). There is, however, an entry for this specimen (serial number 8658, tube number 13) in the collection files of Roewer, in which "Borneo" (in blue ink, as for other entries on the same page) was overwritten by "Siam" (in black ink).

In the case that the holotype of *O. expatriatus* sp. n. really originates from near Bangkok, then there is little hope that the corresponding population of this species still exists there today. Leaf litter sifting in semi-evergreen rainforest in the lowland and lower montane rainforest (terminology according to Whitmore, 1991) of Khao Yai National Park (about 90 km NE of Bangkok; the most promising locality to find oncopodids in this area) by I. Löbl & D. Burckhardt and by P.J. Schwendinger has revealed the presence of *Gnomulus*, but not of *Oncopus* (see Schwendinger & Martens, 2002: 107).

Relationships. Congruencies in genital morphology (terminal setae of truncus penis resting on sockets; subdistal lateral setae arranged in one or two curved rows; glans penis with a very wide median plate and with laterad-directed "knees" at the base of the lateral sclerites) and in external morphology (i.e. indistinctly developed antero-proximal apophysis on ventral side of leg coxa II; no ventral process on mobile finger of chelicerae) indicate a close relationship between *O. expatriatus* sp. n. and the sister species *O. megachelis* and *O. hosei.*

Distribution. According to its dubious label data, the holotype of *O. expatriatus* sp. n. was found in central Thailand [Fig. 1 (1)]. Morphological characters, however, indicate that this species actually occurs on Borneo (see remarks above).

UNIDENTIFIED MATERIAL

MALAYSIA (peninsula), Pahang, Bukit Charas [Fig. 1 (10)], 60 m, near Panching, 30 km NW of Kuantan, 1 juvenile (MHNG), leg. P.J. Schwendinger, 8.VII.2001. This specimen possibly belongs to *O. malayanus* sp. n.

MALAYSIA (east), Sarawak, confluent of Suan Oyan and Mujong rivers [Fig. 1 (23)], 150m, east of Kapit, 1 juvenile (MHNG), leg. I. Löbl & D. Burckhardt, 19.V.1994. This quite small specimen does not show the characteristics of *O. doriae* and of *O. hosei*; it possibly belongs to an undescribed species.

INDONESIA, Kalimantan, East Kalimantan, from a degraded rainforest near Sepaku [Fig. 1 (28)], 40 km NNW of Balikpapan, 1 juvenile (MAR), leg. C. Deeleman, 2.-5.III.1980. This specimen is similar to juveniles of *O. doriae*, but it possesses no subdistal ventral process on the palpal femur.

INDONESIA, Kalimantan, East Kalimantan, Samarinda District, Sangasanga Muara [Fig. 1 (27)], 4 juveniles (ZMT), leg. P. Lehtinen. These specimens appear to be conspecific with the previous one.

INDONESIA, Sumatra, West Sumatra Province, off the road Pematangsiantar - Prapat, 18 km from Prapat [Fig. 1 (16)], 980 m, 1 juvenile (MHNG), leg. B. Hauser, 8.XI.1985. This is the only known record of *Oncopus* from Sumatra Island. In the course of that journey (Sum-85) B. Hauser also collected in Singapore, but a confusion of localities can be ruled out. This fairly large specimen from Sumatra is distinct from all other *Oncopus* juveniles examined in that it possesses a light median longitudinal stripe on the anterior part of the dorsal scutum, running from the carapace front margin to opisthosomal area III. No such pattern is present in the *O. truncatus* juveniles examined from Singapore. Some small juveniles of *O. doriae* (not all of them and not the large juveniles) also possess a median longitudinal stripe over the carapace region, but it is less pronounced, narrower and not extending onto the anterior opisthosomal areas.

DISCUSSION

TAXONOMIC CHARACTERS AND RELATIONSHIPS

Bristowe (1975) was so impressed by the external morphology of the *O. feae* ♀ he found on Penang Island that he proposed a new suborder, Oncopodines, for the family Oncopodidae. This was obviously done in ignorance of the fact that the same one-sided interpretation (not taking genitalia into consideration) of oncopodid morphology has earlier led Šilhavý (1961) to establish the suborder Oncopodomorphi. On the basis of plesiomorphic similarities in external morphology with the Cyphophthalmi, both authors considered the Oncopodidae as a primitive group at the base of the opilionid system. It was not until genital morphology in opilionids became better known that this view changed considerably. The studies of Martens and collaborators (Martens, 1976, 1980, 1986; Martens *et al.*, 1981) showed that oncopodids are actually a highly evolved branch within the Laniatores. This was corroborated by an analysis of morphological and molecular data by Giribet *et al.* (2002) and by our investigations on the penis morphology of all known oncopodid species (Schwendinger, 1992; Martens & Schwendinger, 1998; Schwendinger & Martens, 1999, 2002a, b and this paper).

Oncopus species possess several characters which seem to be apomorphic within the family, i.e. large body size, massive chelicerae with a ventral process on mobile finger, reduced "carapace-abdomen bridge", reduced number of leg tarsalia (1-1-1-1), scale-like anteroproximal apophysis on ventral side of leg coxa II, white enclosures in keeled elevations of ventral scutum in ♂♂, terminal setae on truncus penis, and proximad-directed glans penis. Therefore we consider *Oncopus* as a taxon that occupies an advanced position in oncopodid phylogeny, either as the sister group to *Gnomulus* or of *Caenoncopus* (see Schwendinger & Martens, 2002b: fig. 59).

Four species groups are here distinguished. The *feae*-group (*O. feae, O. malayanus* sp. n.) and the *truncatus*-group (*O. truncatus, O. tiomanensis* sp. n., *O. lingga* sp. n.) from the Malay Peninsula and nearby islands are closely related to each other, and both probably have a more distant relationship to *O. doriae* (*doriae*-group) from northwestern Borneo. The *hosei*-group (*O. hosei, O. megachelis, O. expatriatus* sp. n.) appears to be further apart from the other three species groups and sister to them.

Most species are clearly distinct in their penis morphology. Intraspecific variation in genital morphology of *O. truncatus* is considerable, and the penes of this species are only little different from those of *O. tiomanensis* sp. n. In external morphology, however, these species are clearly distinguishable and therefore we treat them as separate species.

We want to draw attention to the light enclosures embedded in the transversal keels of the ventral scutum in ♂♂ of some *Oncopus* species, which are not found in other oncopodids. These cuticular structures possibly have a similar function as the glandular setae of ♂♂ in some *Gnomulus* species (see Schwendinger & Martens, 1999: fig. 69a, b) and they deserve histological investigation.

Cheliceral teeth and palpal claws are strongly worn in old specimens (mature *Oncopus* are presumably long-lived), which indicates that chelicerae and palps are used for digging and for handling obstacles. The shape of the cutting edges of the cheliceral fingers is therefore only useful as a taxonomic character in "young" mature specimens.

ZOOGEOGRAPHY

The genus *Oncopus* occurs in Peninsular Malaysia, on Singapore Island, Sumatra and its islands to the east, and on Borneo. It obviously is restricted to the perhumid zone of the SE-Asian tropics and occurs roughly in between 6°N and 4°S. The two records from Thailand (one of them from near Bangkok and the other from an unspecified locality), based on 2 specimens from the collection of Roewer, are extremely dubious. No additional *Oncopus* specimens have since been collected in this country despite intensive leaf litter sifting in southern Thailand by various persons during recent years. Furthermore, the seasonally dry climate of central Thailand presumably does not meet the ecological requirements of this genus. We would, however, not be surprised if *Oncopus* is one day discovered in the most southern provinces of Thailand.

In contrast to the species-rich genus *Gnomulus*, syntopic occurrences of two or more *Oncopus* species are not known and probably do not exist. Previous records of sympatric *Oncopus* species on relatively small islands (*O. feae* and "*O. alticeps*" on Penang and *O. truncatus* and "*O. acanthochelis*" on Singapore) were long considered dubious, especially since the type of each "sympatric species" either belongs to the opposite sex or to a different postembryonic instar.

Ranges of distribution in *Oncopus* species seem to be fairly small (with the exception of *O. malayanus* sp. n.) and therefore we expect that several unknown species remain to be discovered; most likely so on Sumatra and in the southern part of Borneo from where juvenile specimens are already known.

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Colasidia wau, a new leleupidiine species from Papua New Guinea (Insecta, Coleoptera, Carabidae, Zuphiinae)

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***Colasidia wau*, a new leleupidiine species from Papua New Guinea (Insecta, Coleoptera, Carabidae, Zuphiinae). -** A new species of the leleupidiine genus *Colasidia* Basilewsky is described from Papua New Guinea: *C. wau* sp. n. The new species is most similar to *C. papua* Darlington, differing from it by even smaller eyes, narrower pronotum, and longer elytra. A key to all Australian-New Guinean species of *Colasidia* is provided.

Key-words: Coleoptera - Carabidae - Zuphiinae - Leleupidiini - *Colasidia* - new species - Papua New Guinea.

INTRODUCTION

Within a sample of specimens collected in central Papua New Guinea in 1992 by G. Cuccodoro of Geneva Museum, a single specimen of the genus *Colasidia* of the zuphiine tribe Leleupidiini was detected that is different from all described New Guinean species and, although it reminds *C. papua* Darlington in general shape and structure, it differs considerably from that species in body shape and size of eyes, and therefore is described as a new species. While working on the present paper, R. T. Bell (Burlington) sent me another *Colasidia* specimen for determination, collected by him in the same area in 1982, that turned out to belong to the same new species. As both specimens are males, the species identity is doubtless, although even in external structures the new species is different from all other known New Guinean *Colasidia*.

This paper is a supplement to my monograph of the Oriental-Australian species of the genus *Colasidia* (Baehr, 1997).

MATERIAL AND METHODS

Two specimens of the new species are available that were collected by different collectors but approximately at the same locality and at same altitude. The holotype was kindly presented by the collector to Zoologische Staatssammlung, München, and is presently located in the working collection of the author (CBM-ZSM). The paratype is in Muséum d'histoire naturelle, Genève (MHNG).

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For dissection of the male genitalia the specimens were soaked in a wet jar for one night, the genitalia were then cleaned for a short while in hot 4% KOH. For the description normal taxonomic methods were used. The description follows the style of my synoptic paper of the Oriental-Australian *Colasidia* (Baehr, 1997).

The habitus photograph was obtained using SPOT Advanced, version for Windows 3.5, and subsequently was worked using MS Corel Photo Paint 10.

Measurements were taken using a stereo microscope with an ocular micrometer. Length has been measured from apex of labrum to apex of elytra. Length of pronotum was measured along midline, width of base of pronotum at the extreme tips of the basal angles. Length of head was taken from apex of labrum to anterior border of "neck", length of orbit was likewise measured to anterior margin of "neck".

Colasidia Basilewsky, 1954

For information about taxonomy and distribution of the genus *Colasidia* see Baehr (1997: 613). From New Guinea four species were recorded so far: *C. madang* Darlington, *C. papua* Darlington, *C. kokodae* Baehr, and *C. garainae* Baehr (Darlington, 1971; Baehr, 1991, 1997, 2000a). Surprisingly, no *Colasidia* has been recorded from Irian Jaya so far, and even the records from Papua New Guinea are few and from a rather restricted range in the central part. Probably, this is mainly due to absolutely inadequate sampling of these litter- or even soil inhabiting tiny flightless beetles that are probably best sampled by sieving or Berlese extraction of litter and soil. Therefore, it is not too surprising, that one specimen of the new species was collected by staff of the Geneva Museum who is well known for its very successful sampling of litter and soil inhabiting tiny insects.

Almost all *Colasidia* from New Guinea (and Australia) are known from single specimens only which further demonstrates the rarity of these beetles and/or the little collecting efforts that were made. I suspect, however, that in New Guinea at least, distribution of these beetles is rather scattered, and that it would need enormous efforts to get a better picture of species inventory and distribution.

Colasidia wau sp. n. Figs 1, 2

Type material: Holotype: ♂, PAPUA NEW GUINEA Wau-Mt. Misim March 15, 1982 Coll. R. T. Bell / 1400 m /under stone / *Colasidia* nr. *madang* (CBM-ZSM).

Paratype: 1 ♂, PAPUA NG: Morobe above Wau 1450m, 21.V.1992 G. Cuccodoro #5b (MHNG)

Diagnosis: Medium sized, fairly elongate, piceous species, characterized by elongate, posteriorly markedly rounded head with fairly small eyes, rather elongate elytra with convex apical margin, and rather coarse and sparse, regularly arranged puncturation and pilosity; further distinguished from related species by the short, compact aedeagus having a moderately elongate, slightly upturned apex, and by presence of an elongate, folded sclerite in the internal sac.

DESCRIPTION

Measurements: Length: 4.75-4.80 mm; width: 1.60-1.62 mm. Ratios. Length/width of head: 1.64-1.65; length orbit/eye: 3.9-4.1; length/width of pronotum: 1.16-

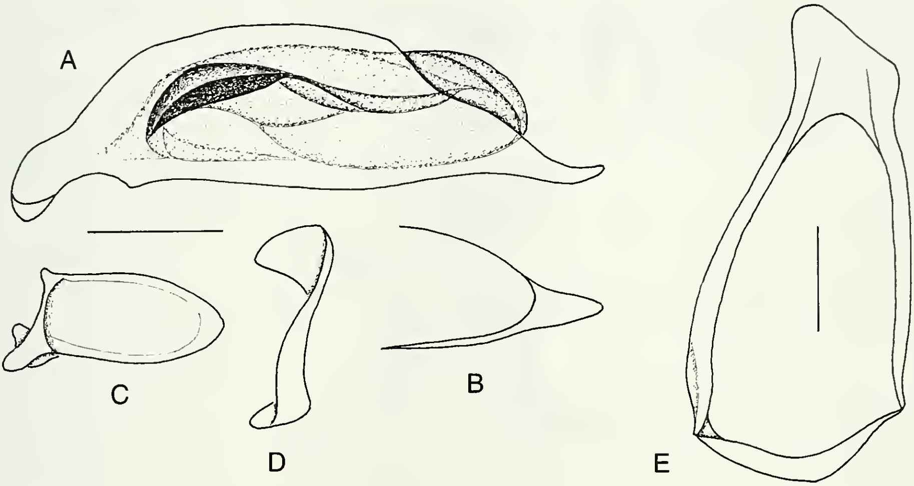

FIG. 1

Colasidia wau sp. n. Male genitalia: A) aedeagus (left side), B) shape of apex (from below), C) left and D) right parameres, E) genital ring. Scales: 0.25 mm.

1.22; width widest part/base of pronotum: 1.54-1.61; width pronotum/head: 1.21-1.30; length/width of elytra: 1.54-1.55; width elytra/pronotum: 1.80-1.88.

Colour: More or less dark piceous, suture of elytra very narrowly reddish. Labrum, palpi, legs, and antennae somewhat lighter, dark yellowish to light brown.

Head: Rather elongate, very slightly widened behind eyes, widest far away from base, orbits posteriorly very widely rounded. Clypeus and frons in middle slightly raised, frons not grooved. Eyes small, laterally barely projecting, length only about 1/4 of orbit length. Surface above and behind eye with a narrow, deep groove. Clypeus anteriorly faintly concave, lateral angles (above base of antenna) barely projecting. Clypeal suture laterally with shallow grooves. Labrum anteriorly rather excised, 6-setose, inner 4 setae slightly shorter than outer ones, lateral margin densely pilose. Mandibles short. Mentum with triangular, at apex faintly excised tooth. Labium truncate. Maxillary palpus moderately elongate, apex obtusely rounded. Terminal segment of labial palpus large and very elongate. Antenna very short, barely attaining anterior third of pronotum. Median antennomeres >1.5 x as wide as long, 3rd antennomere c. 2/3 as long as 1st, c. 1.5 x as long as 2nd antennomere. Surface without microreticulation, highly glossy. Puncturation rather coarse, moderately dense, diameter of punctures slightly wider than distance between punctures. Pilosity moderately dense, rather elongate, moderately erect, inclined anteriorly. Both supraorbital setae elongate, fairly well distinguished from pilosity, posterior supraorbital setae situated far behind eye.

Pronotum: Rather elongate, cordiform, anteriorly considerably widened, slightly longer than wide, considerably wider than head, widest in anterior third. Upper surface rather convex, faintly sulcate along median line. Lateral margin in anterior two thirds strongly convex, in front of posterior angles deeply but somewhat irregularly sinuate, basal third almost straight. Apex wide, faintly excised, anterior angles convex,

FIG. 2
Colasidia wau sp. n. Paratype, habitus. Length: 4.8 mm.

barely projecting. Base rather narrow, laterally angulately excised, basal angles projecting as sharp, small denticles. Lateral margin slightly raised, with distinct border line, but without distinct marginal channel. Median line distinct, though but faintly impressed. Prebasal grooves deep. Both marginal setae very elongate, anterior seta situated slightly behind anterior fourth of pronotum, posterior seta situated right on basal angle. Surface without microreticulation, highly glossy, with moderately dense, very coarse puncturation. Diameter of punctures wider than distance between them. Pilosity fairly dense, elongate, hirsute, irregularly inclined, rather erect.

Elytra: Rather elongate and but moderately wide, laterally evenly but gently curved, widest slightly behind middle, upper surface moderately convex. Intervals not raised. Humeri wide, rather projecting, rounded off. Apex wide, gently convex, slightly redressed to suture. Striae rather regularly marked by rows of punctures, puncturation moderately sparse, very coarse, rather regularly arranged to longitudinal rows. Diameter of punctures considerably wider than distance between them. Fixed setae in third interval very difficult to recognize within the coarse puncturation. Series of marginal pores extremely difficult to detect when setae broken, apparently consisting of 8 basal, 3 postmedian, 6 apical pores, and 1 pore at apex of 3rd stria. Setae very elongate. Surface without microreticulation, highly glossy. Pilosity rather sparse, elongate, hirsute, rather regular, inclined posteriorly, rather depressed.

Male genitalia: Genital ring fairly narrow, irregularly triangular and rather asymmetric, basal part short, apical plate very wide, oblique. Aedeagus rather short, with moderately elongate, rather narrow, slightly upturned apex. Lower surface very gently bisinuate. Internal sac in middle with an elongate, folded sclerite. Both parameres fairly short, of very different size and shape, left paramere rather parallel, with widely rounded apex.

Female genitalia: Unknown.

Variation: Apart from slightly wider pronotum in the paratype, very little variation noted.

Etymology: The name refers to the locality where the new species was detected.

Distribution: Central eastern Papua New Guinea. Known only from the immediate vicinity of Wau.

Collecting circumstances: Holotype collected "under stone" at 1400 m, paratype sampled by sieving and Winkler extraction of rotting trunk and vegetational debris in mountain rain forest, at 1450 m. Like the other New Guinean species of the genus *Colasidia*, this is a ground living beetle of the rain forest litter that occurs at median altitude in the lower level of the montane rain forest zone.

KEY TO SPECIES OF *COLASIDIA* OF NEW GUINEA AND AUSTRALIA

To facilitate identification of the new species the most recent key to the recorded Australian-New Guinean species of *Colasidia* (Baehr, 2000a) is revised here. For the benefit of the user some figures from previous papers on the subject are mentioned in this key: **B00**: Baehr, 2000a; **B87**: Baehr, 1987; **B91**: Baehr, 1991.

1. Head about parallel, or wider across eyes than across orbits; base of head usually considerably rounded (doubtful specimens under both couplets) 2

- Head decidedly wider at posterior angles or across orbits than across eyes; base of head less rounded, more square 4

2. Head short, eyes very large, ratio of distance from orbit to neck/eye length <1.5; basal angles of head very widely rounded (**B91** fig. 6); puncturation of elytra irregular, rather confused; odd intervals raised in anterior half; aedeagus unknown. Kokoda, central Papua Peninsula, eastern Papua New Guinea . . . . *kokodae* Baehr

- Head longer, eyes smaller, ratio of distance from orbit to neck/eye length >3 ; basal angles of head less widely rounded; puncturation of elytra in regular rows; intervals not markedly raised 3

3. Eyes larger, ratio of distance from orbit to neck/eye length c. 3; prothorax shorter, ratio length/width c. 1.10; prothorax less wide in comparison to head, ratio width of prothorax/width of head c. 1.16; elytra shorter and wider, ratio length/width c. 1.50; aedeagus unknown. Dobodura, central Papua Peninsula, eastern Papua New Guinea . . . . *papua* Darlington

- Eyes smaller, ratio of distance from orbit to neck/eye length c. 4; prothorax longer, ratio length/width >1.16; prothorax wider in comparison to head, ratio width of prothorax/width of head >1.20; elytra longer and narrower, ratio length/width >1.54; aedeagus short, rather compact, with moderately elongate, faintly upturned apex (Fig. 1). Vicinity of Wau, eastern central Papua New Guinea . . . . *wau* sp. n.

4. Eyes very small, ratio of distance from orbit to neck/eye length >5; head very elongate, markedly triangular (**B87** fig. 1). Northeastern Queensland, Australia . . . . *monteithi* Baehr

\- Eyes larger, ratio of distance from orbit to neck/eye length <4.5; head shorter, usually less markedly triangular. New Guinea 5

5. Pronotum shorter and wider, ratio length/width c. 1.05; elytra shorter and wider, less depressed, ratio width of elytra/width of prothorax >2.05, ratio length/width of elytra c. 1.40; aedeagus unknown. Damanti, Huon Peninsula, northern Papua New Guinea . . . . *madang* Darlington

\- Pronotum longer and narrower, ratio length/width >1.12; elytra longer and narrower, more depressed, ratio width of elytra/width of prothorax <1.90, ratio length/width of elytra >1.48; aedeagus see fig. 1, **B00** fig. 1. Distribution different 6

6. Smaller species, length <4.35 mm; head shorter and wider, ratio length/width <1.5; elytra shorter and wider, ratio length/width <1.51; aedeagus elongate, with elongate, at tip very slightly upturned apex (**B00** fig. 1). Garaina, northwestern Papua Peninsula, eastern Papua New Guinea . . . . *garainae* Baehr

\- Larger species, length >4.75 mm; head longer and narrower, ratio length/width >1.64; elytra longer and narrower, ratio length/width >1.54; aedeagus short, compact, with moderately elongate apex (Fig. 1). Vicinity of Wau, eastern central Papua New Guinea . . . . *wau* sp. n.

REMARKS

Even when sampling of these tiny, litter inhabiting beetles is difficult and probably has been conducted quite inadequately in New Guinea so far, the absolute lack of any record from the western half of this island (Irian Jaya) is still enigmatic, because collectors like A. Riedel who conducted extensive sieving and Berlese extraction samplings in Irian Jaya, failed to find any specimens (see Baehr, 2000a). Therefore, it is uncertain, whether the western part of New Guinea represents one of the quite surprising distribution gaps within the extended range of Leleupidiini in the Oriental-Australian region, and whether Leleupidiini still escaped the attention of collectors in this region.

When the leleupidiine fauna of this large island will be better explored, this question will be asked again, in combination with the questions, why not a single *Colasidia* has been ever collected in Java, the Lesser Sunda Islands, Sulawesi, and the Moluccas, whereas they seem to be quite speciose in Malaysia, Sumatra, (northern) Borneo, and Papua New Guinea, and one species even occurs in northeastern Australia. Then, probably the very complex paleogeographic history of New Guinea should be considered for explanation of the curious distribution pattern of the tribe on this large island.

At present, we only can state that a rather limited area in central eastern Papua New Guinea is the single place in New Guinea where Leleupidiini have been recorded so far, and moreover, although being rare in terms of specimens, they are nevertheless quite speciose there. As in other regions where Leleupidiini occur, the species apparently occupy extremely restricted ranges, which is not surprising in view of their inability for flight and the rugged montane landscape of this island, where the ranges of neighbouring species of Leleupidiini usually are separated by deep valleys. As a consequence, the number of species still to be detected in New Guinea likely might be considerably augmented in future, in the same manner, as it has been demonstrated for other flightless, montane New Guinean carabid beetles (Baehr, 1995, 1999, 2000b, 2001a, 2001b).

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Revision of the *Minettia fasciata* species-group (Diptera, Lauxaniidae)

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Revision of the *Minettia fasciata* species-group (Diptera, Lauxaniidae). - The *Minettia fasciata* species-group is defined. It includes 4 Palaearctic species, namely *Minettia czernyi* Freidberg & Yarom, *Minettia fasciata* (Fallén) [= *M. rivosa* (Meigen), synonymy confirmed], *M. subvittata* (Loew) [= *M. cataracta* (Pandellé), syn. conf.] and *M. tabidiventris* (Rondani) [= *M. luteofrontata* (Becker), syn. nov; = *M. fasciata* auctt. nec Fallén]. *Sapromyza pallida* Meigen is treated as a nomen dubium. All available types were studied, the 4 species are described, illustrated and compared with each other. A key to the species of *Minettia* with lateroventral black spots on the scutellum is presented.

Key-words: Diptera - Lauxaniidae - *Minettia fasciata* species-group - Palaearctic region.

INTRODUCTION

The Lauxaniidae are a large family of about 1800 described species worldwide. They are best represented in the tropics of the Old and New World (except for the Afrotropical region), and their diversity declines strongly towards the more temperate regions. Fewer than 180 species are recorded from Europe (Merz, 2003a). Most species are found in forests, on shrubs, trees, and leaves. They are less common in dry and wet grasslands. Despite their often remarkably high population densities and apparent importance in decomposing plant material, they are insufficiently known, even in the comparatively well studied Western Palaearctic region.

Minettia Robineau-Desvoidy, with almost worldwide distribution, is one of the most speciose genera of Lauxaniidae with somewhat less than 100 species described so far. The Palaearctic fauna is the most diverse with 56 described species, although the other regions are less intensively studied and may be much richer than is known today. The genus was divided into 3 subgenera by Shatalkin (2000). Within *Minettia* s. str. a number of species-groups may be recognized, one of which is called the *Minettia fasciata* group which is restricted to the Palaearctic region. This group also includes *Minettia nemorosa* Robineau-Desvoidy, 1830, which is the type species of *Minettia*. The group is characterized by the grey microtrichose mesonotum, a pair of black spots

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on the lateroventral side of the scutellum (Figs 2-5), 0+3 dorsocentral setae, 6 rows of acrostichal setulae, only one dorsal preapical seta on the midtibia, dark transverse stripes on the abdominal tergites (Figs 6-7) and characteristic terminalia.

While studying a large number of specimens with this set of characters I realized that the limits of the described species differ from one author to another and that nomenclature is far from being resolved. The objective of this paper is to clarify the recognized synonymies by studying the types where still available, and to present diagnostic characteristics accompanied by illustrations, helping to define the limits of each species.

HISTORICAL REVIEW

The following account reviews the changing history of the names associated with the species of the *Minettia fasciata* group as briefly diagnosed above and extensively described below. This summary is not complete; only major revisions and catalogues are included which differ in their interpretations from other papers.

The first two species which belong to this complex are *Lauxania fasciata* Fallén, 1826, and *Sapromyza rivosa* Meigen, 1826, with Fallén having priority.

In 1830, Meigen described *Lauxania pallida* and Robineau-Desvoidy proposed in the same year the genus *Minettia* and described, among others, *M. nemorosa* which was designated as type species of *Minettia* by Westwood (1840).

The various interpretations of the different species started with Macquart (1835), who synonymized *nemorosa* with *rivosa*. The following history is given in an abbreviated form. Papers with descriptions of new species relevant for this study are marked with an asterix (*):

Westwood (1840): (1) *fasciata* (= *rivosa*, = *nemorosa*), (2) *pallida*; designation of *nemorosa* as type species of *Minettia*.
*Loew (1847): (1) *fasciata* (= *rivosa*), (2) description of *Sapromyza subvittata* Loew
Zetterstedt (1847): *rivosa* (= *fasciata*)
Schiner (1863): (1) *fasciata* (= *rivosa*, = *nemorosa*), (2) *pallida*, (3) *subvittata*
*Rondani (1877): (1) *fasciata* (= *rivosa*), (2) *subvittata*, (3) description of *Sapromyza tabidiventris* Rondani
*Becker (1895): (1) *fasciata* (= *rivosa*, = *nemorosa*), (2) *subvittata* (= *tabidiventris*), (3) description of *Sapromyza luteofrontata* Becker (*pallida* Meigen not included)
*Pandellé (1902): (1) *fasciata* (= *rivosa*, = *nemorosa*), (2) description of *Sapromyza cataracta* Pandellé (= *subvittata* auctt, = *fasciata* var sensu Zetterstedt)
Hendel (1908): (1) *cataracta*, (2) *dimidiata* Loew (= *pallida* Meigen, nec *pallida* Fallén), (3) *fasciata* (= *rivosa*, = *nemorosa*), (4) *luteofrontata*, (5) *subvittata* (= *tabidiventris*)
Czerny (1932): (1) *fasciata* (= *rivosa*, = *nemorosa*, = *luteofrontata*, = *subvittata* sensu Pandellé), (2) *pallida* Meigen (= *dimidiata* Loew), (3) *subvittata* (= *cataracta*, = ? *tabidiventris*)
*Czerny (1937): description of *Minettia quadrisetosa* Czerny
Collin (1948): (1) *fasciata*, (2) *rivosa* (no synonymy)

Papp (1984): (1) *fasciata* (= *nemorosa*, = *subvittata*, = *luteofrontata*, = *cataracta*), (2) *rivosa* (= *dimidiata*). Nomina dubia: (3) *pallida*, (4) *quadrisetosa*, (5) *tabidiventris*

Freidberg & Yarom (1990): (1) *czèrnyi* (= nom. nov. for *quadrisetosa* Czerny, nec Becker), (2) *fasciata*, (3) *rivosa*

Shatalkin (2000): (1) *czernyi*, (2) *fasciata*, (3) *pallida*, (4) *rivosa*, (5) *subvittata* (no synonymy)

It can be concluded from this non-exhaustive review of major papers about Lauxaniidae that the concept of each species and its synonymy varied from author to author. All papers prior to Czerny (1932) are unreliable as genitalic structures were not studied or illustrated, and types of the already described species were not examined. Even Czerny's monograph (1932), although illustrating for the first time the male terminalia of his *Minettia subvittata*, is not particularly helpful because a comparison with related species is missing. The first careful study of genitalic characters was presented by Collin (1948). Unfortunately, he named the two British species without the study of the types. The same deficiency characterizes all subsequent papers, including those of Papp (1979, 1984) and Shatalkin (1998, 2000). As a consequence of this unsatisfactory situation, faunistic papers, checklists and ecological studies including these species are difficult to use because it is impossible to know the identity of the species mentioned.

One species which was often treated as member of the *M. fasciata* group is *Sapromyza dimidiata* (Loew, 1847) (Hendel, 1908; Papp, 1984; see above). A study of the male holotype (ZMHB) revealed that this species belongs to the *M. lupulina* species-group, and so it is not further discussed here.

MATERIAL AND METHODS

This study is based on about 1150 specimens which are deposited in the following collections:

CAS	California Academy of Sciences, San Francisco, USA (P. A. Arnaud, B. Fisher)
CBM	private collection B. Merz, Genève, Switzerland
CCK	private collection Christian Kassebeer, Kiel, Germany
CGB	private collection G. Bächli, Dietikon, Switzerland
CMCT	private collection Miguel Carles-Tolrá, Barcelona, Spain
CME	private collection Martin Ebejer, Cardiff, Wales
CPG	private collection Paul Gatt, Rabat, Malta
ETHZ	Eidgenössische Technische Hochschule, Zürich, Switzerland (A. Müller)
INRA	Institut National de la Recherche Agronomique, Montpellier, France (M. Martinez)
MHNG	Muséum d'histoire naturelle, Genève, Switzerland
MHNN	Muséum d'histoire naturelle, Neuchâtel, Switzerland (J.-P. Haenni)
NML	Natur-Museum, Luzern, Switzerland (L. Rezbanyai-Reser)
MNHNP	Muséum National d'Histoire Naturelle, Paris, France (J. Charbonnel)

MZF	Museo Zoologico "La Specola", Firenze, Italy (S. Whitman)
NHMB	Naturhistorisches Museum, Basel, Switzerland (D. Burckhardt)
NHMW	Naturhistorisches Museum, Wien, Austria (R. Contreras-Lichtenberg)
NRS	Naturhistorisk Rijksmuseum, Stockholm, Sweden (T. Pape)
SIZK	Schmalhausen Institute of Zoology, Kiev, Ukraine (V. A. Korneyev)
SMNS	Staatliches Museum für Naturkunde, Stuttgart, Germany (H. P. Tschorsnig)
SMO	Silesian Museum, Opava, Czech Republic (J. Roháček)
TAU	Tel Aviv University, Israel (A. Freidberg)
USNM	National Museum of Natural History, Washington D. C., USA (S. Gaimari)
ZMB	Zoological Museum Bergen, Norway (L. Greve-Jensen)
ZMHB	Zoologisches Museum, Humboldt Universität, Berlin, Germany (W. Mey, H. Wendt)
ZML	Zoological Museum, University Lund, Sweden (R. Danielsson)
ZMUC	Zoological Museum, University Copenhagen, Danmark (R. Meier)
ZSM	Zoologische Staatssammlung München, Germany (W. Schacht)

Morphological terms in the descriptions follow chapters 1.1-1.3 in Papp & Darvas (2000), but the interpretation of the antennal structures is according to Stuckenberg (1999).

DESCRIPTION OF THE *MINETTIA FASCIATA* SPECIES-GROUP

Diagnosis

Species of *Minettia* s. str. with the following combination of characters: scutellum lateroventrally with a pair of black spots (Figs 2-5); mesonotum uniformly grey or striped brownish-grey, 0+3 dorsocentral setae and 6 rows of acrostichal setulae at level of suture; midtibia with only one dorsal preapical seta; abdomen yellow to brown, in the middle of tergites 3-5 each with a darker transverse stripe which is interrupted medially (Figs 6-7); male pregonite composed of 2 subequal branches (Fig. 20); female sternite 8 with 2 ear-like projections laterally (Figs 45, 48).

Description of Male

Head (Fig. 1) bicoloured: frons and parafacial yellow to brown; fronto-orbital plate, ocellar triangle, occiput and postgena grey microtrichose; face partly pale brown, partly grey; frons with yellow stripe dorsal of lunule and with dirty brown transverse stripe at level of anterior fronto-orbital seta; parafacial with brown spot lateral of antennal base; head in profile about 1.35 times as high as wide; gena one quarter as high as compound eye; the latter elongate ovoid; frons (including frontal plates) slightly wider than length from lunule to posterior margin of posterior ocelli; frons anteriorly with black setulae; face longer than antenna, flat with shallow antennal grooves and slightly raised at vibrissal corner; occiput straight, not conspicuously concave medially above occipital foramen; fronto-facial angle 120-130°; parafacial with single row of about 10 short setulae in ventral third; antenna yellow, sometimes postpedicel dorsally grey to black infuscated; postpedicel about twice as long as wide, apically rounded; arista plumose, longest rays about as long as width of postpedicel; proboscis with yellow to black palpus. The following paired, black setae are present: 2

reclinate fronto-orbital setae of equal length; 1 strong ocellar seta and few smaller setulae posteriorly between ocelli; 1 very long inclinate medial vertical seta; 1 shorter lateroclinate lateral vertical seta; 1 slightly inclinate postocellar seta; one row of strong postocular setae and a slightly unordered row behind.

Thorax with grey ground colour, but to a variable extent brown to yellowish-brown striped; mesonotum in *M. czernyi* yellow with lines of acrostichal setulae pale grey only; sometimes with blackish stripe medial of line of dorsocentral setae; postpronotum usually mostly yellow; pleuron grey varying to orange with only traces of grey microtrichosity, or with a brown stripe on dorsal third of anepisternum only; scutellum dorsally grey, border grey or yellow, lateroventrally pale with a pair of conspicuous black spots laterally which are not connected with each other between apical scutellar setae (Figs 2-5); subscutellum either black or brown, microtrichose; all setae and setulae black; 0+3 dorsocentral setae of subequal length; at level of suture with 6 rows of acrostichal setulae, the setulae of the two median rows slightly longer; 1 strong prescutellar acrostichal seta; 1 postpronotal seta; 2 notopleural setae; 1 presutural and 1 postsutural intraalar seta; 1 supraalar seta; 2 postalar setae; basal and apical scutellar seta; 1 anepisternal seta; 2 katepisternal setae; 1 proepisternal seta.

Wing entirely hyaline, sometimes slightly tinged with yellow, but without pattern; halter and calypters yellow to whitish yellow.

Legs yellow, but femora on all legs may vary from greyish to black, in particular the forefemur; tibiae sometimes slightly darkened towards tip; anteroventral part of forefemur and ventral part of midfemur each with a brown to black subapical spot, which is sometimes weak; midfemur with a row of strong, outstanding setulae anteriorly in apical half; hindfemur with a strong anterodorsal preapical seta; all tibiae with 1 dorsal preapical seta; midtibia with 1 ventral apical seta.

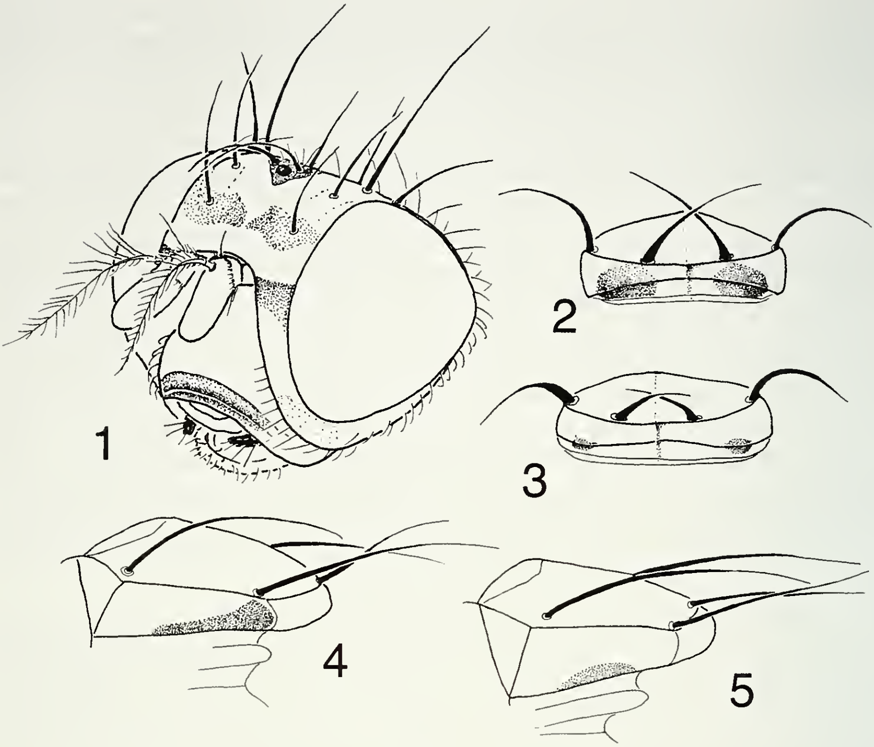
Abdomen brown to yellow, tergites 3-5 each with a brown to black transverse stripe in the middle which is broadly interrupted medially, or which may be reduced to more or less large lateral spots (Figs 6-7); sternites unmodified.

Male terminalia (Figs 9-34). Epandrium semicircular; surstylus black setulose, well developed, distally with tooth or invagination, and medially without tooth in middle; subepandrial plate with 1 long and sometimes 1-3 smaller black setulae (Fig. 19); hypandrium as in other species of genus; pregonite 2-branched, both branches of almost same length (except for *M. czernyi*, Fig. 15), apically more or less pointed and directed to the right [when seen from inside, Fig. 20]; postgonite forming an aedeagal sheath, distal margin straight (Fig. 25) or with 3 tooth like projections (Fig. 14); phallapodeme short to long; ejaculatory apodeme rather complicated, sclerotized medially (Fig. 33); aedeagus membranous, distally “spinulose” (Fig. 25).

DESCRIPTION OF FEMALE

As male, but tergites 3 and 4 of abdomen either unmodified (Fig. 6) or at posterior margin with 4-8 much thicker, enlarged, black setae medially of tergite 3 (Fig. 7) or tergite 4 (in *M. czernyi*); pleural membrane in some species with a conspicuous glandular area on level of segments 4-5 (Fig. 8).

Female terminalia (Figs 35-48) forming retractible pseudoovipositor; tergite 8 a well sclerotized plate (Fig. 40), or as two small “L-”shaped weak sclerites (Fig. 44);



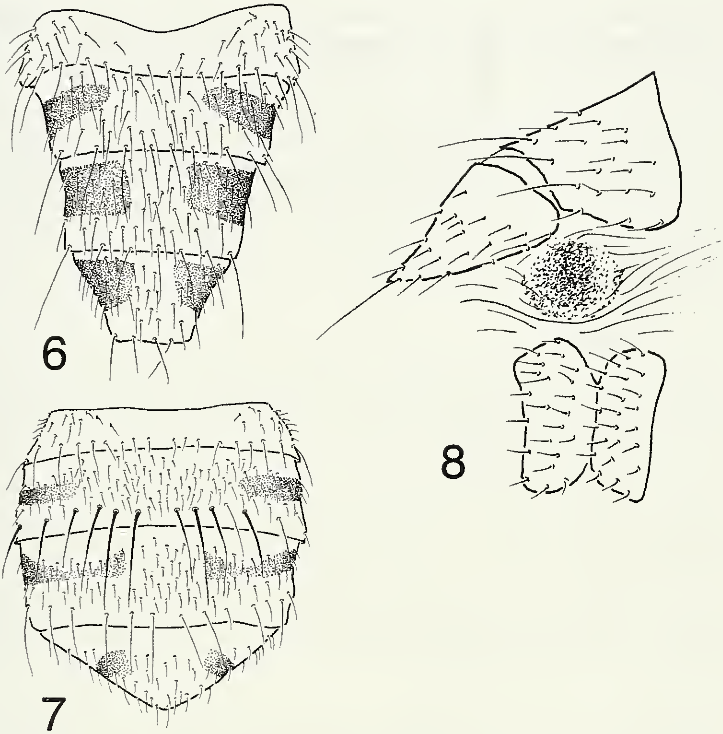
FIGS 1-5

Minettia fasciata (Fallén) (1), *M. czernyi* Freidberg & Yarom (2, 4) and *M. subvittata* (Loew) (3, 5): 1, head; 2-3, scutellum, posterior view; 4-5, scutellum, lateral view.

tergite 9 evenly curved distally, with (Fig. 40) or without (Fig. 44) soft, long setae apically; sternite 8 rather complex, with paired ear-like, heavily sclerotized, invaginated projections laterally (Figs 37, 41); sternite 9 and cerci as usual in genus; 3 (2+1) spermathecae present, with smooth surfaces, paired spermathecae slightly smaller (Fig. 42).

VARIABILITY

Colouration may vary considerably. The lateroventral black spots on the scutellum may occasionally be minute or even absent. The transverse dark stripes on tergites 3-5 may be indistinct or reduced to small dots laterally. The distribution of yellow and grey stripes on the mesonotum may vary within each species. Although the yellow palpus is a good characteristic for quick separation of *M. subvittata* from the other species of the group, it is sometimes almost entirely yellow also in *M. fasciata* or *M. tabidiventris*. In contrast, the terminalia are very characteristic (except for the distal margin of the surstylus in *M. tabidiventris*, see below), and its study is therefore recommended for a safe identification.



FIGS 6-8

Abdominal structures of *Minettia fasciata* species-group. 6, dorsal view of abdomen of holotype female of *Minettia fasciata* (Fallén); 7, dorsal view of abdomen of lectotype female of *M. subvittata* (Loew); 8, lateral view of last abdominal segments of female of *M. fasciata* (Fallén).

REMARKS

Palaearctic species of *Minettia* s. lat. have recently been divided into 3 genera: *Frendelia* Collin, *Plesiominettia* Shatalkin and *Minettia* s. str. (Shatalkin, 2000). No attempt has been made to classify European species of *Minettia* s. str. The only group which has been characterized is the *M. biseriata* species-group (Papp, 1981). This group shares with the *M. fasciata* species-group the shape of the head, the pectinate arista, 0+3 dorsocentral setae, and 6 rows of acrostichal setulae, but differs by the entirely yellow thorax, the mostly yellow abdomen (only last 1-4 tergites in some species with small black spots laterally), the lateroventrally uniform yellow scutellum (except for *M. cypriota* with a pair of black spots; the position of this species is still unresolved and needs further study) and details of the male terminalia with the 2 branches of the pregonite usually of very different size. Other species with a lateroventral pair of black spots on scutellum have either 1+3 dorsocentral setae and/or the abdomen entirely yellow without brown stripes contrasting strongly to the uniform grey mesonotum (*M. desmometopa* (de Meijere), *M. dimidiata*, *M. flaviventris* (Costa), *M. longiseta* (Loew), *M. lupulina*, *M. tubifer* (Meigen)), see also key below. Other species of *Minettia* s. str. have the scutellum lateroventrally uniformly yellow, grey or black and may therefore be easily separated from species of the *M. fasciata* species-group.

The present diagnosis of the *M. fasciata* species-group includes 4 species: *M. czernyi*, *M. fasciata*, *M. subvittata* and *M. tabidiventris*. *M. czernyi* is placed in the group tentatively because it differs in the structure of terminalia of both sexes from the other 3 species. Pending a thorough study of the terminalia of all *Minettia* s. str. I prefer to keep it here because of the external similarities with some pale specimens of *M. subvittata* with which it may be confused.

BIOLOGY AND DISTRIBUTION

Nothing is known about immature stages of the 4 species of the *M. fasciata* species-group (Miller, 1977; Smith, 1989). Adults may be found in various biotopes. They may be observed abundantly on leaves in open deciduous forests, on shrubs and hedges and on isolated trees. As an exception for European Lauxaniidae they are sometimes common in meadows, grasslands and even crop fields (Reddersen, 1994) where they feed on fungi (Reddersen, 1995). The species-group has its apparent center of distribution in the Mediterranean region where all 4 species may be found. The diversity declines north of the Alps and the Carpathian ridge with only 2 species penetrating as far north as Scandinavia. Surprisingly, one species, *M. fasciata*, occurs also in the Western parts of the Nearctic region.

KEY TO THE PALAEARCTIC SPECIES OF *MINETTIA* S. STR. WITH A PAIR OF LATEROVENTRAL BLACK SPOTS ON SCUTELLUM

1 Scutellum dorsally and lateroventrally of same colour: yellow, grey or black . . . . other species of *Minettia*
1* Scutellum lateroventrally either with a pair of black spots or entirely blackish on ventral side, contrasting to the grey or yellow dorsal surface (Figs 2-5) 2

2 Scutellum lateroventrally entirely blackish, including the area between apical scutellar setae . . . . *Minettia lupulina* species-group (4 species; Merz, in prep.)
2* Scutellum lateroventrally with a pair of black spots which are not fused between apical scutellar setae (Figs 2-5) 3

3 1+3 dorsocentral setae present 4
3* 0+3 dorsocentral setae present, presutural dorsocentral seta absent 5

4 Midtibia with 2 dorsal preapical setae; acrostichal setulae in 6 rows; palpus, postpronotum, dorsal surface of scutellum, and femora mainly yellow . . . . *M. tubifer* (Meigen, 1826)
4* Midtibia with 1 dorsal preapical seta; acrostichal setulae in 4 rows; palpus, postpronotum, dorsal surface of scutellum, and femora mainly black . . . . *M. flaviventris* (Costa, 1844) part

5 Acrostichal setulae in 4 rows; mesonotum entirely grey including postpronotum; a pair of blackish longitudinal stripes near or along line of dorsocentral setae often present; abdomen yellow without transverse stripes on tergites; palpus black 6

5* Acrostichal setulae in 6 rows; mesonotum yellow to grey, postpronotum at least partly yellowish; legs usually mostly yellow, rarely femora strongly black; other characters variable 7

6 Postpedicel black; presutural dorsocentral seta always absent; female: tergite 3 short, at posterior margin medially with 4-6 very long, black, thick setae . . . . *M. longiseta* (Loew, 1847)

6* Postpedicel orange-brown, blackish at most along dorsal margin; presutural dorsocentral seta usually present, sometimes absent on one, rarely on both sides; female: tergite 3 not modified, with normal short, black setulae at posterior margin . . . . *M. flaviventris* (Costa, 1844) part

7 Mesonotum and abdomen more or less uniformly yellow, rarely pale grey microtrichose along acrostichal setulae; palpus yellow; black lateroventral spots on scutellum small; female: tergite 3 unmodified and without long setae at posterior margin . . . . *M. cypriota* Papp, 1981

7* Mesonotum at least with conspicuous medial grey stripe along acrostichal setulae; abdomen yellow to brown, but tergites 3-5 usually each with a transverse black stripe which is interrupted in middle (*M. fasciata* species-group, see also Tab. 1) 8

8 Ground colour of subscutellum yellow; scutellum lateroventrally with two large black spots which are larger than separating area (Figs 2, 4); mesonotum mainly yellow to brown, with only a rather narrow grey stripe medially; palpus yellow to brown; male: surstylus connected with subepandrial plate by a conspicuous sclerite (Figs 10-11); postgonite with 3 dorsal hooks (Fig. 14); female: tergite 4 with 2 pairs of very long black setae at posterior margin in middle *M. czernyi* Freidberg & Yarom, 1990

8* Ground colour of subscutellum black; black spots lateroventrally on scutellum smaller, and wider apart from each other than length of one black spot (Figs 3, 5); mesonotum usually more extensively greyish along lateral margin with usually a grey band on level of presutural and postsutural intraalar seta; female: either all tergites with usual setae and setulae (Fig. 6), or tergite 3 with 4-6 pairs of very long setae leaving a gap between them (Fig. 7) 9

9 Male 10

9* Female 12

10 Surstylus strongly concave, with undulated distal margin which is conspicuously invaginated (Figs 28-29), sometimes with an additional medial projection (Figs 30-31) (mesonotum usually uniformly grey without paler stripes over lines of dorsocentral setae, but sometimes with a narrow, black stripe medially of line of dorsocentral setae) . . . . *M. tabidiventris* (Rondani, 1877)

10* Surstylus, indistinctly concave, with a sharp projection at distal posterior margin (Figs 17, 22-23) (mesonotum usually with a more or less developed paler stripe over line of dorsocentral setae) 11

11 Surstylus distinctly longer than wide (Fig. 18); subepandrial plate with 1-3 weaker and shorter setulae in addition to the long seta (Fig. 19); palpus usually entirely black in distal half or only indistinctly brownish ventrally .... *M. fasciata* (Fallén, 1826)

11* Surstylus only slightly longer than wide, almost square (Fig. 24); subepandrial plate usually with one strong seta only (Fig. 22); palpus usually yellow, sometimes dorsally bordered by black margin .... *M. subvittata* (Loew, 1847)

12 Tergite 8 evenly sclerotized (Fig. 40); tergite 9 distally with 2 thick, long, black setae (Figs 39-40); sternite 8 with evenly convex surface; ear-like projection distally rounded (Fig. 39); abdominal pleura at most with a small glandular area on level of tergites 4-5 (mesonotum usually uniformly grey without paler stripes over lines of dorsocentral setae, but sometimes with a narrow, black stripe medially along dorsocentral setae) .... *M. tabidiventris* (Rondani, 1877)

12* Tergite 8 with two faint, L-shaped sclerites (Figs 44, 47); tergite 9 without long apical setae (Figs 43, 46); sternite 8 with a medial longitudinal rib (Figs 45, 48); ear-like projection weakly invaginated, posteriorly sharply pointed (Figs 43, 46); a large glandular area present on pleura on level of tergites 4-5 (Fig. 8) (mesonotum usually with a more or less developed paler stripe through dorsocentral setae) 13

13 Tergite 3 without long black setae along posterior margin (Fig. 6); palpus usually black at least in apical half, sometimes with brown or yellow border ventrally, but tip almost always black or dark brown; sternite 8 with more elongated ear-like lateral projection (Fig. 43), its apex more pointed and its ventral plate in ventral view larger, half-moon shaped (Fig. 45) .... *M. fasciata* (Fallén 1826)

13* Tergite 3 with a row of long black setae at posterior margin which is interrupted in the middle, the middle 2-4 setae are longest and distinctly longer than width of tergite 4 (Fig. 7); palpus usually yellow to brown throughout, dorsal margin sometimes bordered by black, rarely more extensively darkened, but usually with at least a distinct brown stripe to tip; sternite 8 with shorter lateral ear-like projection (Fig. 46), in profile more triangular, its ventral plate in ventral view short, with a lateral point (Fig. 48) .... *M. subvittata* (Loew, 1847)

DESCRIPTION OF THE SPECIES OF THE *MINETTIA FASCIATA* SPECIES-GROUP

The following part lists for each species first the synonymy, then the type material, followed by additional material studied. Labels of primary types are cited verbatim. The diagnosis does not repeat the characteristics given in the description of the *M. fasciata* species-group, but only those characteristics which are needed to separate a species from the other members of this species-groups.

Minettia czernyi Freidberg & Yarom, 1990 Figs 2, 4, 9-15, 35-38

Minettia quadrisetosa Czerny, 1937: 89. Type locality: [Israel]: Rehoboth bei Jaffa.
Minettia czernyi Freidberg & Yarom, 1990: 98 (replacement name for *Minettia quadrisetosa* Czerny, 1937, nec Becker, 1907).

TYPE MATERIAL

Lectotype ♂ (here designated, examined): "Rehoboth bei Jaffa, 27.VII.33, J. Aharoni coll." (printed), "Minettia quadrisetosa Cz. ♂, det. L. Czerny" (in Czerny's handwriting), "Type Czerny 1935" (in Lindner's handwriting), "Lectotypus ♂ Minettia quadrisetosa Czerny, 1937, desig. B. Merz 2003", Minettia czernyi Freidberg & Yarom 1990, det. B. Merz'2003" (upper side), "n. name for M. quadrisetosa Czerny 1937 nec Becker, 1907" (lower side of same label) (SMNS). The specimen is double mounted with a minutien pin, and is in good condition with strong colours, all legs, wings and antennae present, body slightly covered with debris; left posterior fronto-orbital seta, left medial postalar seta and both left scutellar setae are absent; both anterior fronto-orbital setae partly broken.

Paralectotypes (examined): 1♀, same labels as lectotype; 1♂, same labels as lectotype, but 26.VII.33, and "Cotype Czerny 1935" (in Lindner's handwriting) (SMNS).

Comment: The species was described based on 4♂♂ and 2♀♀ from Rehoboth, 25-27.VII.1933. Only 2♂♂ and 1♀ are present in the SMNS (Tschorsnig, in litt.). Freidberg & Yarom (1990) studied a couple in the NHMW which apparently belongs to the type series as well. The fate of the last ♂ is not known. In order to avoid further confusion about the identity of the species, a lectotype is designated here. Another ♂ with the label "Rehoboth bei Jaffa, 25.XI.1933" (SMNS) is not a syntype because it does not correspond with the data mentioned in the original description.

OTHER MATERIAL EXAMINED (35 specimens)

CYPRUS: Lemasos. ISRAEL: Antipatris, Dan, Ein Bazan, Hammat Gader, Herzliyya, Panyas, Ramat-Aviv, Tel-Dan. LEBANON: Aakkar. (CBM, MHNG, USNM)

DIAGNOSIS

Head almost entirely yellow, with faint brown crossband at level of anterior fronto-orbital seta; palpus yellow; mesonotum mat yellow with at least broad grey stripe over line of acrostichal setulae, often with grey pattern between dorsocentral and intraalar setae; pleuron mostly yellow; scutellum lateroventrally with pair of very large black spots; legs almost entirely yellow, only forefemur anteroventrally in apical quarter and midfemur ventrally subapically with rather conspicuous brown spots; abdomen yellow with rather indistinct brown, narrow, transverse bars on tergites 3-5. Male: surstylus in profile slightly recurved (Fig. 10), slightly wider than long when maximally extended (Fig. 12), posterior margin medially concave (Fig. 10) and slightly folded downwards (Fig. 11); subepandrial plate entirely separated from surstylus, with one seta (Figs 10-11); two branches of pregonite of unequal size present (Figs 15), with left gonite much larger, apically swollen and with an indistinct apical tooth; postgonite very large, deeply concave medially (Figs 13-14) and posteriorly with 2+1 strong, black teeth (Fig.14). Female: tergite 4 medially at posterior margin with 4 very long, and 2 shorter black setae, the longest setae longer than the following tergite; tergites 8 and 9 well developed, without longer setae (Figs 15-16); sternite 8 basally with two small, ear-like, roundish projections with a channel-like sclerotization (Figs 35, 37-38); cercus small, with some longer setae apically. Wing length: (4.00) 4.25-4.75 mm.

REMARKS

This species differs from the other 3 species of the group by the slightly longer wings on average, the more yellowish ground colour, in particular of the head, pleuron (the latter mostly grey in the other species) and subscutellum; the black spots on the lateroventral side of the scutellum are much larger; the legs have only two limited brown spots, and the terminalia (♂ and ♀) are characteristic. It may be argued that *M. czernyi* does not belong to the *M. fasciata* species-group, due to genitalic differences, but taking into account the structural similarity with pale specimens of *M. subvittata* and *M. fasciata* it is difficult to place the species elsewhere at the present moment. Further studies of all described species of *Minettia* are needed before placing the species more accurately.

DISTRIBUTION

So far only known from three Eastern Mediterranean countries: Cyprus, Israel, Lebanon.

Minettia fasciata (Fallén, 1826) Figs 1, 6, 8, 16-20, 43-45

Lauxania fasciata Fallén, 1826: 15. Type locality: Sweden: Skåne, Esperöd, nr. Stenshufvud.
Sapromyza rivosa Meigen, 1826: 265. Type locality: not given ("im Sommer ziemlich gemein an Gestraden") (according to Papp, 1984: "? Germany"). [synonymy confirmed]
Minettia nemorosa Robineau-Desvoidy, 1830: 647. Type locality: not given (according to Papp, 1984: "France").

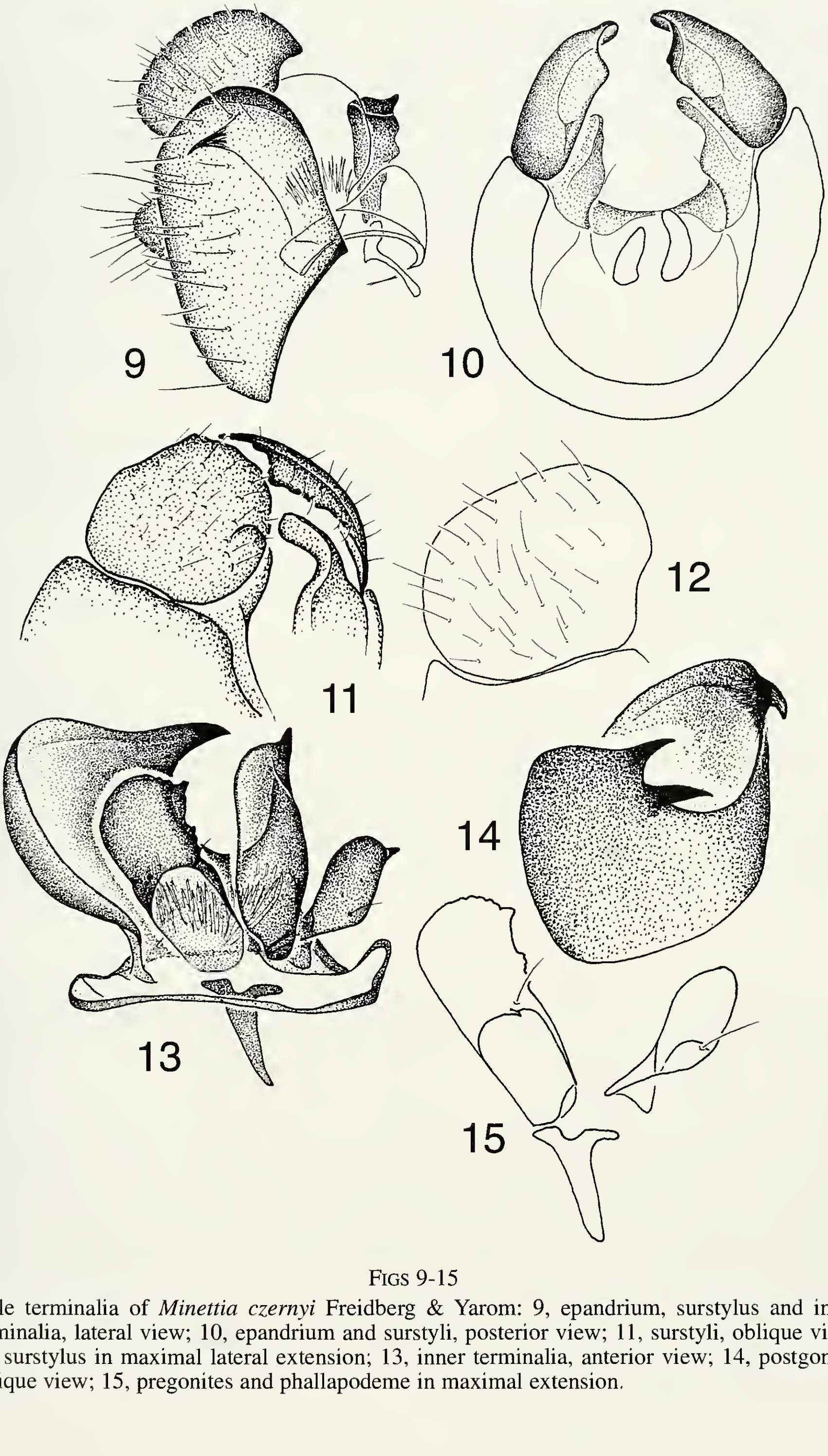
TYPE MATERIAL

Type material of fasciata

Holotype ♀ (examined): "Lauxania fasciata ♀, Fall. Suppl" (handwritten); "Holotype ♀, Lauxania fasciata Fallén, desig. B. Merz 2002" (red label, handwritten) (ZML). The type material of this species is extensively discussed by Merz (2003b) and the comments do not need to be repeated here.

Type material of rivosa

Lectotype ♂ (here designated, examined): "Meigen" (upper side of round label, handwritten); "2402 40" (lower side of same round label, handwritten); "rivosa" (square label, handwritten); "Lectotype ♂, Sapromyza rivosa Meigen, 1826, desig. B. Merz'2002" (red square label, handwritten); "Minettia fasciata (Fallén), det. B. Merz'2002" (white label, handwritten) (MNHNP). The specimen is directly pinned and in a good state of preservation (only right hindleg, last 4 tarsal segments of left midleg and few setae missing; both wings slightly damaged; tip of abdomen slightly



FIGS 9-15

Male terminalia of *Minettia czernyi* Freidberg & Yarom: 9, epandrium, surstylus and inner terminalia, lateral view; 10, epandrium and surstyli, posterior view; 11, surstyli, oblique view; 12, surstylus in maximal lateral extension; 13, inner terminalia, anterior view; 14, postgonite, oblique view; 15, pregonites and phallapodeme in maximal extension.

covered with debris). The genitalia are partly covered with debris, but the right surstylus is clearly visible (as in Figs 16-19).

Paralectotype ♀ (examined): "Meigen" (upper side of round label, handwritten); "2402 40" (lower side of same round label, handwritten); "Paralectotype ♀, Sapromyza rivosa Meigen, 1826, desig. B. Merz'2002" (red square label, handwritten); "Minettia fasciata (Fallén), det. B. Merz'2002" (white label, handwritten) (MNHNP). The condition of the specimen is worse than the lectotype, with the left eye slightly squashed and the lunule sunken into the head.

Comment: Meigen (1826) described this species based on an unknown number of specimens. Two specimens remain in the collection of the MNHNP. They agree well with the original description (p. 265) and illustration (Morge, 1975-1976, plate CXLII, Figs 11-12) and are considered to be syntypes. Because of the difficult taxonomy in the species-group I am designating a lectotype herein in order to avoid further confusion about the identity of this species.

The synonymy of *S. rivosa* with *L. fasciata* was already proposed by Westwood (1840), but they were treated as good species by Collin (1948) and subsequent authors. The comparison of all available type specimens confirms the opinion of Westwood (1840).

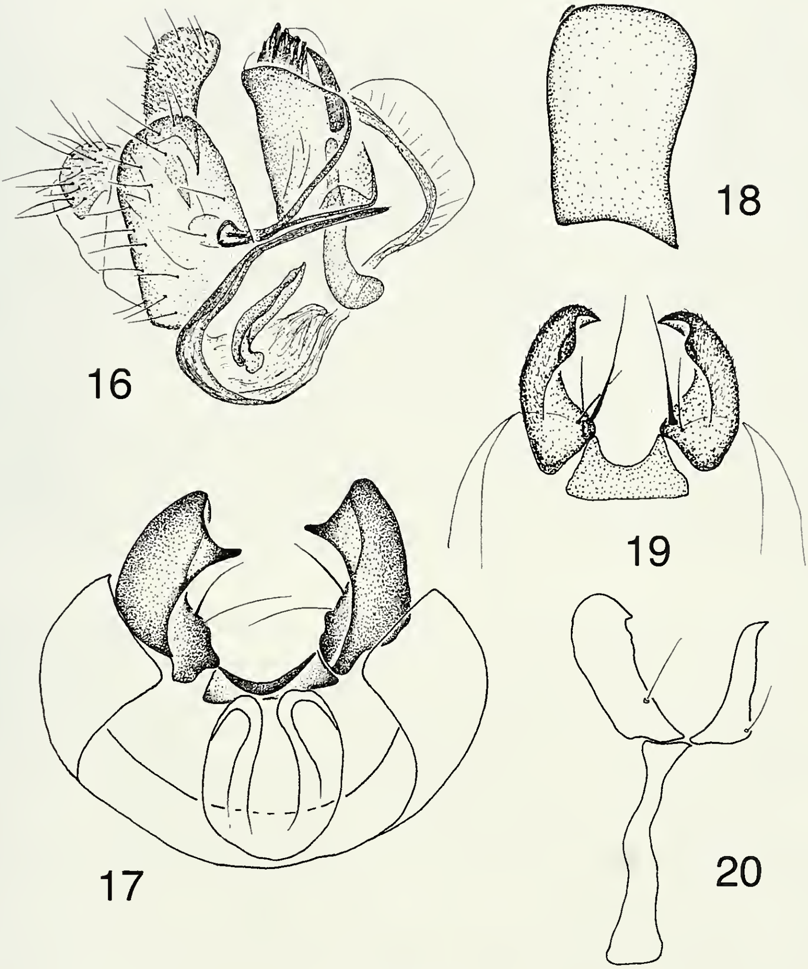
Lauxania fasciata has priority over *S. rivosa* because the exact publication date is not known for the latter and is therefore by default 31 December (ICZN, 1999), whereas *L. fasciata* was published on 6 December.

Type material of nemorosa

This species was described from a large number of specimens, but the collection of Robineau-Desvoidy, now in the MNHNP, is mostly destroyed. No specimen of this species could be found in the MNHNP (Charbonnel, in litt.). Because of the insufficient description presented by Robineau-Desvoidy it is not possible to unambiguously establish the identity of the species. It seems most reasonable to follow Macquart (1835), Westwood (1840) and most subsequent authors who synonymized it with *L. fasciata* and/or *S. rivosa*.

OTHER MATERIAL EXAMINED (598 specimens)

Palaearctic - AUSTRIA: Süd-Steiermark. BELGIUM: Flanders: Knokke, Oostkamp. BULGARIA: Achtopol. CROATIA: Brazza Island; Unie Island; Dalmatia: Savudrja. DANMARK: Jylland: Hansted reserve. ENGLAND: Cambs: Wicken Fen; Herts: Harpenden; Oxfordshire: Wychwood Forest; Norfolk: Wretham Heats; Suffolk: Bury St. Edmunds; Wiltshire: Marlborough. FRANCE: Alpes-de-Haute-Provence: Montagnes de Lure; Alpes Maritimes: Menton, Nice, Sospel; Ariège: Salege; Aude: Aunat, Belcaire, Marsa; Aveyron: Nant; Bouches-du-Rhône: Marseille, Peyrolles; Calvados: Luc-sur-Mer; Corsica: Ghisonaccia, Larc; Doubs: Liesle, Vallée de la Loue; Drôme: Chalancon, Dieulefit; Gard: Camprieux, Dourbies; Haute Savoie: Bossey, Le Pas de l'Echelle, Monnetier, Salève; Manche: Pontorson; Seine-et-Oise: Forêt St. Germain; Var: Les Maures, Sollies Pont; Yvelines: Fontainbleu, Maisons Laffitte. GERMANY: Bayern: Dachau, Etterschlag, München, Schöngeising; Berlin: Berlin; Brandenburg: Eberswalde. GIBRALTAR: Gibraltar. GREECE: Corfu: Hricida; Epyrus: Ionina; Peloponnes: Akhaia, Lakonfas. HUNGARY: Kalocsa. ITALY: Cosenza: Cirella, Grisolia, Marcellina, Santa Maria del Cedro, Verbicaro; Liguria: Monterosso al Mare; Lucca: Orecchiella; Macerata; Mantova: Marmirolo; Puglia: Mte. Gargano; Sardegna: Cuglieri, Dorgali, Iglesias, Oliena, Villacidro; Sicilia: Etna, Linguaglossa, Nebrodi, Randazzo; Verona: Grezzana, Malchesine. LIECHTENSTEIN: Balzers, Ruggell. MALTA: Buskett, Chadwick Lakes, Ghadira,



Figs 16-20

Male terminalia of *Minettia fasciata* (Fallén): 16, epandrium, surstylus and inner terminalia, lateral view; 17, epandrium and surstyli, posterior view; 18, surstylus in maximal lateral extension; 19, surstyli, anterior view; 20, pregonites and phallapodeme in maximal extension.

Gozo-Mgarr-ix-Xini, Mgiebah, Salina Bay, Wied Qanotta. MOROCCO: Rabat. POLAND: Szczecin (= Stettin). PORTUGAL: Estonil, Valenca. SERBIA & MONTENEGRO: Radovici. NETHERLANDS: Noord-Holland: Zandvoort; Zeeland: Ouddorp. SPAIN: Cadiz: Hozgarganta valley; Catalagna: Barcelona; Galicia: Santiago de Compostela; Mallorca: Drach. SWEDEN: Skane. SWITZERLAND: Bern: Ostermundigen; Fribourg: Mt. Vuilly; Genève: Bernex, Cartigny, Champel, Chancy, Dardagny, Jussy, Russin, Sézegnin; Schaffhausen: Beringen, Merishausen, Rüdlingen; Ticino: Gordola, Minusio, Mt. S. Giorgio; Vaud: Cudrefin; Valais: La Rippe, Leuk; Zürich; Zürich. TUNISIA: Ain Sobah, Tabarka. WALES: Glamorgan, Oxwich Bay, Kenfig. **Nearctic** – CANADA: British Columbia: Vancouver area. USA: Oregon: Sand Lake, Tillamook Co; Washington: Pierce Co. (CAS, CBM, CCK, CGB, CMCT, CME, CPG, ETHZ, INRA, MHNG, MHNN, NHMB, NRS, SIZK, SMNS, SMO, USNM, ZMUC, ZSM)

DIAGNOSIS

Palpus black or at least dark brown in distal half, the orangish-brown base sometimes extending ventrally almost to the tip; mesonotum usually not uniformly grey, but with faint to strong orange to yellow stripes along dorsocentral setae; these stripes may be narrow or very wide and almost reach the line of intraalar setae; lateroventral black spots on scutellum small; legs yellow, forefemur sometimes with dark brown pattern or entire legs more extensively darkened, including the apical quarter of all tibiae. Male: surstylus elongated, with an apical tooth (Fig. 17) and usually with 1 strong and 1-3 weak setae on the subepandrial plate (Fig. 19); medial branch of pregonite with a subapical tooth, and apical tooth usually not prominent (Fig. 20); postgonite without toothlike projection distally. Female: tergite 3 with unmodified black setae along posterior margin (Fig. 6); pleurae on level of tergites 4-5 with a conspicuous black glandular area (Fig. 8); tergite 8 with a pair of "L-"shaped sclerites (Figs 43-44); tergite 9 distally without long, black setae, usually wider than long, almost rectangular, smoothly concave medially along posterior margin (Fig. 44); sternite 8 raised medially, with a pair of long ear-like projections (Fig. 45); opening in lateral view more slit-like, elongated, apically sharply pointed (Fig. 43); ventral plate of ear-like projection in ventral view large, semicircular (Fig. 45). Wing length: 3.7-4.25 mm.

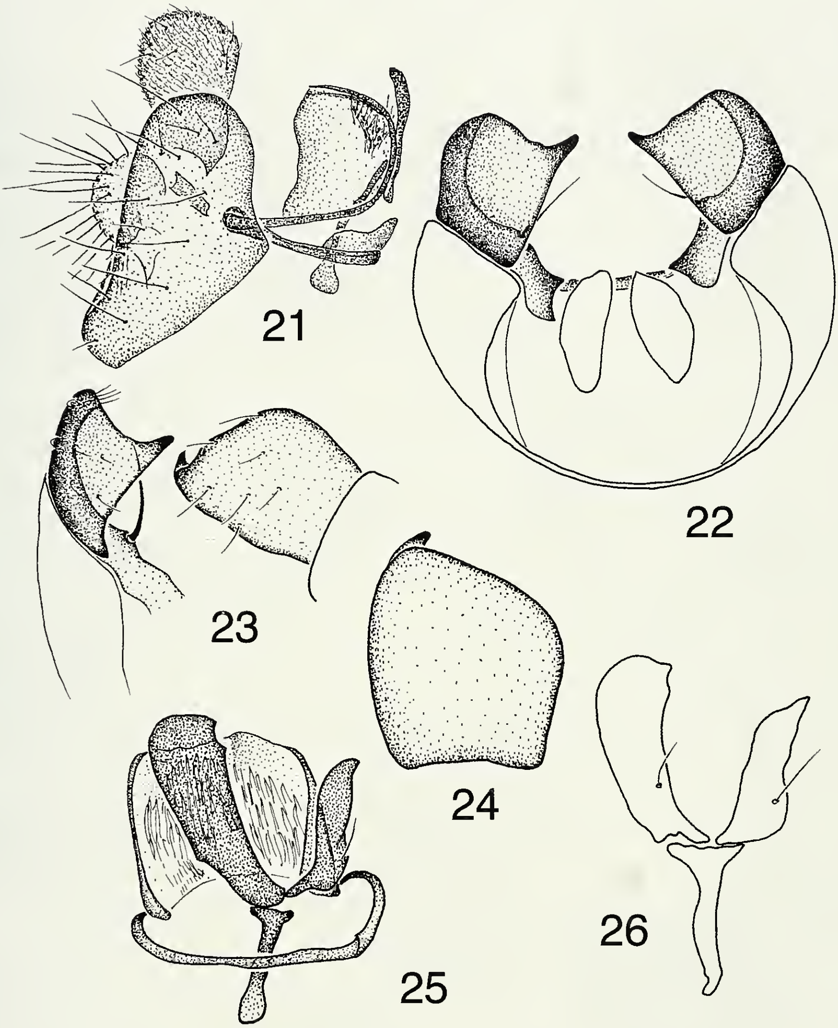
REMARKS

Externally, this species is somewhat intermediate between *M. tabidiventris* and *M. subvittata*. The colour of the mesonotum is quite variable. Specimens from southern Europe tend to be paler than those from northern Europe and the mountains, and may then be easily confused with *M. subvittata*. Specimens with an entirely grey mesonotum (as in *M. tabidiventris*) are rare. A faint paler stripe over the line of dorsocentral seta is usually visible under certain illumination.

M. fasciata is the sister species of *M. subvittata*, both having the same type of genitalia in both sexes, and females of both species have a large glandular area in the abdominal pleurum. The differences in the colour of the palpus as presented in the key apply to about 90% of the specimens. Those with a black tip clearly belong to *M. fasciata*, but a pale palpus may be found in conjunction with a rather yellow thorax in specimens of both species from mediterranean countries. The males differ clearly in the shape of the surstylus which is distinctly longer than wide in profile in *M. fasciata* (Fig. 18) and more square in *M. subvittata* (Fig. 24). Usually, the subepandrial sclerite carries 1-3 weak setulae in addition to the strong seta in *M. fasciata* (Fig. 19), but only one strong seta is present in *M. subvittata* (Fig. 23). The females can be separated by the chaetotaxy of the abdomen and the shape of the ear-like projections of sternite 8, as explained in the key.

DISTRIBUTION

Widespread and common all over Europe. Also known from North Africa, but apparently absent from Israel. According to Shatalkin (2000) also in the Caucasus and the "Near East". An isolated population is known in the Western part of the Nearctic region. These specimens are identical with specimens from Western Palaearctic region. At the present moment it is impossible to explain this remarkable bimodal distribution of this species.



FIGS 21-26

Male terminalia of *Minettia subvittata* (Loew): 21, epandrium, surstylus and inner terminalia, lateral view; 22, epandrium and surstyli, posterior view; 23, surstyli, oblique view (paralectotype); 24, surstylus in maximal lateral extension; 25, inner terminalia, anterior view (paralectotype); 26, pregonites and phallapodeme in maximal extension.

Minettia subvittata (Loew, 1847) Figs 3, 5, 21-26, 46-48

Sapromyza subvittata Loew, 1847: 28. Type localities: Italy: Neapel; Greece, Turkey ("Kleinasien")

Sapromyza cataracta Pandellé, 1902: 398. Type localities: France: Marseille; Italy: Trieste. [synonymy confirmed]

Minettia rivosa auctt. nec Meigen, 1826: Freidberg & Yarom (1990).

TYPE MATERIAL

Type material of subvittata

Lectotype ♀ (here designated, examined): (small, white label with 2 black triangles on top), "Italien, Neapel, 8.1845, Zeller" (handwritten, blue label); "Coll. H. Loew" (printed, white label); "Typus" (printed, red label); "11596" (printed, white label); "Sapromyza subvittata m. [handwriting Loew], Type ♀ Loew [handwriting of unknown person]" (white label); "Zool. Mus. Berlin" (printed, yellow label"); "Lectotypus ♀, Sapromyza subvittata Loew, 1847, desig. B. Merz'2002" (handwritten, red label). (ZMHB). The specimen is directly pinned and is in good condition, with only the right posterior fronto-orbital seta and left medial vertical seta missing, some setae on head partly broken; left lateral postalar seta and right second postsutural dorsocentral seta absent; left wing slightly broken.

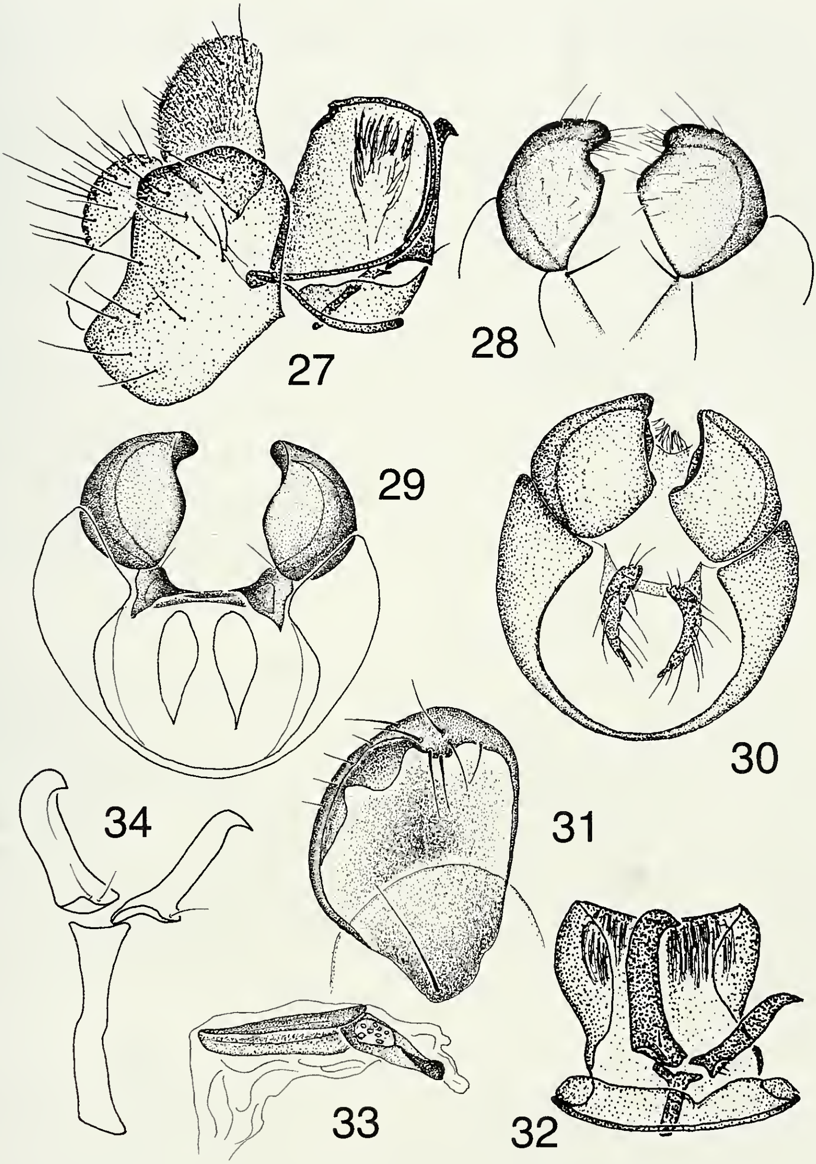
Paralectotype ♂ (examined): (small square, pink label), "KleinAsien, coll. H. Loew" (handwritten, blue label); "Coll. H. Loew" (printed, white label); "Paratypus" (printed, red label); "Sapromyza subvittata Cotype ♀ Loew, 1847" (handwritten [not by Loew], white label); "Zool. Mus. Berlin" (printed, yellow label"); "Paralectotypus ♂, Sapromyza subvittata Loew, 1847, desig. B. Merz'2002" (handwritten, red label). The abdomen has been removed and is stored in glycerol in a glass vial on the same pin as the remaining specimen. Paralectotype ♂ (examined): "95" (handwritten, small, square white label); "Rhodus, coll. H. Loew, Erber 5." (handwritten, blue label); "Coll. H. Loew" (printed, white label); "Paratypus" (printed, red label); "Zool. Mus. Berlin" (printed, yellow label"); "Paralectotypus ♂, Sapromyza subvittata Loew, 1847, desig. B. Merz'2002" (handwritten, yellow label); "Minettia tubifer (Mg.), det. B. Merz'2002" (handwritten, white label) (both ZMHB).

Comment: Another female from the collection H. Loew (ZMHB) labelled "Italien, Neapel, Zeller S., 29.7.1845" does not belong to the syntypic series, because the collecting date (July) does not correspond with the original description (August). This specimen belongs to *Minettia tubifer* (Meigen). The abdomen of the specimen has been removed, and is kept in glycerol in a glass vial on the same pin.

The lectotype is labelled "Typus", and the other specimens "Paratypus", but Loew (1847) did not designate a holotype and the red "Typus"-label was apparently added later to the specimen. It was probably this specimen that Czerny (1932) studied for his re-description and which he appeared to consider as the holotype (only by interference, he never referred to one of the specimens as the "Type" or "Holotype", but he did refer to Paratypes). However, his action was ambiguous and does not fulfill the requirements of the ICZN (1999), articles 74.5 or 74.6. Therefore, a lectotype designation is necessary in order to fix unambiguously the identity of the species. The lectotype corresponds perfectly with the description of Loew and maintains the current concept of the species (Shatalkin, 1998, 2000).

Type material of cataracta

Lectotype ♀ (here designated, examined): "♀, 6522" (handwritten), "Sapromyza cataracta (Pandellé's handwriting), "Lectotypus Sapromyza cataracta Pandellé, 1902, ♀, desig. B. Merz'2003" (red label), "Minettia subvittata (Loew), det. B.



Figs 27-34

Male terminalia of *Minettia tabidiventris* (Rondani): 27, epandrium, surstylus and inner terminalia, lateral view; 28, surstyli, posterior view (paralectotype); 29-30, two extreme forms of epandrium and surstyli, posterior view; 31, surstylus, medial view of extreme form with medio-apical projection; 32, inner terminalia, anterior view; 33, aedeagal apodeme; 34, pregonites and phallapodeme in maximal extension.

Merz'2003" (white label) (MNHNP). The specimen is directly pinned and is in very good condition (colours strong, little debris on integument; mesonotum medially sunken, legs slightly shrivelled).

Comment: Although the species was described at least from two specimens, only the above mentioned female could be found in the MNHNP. (Charbonnel, in litt.). According to the catalogue of Pandellé, the code "6522" means "Marseille, Abeille (abdomen 3ème arc. avec une série marginale d'aiguillons couchés robuste atteignant le 5ème arceau)" [= collected by Abeille in Marseille, 3rd abdominal segment with a series of long setae reaching 5th segment] (Charbonnel, in litt.). It cannot be excluded that further type specimens occur elsewhere. Therefore it is proposed here that a lectotype is designated in order to fix the identity of this species.

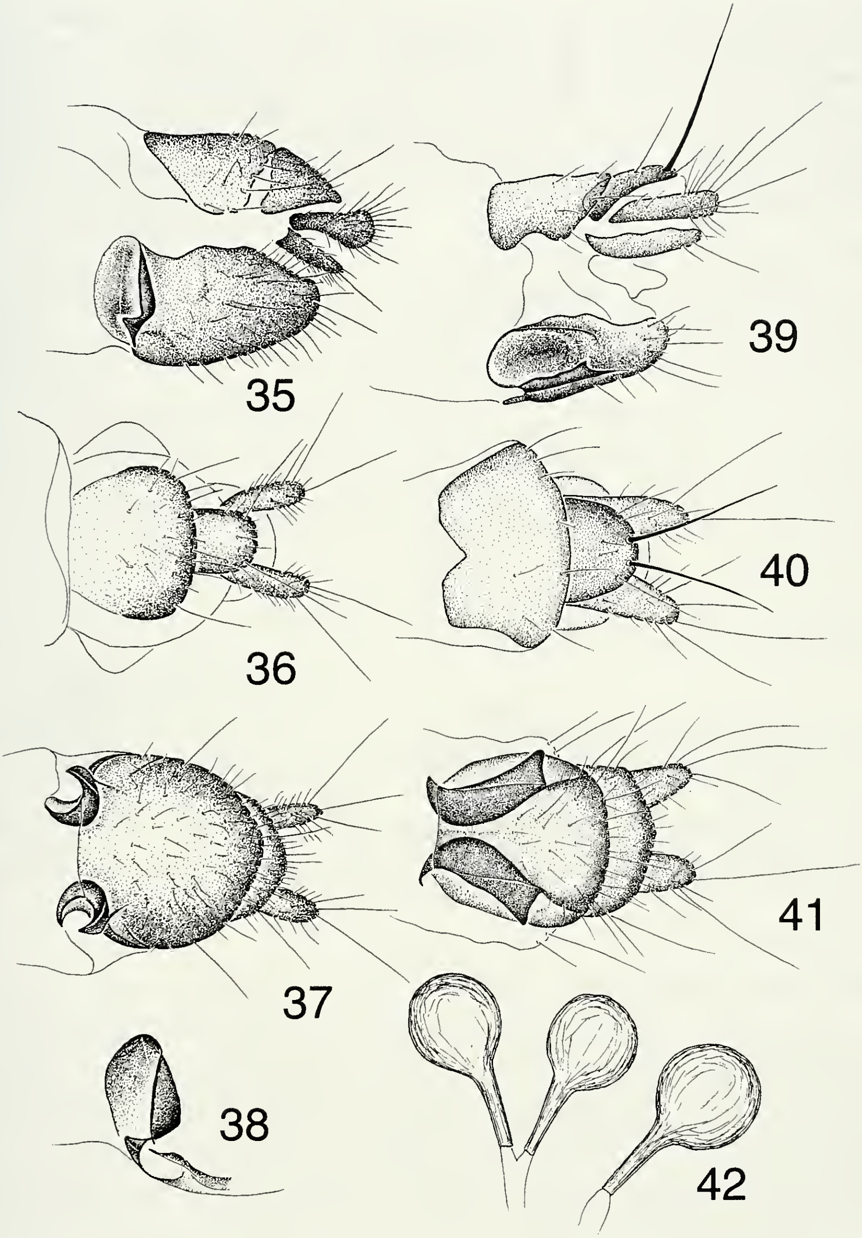
The specimen is characterized by the entirely yellow palpus, the strongly plumose arista, the pair of black spots lateroventrally on the scutellum, 0+3 dorsocentral setae and 3 pairs of strong medial and 3 pairs of weaker lateral setae at the posterior margin of tergite 3. Although the genitalia are retracted into the preabdomen it is obvious that tergite 9 does not have long black apical setae, and sternite 8 is bulging medially. This combination of characters is the same as in *S. subvittata*. Therefore this synonymy which was first proposed by Czerny (1932) without studying the types is confirmed herewith.

OTHER MATERIAL EXAMINED (237 specimens)

CROATIA: Verudela. CYPRUS: Akamas peninsula, Akrotiri peninsula, Diarizos valley, Lemasos, Lefkara, Kalvasos, Kissousa. FRANCE: Alpes-de-Haute-Provence: Montagnes de Lure; Alpes Maritimes: Menton; Aude: St. Pierre de la Mer; Bouches-du-Rhône: Arles, Etang de Berre, Les Baux; Drôme: Curnier; Gard: Pont du Gard, Remoulins. Hérault: Grables, Montpellier, St. Gily-du-Fesc; Pyrénées-Orientales: Port Vendres; Var: Cavalière; Vaucluse: Cucuron; Yvelines: Maisons Laffitte. GREECE: Crete: Agios Galini, Agia Pelagia; Epyrus: Ioanina; Kilkis: Polycastro; Madeconia: Florina, Lahanas hills, Struma valley; Thessaloniki; Peloponnes: Lakonfas, Akhaia. HUNGARY: Kalocsa. ISRAEL: Aniam, Antipatris, Herzliyya, Mezdat Nimrod, Meron, Montfort, Mt. Carmel, Panyas, Park HaYarden, Ramat Aviv, Ramot Naftali, Rehobot, Qusbiye, Snir, Tel Aviv, Tel Dan, Zomet. ITALY: Cosenza: Marcellina, Santa Maria del Cedro; Puglia: Mt. Gargano; Trieste: Trieste. SERBIA & MONTENEGRO: Radovici. SPAIN: Cataluna: Barcelona. TURKEY: Antalya: Antalya, Cavusköy, Kemer, Phaselis, Side; Isparta: Kovada lake; Samsun: Samsun. (CAS, CBM, CGB, CMCT, CME, CPG, INRA, MHNG, MHNN, SIZK, SMNS, SMO, TAU, USNM, ZSM)

DIAGNOSIS

More brownish than grey, with very wide orange to brown stripes along the lines of dorsocentral setae, leaving comparatively narrow grey stripes along the acrostichal and intraalar setae, but dark specimens may have a similar pattern to *M. fasciata*; palpus yellow, rarely with dorsal margin brown to black; black lateroventral spots on scutellum small (Figs 3, 5); legs yellow, but femora often partly grey to black; black transverse stripes on tergites 3-5 (Fig. 7) tend to be narrower than in *fasciata* and *tabidiventris* but this is not a reliable character. Male: surstylus rather square in profile (Fig. 24); apically with a tooth-like projection at posterior margin; subepandrial plate with 1 strong black seta (Figs 22-23); medial pregonite with a subapical tooth, apical tooth barely longer (Fig. 26); postgonites distally without tooth like projection. Female: 3-4 pairs of medially separated, very long, black setae at posterior margin of



FIGS 35-42

Female terminalia of *Minettia czernyi* Freidberg & Yarom (35-38) and *M. tabidiventris* (Rondani) (39-42): 35, 39, lateral view; 36, 40, dorsal view; 37, 41, ventral view; 38, ear-like projection, enlarged; 42, spermathecae.

tergite 3 (Fig. 7); abdominal pleurae with a dark glandular area on level of segments 4-5; tergite 8 with a pair of "L-"shaped sclerites (Fig. 47); tergite 9 with moderatly enlarged black setae at distal margin (Fig. 46), about as wide as long, almost rhomboid, at posterior margin medially smoothly concave (Fig. 47); sternite 8 raised medially, with a pair of rather short ear-like projections (Fig. 48); opening in lateral view triangular (Fig. 46); ventral plate of this ear-like projection in ventral view small, laterally pointed. Wing length: 3.65-4.55 mm.

REMARKS

This species resembles very much pale specimens of *M. fasciata* and a safe separation is only possible by the study of the terminalia (♂ or ♀) as given in the key. As explained under *M. fasciata* the colour of palpus and mesonotum are not fully reliable characters.

M. subvittata may also be confused with dark specimens of *M. czernyi*. The latter species, however, always has much larger black spots lateroventrally on the scutellum (Fig. 2, 4), and differs in the genitalia of both sexes. Tergite 4 instead of tergite 3 has conspicuously long apical setae in *M. czernyi*.

DISTRIBTUTION

A circummediterranean species with northernmost records from Hungary and the Paris area (Yvelines: Maisons Laffitte).

Minettia tabidiventris (Rondani, 1877) Figs 27-34, 39-42

Sapromyza tabidiventris Rondani, 1877: 61. Type locality: not given (according to Papp, 1984: "Italy").

Sapromyza luteo-frontata Becker, 1895: 218. Type locality: "Herkunft nicht angegeben, daher wahrscheinlich aus Posen oder Schlesien". **Syn. n.**

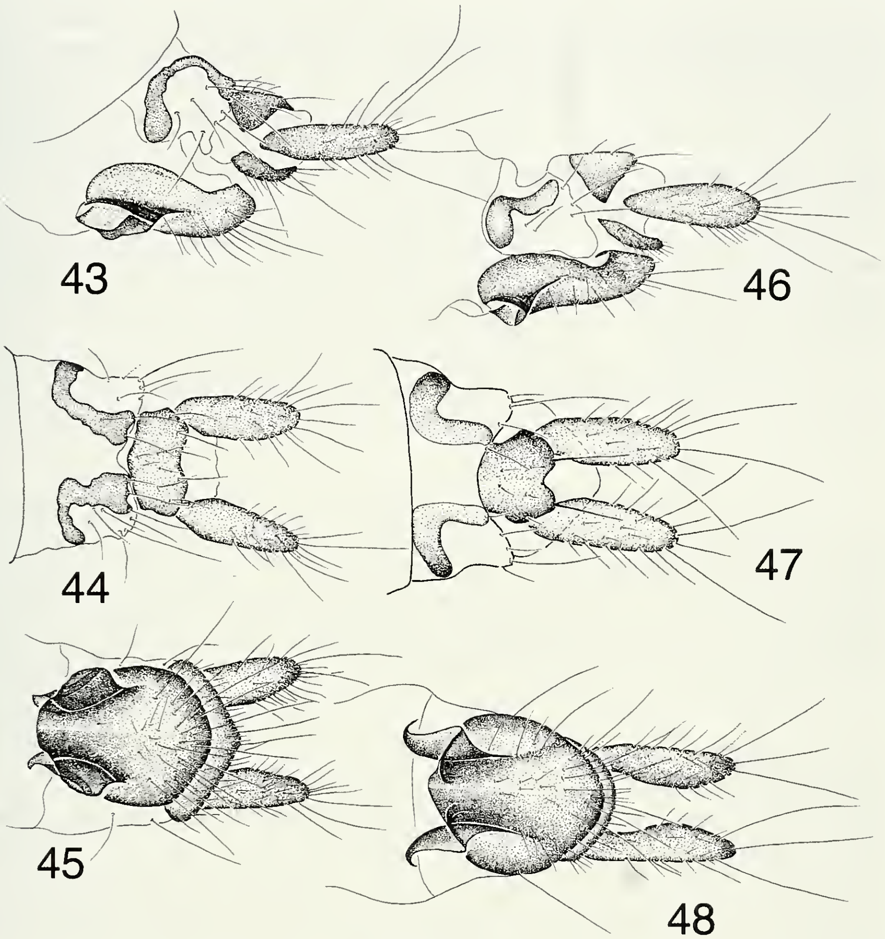
Minettia fasciata auctt. nec Fallén, 1826: Collin (1948); Papp (1979, 1984); Remm & Elberg (1979); Freidberg & Yarom (1990); Shatalkin (2000).

TYPE MATERIAL

Type material of tabidiventris

Lectotype ♂ (here designated, examined): "1553" (printed in red), "Lectotypus ♂, Sapromyza tabidiventris Rondani, 1877, desig. B.Merz'2003" (red label) (MZF). The condition of the specimen is good, with strong colours and antennae and legs fully present; surstylus mostly visible. The following setae are missing: left posterior fronto-orbital, left medial vertical, right posterior notopleural, right anterior dorsocentral, left anterior katepisternal and a series of setulae on the dorsal surface of the abdominal tergites.

Paralectotypes (examined): 1♂, 3♀♀, with same label "1553", "Paralectotypus Sapomyza tabidiventris Rondani, 1877, desig. B. Merz'2003". The male paralectotype was dissected and the abdomen with the genitalia are stored in gylcerol in a glass vial which is attached to the pin of the specimen. The condition of the paralectotypes varies from rather good to bad, each specimen with some damage. One additional ♂ is glued on a cardpoint and has the same label "1553", but represents the species



Figs 43-48

Female terminalia of *Minettia fasciata* (Fallén) (holotype) (43-45) and *M. subvittata* (Loew) (46-48): 43, 46, lateral view; 44, 47, dorsal view; 45, 48, ventral view.

Minettia lupulina (Fabricius, 1787), and therefore differs in various external characters from the original description and is not considered part of this type series.

Comment: This species was described from an unknown number of specimens ("non infrequens, exemplaribus preaecedentis [= *subvittata* Lw.] permixta"). All five syntypic specimens belong clearly to the same species, fitting perfectly the original description. However, because of the difficult taxonomy of the group with the inclusion of another species in the series with the same number ("1553"), a lectotype is designated in order to fix the identity of the species.

Type material of luteofrontata

Holotype ♀ (examined): "14/8 46" (handwritten); "Coll. H. Loew" (printed); "11607" (printed); "Type" (red label, printed); "luteo-frontata Beck." (Becker's handwriting); “Holotypus ♀, Sapromyza luteo-frontata Becker 1895” (red bordered label, L. Papp’s handwriting); “Minettia fasciata Fall. ♀, det. L. Papp” (handwritten); “Zool. Mus. Berlin” (yellow label, printed); “Minettia tabidiventris (Rondani), ♀, det. B. Merz’2003” (handwritten) (ZMHB). The specimen is in a moderately good state of preservation (no debris, pin not damaged, colours strong, but right posterior half of pleura (meron, anatergite, katatergite, anepimeron) and right half of abdomen eaten by pest and some setae on head and thorax missing).

Comment: Becker (1895) described this species from one specimen in the Loew collection. He alternatively considered this species to be a male (title) or a female (diagnosis). Although not very comprehensive, the description of Becker fits the present specimen well. It is thus concluded to be the holotype.

The comparison of the types of *tabidiventris* and *luteofrontata* clearly shows that they are conspecific and their synonymy is proposed here.

OTHER MATERIAL EXAMINED (255 specimens)

CROATIA: Dubrovnik (Ragusa). CYPRUS: Akrotiri, Diarizos valley, Kissousa, Kofinous, Kouklia, Lemasos. DANMARK: Jylland: Thy. Nors. FRANCE: Alpes-de-Haute-Provence: Montagnes de Lure; Alpes Maritimes: Le Bar-sur-Loup; Aude: Marsa; Doubs: Vallée de la Loue; Drôme: Chalancon; Gard: Claret; Haute Savoie: Bossey, Le Pas de l’Echelle, Monnetier, Salève; Hérault: Grables, Lattes; Hautes Alpes: Agnielles; Haute Savoie: Albertville; Pyrénées-Orientales: Argèles-s-Mer, Collioure; Vaucluse: Beaumont. GERMANY: Baden-Württemberg: Lottstetten; Bayern: Bamberg, Dachau, Erlau b. Passau, Etterschlag, München, Schöngeising; Rheinland-Pfalz: Mainz; Sachsen-Anhalt: Wernigerode. GREECE: Corfu: Corfu, Merlin Marah; Macedonia: Seres; Sterea Elada: Itea, Paranssos mountains. HUNGARY: Kalocsa. ISRAEL: Mt. Carmel, Mt. Meron, N. Amud, N. Bezet, Panyas, Park HaYarden. ITALY: Trento: Mt. Lessini; Sicily: Nebrodi, Randazzo; Verona: Erbezzo. LIECHTENSTEIN: Balzers, Ruggell. MALTA: Buskett. NORWAY: Oslo: Hovedoya; Tey: Bamble. PORTUGAL: Praia des Macas. SPAIN: Catalana: Barcelona; Granada: Sierra de Alhama. SWEDEN: Gotland: Ardre, Ljugarn. SWITZERLAND: Bern: Mörigen, Sonceboz; Genève: Bernex, Cartigny, Chancy, Chèvres, Collonge-Bellerive, Dardagny, Russin, Sézegnin; Fribourg: Mt. Vuilly; Graubünden: Brienz-Surava, Valbella; Neuchâtel: Neuchâtel; Sankt Gallen: Betlis-Quinten; Schaffhausen: Merishausen, Rüdlingen; Schwyz: Gersau; Valais: Baltschieder, Leuk; Zürich: Dietikon, Unterengstringen, Winterthur, Zürich. TURKEY: Antalya: Cavusköy, Selale. WALES: Tenby: Manorbier Beach. (CBM, CGB, CPG, CMCT, INRA, ETHZ, MHNG, MHNN, NHMB, NML, NRS, SMNS, SMO, TAU, USNM, ZMB, ZMUC, ZSM)

DIAGNOSIS

Palpus always black at least in apical half; mesonotum uniformly grey microtrichose, without paler stripes along lines of dorsocentral setae, but sometimes with narrow black stripe just medially of line of dorsocentral setae; scutellum lateroventrally with two small black spots (as in Figs 3, 5); legs yellow, but anterior femur often dark brown to black and apices of tibiae often also darkened; transverse dark bands on tergites 3-5 broadly interrupted, leaving sometimes only 1-2 pairs of dark spots (as in Fig. 7). Male: surstylus almost square in profile, distal margin characteristically concave and invaginated (Figs 28-31); left pregonite usually with a simple apical tooth (Fig. 34); postgonite distally without protuberances; subepandrial plate usually with 1 rather short seta only (Figs 28, 31). Female: without long setae along posterior margin of tergite 3; pleurae usually with only weak glandular area on level of tergites 4-5; tergite 8 forming a large sclerotized plate (Fig. 40); tergite 9 with a pair of very long, black, soft setae in the middle of the posterior margin (Fig. 40); sternite 8 indistinctly raised medially, ear-like projections not separated by depression (Fig. 41); ear-like projection in profile more or less parallel-sided, with deep invagination (Fig. 39). Wing length: 3.75-4.45 mm.

VARIABILITY

Specimens from Southern Europe (France, Alpes Maritimes; Italy, Sicily; Greece, Macedonia; Malta) show considerable variation in the outline of the distal margin of the surstylus. It is evenly concave in typical specimens (Figs 28-29) but there is a tendency to develop an additional tooth-like projection near the middle. The most extreme forms exhibit a very strong medial projection giving the impression of the presence of 3 lobes (Figs 30-31). The shape and orientation of this projection is subject to strong variability. Because of the continuous variation of this character and the presence of different types of projections in the same population it is concluded that one variable species only is involved.

REMARKS

M. tabidiventris differs from the couplet *fasciata* and *subvittata* by the usually entirely grey mesonotum without paler stripes over the lines of the dorsocentral setae, in the male in the shape of the surstylus and the left pregonite and in the female in the entirely sclerotized tergite 8, the long pair of setae along the posterior margin of tergite 9 and the structure of sternite 8 with a slightly concave surface and parallel-sided ear-like projection in profile.

DISTRIBUTION

Known throughout Europe except the very north of Scandinavia, Turkey and Israel. Apparently absent from North Africa. According to Shatalkin (2000) also in the Caucasus.

DOUBTFUL SPECIES

Lauxania pallida Meigen, 1830, nomen dubium

Lauxania pallida Meigen, 1830: 381. Type locality: not given ("von Herrn von Winthem").

No syntypic specimens could be found in the collections of Meigen in Paris (MNHNP, Charbonnel, in litt.), nor in Vienna (NHMW, Contreras-Lichtenberg, in litt.). The description is short, and the species is compared by Meigen with *Minettia lupulina* (Fabricius, 1787), differing from the latter by the black antenna, entirely transparent wing and the apparently uniformly grey scutellum dorsally (see Morge, 1975-1976, plate CCX, Fig. 8). Although sometimes treated as a species of the *Minettia fasciata* group (Papp, 1984) it seems more reasonable to assume that *L. pallida* either is a senior synonym of *Sapromyza longiseta* Loew, 1847 (if Meigen's illustration of *pallida* is a male) or it is one of the species of the *M. lupulina* group, as it was suggested by various authors who synonymized it with *Sapromyza dimidiata* Loew (Becker, 1902; Hendel, 1908; Czerny, 1932). Because of the insufficient description and the lack of type specimens, *L. pallida* must be considered at the present moment as nomen dubium.

Tab. 1

Synoptic comparison of the 4 species of the *Minettia fasciata* species-group. M = Male; F = Female; bold = diagnostic characters

Character	*M. czernyi*	*M. fasciata*	*M. subvittata*	*M. tabidiventris*
Colour of palpus	yellow	at least apically, but usually entirely black	usually yellow	usually black
Colour of mesonotum	yellow with medial grey stripe along line of acrostichal setulae	variable, from golden-grey to ash-grey, striped or unstriped	yellow-grey with yellow stripes over line of dorsocentral setae	usually uniformly grey, rarely with yellow dorsocentral stripes
Size of black spots on scutellum	**large**	small	small	small
Colour of subscutellum	**yellow**	black	black	black
F: Marginal setae on tergites	**tergite 4 with 4-6 long, thick setae medially**	without enlarged setae	**tergite 3 with 6-8 long, black setae medially**	without enlarged setae
M: Surstylus	sides bulging, irregularly shaped, **apically undulating**	parallel-sided, **twice as long as wide,** with apico-dorsal tooth	parallel-sided, **as long as wide,** with apico-dorsal tooth	sides bulging, **apically concave or with medial protuberance**
M: Setae on subepandrial plate	1 long	**1 long and 1-4 small**	1 long	1 long
M: Left gonite	**large and thick,** small process below tip	slender, small process below tip	slender, small process below tip	slender, **evenly pointed**
F: Tergite 8	1 rectangular sclerite	2 L-shaped sclerites	2 L-shaped sclerites	1 rectangular sclerite
F: Tergite 9	short setulose	short setulose	short setulose	**one pair of long medial marginal setae**
F: Sternite 8	**evenly convex, without keel**	medially raised, with an indistinct keel	medially raised, with an indistinct keel	**more or less flat**
F: Ear-like projection of sternite 8	small, round, **higher than wide in profile**	slit-like, long, **parallel-sided in profile**	short, strongly **pointed in profile**	**distally semicircular,** longer than wide in profile

TAXONOMIC SUMMARY

The *Minettia fasciata* species-group contains at present four valid species:

Minettia czernyi Freidberg & Yarom, 1990
- = *M. quadrisetosa* Czerny, 1932 (junior primary homonym of *M. quadrisetosa* Becker, 1907)

Minettia fasciata (Fallén, 1826)
- = *M. rivosa* (Meigen, 1826) (synonymy first proposed by Westwood, 1840, confirmed herein)
- = *M. nemorosa* (Robineau-Desvoidy, 1830) [synonymy doubtful] (synonymy of *rivosa* with *nemorosa* proposed by Macquart, 1835: 403)

Minettia subvittata (Loew, 1847)
- = *M. cataracta* (Pandellé, 1902) (synonymy first proposed by Czerny, 1932, confirmed herein)
- = *M. rivosa* auctt. nec Fallén, 1826: Freidberg & Yarom (1990)

Minettia tabidiventris (Rondani, 1877)
- = *M. luteofrontata* (Becker, 1895), **syn. n.**
- = *M. fasciata* auctt. nec Fallén, 1826: Collin (1948), Papp (1979, 1984), Freidberg & Yarom (1990), Shatalkin (1998, 2000)

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A new species of *Astyanax* (Characiformes, Characidae) from the upper río Bermejo basin, Salta, Argentina

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A new species of *Astyanax* (Characiformes, Characidae) from the upper río Bermejo basin, Salta, Argentina. - *Astyanax latens* sp. n., from the Bermejo river basin, is described in this paper. *Astyanax latens* is diagnosed by a combination of characters: somewhat rhomboidal body; presence of 24-29 branched anal fin rays; 1-4 maxillary teeth; long pectoral fins (23.2-26.6 % of SL) always reaching one third of pelvic fin; long pelvic fins (17.6-22.0 % of SL) always surpassing anal fin origin; anal fin base long (32.3-36.7 % of SL); 26-27 gill rakers on first branchial arch; lateral band extremely narrow; one large vertically elongated humeral spot and a second one very faint; relatively shallow caudal peduncle (10.0-11.4 % SL); fifth tooth of inner premaxillary series very small and scarcely posterior to main series; origin of anal fin below dorsal fin.

Key-words: Characiformes - Characidae - *Astyanax* - new species - río Bermejo basin.

INTRODUCTION

The genus *Astyanax* Baird & Girard, 1854 includes more than 100 nominal species (Garutti & Britski, 2000), distributed from Southern United States to the río Negro in Argentina (Almirón *et al.*, 1997). Since the original description of the genus, the most complete revision of *Astyanax* has been done by Eigenmann (1921, 1927) who diagnosed the genus with characters that are present in many Characiformes. Subsequently, many authors followed that classification (among others, Ringuelet *et al.*, 1967; Géry, 1977; Bertaco & Malabarba, 2001). Traditionally, the genus is defined by the presence of two series of teeth in the premaxilla, the first series with several teeth, a second series with equal or graduated teeth, usually five in number, four in a few species; crowns of premaxillary and mandibulary teeth usually ridged and denticulated; maxillary with few or none teeth; complete lateral line, gill rakers setiforms,

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and absence of predorsal spine and scales on the caudal peduncle base. The combination of those characters still defines the species recognized within the genus which has never been considered in a phylogenetic revision.

About 20 species of the genus *Astyanax* were previously cited in Argentina. Some of those records need to be revised because they probably correspond to misidentifications due to external morphological similarities with species from other basins. A detailed revision of the species of the Río de la Plata basin is necessary, although, systematic papers concerning species of the genus *Astyanax* were published in the last recent years. Those papers reveal the presence of seven new species in the northeastern Argentina (Azpelicueta & García, 2000; Azpelicueta *et al.*, 2002a, 2002b; Almirón *et al.*, 2002; Casciotta *et al.*, 2003a, 2003b). Also, new collecting trips in the northwestern Argentina show the presence of new species, fact that allows us to describe *A. latens* sp. n. from the upper río Bermejo basin. The description of the new species is the objective of this paper, providing osteological information that may be useful in future phylogenetic studies.

MATERIAL AND METHODS

Specimens were cleared and counterstained (C&S) following Taylor & Van Dyke (1985). Measurements are straight distances taken with calliper to nearest 0.01 mm. Standard length was measured from snout tip to hypural joint; head length includes opercular flap; length of caudal peduncle was the distance between last anal fin ray insertion and hypural joint. Counts of vertebrae include Weberian apparatus and the caudal complex centrum as one element.

Material is deposited in Asociación Ictiológica, La Plata (AI, asociacionictiologica@interlap.com.ar); Facultad de Ciencias Naturales y Museo, La Plata (MLP); Fundación Miguel Lillo, Tucumán (CI-FML); Museo Argentino de Ciencias naturales Bernardino Rivadavia, Buenos Aires (MACN); Museum d'histoire naturelle de Genève, Genève (MHNG); The Academy of Natural Sciences of Philadelphia, Philadelphia (ANSP).

COMPARATIVE MATERIAL (SL in mm). *Acrobrycon tarijae* Fowler, 1940: CI-FML 3270, 1 ex., 66.6 mm, Argentina, Salta, Orán, La Bambú, río Bermejo basin, río Blanco. *Astyanax abramis* (Jenyns, 1842): MLP 9427, 2 ex., 102.0-113.0 mm, Argentina, Misiones, río Paraná. *Astyanax cf. abramis*: CI-FML 3368, Argentina, Salta, Orán, La Bambú, río Bermejo basin, río Blanco. *Astyanax alleni* (Eigenmann & McAtee, 1907): MLP 6774, 5 ex., 50.0-64.2 mm, Argentina, Santa Fe, Laguna Setúbal. *Astyanax asuncionensis* Géry, 1972: MLP 8660, 5 ex., 43.6-61.4 mm, Argentina Santiago del Estero. Bañado de Añatuya. MLP 8844, 7 ex., 25.0-44.9 mm, Argentina, Formosa, río Bermejo basin, arroyo Mbiguá. *Astyanax eigenmanniorum* (Cope, 1894): ANSP 21627, paratypes, 2 ex., 42.5-49.4 mm, Brasil, Rio Grande do Sul. *Astyanax cf. eigenmanniorum*: CI-FML 3262, 23 ex., 29.4-50.7 mm, Argentina, Salta, La Bambú, río Bermejo basin, río Anta Muerta. *Astyanax cf. fasciatus*: MLP 7115, 1 ex., 47.8 mm, Argentina, Santa Fe, río Paraná basin, San José del Rincón, AI 111, 2 ex., 57.8-62.6 mm, Argentina, Buenos Aires, río de la Plata in Punta Lara. MLP 8647, 5 ex. 34.0-45.8 mm, Argentina, Santiago del Estero, río Salado. *Astyanax ita* Almirón *et al.*, 2002: MLP 9599, holotype, 64.0 mm, Argentina, Misiones, río Iguazú basin, arroyo Tateto. *Astyanax leonidas* Azpelicueta *et al.*, 2002: MLP 9580, holotype, 45.6 mm, Argentina, Misiones, río Paraná basin, headwaters of arroyo Urugua-í. *Astyanax lineatus* (Perugia, 1891): CI-FML 3272, 3 ex., 35.3-72.1 mm, Argentina, Salta, Orán, La Bambú, río Bermejo basin, río Blanco. *Astyanax ojiara* Azpelicueta & García: MLP 9470, holotype, 50.5 mm, Argentina, Misiones, arroyo Benítez. *Astyanax pynandi* Casciotta *et al.*, 2003a: MACN

8543, holotype, 52.0 mm, Argentina, Corrientes, Laguna Iberá. *Astyanax saguazu* Casciotta *et al.*, 2003b: MLP 9603, holotype, 63.0 mm, Argentina, Misiones, río Uruguay basin, arroyo Once Vueltas. *Astyanax troya* Azpelicueta *et al.*, 2002, MACN 8310, holotype, 73.8 mm, Argentina, Misiones, arroyo Cuñapirú Chico. *Bryconamericus iheringii* (Boulenger, 1887): MLP 9073, 110 ex. (5 measured), 39.9-44.3 mm, Argentina, Buenos Aires, Sierra de la Ventana. MLP 9103, 15 ex., 34.8-49.2 mm, Argentina, Buenos Aires, Berisso, Los Talas (Man-made ponds connected to Río de la Plata). *Bryconamericus thomasi* Fowler, 1940: CI-FML 1969, 94 ex. (5 measured, 2 males and 3 females), 40.3-55.4 mm, Argentina, Salta, río Piedras. *Moenkhausia intermedia* Eigenmann, 1908: CI-FML 3257, 60 ex. (5 measured), 20.1-31.5 mm, Argentina, Salta, Orán, La Bambú, río Bermejo basin, arroyo El Oculto. *Odontostilbe microcephala* Eigenmann, in Eigenmann & Ogle, 1907: CI-FML 3369, 2 ex., 48.2-51.6 mm, Argentina, Salta, La Bambú, río Bermejo basin, río Blanco. *Odontostilbe pequira* (Steindachner, 1882): CI-FML 3451, 1 ex., 31.5 mm, Argentina, Salta, Rivadavia, río Bermejo basin, Pozo de los Yacarés. *Oligosarcus bolivianus* (Fowler, 1940): CI-FML 3277, 4 ex., 89.8-113.8 mm, Argentina, Salta, Orán, La Bambú, río Bermejo basin, río Blanco.

Cleared and stained material (Personal coallection). *Astyanax abramis*: 2 ex., 74.5-92.0 mm, Argentina, Buenos Aires, río de la Plata in Punta Lara. *Astyanax asuncionensis*: 2 ex., 80.4-92.7 mm, Argentina, Misiones, río Uruguay in San Isidro. *Astyanax eigenmanniorum*: 1 ex., 45.0 mm, Brasil, Rio Grande do Sul, Viamão, açude Charolês; 2 ex., 17.7-33.0 mm, Argentina, Buenos Aires, desembocadura del río Colorado; 1 ex., 60.3 mm, Argentina, Buenos Aires, Río de la Plata. *Astyanax cf. fasciatus*: 2 ex., 91.0-106.5 mm, Argentina, Misiones, río Uruguay in San Isidro. *Astyanax latens* sp. n.: 2 ex., 40.6-44.0 mm, Argentina, Salta, Orán, La Bambú, río Bermejo basin, arroyo El Oculto. *Astyanax leonidas*: 6 ex., 33.0-45.6 mm, Argentina, Misiones, río Paraná basin, arroyo Urugua-í. *Astyanax ojiara*: 10 ex., 37.8-58.0 mm, Argentina, Misiones, arroyo Benítez. *Astyanax paris*: 3 ex., 66.2-68.5 mm, Argentina, Misiones, río Uruguay, arroyo Yabotí Guazú. *Astyanax saguazu*: 3 ex., 41.6-54.2 mm, Argentina, Misiones, río Uruguay basin, arroyo Once Vueltas. *Astyanax troya*: 2 ex., 76.0-81.5 mm, Argentina, Misiones, río Paraná, arroyo Cuñapirú Chico. *Astyanax* sp. A: 1 ex., 73.5 mm, Argentina, Misiones, arroyo Cuñapirú Chico.

RESULTS

Astyanax latens sp. n. Figs 1-5, Table 1

Holotype. CI-FML 3400 male, 44.3 mm SL, Argentina, Salta, río Bermejo basin, arroyo El Oculto (64° 30' W - 23° 07' S), coll. M. Mirande & G. Aguilera, October 2001.

Paratypes. MHNG 2640.36, 5 ex., 44.0-52.0 mm SL, collected with the holotype. AI 110, 4 ex., 40.3-45.0 mm SL, Argentina, Salta, río Bermejo basin, arroyo El Oculto, coll. M. Mirande & G. Aguilera, February 2002. CI-FML 3401, 5 ex., 46.8-52.4 mm SL, Argentina, Salta, río Bermejo basin, arroyo El Oculto, coll. M. Mirande & G. Aguilera, November 2002, CI-FML 3402, 10 ex., 42.8-47.8 mm, Argentina, Salta, río Bermejo basin, arroyo El Oculto, coll. M. Mirande & G. Aguilera, February 2002. AI 112, 2 ex. C&S, 41.0-45.0 mm, Argentina, Salta, Orán, arroyo El Oculto, coll. M. Mirande & G. Aguilera, February 2002.

Diagnosis. *Astyanax latens* is distinguished from all other *Astyanax* species by the possession of somewhat rhomboidal body (body depth 34.9-39.1 % SL); 24-29 branched anal fin rays; 1-4 maxillary teeth; long pectoral fins (23.2-26.6 % of SL) always reaching one third of pelvic fin; long pelvic fins (17.6-22.0 % of SL) always surpassing anal fin origin; anal fin base long (32.3-36.7 % of SL); 26-27 gill rakers on first branchial arch; origin of anal fin placed below dorsal fin; fifth tooth of inner premaxillary series very small and scarcely posterior to main series; presence of one large vertically elongated humeral spot followed by a second one very faint; lateral band extremely narrow; 37-38 perforated scales in the lateral series, and relatively shallow caudal peduncle (10.0-11.4 % of SL).

Description. Morphometrics of holotype, 20 paratypes and 2 C&S specimens are presented in table 1. Body somewhat rhomboidal (Fig. 1), laterally compressed, with maximum body depth anterior to dorsal fin origin. Dorsal profile of body straight from snout to supraoccipital area, slightly concave above supraoccipital spine, convex from this point to dorsal fin origin; slanted ventrally from dorsal fin origin to caudal peduncle; gently concave along caudal peduncle to base of caudal fin rays. Ventral profile of body convex from tip of lower jaw to pelvic fin origin, somewhat straight between pelvic and anal fin origins, posterodorsally slanted from anal fin origin to caudal peduncle, and slightly convex along caudal peduncle. Ventral portion of body between bases of pectoral and pelvic fins transversally rounded; ventral portion of body between origins of pelvic and anal fins laterally compressed.

Dorsal fin origin usually nearer base of caudal fin rays than snout tip (see table 1). Pelvic fin origin situated markedly anterior to vertical through dorsal fin origin. Anal fin origin located on vertical through base of posteriormost dorsal fin rays. Tip of pectoral fin always reaching one third of pelvic fin or more; tip of pelvic fin always surpassing anal fin origin, in all specimens independently from size and sex.

Dorsal profile of head convex on snout and over eyes and slightly concave on supraoccipital area. Mouth terminal, placed at level of middle eye. Premaxilla bearing two series of teeth; ascending process with broad base and acute tip. Outer row with 3-5 (5 ex.= 3); (10 ex.= 4); (7 ex. including the holotype= 5) tricuspidate teeth, with circular base and distal tip slightly compressed; inner row with 5 teeth, anterior face of them slightly concave; symphysial tooth slender, with 4 cusps; remaining teeth with five, four or three cusps; central cusp large and lateral ones small; fifth tooth much smaller than other teeth in series, usually tricuspidate, inserted posteriorly to fourth tooth (Fig. 2). Ascending maxillary process slender, straight; lateral process of maxilla long, laminar, and narrow, with 1-4 (1 ex.= 1); (16 ex.= 2); (4 ex. including holotype= 3); (1 ex.= 4) tricuspidate teeth (Fig. 3). Dentary with 11-13 teeth (2 ex.= 11); (1 ex.= 12); (1 ex.= 13); first three or four pentacuspidate and notably larger than remaining tricuspidate to conic teeth (Fig. 4). Posterior face of large dentary teeth convex near its base and slightly concave near distal tip. Dentary and premaxillary teeth of inner row bearing a central cusp large, slightly curved posteriorly and lateral ones small, placed oblique to main axis of central cusp.

Eye large, longer than snout, little more than two times in head; interorbital wide. Third infraorbital not contacting latero-sensory canal of preopercle either ventrally or posteriorly.

Dorsal fin with iii,8-9 rays (2 ex.= 8); (20 ex. including holotype= 9); distal margin of dorsal fin straight, with last unbranched and first branched dorsal fin rays longest. First unbranched dorsal fin ray mostly visible in cleared and stained specimens. Enlarged anal fin with iv-v, 24-29 rays (3 ex.= 24); (11 ex. including holotype= 25); (7 ex.= 26); (1 ex.= 29). Males with distal margin straight, and females with last unbranched and first five or six branched rays lengthened to form a small lobe. Males with hooks on last unbranched anal fin ray and posterior branch of first 8-16 branched anal fin rays; one pair of hooks per segment.

Caudal fin with principal rays i,17,i; ventral caudal lobe longer than upper one. Pectoral fin with i,12-14 rays (3 ex.= 12); (13 ex.= 13); (6 ex. including holotype= 14),

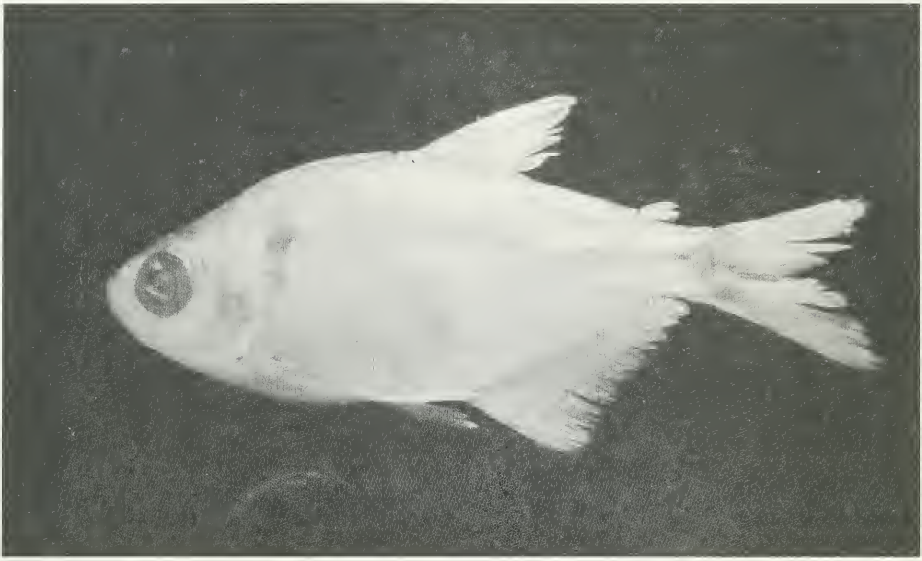

FIG. 1

Astyanax latens sp. n., holotype, CI-FML. 3400, male, 44.3 mm SL, Argentina, province of Salta, Orán, río Bermejo basin, arroyo El Oculto.

one non-type specimen with 11; distal margin straight. Pelvic fin with i,7 rays (one specimen with i,6); pelvic fin distal margin slightly rounded. Males bearing hooks in all branched pelvic fin rays, usually on posterior branch; sometimes, more than one pair of hooks per segment.

Scales cycloid. Lateral series with 37-38 (8 ex.= 37); (14 ex. including holotype= 38; one non-type specimen with 39) perforated scales. Scales between dorsal fin origin and lateral line 7; scales between lateral line and pelvic fin origin 6-7. Scales around caudal peduncle 14-15. Scales between tip of supraoccipital spine and base of dorsal fin 12-13, usually forming a regular row. One row of scales situated along anal fin base, covering base of all unbranched and first twelve to fifteen branched anal fin rays. Few scales on caudal fin base.

Colour in life: Body uniformly silvery, dark on dorsal part of flanks. Lateral band inapparent. First humeral spot vertically elongated, narrow, and second one faint. Caudal spot visible, occupying complete depth of caudal peduncle. Anal and caudal fins orange, becoming redish in specimens recently collected.

Colour in alcohol preserved specimens: Body uniformly yellowish. First black humeral spot vertically elongated, very narrow; second one faint although always marked. Chromatophores scattered over body, especially concentrated on dorsal portion of flanks, forming a reticulate pattern. In lower half of flanks, chromatophores following myosepta; also, chromatophores forming lines perpendicular to anal fin base. Lateral band very narrow, formed by small superficial chomatophores and deep chromatophores placed as small V, with vertex directed anteriorly. Caudal spot well developed, black, triangular or irregular in shape, extending on middle caudal fin rays.

TABLE 1. *Astyanax latens* sp. n. Morphometrics of holotype and 20 paratypes. Minimum, maximum, and mean ± standard deviation in brackets. SL is measured in mm. SOC= supraoccipital

	holotype	**females** (n=10)	**males** (n=11)
SL	44,3	42.3 – 52.5	43.6 – 52.0
% of standard length			
Predorsal distance	53.8	51.9 – 55.6 (54.4 ± 1.1)	51.7 – 55.3 (53.7 – 1.0)
Preventral distance	42.8	44.3 – 46.3 (45.5 ± 0.8)	42.6 _ 45.8 (46.0 ± 1.2)
Preanal distance	59.1	59.9 – 63.3 (61.5 ± 1.2)	57.6 – 61.0 (59.5 ± 1.2)
Body depth	38.5	36.1 – 39.1 (37.3 ± 0.9)	34.9 – 38.8 (37.5 ± 1.2)
Anal-fin base	35.7	32.3 – 36.6 (33.5 ± 1.3)	33.6 – 36.7 (34.8 ± 0.9)
Pectoral-fin length	25.9	23.8 – 26.6 (25.0 ± 0.8)	23.2 – 25.9 (24.9 ± 0.8)
Pelvic-fin length	20.3	17.6 – 20.4 (19.4 ± 0.8)	17.6 – 22.0 (20.0 ± 1.2)
Distance between pectoral and pelvic fin origins	18.5	18.6 – 21.8 (20.1 ± 1.0)	18.2 – 19.9 (19.0 ± 0.5)
Distance between pelvic and anal fin origins	17.3	16.6 – 20.0 (18.4 ± 0.9)	15.6 – 18.7 (17.2 ± 1.0)
Head length	27.2	25.8 – 28.5 (26.9 ± 0.7)	25.8 – 28.1 (27.1 ± 0.6)
Prepectoral distance	26.6	25.8 – 27.8 (27.0 ± 0.6)	24.7 – 28.3 (26.9 ± 1.1)
Postdorsal distance	38.3	36.4 – 40.6 (38.3 ± 1.3)	35.5 – 40.5 (38.3 ± 1.5)
Snout tip-SOC posterior tip	28.6	26.3 – 28.0 (27.2 ± 0.5)	26.2 – 28.9 (27.7 ± 0.9)
Caudal peduncle depth	11.1	10.0 – 11.4 (10.6 ± 0.5)	10.2 – 11.3 (10.8 ± 0.3)
Caudal peduncle length	11.6	10.7 – 12.9 (11.5 ± 0.8)	10.7 – 13.2 (11.9 ± 0.8)
% of head length			
Peduncle length	42.6	38.3 – 49.0 (43.0 ± 4.0)	38.9 – 51.2 (43.9 ± 4.0)
Peduncle depth	40.6	38.0 – 41.8 (39.4 ± 1.3)	38.8 – 41.3 (39.9 ± 0.9)
Snout length	26.4	22.4 – 25.0 (23.6 ± 0.8)	22.4 – 26.4 (23.9 ± 1.0)
Eye diameter	40.3	38.4 – 42.1 (40.1 ± 1.3)	35.9 – 41.2 (38.8 ± 1.4)
Interorbital width	29.7	27.5 – 30.5 (29.2 ± 0.9)	27.8 – 32.2 (29.3 ± 1.1)
Maxillary length	34.9	31.6 – 36.6 (34.0 ± 1.5)	30.0 – 35.2 (33.8 ± 1.4)
Premaxillary+maxillary length	41.8	37.4 – 40.8 (39.5 ± 1.1)	36.7 – 41.8 (39.5 ± 1.6)

Dorsal fin with scattered small chromatophores along fin rays. Adipose fin with few chromatophores on its base. Black chromatophores scattered on caudal and anal fins, especially on membranes and along ray margins. Pectoral and pelvic fins with few chromatophores along ray margins. Dorsum of head dark; chomatophores concentrated on premaxilla, many of them on maxilla and upper portion of dentary. A line of black chromatophores around eye.

Osteological characters. In 6 cleared and stained specimens: first branchial arch bearing 26-27 gill rakers placed as follow: 9-10 on epibranchial, 1 on cartilage, 14 on ceratobranchial, and 2 on hypobranchial.

Caudal fin with 8-9 dorsal and 7-8 ventral procurrent rays. Thirty five to 37 vertebrae (percaudal vertebrae 15-16, caudal vertebrae 20-22). Ten or eleven dorsal fin pterygiophores between neural spines of vertebrae 10-11 and 18-19; 27-28 anal fin pterygiophores between hemal spines of vertebrae 17 and 28-29. First anal fin pterygiophore bearing 4 unbranched anal fin rays. Five or six supraneurals; 10-11 pairs of ribs.

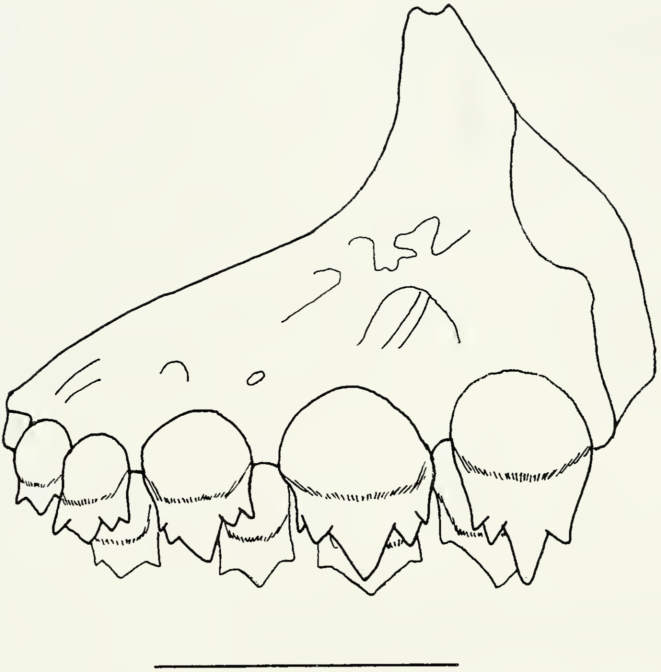

FIG. 2
Astyanax latens sp. n., 44.0 mm SL, premaxilla in left internal view. Scale bar = 1 mm.

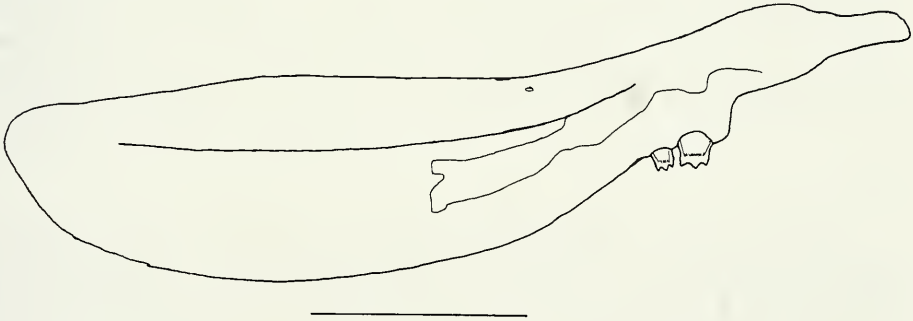

FIG. 3
Astyanax latens sp. n., 44.0 mm SL, maxilla in left internal view. Scale bar = 1 mm.

Upper edge of dentary almost parallel to lower mandibular margin; dentary foramen placed anteriorly and scarcely above level of Meckel cartilage. Cusps of premaxillary teeth placed forming an almost straight line in ventral view.

Ventral surface of mesethmoid with lateral and medial processes for vomer articulation forming an obtuse angle. Rhinosphenoides well ossified occasionally.

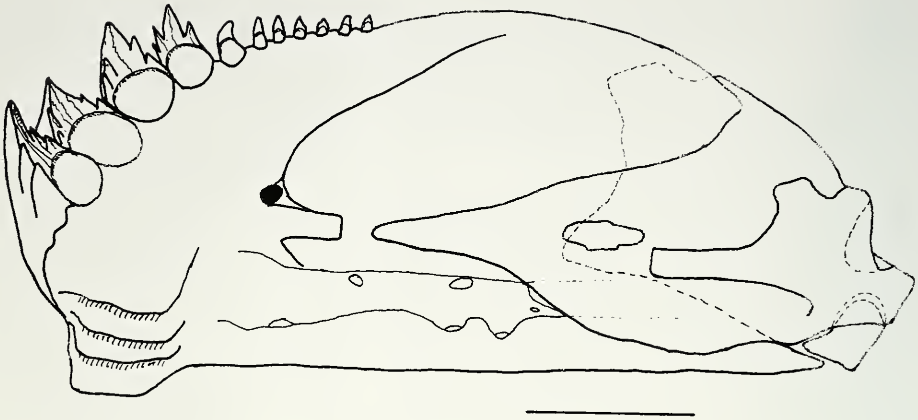

FIG. 4
Astyanax latens sp. n., 44.0 mm SL, lower jaw in medial view. Scale bar = 1 mm.

Etymology. The specific epithet *latens* is a Latin word that means hidden; the spanish name of the type locality also means hidden.

Distribution. *Astyanax latens* is known from arroyo El Oculto and the rivers Anta Muerta and Blanco, which flow into upper río Bermejo (Fig. 5). The type locality of *A. latens*, arroyo El Oculto, is a small stream of springs, with clear and slow water, muddy bottom and pools more than 1 m deep. The temperature and the caudal of the water are constant along the year, contrasting with those of streams and rivers of the area under marked seasonality. The place where *A. latens* was found is usually covered by shadow of the circumambient vegetation; many specimens were collected all around the year. A lower number of specimens of *A. latens* was occasionally found in the río Anta Muerta, a tributary on río Blanco in which other specimens were collected also.

DISCUSSION

Astyanax latens sp. n. is differentiated from the species of the genus living in southern South America by the presence of 28-34 and fin rays in combination with other characters. *Astyanax pelegrini* (41-45), *A. erythropterus* (45), *A. correntinus* (45), and *A. alleni* (39-41) have higher numer of anal fin rays. Low number of anal fin rays is present in *A. brachypterygium* (16-20), *A. cremnobates* (18-22), *A. gymnogenys* (21-22), *A. scabripinnis paranae* (17-23), *A. ita* (23-28), *A. eigenmanniorum* (22-26), *A. ojiara* (24-28), *A troya* (22-26), *A. leonidas* (20-25), *A. pynandi* (21-26), and *A. paris* (24-27). The number of maxillary teeth of *A. latens* (1-4) is shared with *A. paris*.

The pigmentation pattern of *A. lineatus* (with several bands along the flanks), *A. laticeps* (with horizontally oval humeral spot), and *A. marionae* (without caudal spot) distinguishes them from *A. latens* wich only has a very narrow lateral band, humeral spot vertically elongated, and triangular caudal spot.

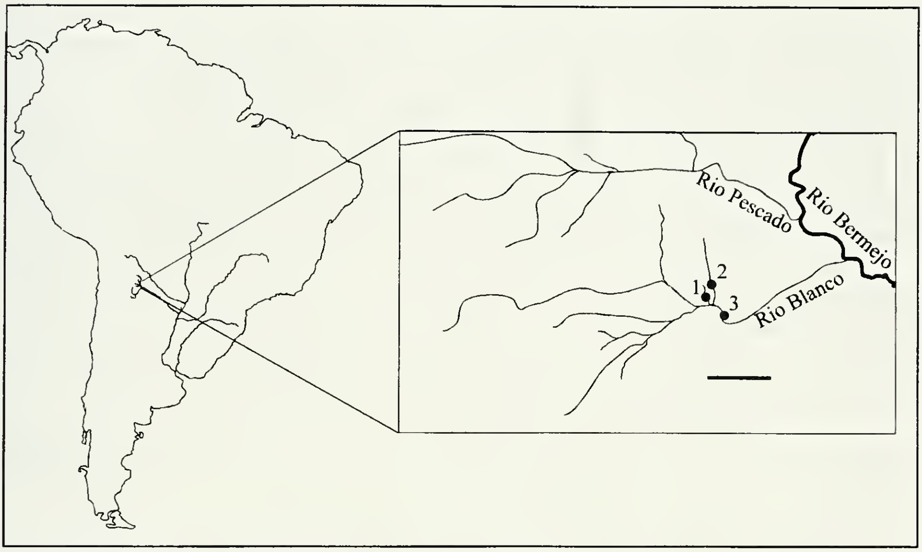

FIG. 5

Geographic distribution of *Astyanax latens* sp. n. in Argentina, Salta, río Bermejo basin. 1, arroyo El Oculto (type locality); 2, río Anta Muerta; 3, río Blanco. Scale bar = 10 km.

Astyanax asuncionensis (30-32) and *A. abramis* (30-34) have similar number of anal fin rays, but they also bear a horizontally elongated humeral spot, and 0-1 maxillary tooth. A similar number of anal fin rays than that of *A. latens* is present in *A. cf. fasciatus* (24-31). However, *A. cf. fasciatus* has a wide lateral band, only one maxillary tooth (vs. 1-4), shorter pectoral fins never reaching pelvic fin origin (vs. pectoral fin tip always surpassing pelvic fin origin), and distal tips of premaxillary teeth placed forming an arch of 180°, with concavity directed anteriorly (vs. premaxillary teeth cusps placed forming a line or scarcely curved). Also, *A. latens* is a smaller species, it occasionally reaches more than 55 mm SL.

Astyanax saguazu shares the number of anal fin rays, the number of scales in the lateral series, and the disposition of the teeth cusps with *A. latens*. Nonetheless, *A. saguazu* has a notable lateral band and 19-23 gill rakers on first branchial arch whereas *A. latens* has very narrow lateral band and 26-27 gill rakers on the same arch. Also, *A. saguazu* has a larger eye (41.1-45.5 % vs. 38.4-42.1 % HL), and a shorter predorsal distance (46.3-52.9 % vs. 51.7-55-6 % SL), pectoral (21.6-24.7 % vs. 23.2-26.6 % SL) and pelvic (16.5-18.8 % vs. 17.6-22.0 % SL) fin lengths, and anal fin base (29.5-33.8 % vs. 32.3-36.7 % SL).

OSTEOLOGICAL CONSIDERATIONS

Few osteological characters of species included in the genus *Astyanax* are known; most of them concern teeth and jaws. With no doubt, a revision of the genus is needed and, as the diagnostic characters of the genus could be plesiomorphic characters, a phylogenetic study will be welcomed.

In comparison, the teeth of different species of *Astyanax* bear several characters that could help to differentiate them. *Astyanax latens* shares with *A. saguazu* and *Astyanax* sp. A, a maximum of five cusps in the teeth, while most species of *Astyanax* examined have the larger teeth with seven cusps or more (e.g., *A. cf. fasciatus*, *A. eigenmanniorum*, *A. troya*, *A. ojiara*, *A. asuncionensis*, *A. ita*). Also, the base of the inner premaxillary teeth is broader than the distal portion in *A. latens*, *A. saguazu*, and *Astyanax* sp. A. whereas some species have premaxillary teeth with broad distal portions (e.g., *A. troya*, *A. ojiara*, *A. pynandi*, *A. giton*, *A. hastatus* following Melo, 2001).

Most of the *Astyanax* species examined have cusps of the inner premaxillary teeth forming an arch of 180° in ventral view, and leaving an anterior concavity (among others, *A. lineatus*, *A. asuncionensis*, *A. abramis*, *A. eigenmanniorum*, *A. troya*, *A. ojiara*, *A. leonidas*, *A. cf. fasciatus*, *A. alleni*). *Astyanax latens*, *A. saguazu*, and *Astyanax* sp. A have premaxillary cusps arranged in a straight line.

The crest for insertion of the *adductor operculi*, in the internal surface of opercle, is very small in *A. latens* whereas the crest is longer, occupying more than half of the distance between anterior and posterior opercular margins in other species such as *A. ojiara*, *A. ita*, *A. paris*, *A. lineatus*, or *A. asuncionensis*.

Astyanax latens shares some characters with species of different genera. For example, the ventral mesethmoides processes for articulation of the vomer are usually T-shaped as in *Brycon* (Weitzman, 1964), *Oligosarcus* (per. obs.), and other species of the genus *Astyanax* (e.g., *A. abramis*, *A. asuncionensis*, *A. lineatus*, pers. obs.); in contrast, the ventrolateral and ventromedial processes of mesethmoides form a slight angle (almost Y-shaped) in *A. latens*, *Moenkhausia intermedia*, and *Acrobrycon tarifae*. This angle was observed to be more pronunciated in *Bryconamericus iheringii*, *B. thomasi* and *Odontostilbe pequira*.

The posteroventral process of pterotic is present in *Brycon* (Weitzman, 1964; per. obs.), *A. abramis*, and *A. asuncionensis*, whereas it is absent in *A. latens*, most species of *Astyanax*, *Moenkhausia intermedia*, *Acrobrycon tarijae*, *Bryconamericus thomasi*, and *Odontostilbe pequira*.

All these observations show that detailed revisions of the genus *Astyanax* and other genera of tetragonopterine characiforms of the family Characidae, probably closely related as *Hyphessobrycon*, *Moenkhausia*, or *Hemigrammus*, are necessary to establish polarity of characters and the intrageneric relationships among them.

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Morphology and phylogenetic relationships of the Cyprus racer, *Hierophis cypriensis*, and the systematic status of *Coluber gemonensis gyarosensis* Mertens (Reptilia: Squamata: Colubrinae)

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Morphology and phylogenetic relationships of the Cyprus racer, *Hierophis cypriensis*, and the systematic status of *Coluber gemonensis gyarosensis* Mertens (Reptilia: Squamata: Colubrinae). - External morphology, skull bones, and hemipenis features of *Hierophis cypriensis* (Schätti) were examined and new lowland findings are reported. Morphological and molecular data confirm sister species status of the Cyprus racer vis-à-vis the western Mediterranean racers *H. gemonensis* (Laurenti) and *H. viridiflavus* (Lacépède). Apart from the Cyclades viper, *Macrovipera schweizeri* (Werner), *H. cypriensis* is the only endemic Mediterranean insular snake species. *Coluber gemonensis gyarosensis* Mertens from Gyaros Island (Cyclades) is a junior synonym of *H. viridiflavus*. This Aegean population, highly isolated from the continuous range of the species, was most probably introduced by human activity in historical times. Molecular data suggest validity of *H. viridiflavus carbonarius* (Bonaparte) for melanotic populations of the European whip snake including the Gyaros racer.

Key-words: *Hierophis cypriensis* - morphology - zoogeography - Cyprus - *Coluber gemonensis gyarosensis* - *Hierophis viridiflavus* - phylogeny - mtDNA (COI, 12S rRNA).

INTRODUCTION

Since the description of *Coluber cypriensis* Schätti, 1985, the systematically difficult racer taxon *Coluber* auct. underwent drastic taxonomic changes. *Coluber* Linnaeus, 1758 is a purely Nearctic genus. Old World racers and whip snakes formerly parading under *Coluber* auct. (e.g., Schätti & Wilson, 1986) belong to at least four different genera, viz., *Hemerophis* Schätti & Utiger, *Hemorrhois* Boie, *Hierophis* Fitzinger, and *Platyceps* Blyth (Schätti, 1986, 1987; Schätti & Utiger, 2001).

In an unpublished thesis, Schätti (1988) briefly discussed presumed phylogenetic affinities of the Cyprus racer (or whip snake), stating that the *in situ* hemipenis shows strong resemblance to *Hierophis* spp. Schätti & Sigg (1989b) formally referred *Coluber cypriensis* to the predominantly southern Palaearctic genus *Hierophis* Fitzinger in Bonaparte, 1834 with the type species *H. viridiflavus* (Lacépède). Böhme & Wiedl (1994) figured an everted hemipenis of *H. cypriensis* and considered "[...] the

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overall phenetic similarity being greatest with *C.[oluber]* (*H.*) *gemonensis*" (Laurenti). However, these authors continued to refer the Cyprus racer to *Coluber* auct., and not to "the *Hierophis* section of *Coluber*".

Hierophis Fitzinger is made up of two European species (viz., *H. gemonensis* and *H. viridiflavus*) as well as *H. caspius* (Gmelin) from the Balkans, the eastern Mediterranean *H. jugularis* (L.) and *H. schmidti* (Nikolskij), the endemic *H. cypriensis*, and *H. spinalis* (Peters) from Central Asia to Korea (Schätti 1987, 1993; Schätti & Utiger, 2001).

The systematic status of *Coluber gemonensis gyarosensis* Mertens, 1968 from Gyaros Island (Aegean Sea, Cyclades) is controversial (see Böhme, 1993). Schätti (1988) stated that this population cannot be separated from the western Mediterranean *Hierophis viridiflavus* as far as external morphology is concerned.

This paper describes external morphological features and osteological characters of *Hierophis cypriensis*, compiles the known distribution of this insular endemic, and provides sequence data for two mitochondrial genes, COI and 12S rRNA. The objective of the present study is to clarify the phylogenetic relationships of the Cyprus racer as well as the validity and systematic status of the racer population from Gyaros Island.

MATERIAL AND METHODS

The material examined for the purpose of this study is deposited in The Natural History Museum (formerly British Museum, Natural History), London (BMNH), Department of Zoology, The Hebrew University, Jerusalem (HUJ), Muséum d'histoire naturelle, Geneva (MHNG), Naturhistorisches Museum, Vienna (NMW), and Zoologisches Museum und Forschungsinstitut Alexander Koenig, Bonn (ZFMK). The specimens are: BMNH 87.9.27.25 (♂), "Cyprus, Lord Lilford" (leg. Guillemard, paratype). HUJ 3331 (♀), Kykko Monastery (Panagía tou Kýkko), approx. 34°58'N 32°44'E, c. 1'100 m a.s.l., Nicosia District, leg. Mavromoustakis; HUJ 3786 (♂), "Polemedia Hills" (Polemidia), c. 200 m (600 ft.), Limassol, leg. Mavromoustakis. MHNG 2206.30 (♀), between Arakapás and Kalokhorio, approx. 34°51'N 33°06'E, 470 m, Limassol, B. Schätti, 14 April 1983 (holotype); MHNG 2453.60 (♂), between Kannaviou and Stavros tis Psokas, c. 750 m, Paphos, W. Teschner, 11 May 1989; MHNG 2618.99 (♂), between Germasógeia (Yermasoyia) and Akroúnta, approx. 34°45'N 33°06'E, c. 75 m, Limassol, B. Schätti, 27 May 2001 (roadkill). NMW 15185.1 (♀), "Platraes, Troodos", Limassol, 1'400 m, F. Werner, May 1935 (paratype). ZFMK 48877 (♂), 1 km northwest of Pano Platraes, Limassol, K. Osenegg & S. Demetropoulos, 26 June 1988; ZFMK 51283 (♂), Pano Panagia (Panayia), 1'000 m, Paphos, H. Wiedl, October 1989; ZFMK 51881 (♂), Mt. Triphylos, approx. 34°59'N 32°40'E, Paphos, H. Wiedl, September 1990. Furthermore, MHNG 2618.100, consisting of a portion of a shed skin from the upper Livadi River area at approx. 35°04'N 32°36'E (c. 600 m) in Paphos District, was used for verification of dorsal scale characters (apical pits, transverse position of reduction levels) and molecular studies (12S rDNA, see footnote 3).

External morphological data (pholidosis, length, dorsal colour pattern) are based on this material (ten complete specimens) and two male roadkills from the vicinity of Pano Platraes (Troodos road, "ca. 5 km südlich Troodos") and Kakopetria (leg. S. Demetropoulos 1988) reported by Osenegg (1989: Tb. 24). Osteological characters were ascertained in MHNG 2453.60, MHNG 2618.99, and ZFMK 51881; additional teeth counts (right dentigerous bones) are based on HUJ 3331 (dentary, maxilla, palatinum), HUJ 3786 (dentary, maxilla), MHNG 2206.30 (maxilla), and NMW 15185.1 (maxilla).

Methods and definitions of terms used in the descriptive part and comparative section of this text are explained in Schätti (1987, 1988). The position of bilateral dorsal scale row reductions along the trunk is given in terms of absolute numbers of ventrals and as a percentage thereof (%ven), and calculated on the basis of the average of right and left side counts. The length of the hemipenis and the *M. retractor penis magnus* are expressed in absolute numbers of subcaudals and as a percentage thereof (%sub). Vertebra measurements used in this study are the length of the centrum (lc), length of neural crest (nc), least width of neural arch (wn), and the width across prezygapophyses (wp).

DNA sequences of two mitochondrial genes, cytochrome oxidase I (COI), and the small ribosomal subunit (12S rRNA), of 13 Palearctic and Afrotropical racers as well as the Oriental racer *Coelognathus flavolineatus* (Schlegel) (see Utiger, 2002) are from an earlier study (Schätti & Utiger, 2001) and listed in the Appendix. Eight tissue samples belonging to four different taxa and frozen at -80°C are new: *Hierophis cypriensis* (MHNG 2618.99, liver), *H. gyarosensis* (MHNG 2402.91 and 2401.92, Gyaros Island, Cyclades; muscle), *H. spinalis* (MHNG 2443.5, Wonju, Kangwon, S Korea; muscle; MVZ 211019, N shore Huang He, Shapotou, Yinnan Prefecture, China; liver), and *H. viridiflavus* (MHNG 2402.11, Chizé, Deux-Sèvres, France; muscle; MHNG 2402.66, Finaita, Sicily, Italy; muscle; MHNG 2402.83, Krk Island, Croatia; muscle). The corresponding Genbank accession numbers are AY 541502-541512.

DNA isolation, purification, polymerase chain reaction (PCR) and sequencing procedures were performed as described in Schätti & Utiger (2001).

Because of considerable constraints in laboratory facilities, only one gene region, 12S rDNA, was analysed for the new specimens of *Hierophis viridiflavus*. These sequences were added to an alignment file consisting of two partially sequenced genes (COI and 12S rRNA) and a selection of 14 species from an earlier study (Schätti & Utiger, 2001). Where sequence information on the COI gene region was not available, characters were coded as "missing".

All phylogenetic analyses were performed with PAUP* version 4.0b10 for Mac (Swofford, 1998). Neighbour joining (NJ, Saitou & Nei, 1987) calculates gene distances based on the number of mutation events between all pairs of taxa. Under the present circumstances, the calculation of genetic distances between specimens with complete and incomplete sequence data is inappropriate because of different mutation properties within each gene region. In this case, maximum parsimony (MP) is a good alternative to NJ as it reconstructs a tree based on both gene regions. In addition, MP counts the mutation steps that occurred in the 12S gene region between specimens with complete sequence data and those lacking information on COI. This gives a qualitatively satisfying result but deals with an underestimate of the intraspecific sequence variability of *Hierophis viridiflavus* compared to the branch lengths of the overall topology.

Gaps in the 12S sequence were treated as fifth character state. After a first run with heuristic search and tree-bisection reconnection (TBR) branch swapping, characters were weighted with the rescaled consistency index (RC, Farris, 1989) and a second heuristic search was performed. The weighting procedure was repeated once; subsequent weighting procedures did not alter the parameters of the resulting tree. Nonparametric bootstrap calculations (Felsenstein, 1985) with 1000 replicates were performed for unweighted as well as weighted characters.

The justification for including gaps and weighting characters is given in Utiger *et al.* (2002). Essentially, gaps supply additional phylogenetic information whereas weighting procedures favour characters which bear phylogenetic content. Using these measures, tree dependent (RC) and independent phylogenetic signals (tRASA, Lyons-Weiler, 2001) intensify (Tb. 1).

TABLE 1. Sequence properties and tree reconstruction parameters.

	gaps: missing	gaps: 5th character state	
	unweighted MP	unweighted MP	weighted MP
Length of sequence alignment (COI/12S)	1016 (407/609)	1016 (407/609)	1016 (407/609)
Total of variable characters (COI/12S)	322 (142/180)	333 (142/191)	333 (142/191)
- parsimony-informative (COI/12S)	225 (116/109)	232 (116/116)	232 (116/116)
Number of most parsimonious trees	1	2	1
Tree length	918	956	267.38
Rescaled consistency index (RC)	0.232	0.242	0.548

RESULTS

Hierophis cypriensis (Schätti, 1985)

MORPHOLOGY

Loreal and preocular single, two postoculars. Eight supraoculars (nine on left side of MHNG 2453.60), fourth and fifth (fifth and sixth) in contact with eye, sixth and seventh (seventh and eighth) largest. One anterior subocular situated between the third and fourth supralabial. One (holotype) or two anterior temporals, two or three scales in second row; lower anterior temporal vertically divided in NMW 15185.1. Ten sublabials, anterior four in contact with first inframaxillary, sixth largest. Anterior inframaxillaries slightly shorter than and more or less the same width as posterior pair, which is cranially separated by one row of small scales and caudally by two to four rows.

Ventrals in males 194-202 (n=8), females 204-206 (3), subcaudals 123-133 (6) and 121-130 (3), respectively; anal plate divided. Dorsal scales smooth, with two apical pits; arranged in 17 longitudinal rows at the level of the tenth ventral and at midbody, 13 immediately prior to the vent. First reduction involving third and fourth row between ventrals 121 and 133 (62-68%ven) in males and 126-132 (61-64%ven) in females; second reduction (rows 6+7 or 7+8) situated between ventrals 136-159 (70-79%ven, ♂♂) and 133-156 (66-73%ven, ♀♀) [1].

Total length in males 93,7 (62,0 + 31,7) cm (MHNG 2618.99), females approx. 92 (62 + 30) cm (NMW 15185.1); tail/body ratio 0.48-0.52 (♂♂) and 0.45-0.48 (♀♀). Presumed maximum length probably not exceeding 120 cm.

Dorsal colouration in adults dark olive to anthracitic. Supraocular with a light streak running from the posterior border of the eye toward the frontal, and often also present along the lateral edge of the supraocular. Irregular light markings (dots and streaks) on the frontal and parietals. Supralabials mostly light except upper borders. Preoculars and postoculars yellowish white. Posterior temporal region with light dots. Throat pale yellow or off-white, irregularly mottled with fine greyish or sometimes black dots. Holotype with caudally converging dorsolateral nuchal stripes (Pl. 1). Anterior portion of neck usually somewhat lightened laterally. Forebody dorsally with fine white or creamish transverse bands. Posterior third of trunk and tail uniformly greyish olive (scales with lighter centres). Median part of venter pigmented with dark spots (less so anteriorly), with a fine whitish line along the ventral edges; lateral region invaded by dorsal colouration. ZFMK 48877 virtually black throughout the posterior three quarters of the underside. An irregular black line running along the median edges of the subcaudals.

The dorsal colour pattern is subject to ontogenetic change, i.e., juveniles (beige above) and subadult specimens (dorsum olive) have dark transverse blotches on the anterior two thirds of the body and an orange iridescent venter (H. Wiedl, pers. comm.). Illustrations of this species are found, for instance, in Schätti (1985), Gruber (1989), Osenegg (1989), and Schätti & Sigg (1989b).

Maxillary teeth 14-16 + 2 (n=6), with a distinct diastema and the posterior teeth enlarged (last offset laterad). Counts for other dentigerous bones 10-11 (palatinum, n=3), 17-20 (pterygoid, 2), and 19-20 (dentary, 4). Palatine processus of maxilla comparatively long, lateral border more or less straight and ending in a distinct tip; posterior processus poorly developed. Lateral processus of palatinum stout, its posterior tip reaching insertion of choanal processus. Anterior portion of pterygoid narrow and slightly constricted behind the simple lateral processus. Parasphenoid not constricted at the basis, middle posterior border of basisphenoid somewhat convex (Fig. 1). Midbody vertebra ratios (n=2) are 1.38-1.58 (lc/wn), 0.74-0.80 (lc/wp), and 1.11-1.28 (nc/wn).

Hemipenis with a basal hook (Böhme & Wiedl, 1994: Fig. 6), distally followed by a series of spines (less numerous on sulcate side), apex distinctly calyculate, borders of depressions spinose on asulcate side. Tip of apex *in situ* reaching to subcaudal 9-10 (7-8%sub, n=4), *M. retractor penis magnus* inserting at subcaudal 30-32 (24-25%sub, n=6).

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[1] Osenegg (1989: Table 24) gave 121 subcaudals for a male specimen (no. III). This figure as well as the reduction level to 15 dorsal scale rows are not included in the data because, strangely enough, subcaudal and reduction data for specimens III and V-VI are identical. Definitely, the reduction pattern of two specimens of the type series, i.e., MHNG 2206.30 and NMW 15185.1 (Osenegg, 1989: nos. V-VI) is erroneous.

PLATE 1
Female holotype of *Hierophis cypriensis* (MHNG 2206.30).

DISTRIBUTION AND ECOLOGY

The Cyprus racer is reported from Limassol District, southwestern Nicosia (Lefkosa), and the Stavros woods in eastern Paphos, i.e., the Troodos massif and its foothills in western Cyprus (Fig. 3) [2].

Most records are from pine forest with abundant coppice between 400 to 1'700 m a.s.l. near Pano Platraes (H. Wiedl, pers. comm.). The Cyprus racer also occurs at lower elevations, viz. below 250 m as exemplified by specimens collected in the immediate hinterland of Limassol (HUJ 3331 and 3786, MHNG 2618.99).

Based on the limited number of preserved specimens and field observations, *Hierophis cypriensis* might appear to be either an uncommon, secretive, or locally restricted species. However, the Cyprus racer seems to be fairly common at least in the Xyliatos dam area (c. 550 m) and the Lagoudhera valley situated on the northern Troodos foothills at approx. 35°00'N 33°02'E in Nicosia District. There, from a total of 58 field observations during three years, 47 individuals found in the immediate surroundings of the dam were usually observed between 10 a.m. and 3 p.m., mostly from July to September, with a single record 50 m from the water in March (Blosat, 1998).

Virtually all specimens housed in scientific collections and many field observations are from habitats with dense bushy vegetation close to creeks and rivers. In many

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[2] Apart from records shown on Böhme & Wiedl's (1994: Fig. 5) map, Wiedl found *Hierophis cypriensis* "together with *Telescopus fallax*" at Kámpos and "Chalkistra" (Tsakistra, 35°01'25"N 32°43'27"E) in western Nicosia District (Böhme & Wiedl, 1994: 40), a few kilometres roughly north of Kykko Monastery on the Agios Mámas road.

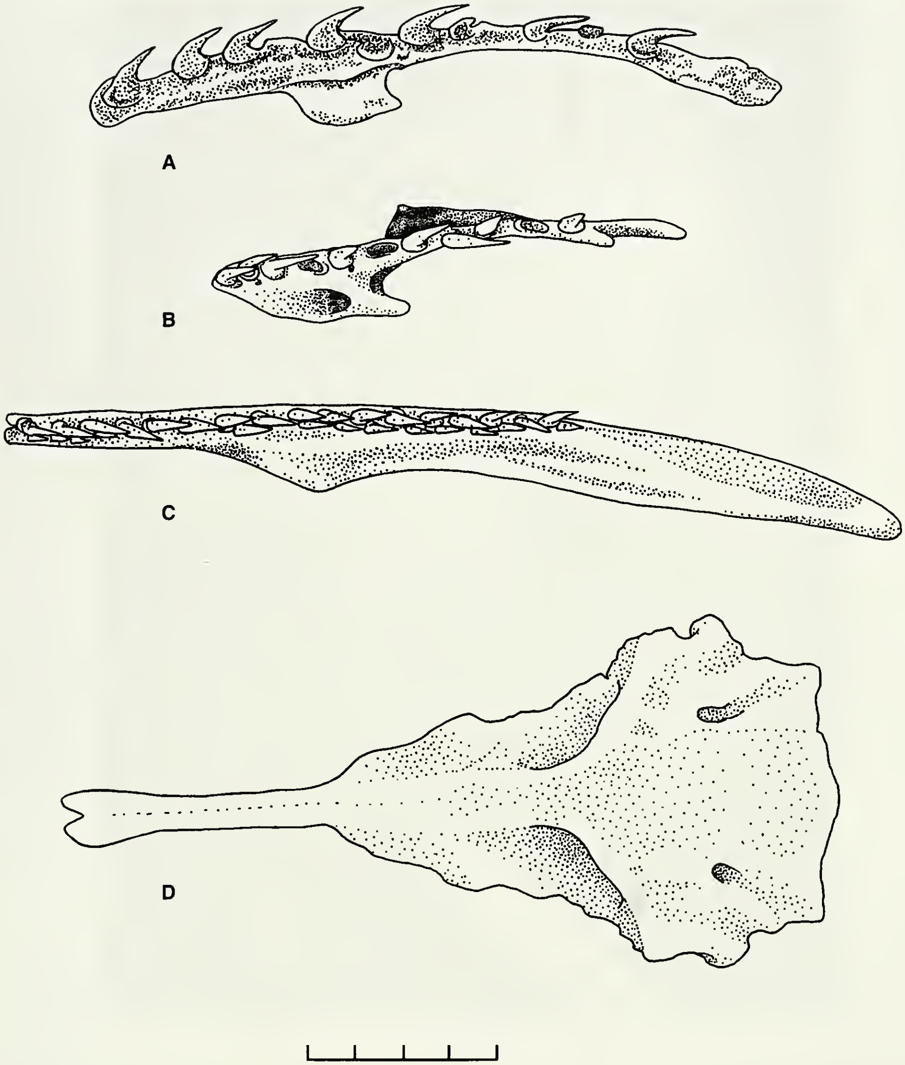

FIG. 1

Skull bones of *Hierophis cypriensis*: Left maxilla (A), right palatinum (B), right pterygoid (C), and basisphenoid (D, parasphenoid broken, reconstructed). Scale equals 2 mm. Drawings by Corinne Charvet (A: MHNG 2453.60) and Beatrice Naef (B-D: ZFMK 51881).

of these places, *Hierophis cypriensis* is sympatric with *Macrovipera* (or *Daboia*) *lebetina* (L.). In the Xyliatos dam area, the Cyprus racer is found in the same habitat as *Natrix natrix cypriaca* (Hecht).

Hierophis cypriensis preferably feeds on smaller species of lizards, in particular *Ablepharus kitaibelii* (Bibron & Bory) and *Ophisops elegans* (Ménétries), and green

FIG. 2

Hierophis cypriensis: Lateral view of right hemipenis of MHNG 2618.99 (roadkill). Photograph by Claude Ratton.

frogs, i.e., *Rana* cf. *bedriagae* Camerano (see Plötner *et al.*, 2001). Blosat (1998) observed one specimen that captured a "Lacertide", probably *Lacerta laevis troodica* Werner, and an incidence of ophiophagy (*Natrix natrix cypriaca*). The holotype regurgitated a centipede. In captivity, *H. cypriensis* also preys on mammals, i.e., small mice (personal observation).

Contrary to most congeneric species, *Hierophis cypriensis* is a placid snake that does not bite upon collecting. In one instance, the Cyprus racer was found feigning death (W. Teschner, in litt.). Since this was observed on a road, it cannot be ruled out that a car had driven over the specimen before being encountered by the correspondent.

FIG. 3

Known distribution of *Hierophis cypriensis*. Solid circles denote examined specimens with precise locality data and MHNG 2618.100 from the upper Livadi River, Paphos (see Material and Methods and footnote 3). Open symbols correspond to four localities in the central Troodos (Kakopetria, Platania, and "ca. 5 km südlich Troodos") and eastern Paphos District (Stavros tis Psokas) cited in Osenegg (1989: Fig. 44) as well as the Xyliatos dam area, an unspecified station near the type locality (Böhme & Wiedl, 1994: Fig. 5), and Kampos and Tsakistra (see footnote 2). Elevations from 400 m to 1'200 m hatched, areas over 1'200 m in the central Troodos blank. Map partly redrawn from Böhme & Wiedl (1994).

ZOOGEOGRAPHY AND RELATIONSHIPS

Böhme & Wiedl (1994) presumed that *Hierophis cypriensis* had been "existing much longer on Cyprus than the rest of the herpetofauna." Arguing that "snakes are generally primarily absent from oceanic islands", these authors though that "the case of *Coluber cypriensis* in particular would corroborate" the assumption of a land bridge. This alludes to Haas (1952) who postulated a terrestrial connection across the Golf of Iskenderun in the Pliocene or early Quaternary (see, e.g., Schmidt, 1960; Spitzenberger, 1979). However, there is no geological evidence for a land bridge during that period. Rather, Cyprus is isolated from the surrounding mainland since the Upper Miocene salinity crisis of the Mediterranean (Hsü, 1972) as assumed by Schätti & Sigg (1989a).

Hierophis cypriensis is most similar to *H. gemonensis* and *H. viridiflavus* with respect to certain osteological features (Fig. 1) as, for instance, the comparatively long palatine processus of the maxilla (also found in *H. jugularis* but not in *H. caspius*). *H. cypriensis* and *H. gemonensis* have more maxillary teeth (16-19 vs. 12-16) than the remaining species of this genus. These two species as well as *H. spinalis* (in prep.) possess an enlarged spine (hook) at the basis of the hemipenis.

Based on morphological evidence and preliminary molecular data (mtDNA sequences), Schätti & Utiger (2001: 934, 939) considered *Hierophis cypriensis* to be "most closely related to congeneric European species" [3]. The present results (Fig. 4) confirm sister species status of *H. cypriensis* vis-à-vis the western Mediterranean *H. viridiflavus* and *H. gemonensis*, viz. the Balkans and European whip snake.

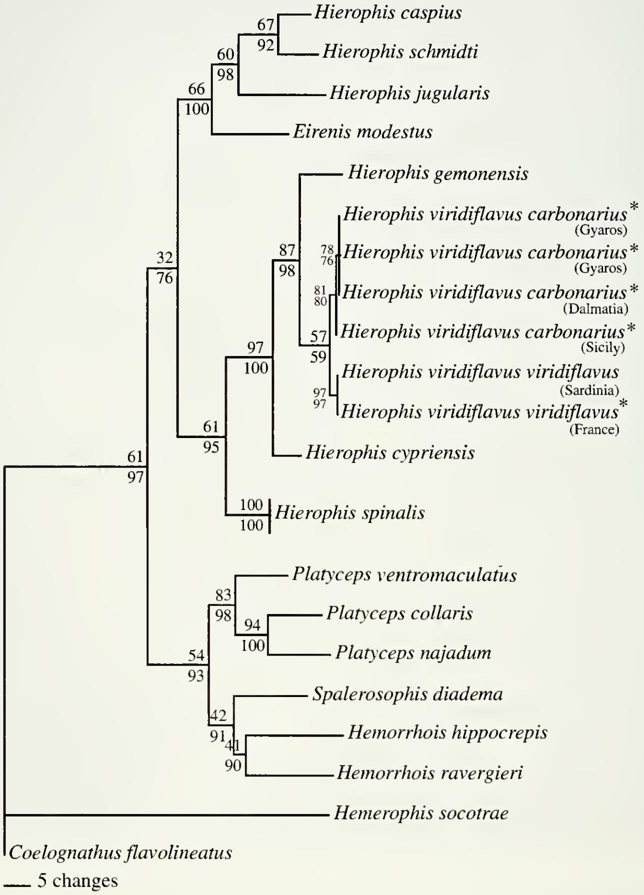

FIG. 4

Most parsimonious tree from a weighted MP analysis of two partial gene sequences, COI and 12S rDNA. Numbers above branches indicate bootstrap values from an unweighted, those below from a weighted MP analysis. Asterisks denote specimens lacking COI sequence data (see also footnote 3).

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[3] Schätti & Utiger (2001) examined a fragment of the 12S rDNA subunit of MHNG 2618.100 (epidermal skin, see Material and Methods). The sequence shows only small difference (2 out of 592 base pairs) vis-à-vis MHNG 2618.99. The specimen was not used for the phylogenetic recontruction because the lack of the COI partition significantly lowered the resolution of the tree topology.

Molecular data and considerable morphological divergence of *Hierophis cypriensis* (e.g., dorsal colour pattern, paravertebral reductions, processi of dentigerous bones, general shape of basisphenoid) from congeneric, and in particular the most closely related western Mediterranean, species support the theory of the isolation of Cyprus for the last approx. 5,2 my.

Apart from *Macrovipera schweizeri* (Werner) from the Cyclades, *Hierophis cypriensis* is the only endemic Mediterranean insular snake species.

Hierophis viridiflavus (Lacépède, 1789)
Coluber gemonensis gyarosensis Mertens, 1968 **syn. nov.**

The systematic status and specific allocation of *Coluber gemonensis gyarosensis* Mertens, 1968 have been a matter of controversy (see Introduction). Specific status (Schätti, 1988) was accorded based on morphological differences vis-à-vis two whip snake species (*Hierophis caspius, H. gemonensis*) distributed in the Aegean region. Böhme (1993) considered the melanotic taxon from Gyaros to be the rarest European snake species.

Racers from Gyaros most strikingly resemble the European whip snake, *Hierophis viridiflavus*, in general appearance, habitus, and morphology (Schätti, 1988). In fact, the insular taxon cannot be distinguished from *H. viridiflavus* and molecular data (Fig. 4) clearly demonstrate that *Coluber gemonensis gyarosensis* Mertens, 1968 is a junior synonym of *H. viridiflavus* (Lacépède, 1789).

The western Mediterranean *Hierophis viridiflavus* has a continuous range from the Pyrenees region (NE Spain) to northern France, Luxembourg, and western Switzerland as well as throughout the Appenine Peninsula, Ticino, and eastward to northern Dalmatia. The species is widespread in the Tyrrhenian Sea, found on Sicily and many surrounding islands and islets, Malta, Gozo, and in the Adriatic Sea (Krk, Tremiti Islands). The isolated Aegean occurrence on Gyaros is most probably due to human introduction in historical times. To conclude from our molecular data (Fig. 4), *H. viridiflavus* was most likely transported to Gyaros from the northern Adriatic region.

Gyaros (Gioura, Yíoura), nowadays known as Yiaros or Nisos, is a mountainous island (up to 490 m a.s.l. in the central part) of ca. 20 km^2 at 37°37'N 24°43'E in the Cyclades, roughly 15 km northwest of Syros about halfway between Kea and Tinos. From the beginning of our era until the Middle Ages, the island was a haven for marauding corsairs who attacked merchant ships throughout the Aegean. During the Roman Imperial epoch, Gyaros served as a place of exile.

All surrounding larger islands (viz., Andros, Kea, Kythnos, Syros, and Tinos) are inhabited by *Hierophis caspius*, an eastern Mediterranean species widespread in the Aegean Sea and found on all larger Cyclade islands surrounding Gyaros (e.g., Schätti, 1988; Szczerbak & Böhme, 1993). The absence of the Caspian whip snake from Gyaros may have favoured the colonization of this island by *H. viridiflavus*.

External morphological characters of *Hierophis viridiflavus* analysed by Schätti & Vanni (1986) hardly allow a distinction between typical and melanotic populations commonly referred to *H. v. carbonarius* (Bonaparte). These authors considered this phenotype as a colour morph of the European whip snake, *H. viridiflavus*. Based on molecular data, our limited sample shows genetic separation of typically coloured specimens (France, Sardinia) and melanotic individuals from Dalmatia (Krk), Sicily, and Gyaros Island. Pending studies using specimens from further regions, this result may justify the revalidation of *H. v. carbonarius* for populations from northeastern Italy and Dalmatia, the southern Appenine Peninsula including islands such as Sicily and Malta, and the isolated Gyaros population.

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APPENDIX. Genbank numbers of specimens examined by Schätti & Utiger (2001) used in this study (COI/12S). *Coelognathus flavolineatus* (AY039200/AY039162); *Eirenis modestus* (AY039181/AY039143); *Hemerophis socotrae* (AY039167/ AY039129); *Hemorrhois hippocrepis* (AY039194/AY039156), *H. ravergieri* (AY039193/AY039155); *Hierophis caspius* (AY039164/AY039126), *H. gemonensis* (AY039183/AY039145), *H. jugularis* (AY039188/ AY039150), *H. schmidti* (AY039197/AY039159), *H. viridiflavus* (AY039175/AY039137); *Platyceps collaris* (AY039195/AY039157), *P. najadum* (AY039179/AY039141), *P. ventromaculatus* (AY039172/AY039134); *Spalerosophis diadema* (AY039182/AY039144).

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