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## Four new stygobiontic beetles (Coleoptera: Dytiscidae; Noteridae; Elmidae)

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**Abstract:** Four new species and three new genera of stygobiontic beetles are described: Dytiscidae: *Siamoporus deharvengi*, new genus, new species from Thailand; *Sinodytes hubbardi*, new genus, new species, from China; Noteridae: *Speonoterus bedosae*, new genus, new species, from Indonesia; Elmidae: *Neoelmis sketi*, new species, from Ecuador. All of the taxa were collected from aquatic habitats in caves and bring the total known stygobiontic beetles to 23 species, 1 subspecies, and 20 genera, in 5 families. A list of the described stygobiontic beetles is included. Line drawings and/or micrographs illustrate the taxa and a map shows the type localities.

### Introduction

The order Coleoptera with 350,000 to 500,000 described species in the world fauna represents 40 to 50 % of all known species of insects. Of that number of beetles, about 10,500 epigeal species in 24 families have made the difficult transition from terrestrial to aquatic life. Some of those beetles are aquatic in either their adult or larval stage and others are aquatic in both stages but return to the soil to pupate (Spangler, 1986). The known exceptions to pupation on land are members of four genera of the Noteridae. Taxa of the genus *Noterus* from the Eastern Hemisphere (Balfour-Browne & Balfour-Browne, 1940) and of three genera from the Western Hemisphere—*Hydrocanthus*, *Suphis*, and *Suphisellus* (Spangler, 1981a) have been reported to pupate underwater. Respiration by the noterids during pupation is presumed to occur between the pupa and the aerenchymatous cells of the aquatic plants which the larva pierces before the pupal cocoon is secreted. Nothing is known about the pupation of hypogean water beetles; rearing larvae in an artificial setting may establish how and where stygobiontic beetles pupate.

The transition from inhabiting surface waters to life in subterranean waters must be extremely difficult and, presently, there are only 17 genera, 19 species, and 1 subspecies of described stygobiontic beetles in 5 families. To be true stygobionts, beetles must be free living taxa that (a) are exclusively found, or almost so, in all their developmental stages in one or more subterranean aquatic habitat and (b) display adaptations generally seen as characteristic of subterranean aquatic animals (fide Botosaneanu, 1986). The additional three new genera and four new species are described to make their names available for anyone interested in

stygobiontic fauna and add to our knowledge of stygobiontic beetles.

All of the new taxa here described were collected by biospeleologists who were searching for various organisms in caves. Specimens of the new noterid genus and species were collected in Indonesia in 1986 by Anne Bedos and Louis Deharveng, two members of the Association Pyrénéenne de Spéléologie (Deharveng, 1987). Along with their colleague Didier Rigal, they also collected specimens of a new dytiscid genus and species in Thailand during fieldwork in 1987 (Deharveng, 1987). In 1993, David A. Hubbard, Jr., collected a single specimen of another new dytiscid genus and species in The Peoples Republic of China. The fourth new stygobiontic beetle is a new species of the elmid genus *Neoelmis* collected in Napo Province, Ecuador, by Boris Sket.

The interest and attention paid to these small specimens by the biospeleologists is appreciated and I thank all of them for their generosity in allowing me to study and describe them.

### Dytiscidae, Hydroporinae, Hydroporini

#### *Siamoporus* Spangler, new genus

**Diagnosis:** A light reddish-brown stygobiontic hydroporine dytiscid with characteristics of the subfamily Hydroporinae and tribe Hydroporini but eyeless and without flight wings; with numerous, long, slender, hair-like setae on body and legs. Pronotum broad, cordate. Prosternum with tectiform carina in front of procoxae and a broad tooth-like process between anterior edges of procoxae.

**Description:** Body elongate, subrectangular (Figure 1). Apicolateral angles of pronotum acute. Elytral apices subtruncate. Head and pronotum

microreticulate; elytral reticulation mostly effaced. Head large, broad; eyes absent; clypeus with anterior margin declivous, without rim; labrum emarginate apicomediaally and emargination bordered by dense golden setae; lateral lobes of mentum normal; palpi slender with apical segments elongate and slightly swollen; antennae 11 segmented and subfiliform, segments wider apically. For future comparative studies illustrations of the proven-triculus are included (Figures 32, 33). Pronotum broad, cordate. Scutellum not visible. Elytra elongate; each with few, fine, scattered punctures in poorly defined row near suture. Epipleura widest and strongly inclined at base then becoming narrow and less strongly inclined to lateral angle at beginning of subtruncate apex of elytron. Prosternum with tectiform carina in front of procoxae and a broad tooth-like process between anterior edges of procoxae (Figures 20, 21, 31). Prosternal process not extending to intercoxal process of metasternum (Figure 20); strongly sinuate in lateral view. Metasternal wing-like lateral extensions long and narrow (Figure 20). Metacoxal process emarginate posterolaterally for reception of metatrochanter (Figure 23). Procoxae and mesocoxae enlarged and globular. Male protarsus and mesotarsus each 4 segmented; segments broad; segment 3 deeply bilobed apically; segments 1-3 with many small adhesive setae ventrally, setae with apical discs (Figures 14, 15). Metatarsus of 5 slender segments. Mesotibia with lateral fringe of long, hair-like setae. Metatibia and metatarsus each with lateral and medial fringe of long natatory setae. Metatrochanter large, elongate, and inflated. All tarsi with 2 simple, rather short claws; claws nearly equal in length. Abdomen of 5 visible sterna; sterna 2 and 3 fused.

**Type species:** *Siamoporus deharvengi* Spangler, new species.

**Comparative notes:** This new genus *Siamoporus* resembles the stygobiontic hydroporine genus *Morimotoa* Uéno (1957) described from Japan but may be distinguished immediately by the more definitively cordate shape of the pronotum; by the tectiform carinae in front of the procoxae; and the distinctly arcuate sides and subtruncate apices of the elytra. Also, in contrast to the five-segmented protarsus and mesotarsus of *Morimotoa*, the protarsus and mesotarsus of *Siamoporus* are four segmented.

***Siamoporus deharvengi* Spangler, new species.**

(Figures 1-38, 80)

**Diagnosis:** The only known species of the genus is distinguished by the character states of the genus.

**Holotype** ♂: Body Form and Size: Elongate and rather flat; in profile, dorsally, continuous from clypeus to elytral apices and nearly straight from pronotum to apical two-fifths of elytra. Length, 3.5 mm; greatest width, 1.7 mm.

**Color:** Light reddish brown.

**Head:** Large; semicircular and very broad; lateral sides continuous with those of pronotum. Eyes absent; trace of eye discernible on each side by a depression behind insertion of antenna. Clypeus fused with front; declivous and shallowly emarginate apicomediaally. Labrum narrow, transverse; apical margin widely and moderately deeply emarginate, with a row of dense, golden, hair-like setae in emargination. Mandibles as illustrated (Figure 29); short and robust; each hollowed out on inner side. Mentum (Figure 30) transverse and not fused with submentum; deeply emarginate apicomediaally; microreticulate; lateral lobes rather wide. Ligula transverse; with 5 setae on each apicolateral angle; apical margin slightly sinuate at middle; apicolateral angles rounded. Labial palpus, 3 segmented; rather short and stout; apical segment about as long as penultimate segment, moderately swollen medially, and indistinctly bifid at apex. Maxilla with lacinia arcuate; lacinia with a row of 7 basal and 6 subterminal stout setae along inner margin; basal setae compact; subterminal setae more widely spaced; a longitudinal row of 3 stout setae ventrally. Galea with apical segment longer than basal segment; apical segment slightly arcuate and tapering towards the tip; tip with sensillum. Maxillary palpus (Figures 8, 9, 34) slender; basal segment small; segment 2 about a third longer than basal segment and longer than wide; segment 3 slightly longer than segment 2 and obviously longer than wide; apical segment elongate-fusiform, about as long as length of 2 preceding segments combined, with 3 fine lateral setae, bifid apically, each lobe with a sensory area (Figure 9). Antenna (Figure 4) subfiliform and slender; segment 2 slightly swollen and subequal to segment 3; penultimate segment (Figure 5) with sensory area apicoventrally; apical segment longest, fusiform in profile, with sensory area apicoventrally (Figure 6).

**Thorax:** Pronotum cordate; widest and deeply emarginate anteriorly; distinctly convergent posteriorly; lateral margins narrowly rimmed; apicolateral angles extending forward; slightly but distinctly sinuate in front of hind angles; hind angles

acute and extended posterolaterally; base moderately sinuate. Scutellum concealed. Elytra elongate, arcuate; widest slightly behind midlength; each with a few, fine punctures in poorly defined row near suture. Epipleuron widest and obliquely inclined at base then becoming narrow and less inclined to lateral angle at beginning of subtruncate apex of elytron. Prosternum transverse, with a tectiform carina in front of each procoxa; with a tooth-like process on midline between anterior margins of procoxae. Prosternal process narrow and rises steeply from level of prosternum between procoxae; then broader and sinuous laterally and attenuated towards apex; apex separated from inter-metasternal process; surface raised medially; sinuate in lateral view. Mesepimeron rudimentary. Metasternum v-shaped. Inter-metasternal process short. Metasternal wing-like lateral extensions long and narrow (Figure 20); arcuate posterolaterally; attenuated and reaching epipleura. Metepisternum subtriangular; widest in front, extending medially but not attaining mesocoxal cavity. Metacoxal plate broad; front margin rounded; hind margin oblique. Metacoxal process with hind margin moderately emarginate and median part extended backwards on same plane as abdomen. Metacoxal lines slightly diverging anteriorly (Figure 23). Front and middle legs relatively long; hind legs, except swollen trochanters (Figure 23), slender. Hind legs with numerous, long, golden, hair-like natatory setae. Profemur distinctly emarginate apicoventrally for  $\frac{1}{4}$  its length (Figure 11); with a row of dense, long, stout setae in emargination. Mesofemur (Figure 10) and metafemur moderately swollen; each with a row of long, stout, sparse setae on medial margin. Protibia with row of dense, long, stout setae on basal third of medial margin (Figures 16, 17). Row of setae on protibia and those on apicomedial portion of metafemur form a grooming device when protibia is retracted against profemur. Mesotibia with row of dense, short, stout setae on medial margin (Figures 10, 12, 18). Protarsus (Figures 13, 14) and mesotarsus, each 4 segmented; third segments elongate and deeply bilobed, about as long as segment 2. Male with 3 basal segments of protarsus and mesotarsus broad and, ventrally, with numerous, small, adhesive setae (Figures 14, 15). Metatarsus, 5 segmented.

**Abdomen:** Visible sternum 1 divided by metacoxae. Sterna 2 and 3 large, fused. Sterna 4 and 5 not fused; with shallow, coarse medial punctures; each puncture with 1 long, slender, hair-like seta (Figures 23, 24, 35).

**Genitalia:** Typical hydroporine type, as illustrated (Figures 36–38).

**Female:** Similar to male but slightly longer and wider. Protarsi and mesotarsi without adhesive setae as found on male.

**Variation:** Males vary in length from 3.24 to 3.50 mm and width from 1.40 mm to 1.70 mm. Females vary in length from 3.60 mm to 3.62 mm and width from 1.68 mm to 1.70 mm.

**Discussion:** Micrographs (X500 and above) of visible abdominal sterna 1–5 of a female specimen of *S. deharvengi* show unusual pore-like openings (Figures 25–27). Figure 35 shows the general distribution of these pore-like openings, which are absent from abdominal segment 6. Perhaps the function of these unusual structures will be learned in the future.

**Type Data:** Holotype Male: Thailand: Khon Kaen Province: Tham Kubio (Tham = cave) near road from Chumphae to Loei, 19 June 1987, Anne Bedos, Louis Deharveng, Didier Rigal, Thai Expedition 87; deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C. Allotype: Same data as holotype. Paratypes: Same data as holotype, 3 males (1 dissected for study and illustration), 3 females (1 coated for SEM micrographs).

**Etymology:** The trivial name *deharvengi*, a patronym for Louis Deharveng, biospeleologist and member of the expedition during which the specimens of this new stygobiont were collected.

**Habitat:** The specimens of *Siamoporus deharvengi* were collected from Kubio cave; Dr. Bedos reported (in litt.): “numerous beetles were walking on the bottom of ponds of clear water. In the same ponds, there was a very rich aquatic fauna (Asellidae, Planaria, Amphipoda, Worms).”

## Bidessini

### *Sinodytes* Spangler, new genus

**Diagnosis:** A small subparallel-sided, eyeless, stygobiontic dytiscid with the characteristics of the subfamily Hydroporinae. The absence of metacoxal lines will separate this genus from all other described stygobiontic dytiscid genera except the bidessine *Comaldessus stygius* Spangler and Barr (1995) from Texas, USA. The presence of vague pronotal and elytral plicae and absence of natatory setae on the legs distinguishes *Sinodytes* from *Comaldessus*, which has distinct plicae on the pronotum.

tum and elytra and natatory setae on all tibiae and the metatarsi.

**Description:** Body subparallel sided (Figure 39). Color pale reddish brown. Eyes absent. Palpi short, robust; apical segments ovate, swollen; apices bifid, with sensory area on each lobe. Maxillary palpus, 4 segmented. Labial palpus, 3 segmented. Pronotum narrowed anteriorly and posteriorly; sinuate laterally; anterolateral angles rounded and deeply emarginate medially for reception of head; with vague indication of basal plicae. Elytra with vague indication of basal plicae; without sutural striae. Scutellum concealed. Hind wings absent. Epipleura without oblique subbasal carina. Prosternum in front of procoxae about  $\frac{1}{4}$  length of procoxa. Prosternal process very slender between mesocoxae; apex about 3 times its width between mesocoxae; apex not reaching metathorax. Mesosternum concave for reception of apex of prosternal process. Metathoracic wing-like processes slender; metacoxal plates broadly rounded anteriorly. Metacoxal lines absent. Legs slender. Tarsal formula 4-4-5. Abdomen with 6 visible sterna but sterna 2 and 3 fused.

**Etymology:** The generic name is a combination of the name *Sinos*, G. = Chinese plus *dytes*, G. = diver; feminine.

**Type species:** *Sinodytes hubbardi* Spangler, new species.

**Comparative notes:** Although this tiny beetle keys to the subfamily Hydroporinae in Sharp's key (1882), the tribal assignment is provisional. Young (1967), Guignot (1959), and Biström (1988) referred to the problems encountered in separating the tribe Bidessini from other tribes assigned to the subfamily Hydroporinae. Guignot and Biström concluded that the only character that they found to separate the Bidessini from the other hydroporine tribes was a single male character state—the 2- or 3-segmented parameres. Without a male specimen to determine the tribal assignment, I provisionally assign the unique female holotype of *Sinodytes hubbardi* Spangler, new species, to the Bidessini because of its size and vague indications of plicae on the bases of the pronotum and elytra.

***Sinodytes hubbardi* Spangler, new species**  
(Figures 39-45, 80)

**Diagnosis:** The only known species of the genus is distinguished by the character states of the genus.

**Holotype**, ♀: Body Form and Size: Subparallel-sided (Figure 39). Length, 1.63 mm; greatest width, 0.76 mm.

**Head:** Broad, almost as wide as pronotum at apex; rounded anteriorly; sides parallel. Flattened and slightly depressed where eyes would be; margins of ocular area slightly raised and angulate where anterior edge of eye would be. Cuticular surface sparsely microreticulate; discal area coarsely, sparsely punctate; punctures separated by 1 to  $1\frac{1}{2}$  times puncture diameter. Maxillary palpus, 4 segmented (Figure 41); segment 1 shortest; segments 2 and 3 subequal in length; last segment swollen, about  $1\frac{1}{2}$  times thicker than segment 3. Mentum (Figure 44) transverse and deeply emarginate apicomediaally; lateral lobes moderately wide. Labial palpus, 3 segmented; basal segment shortest; apical segment swollen (Figures 42, 43).

**Thorax:** Pronotum with surface microreticulate and coarsely, moderately densely punctate; punctures along anterior and posterior margins separated by  $\frac{1}{2}$  to 1 times puncture diameter; disc sparsely punctate; lateral margins narrowly rimmed; numerous, long, slender, yellow, hair-like setae along rim of lateral margins; basal half of lateral margins constricted; junction between pronotum and elytral base discontinuous. Elytra elongate, finely rimmed laterally; slightly narrowed basally; apices broadly rounded; cuticular surface coarsely, densely punctate except space between punctures finely, sparsely punctate; coarse punctures separated by  $\frac{1}{3}$  diameter of puncture. Epipleuron moderately densely punctate and microreticulate; broad at base and narrowing at about level of abdominal sternum 1. Prosternum, mesosternum, and metasternum coarsely, moderately densely punctate. Prosternal process does not extend to metasternum; very slender between mesocoxae, slightly widening behind mesocoxae, and ending in an acute apex (Figure 45). Metasternal wing-like processes slender (Figure 40). Discrimen distinct, extending anteriorly from metacoxal processes to hind margin of metasternum. Metacoxal processes with shallow, apicolateral emarginations (Figure 40). Profemur, mesofemur, and metafemur with few, short, stout setae arising from punctures on upper (anterior) surfaces. Protibia slender at base but widening abruptly to about 4 times its width at base; apicolateral angle extended, with 2 robust spurs. Protibiae, mesotibiae, and metatibiae without fringe of natatory setae. Metatrochanter large, about  $\frac{1}{3}$  length of and slightly wider than greatest width of metafemur. Metatibia curved moderately;

basal half slender, apex moderately expanded. Pro-tarsus and mesotarsus, each 4 segmented. Meta-tarsus, 5 segmented. All tarsal claws short and equal in length.

**Abdomen:** Cuticle finely microreticulate and moderately coarsely punctate.

**Type Data:** Holotype ♀: The Peoples Republic of China: Guangxi Province: Lingchuan Co., Jiazhai Taiping Yan [yan = cave], just north of Guilin, 1 Aug 1992, David A. Hubbard; deposited in the Institute of Applied Zoology, Academia Sinica, Shenyang, Peoples Republic of China.

**Etymology:** The specific name is a patronym honoring the collector, David A. Hubbard, Biospeleologist.

**Habitat:** According to the collector, the unique female type specimen was found swimming around in a rimstone pool in Jiazhai Taiping Cave. The pool was formed from percipitates from water supersaturated by calcium carbonates, was several feet in diameter, and was about 1–2 inches deep. The beetle was observed swimming actively and frequently bouncing its head off of the bottom as though it was attempting to feed on something on the substrate.

#### Noteridae, Notomicrinae, Notomicrini

In a review of troglophilic water beetles of the world, Spangler (1986) reported that there are only 15 described species and 1 subspecies of aquatic troglophilic beetles described in four families as follows: Dytiscidae, 10; Noteridae, 1; Elmidae, 4; Hydrophilidae, 1.

In that review I followed Bertrand (1972) and included *Phreatodytes* in the Noteridae. The family Phreatodytidae was accepted by Franciscolo (1979, 1983), but most subsequent workers (Crowson, 1981; Smrz, 1982; Spangler, 1986; Belkaceme, 1991; Beutel, 1995; Lawrence & Newton, 1995) have treated *Phreatodytes* as a genus in the subfamily Phreatodytinae in the Noteridae.

Following the presently accepted placement of *Phreatodytes* as a noterid, the new genus and species described below becomes the second troglophilic taxon in the Noteridae.

#### *Speonoterus* Spangler, new genus

**Diagnosis:** A tiny, oblong-oval, lightly pigmented, eyeless noterid with slender tibial spurs and metathoracic wings absent. Distance from anterolateral angles of noterid platform to mesocoxal

cavities shorter than diameter of mesocoxae. Metasternum short, fused with metacoxae, without lateral wing-like extensions. Legs without natatorial setae.

**Description:** Body short, broad, oblong-oval; pronotum broadest across midlength, base discontinuous from base of elytra (Figures 46–48). Color entirely light reddish brown. Head without eyes. Antenna, 11 segmented; segment 1 constricted near midlength (Figures 49, 52); other segments unmodified. Scutellum minute (Figure 62). Elytra without sutural striae. Metathoracic flight wings absent. Prosternal process lanceolate, flattened (Figures 55, 59); on same plane as metathorax. Mesepimeron narrow, reaching mesocoxal cavities. Metepisterna triangular. Metasternum small, fused with metacoxal plates (Figure 76). Metasternal projection between mesocoxae concave apically for reception of apex of prosternal process (Figures 56, 59). Noterid platform extending anteriorly almost to mesocoxal cavities (Figures 56, 76). All tibiae and tarsi without lateral fringe of natatory hair-like setae. Protibia with a few short apical spurs and 1 outer and 1 inner longer slender spur (Figure 64). Tarsal formula, 5-5-5. Abdomen with 5 visible sterna. Male genitalia of noterid type with right and left parameres dissimilar (Figures 73–75).

**Type of the genus:** *Speonoterus bedosae*, Spangler, new species.

**Etymology:** Because this noterid genus and species is a cave inhabitant it is named *Speonoterus* from the Greek *speos* (cave) plus *noterus* (the genus serving as the family group name).

**Comparative Notes:** This new noterid keys to the tribe Notomicrini in Zimmermann's (1919) and Guignot's (1948) key because it has a slender outer protibial spur similar to the inner spur. The outer protibial spur of members of all other noterid tribes is a large, curved hook with the apex prolonged hood-like over the base of the tarsus.

*Speonoterus* is similar to and most closely resembles its sister genus *Notomicrus* (Figure 77) in general shape, size, and presence of a minute scutellum (Figure 72); however, the two genera differ as follows. In *Speonoterus* the distance from the anterolateral angles of the noterid platform to the mesocoxal cavities is shorter than the diameter of a mesocoxa (Figures 56, 76); while, in *Notomicrus* the distance is 1½ times the diameter of a mesocoxa (Figure 77). *Speonoterus bedosae* has no tibial fringes of natatory setae; and, although difficult to see unless in fluid and contrary to Beutel and Roughley (1987), species of *Notomicrus* have fringes of nata-

tory setae on the protibiae, mesotibiae, and metatibiae (Figures 67–71).

***Speonoterus bedosae* Spangler, new species**  
(Figures 46–66, 73–76, 80)

**Diagnosis:** The only known species of the genus is distinguished by the character states of the genus.

**Holotype** ♂: Body Form and Size: Elongate; pronotum slightly wider than base of elytra. Length, 1.11 mm; greatest width, about basal third of elytra, 0.48 mm.

**Color:** Entire body pale reddish yellow.

**Head:** Microreticulate, finely and sparsely punctate; punctures on discal area separated by about 1 to 2 times puncture diameter. Antenna, 11 segmented; segments 1–5 and 9 and 10 cylindrical; segments 6–9 subserrate (Figure 49). In dorsal view, clypeus arcuate and broadly, moderately emarginate (Figure 63); not thickened anteriorly. Labrum large; truncate anteriorly. Maxillary palpus, 4 segmented; apical segment moderately swollen and as long as segments 1–3 combined (Figure 58). Labial palpus, 3 segmented; apical segment swollen and as long as segments 1 & 2 combined. Ventral surface microreticulate (Figures 55, 57, 58).

**Thorax:** Pronotum arcuate and finely rimmed laterally; widest across midlength; margins very narrow anteriorly but becoming broader on basal half; anterolateral angles acute; posterolateral angles obtuse; angle between pronotum and elytra obtuse (dorsal view); punctation and microreticulation (Figure 54) similar to but more distinct than that on head (Figures 53, 61). Elytra almost parallel sided at base then evenly curved to apices; microreticulate and finely sparsely punctate; punctures on discal area separated by about 3 to 6 times puncture diameter. Prosternum with anterior margin broadly and shallowly bisinuate. Prosternal process narrow between anterior halves of procoxae then becoming lanceolate (Figures 55, 59). Discrimen extending entire length of noterid platform and slightly beyond (Figure 76). Legs and coxae finely, sparsely punctate. Protibia distinctly diverges apically; with 3 large, stout spurs and 3 smaller, more slender setae laterally. Mesotibia with 4 large, stout spurs and 3 smaller, more slender setae laterally. Metatibia with 3 moderately stout spurs. Tarsal segments becoming increasingly slender distally. Segments 1 and 2 of protarsus and mesotarsus broad, with adhesive setae on ventral surface. Last seg-

ment of protarsus and mesotarsus about as long as segments 1–3 combined; last segment of metatarsus about half as long as segments 1–4 combined.

**Abdomen:** Sterna unmodified.

**Genitalia:** With parameres dissimilar and unjointed; as illustrated (Figures 73–75).

**Female:** Similar to male but without the broad segments and adhesive setae found on the first two segments of the protarsus and mesotarsus of the male.

**Variations:** None observed.

**Type Data:** Holotype male and allotype: Indonesia: Sulawesi Selatan [Southern Sulawesi]: Malawa, in Gua Mananga (Mananga Cave), alt. 305 m, 15 July 1986, Anne Bedos; deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

**Paratypes:** Same data as holotype, 2 females (1 coated for SEM study); deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

**Etymology:** Named *bedosae*, a patronym, for the collector of this new species.

**Habitat:** The specimens described above were collected by Dr. Anne Bedos in Gua [Cave] Mananga, one of many limestone caves in the wet and heavily cultivated countryside, and described by Dr. Bedos as follows (in litt.). The cave is about 50 meters long; with a few puddles of water but no stream; the entrance opens about 3–4 meters above the S. Batupute River, which flows down the side of a volcano that is 1695 meters high. Approximately 12 beetles were observed crawling on the bottom of a puddle that was about 30 meters from the cave entrance, was raised slightly above the cave floor, and was about 50 cm long and not more than 10 cm deep. None of the beetles was observed swimming.

**Elmidae, Elminae**

***Neoelmis sketi* Spangler, new species**  
(Figures 78–80)

**Diagnosis:** With features of the genus *Neoelmis* as described by Musgrave (1935) but lightly pigmented, eyes reduced to only 15–20 facets, and metathoracic wings absent. With cleaning fringes of golden setae as follows: protibia with 1; mesotibia with 2; metatibia with 1.

**Holotype** ♀: Form and Size (Figure 78): Body elongate, subparallel, and moderately convex. Length, 1.69 mm; greatest width, 0.54 mm.

**Plastron:** Covers integument of genae; epipleura; sides of prosternum, mesosternum, and metasternum; abdominal sterna except disc of sterna 1-4; legs except tarsi.

**Color:** Cuticle entirely light reddish brown.

**Head:** Partly retracted into pronotum. Eyes reduced to a few facets. Maxillary palpus, 4 segmented; apical segment wide, wider than apex of segment 3 and as long as length of segments 2 and 3 combined. Labial palpus, 3 segmented; apical segment widest, a third wider than segment 2. Antenna, 11 segmented; segments 9 and 10 each with a stout seta apicomedia; apex of segment 11 with few golden hair-like setae. Clypeus microreticulate; punctate; with short, recumbent, hair-like setae; anterior margin broadly, shallowly emarginate; anterolateral angles broadly rounded. Labrum narrow, microreticulate; anterior margin subtruncate.

**Thorax:** Pronotum widest at basal third; sides broadly arcuate, indistinctly bisinuate; apical margin broadly arcuate; anterolateral angles acute; with a well-developed, sublateral carina on each side extending from base to subapex; with a deep, complete, transverse impression at midlength; bottom of impression microreticulate. Pronotum microreticulate on base, apex, most space between sublateral carinae and margins of pronotum, and inner margins of sublateral carina. Prosternum microreticulate; anterior three-fifths bent downward (lateral view); with 2 carinae on posterior two-fifths; carinae prominent, parallel, and separated by a distance nearly equal to half of base of prosternal process. Hypomeron densely microreticulate; with a broad depression on basal third and a deep pit on apical third. Prosternal process microreticulate, with some sparse granules; subparallel sided; with an indistinct rim; apex broadly rounded. Mesosternum microreticulate; with a broad groove for reception of prosternal process. Metasternum with a very broad, deep discripen extending from base to apical fourth; impression with bottom microreticulate, sides smooth and shiny; disc of metasternum densely microreticulate; a fovea on each side of midline of disc between mesocoxae and metacoxae. Elytron alutaceous; with 7 rows of punctures; without an accessory row of punctures; intervals almost flat; lateral margins with short sparse setae; without a subapical notch; apex obtusely rounded. Scutellum subobovate; with base truncate and apex broadly rounded; alutaceous. Protibia with an apicomedial (anterior) cleaning fringe. Mesotibia with 2 cleaning fringes— 1 apicolateral (anterior) and 1

longer, apicomedial (posterior). Metatibia with an apicomedial (posterior) cleaning fringe. Claws without teeth.

**Abdomen:** With 5 visible sterna. Sternum 1 with area between coxae strongly concave; bottom of concavity microreticulate from base to apical fourth; a carina on each side of concavity. Sterna 1 and 2 without plastron on disc. Sternum 5 with anterolateral angles upturned, toothlike.

**Genitalia:** As illustrated (Figure 79).

**Male:** Unknown.

**Type data:** Holotype ♀: Ecuador: Napo Province: Cueva de Jumandi, near Tena, Dec 1978, Boris Sket; deposited in the National Museum of Natural History, Smithsonian Institution.

**Etymology:** Named *sketi* in honor of the biospeleologist and collector of this interesting stygobiont, Boris Sket.

**Comparative notes:** The stygobiontic *Neoelmis sketi* from Ecuador along with the three Haitian stygobionts described by Spangler (1981b)—*Anommatalmis botosaneau*, *Lemalelmis fontana*, *Lemalelmis minyops*—and the African *Troglelmis leleupi* Jeannel (1950) are the only elmids known to have a reduced number of eye facets. *Neoelmis sketi* may be distinguished immediately from the Haitian and African species by its elongate, subparallel shape; the distinctive transverse pronotal impression near the midlength (Figure 78); and its shorter length (1.69 mm vs 1.95 mm–2.80 mm).

**Habitat:** Professor Sket reported (in litt.) that the type specimen was found in the main brook above a dam in Jumandi Cave. I visited the cave in 1990 for a short time; but the water was high and I could not collect above the dam. All of the elmids I collected from the stream outside of the cave were typical epigeal elmids.

### Known species of stygobiontic beetles and localities

#### Adephaga, Dytiscidae:

- Comaldessus stygius* Spangler & Barr, 1995; USA: Texas, New Braunfels, Comal Springs
- Haideoporus texanus* Young & Longley, 1976; USA: Texas, San Marcos; artesian well
- Kuschelhydrus phreaticus* Ordish, 1976; New Zealand: South Island; well
- Morimotoa phreatica phreatica* Uéno, 1957; Japan: Aioi, Himeji, Kyoto, & Yatabe; wells
- Morimotoa phreatica miurai* Uéno, 1957; Japan: Kaibara and Fukuchiyama; wells



- Phreatodessus hades* Ordish, 1976; New Zealand: South Island, Livingstone's Well
- Phreatodessus pluto* Ordish, 1991; New Zealand: South Island, Dalgety Agrisearch Station Rua Pae Farm; well
- Sanfilippodytes sbordonii* Franciscolo, 1976; Mexico: Tamaulipas, El Porvenir, Gomez Farias, Cueva de la Capilla
- Siamoporus deharvengi* Spangler, new genus, new species; Thailand: Khon Kaen Province, Tham Kubio (Kubio = cave)
- Siettitia avenionensis* Guignot, 1925; France: Avignon near Lyon, Rhone Valley; well
- Siettitia balsetensis* Abeille de Perrin, 1904; France: Le Bausset, La Seyne-sur Mer, Lyon area, Toulon; wells
- Sinodytes hubbardi* Spangler, new genus, new species; China: Jiazhai Taiping Yan, just north of Guilin (Yan = cave)
- Stygoporus oregonensis* Larson & LaBonte, 1994; USA: Oregon, near Dallas; well
- Trogloguignotus concii* Sanfilippo, 1958; Venezuela: SE of Coro, Cueva de Rio Gueque (Hueque)
- Uvarus chappuisi* (Peschet), 1932 [as *Bidessus*]; Burkina Faso [Upper Volta]: Banfora; well

#### Noteridae:

- Phreatodytes relictus* Uéno, 1957; Japan: Aioi, Gifu, Himeji, Kôchi, Kyoto, & Yatabe; wells
- Speonoterus bedosae* Spangler, new genus, new species; Indonesia: Sulawesi Selatan, Malawa, Gua Mananga; (Gua = cave)

#### Polyphaga, Dryopidae:

- Stygoparnus comalensis* Barr & Spangler, 1992; USA: Texas, New Braunfels, Comal Springs

#### Elmidae:

- Anommatelmis botosaneanui* Spangler, 1981b; Haiti: Presbytère Catholique of Limbé; Camp Coq, beside Ecole Commuautoire; Limbé, Hôpital Le bon Samaritain; well
- Lemalelmis fontana* Spangler, 1981b; Haiti: Tessier between Beaucalin and Ravine Blanche; karst spring
- Lemalelmis minyops* Spangler, 1981b; Haiti: Jérémie (Département de la Grande Anse); Source Débarasse; karst spring
- Neoelmis sketi* Spangler, new species; Ecuador: Napo Province, near Tena, Jumandi Cave
- Troglelmis leleupi* Jeannel, 1950; Zaire (Congo Belge): Léopoldville Province, District du Bas-Congo, grotte de Koke pres de Thysville

#### Hydrophilidae:

- Troglochaes ashmolei* Spangler, 1981c; Ecuador: Morona-Santiago Province, Los Tayos Cave

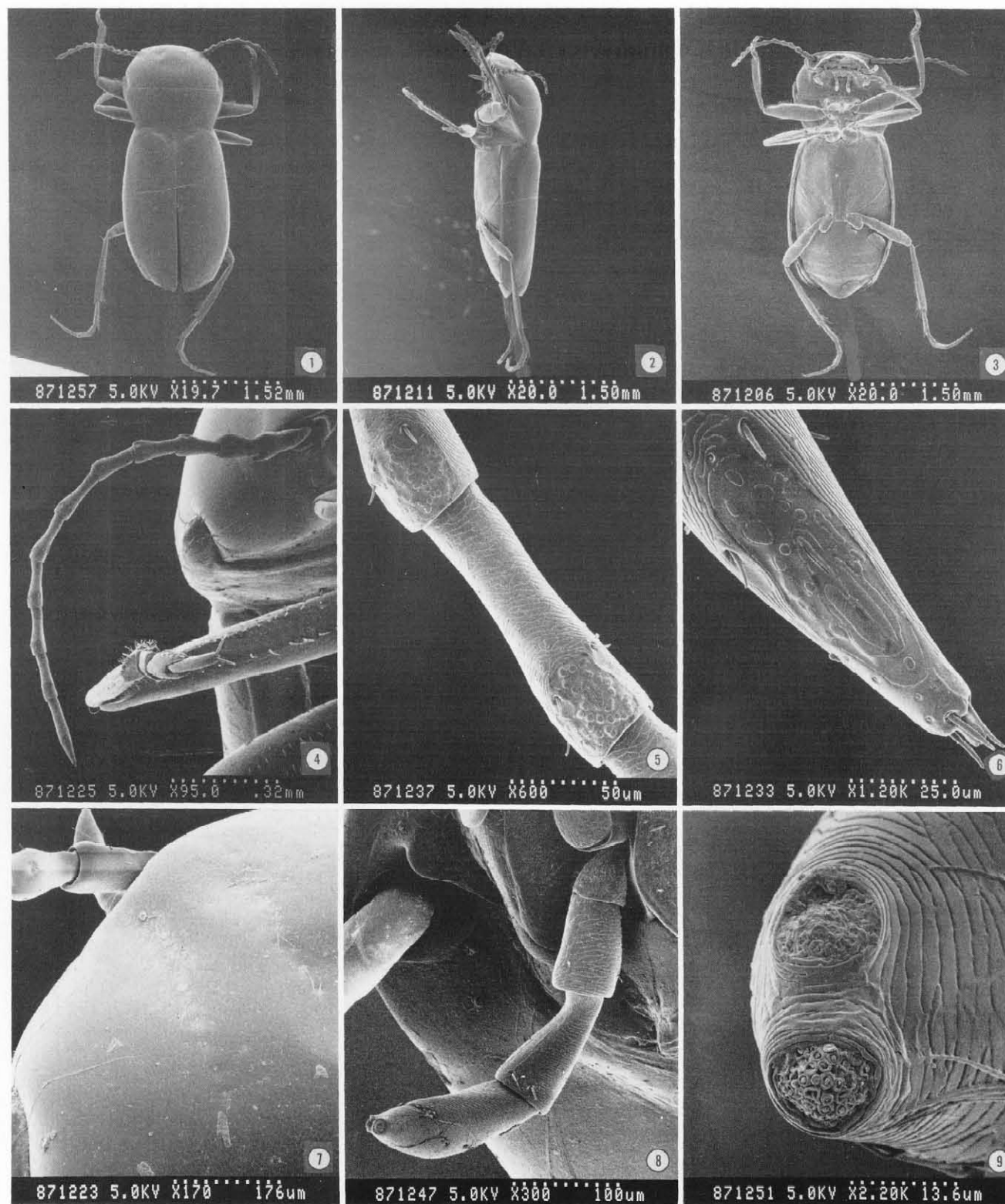
#### Acknowledgments

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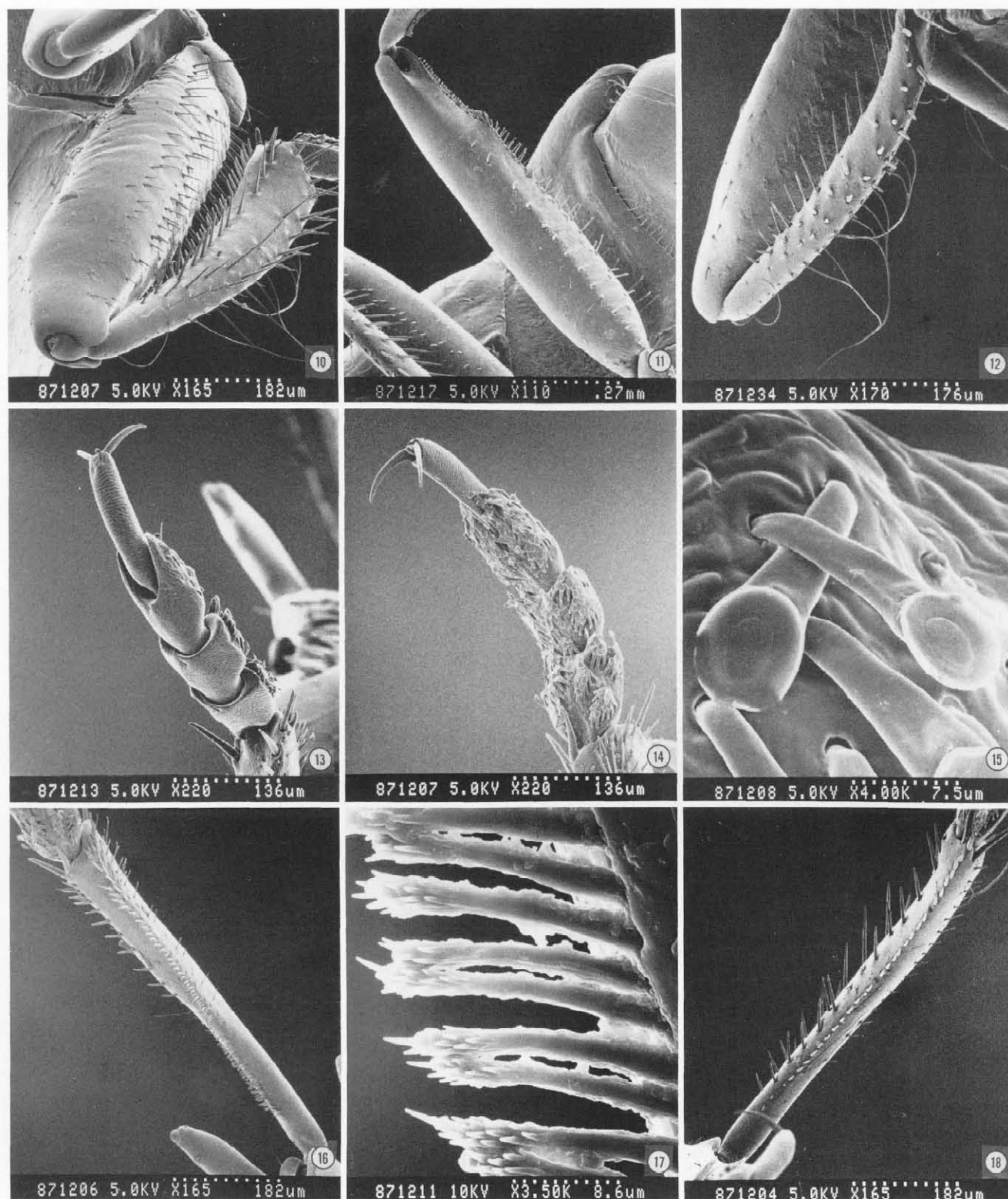
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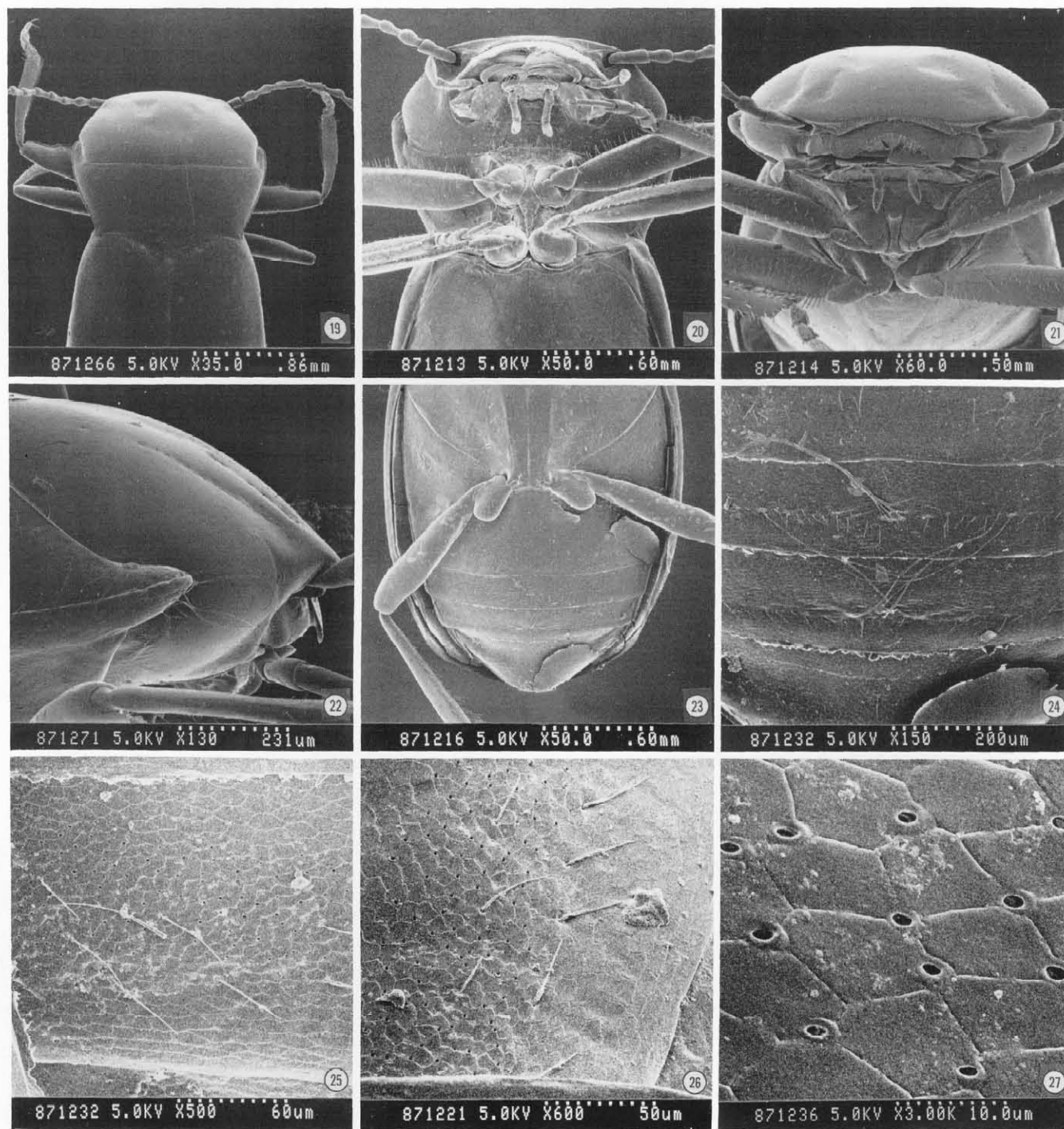


**Figures 1-9:** *Siamoporus deharvingi*, new genus, new species: habitus: 1, dv, x19.7; 2, vv, x20; 3, vv, X20; 4, antenna and ocular area, vv, x95; 5, antenna, sensilla, penultimate segment, vv, x600; 6, antenna, sensilla, last segment, vv, x1200; 7, ocular area, dv, x170; 8, maxillary palpus, vv, x300; 9, sensilla, maxillary palpus, last segment, apex, x2200. dv = dorsal view; vv = ventral view

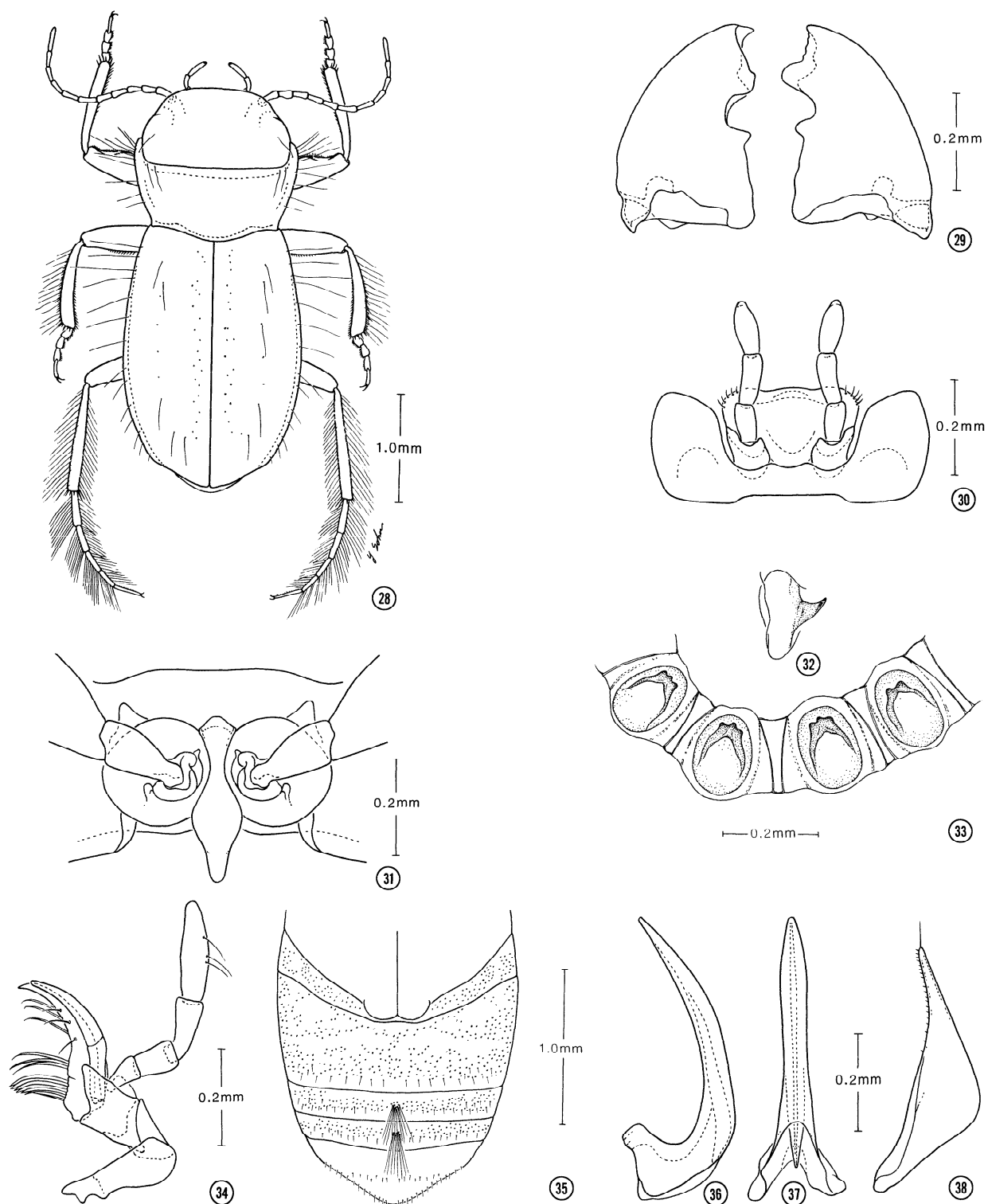


**Figures 10-18:** *Siamoporus deharvengi*, new genus, new species: 10, mesofemur and mesotibia, x165; 11, profemur, vv, x110; 12, mesotibia, ov, x170; 13, protarsus, dv, x220; 14, protarsus, vv, adhesive setae, x220; 15, mesotarsal adhesive setae, x4000; 16, protibia, vv, x165; 17, protibial cleaning fringe setae, x3500; 18, mesotibia, vv, 165. dv = dorsal view; ov = oblique view; vv = ventral view

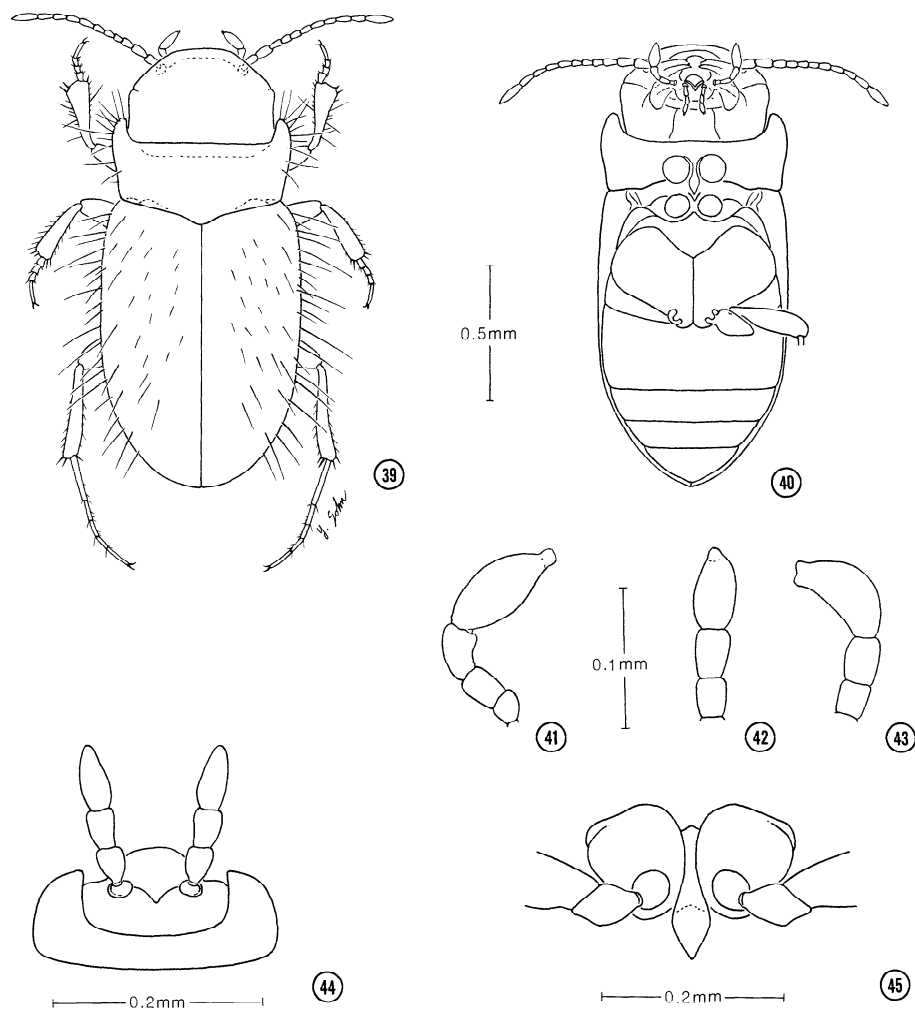




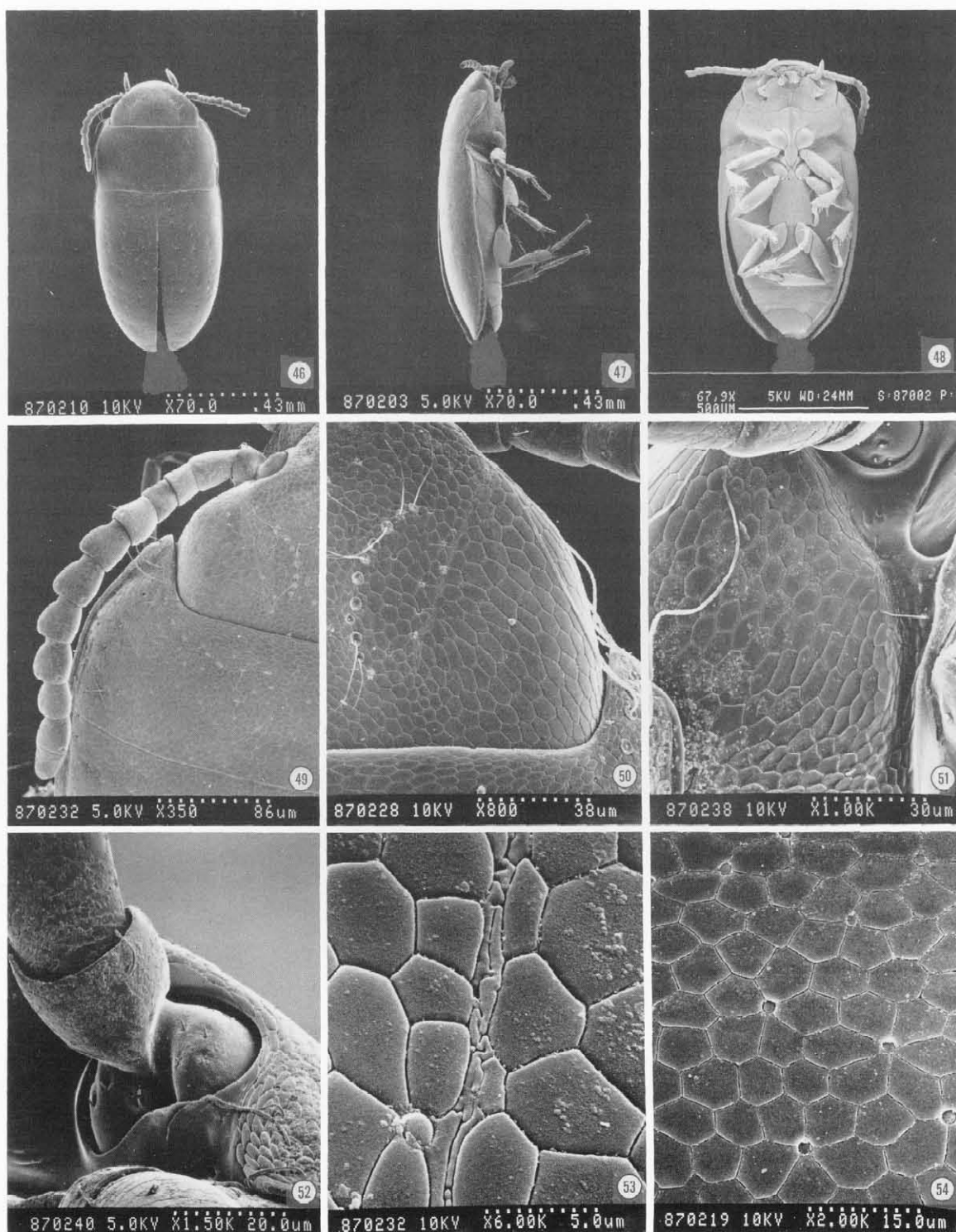
**Figures 19-27:** *Siamoporus deharvengi*, new genus, new species: 19, head, pronotum, and elytral base, x35; 20, head, prosternum, mesosternum, and metasternal base, x60; 21, head, prosternum, prosternal tooth and carinae, x60; 22, head and ocular area, lateral view, x130; 23, abdomen and metacoxal processes, x50; 24, abdomen, surface sculpture, x150; abdomen, surface sculpture and pores: 25, x500; 26, x600; 27, x3000.



Figures 28–38: *Siamoporus deharvengi*, new genus, new species: 28, habitus; 29, mandibles, dv; 30, labium, vv; 31, prosternal process, tooth and carinae; 32, proventricular tooth, lv; 33, proventriculus, split open; 34, maxilla, vv; 35, abdomen, showing area covered by pores; male genitalia: 36, median lobe, lv; 37, median lobe, vv; 38, paramere, lv. dv = dorsal view; lv = lateral view; vv = ventral view

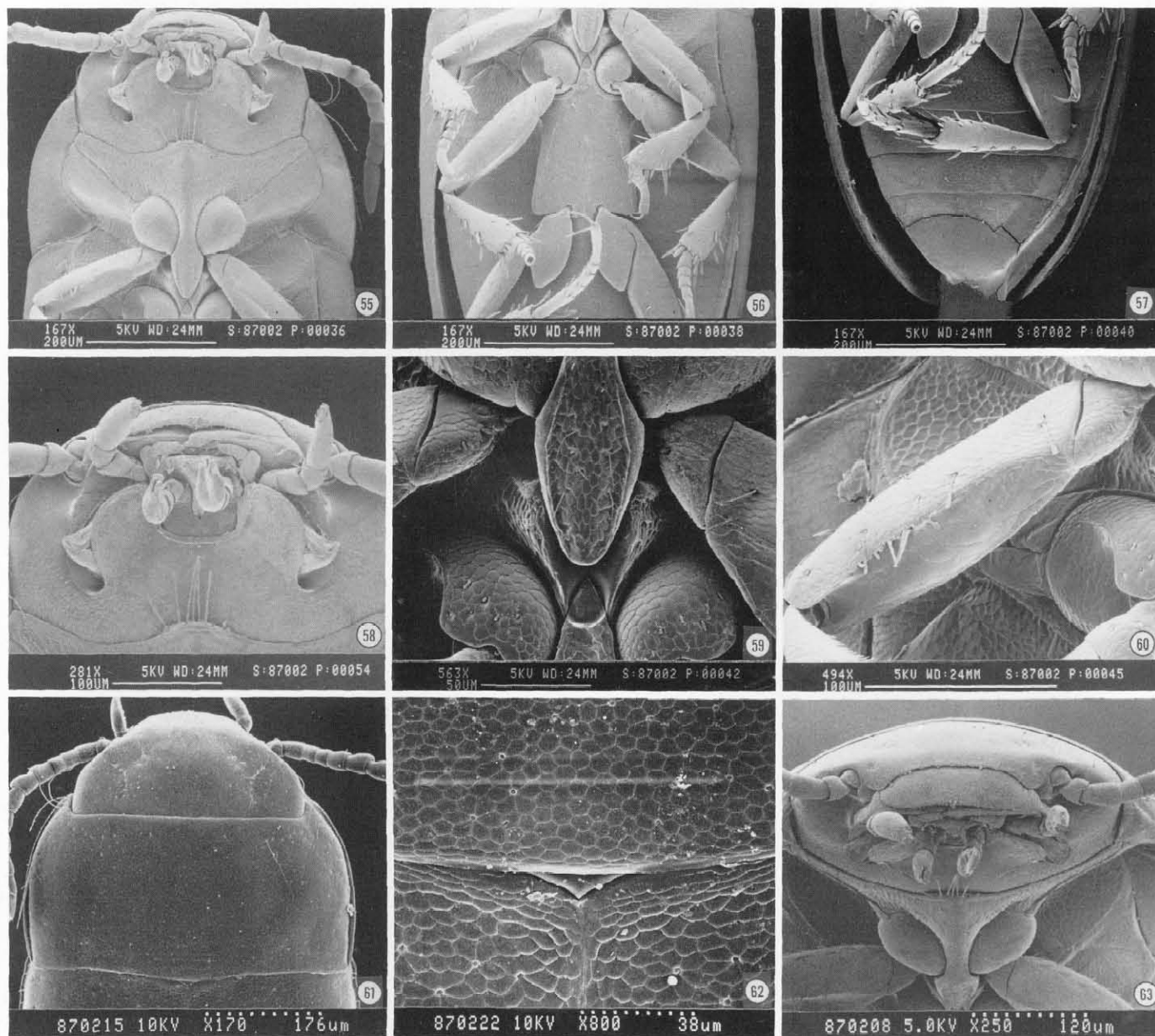


**Figures 39–45:** *Sinodytes hubbardi*, new genus, new species: 39, habitus, dv; 40, habitus, vv; 41, maxillary palpus, vv; 42, labial palpus, vv; 43, labial palpus, vv; 44, labium, vv; 45, prosternal process. dv = dorsal view; vv = ventral view

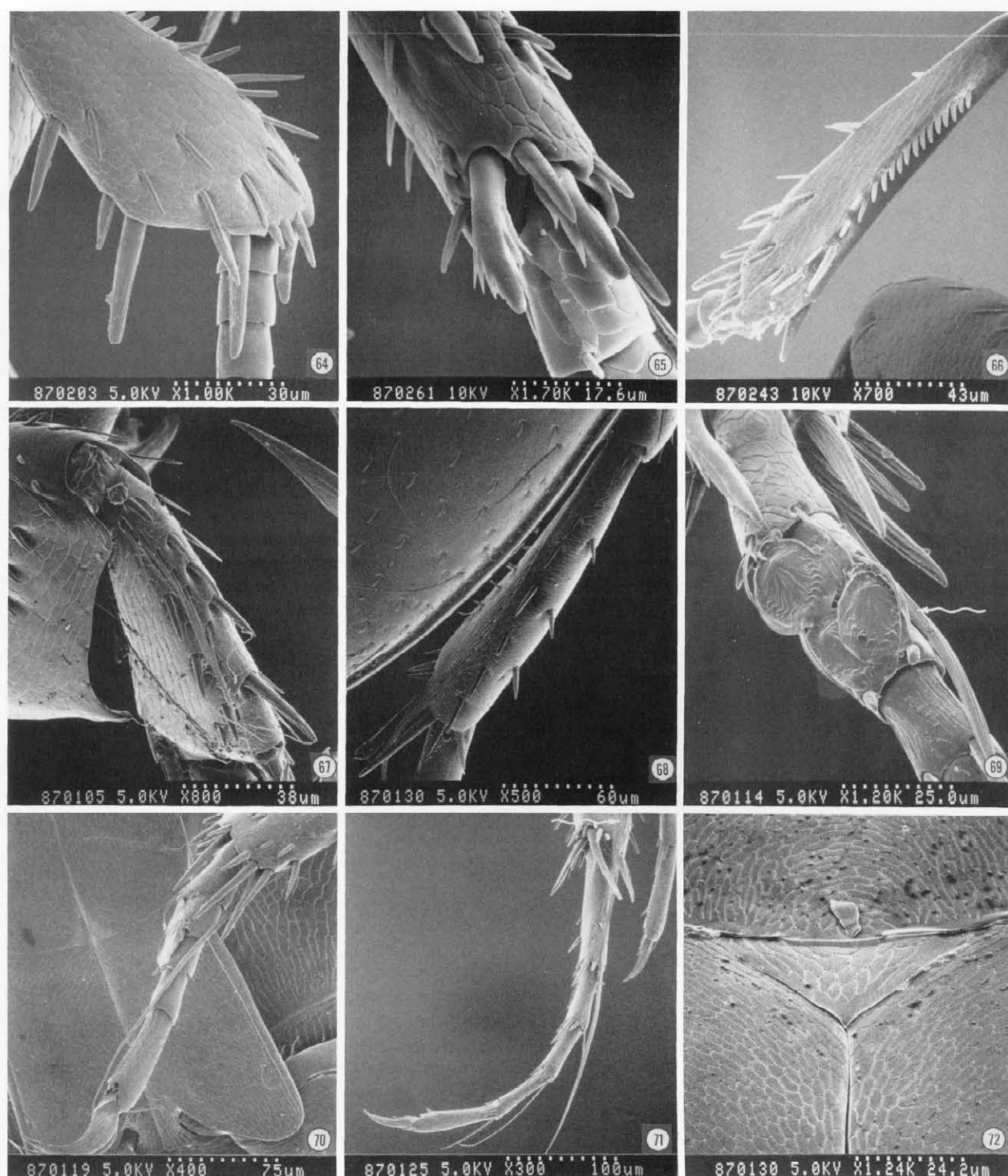


**Figures 46–54:** *Speonoterus bedosae*, new genus, new species: habitus: 46, dv, x70; 47, lv, x70; 48, vv, x67.9; 49, antenna and ocular area, dv, x350; 50, ocular area, dv, x800; 51, ocular area, lv, x1000; 52, antenna, basal segment, x1500; 53, ocular area (right), juncture with interocular area (left), x6000; 54, pronotal sculpture, x2000. dv = dorsal view; lv = lateral view; vv = ventral view

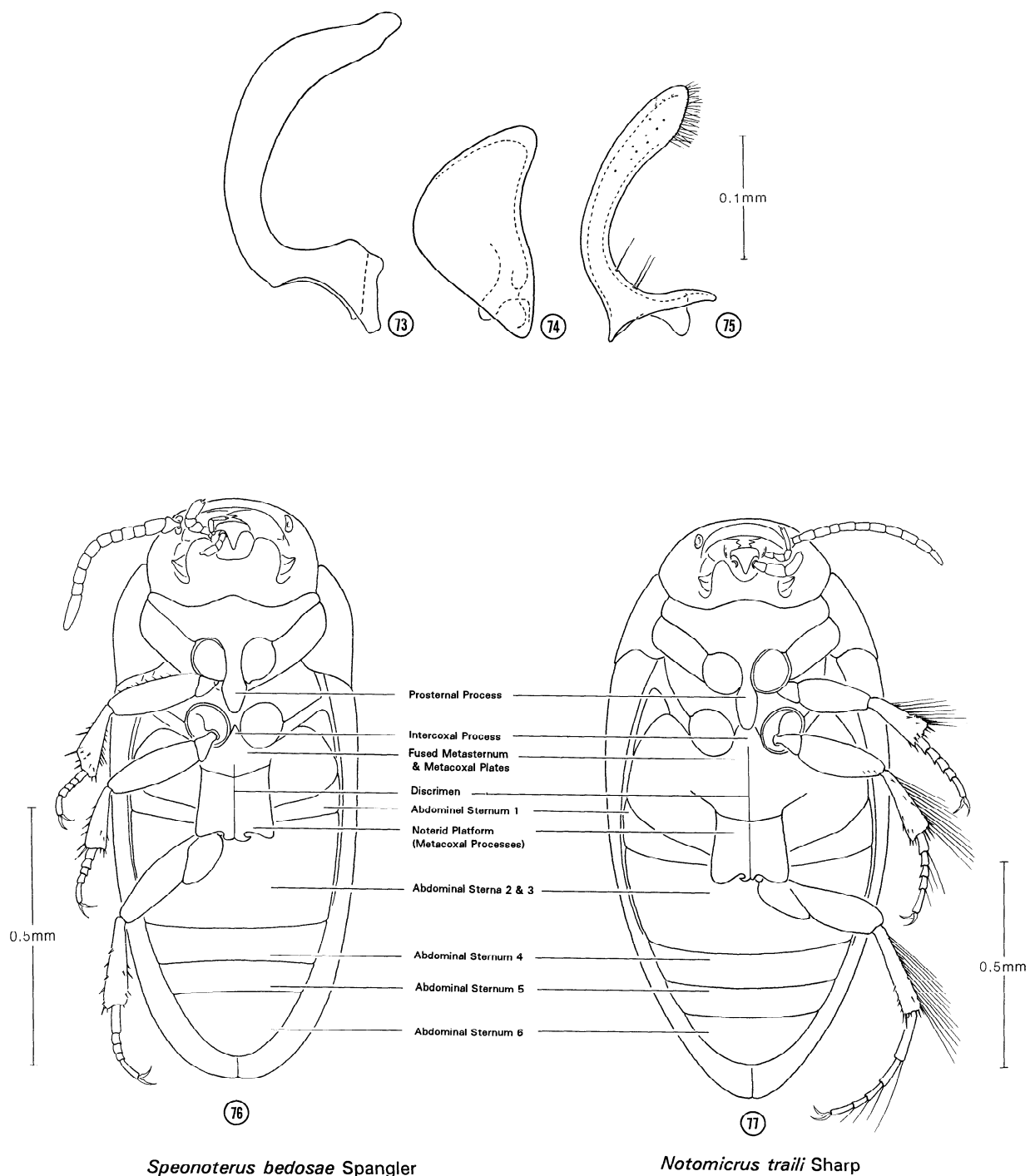




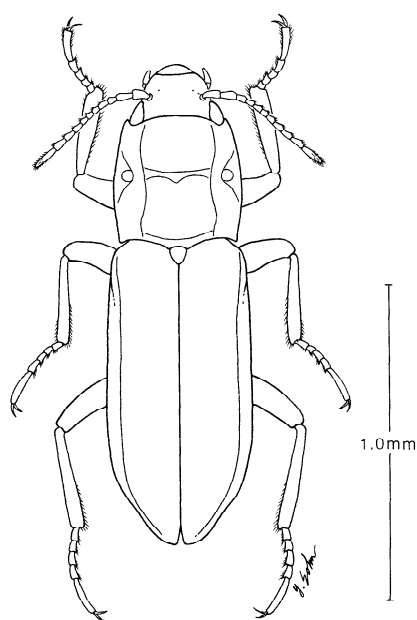
**Figures 55–63:** *Speonoterus bedosae*, new genus, new species: 55, head and prosternum, x167; 56, metasternum and noterid platform, x167; 57, abdomen, x167; 58, head and mouthparts, vv, x281; 59, prosternal process and intercoxal process of metasternum, x563; 60, profemur, ov, x494; 61, head, pronotum, and scutellum, x170; 62, scutellum, x800; 63, head and prosternum, ov, x250. dv = dorsal view; ov = oblique view; vv = ventral view



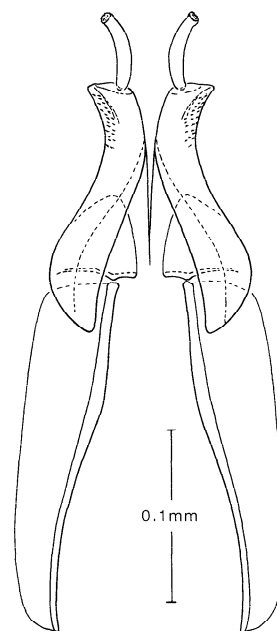
**Figures 64–66:** *Speonoterus bedosae*, new genus, new species: 64, protibial spurs, x1000; 65, mesotibial distal spurs, x1700; 66, protibial spurs, posterolateral surface, x700. **Figures 67–72:** *Notomicrus traili*, Sharp: 67, protibial natatory fringe, x800; 68, metatibial natatory fringe, x500; 69, mesotibial apex and natatory fringe (arrow), x1200; 70, mesotibial natatory fringe and mesotarsus, x400; 71, metatibial natatory fringe (arrow), x300; 72, scutellum, x1240.



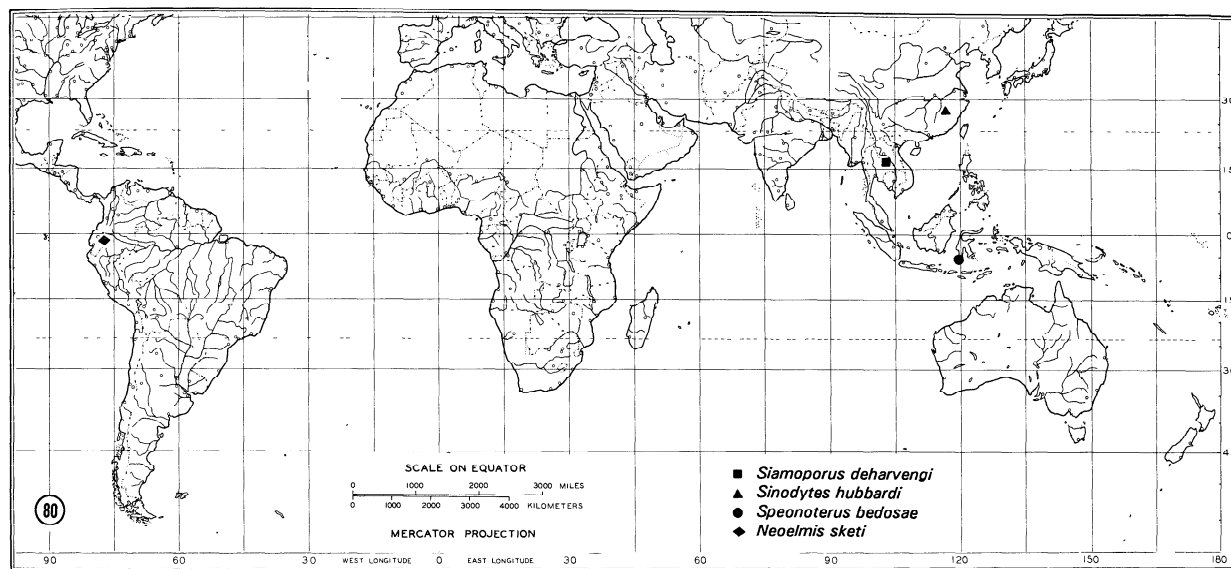
**Figures 73–77:** Figures 73–75: *Speonoterus bedosae*, new genus, new species, male genitalia: 73, median lobe, left aspect; 74, left paramere; 75, right paramere. Figures 76 and 77: Comparison of characteristics of venters: 76, *Speonoterus bedosae*, new genus, new species; 77, *Notomicrus traili* Sharp.



78



79



**Figures 78–80:** Figures 78 and 79: *Neelmis sketi*, new species: 78, habitus; 79, female genitalia. Figure 80: Type localities of the new stygobionts.