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SCALPELLONISCUS, A NEW GENUS FOR TWO SPECIES OF CRYPTONISCID ISOPODS (EPICARIDEA) PARASITIC ON ABYSSAL STALKED BARNACLES

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Abstract.—The genus *Scalpelloniscus* is proposed for 2 species of ectoparasitic cryptoniscid isopods from scalpellid barnacles. *S. penicillatus*, n. sp. infests various barnacles at about 4500 m near the Walvis Ridge in the South Atlantic. The male and immature female stages are described. The cryptoniscus larva of *Cyproniscus binoculis* Menzies and George, living on *Catherinum perlongum* in the Peru-Chile Trench, is redescribed and the species transferred to *Scalpelloniscus*. Attention is drawn to possible sequential sexual dimorphism in the "cryptoniscus larva" stage of cryptoniscid isopods, and it is suggested that future generic diagnoses in this family rely less upon host organisms, and more upon morphological details shared among species.

Introduction

Epicaridean isopods of the family Cryptoniscidae are parasitic upon a wide variety of marine crustaceans. They comprise 6 primarily host-defined subfamilies (sometimes considered families) and a large number of unassigned monotypic genera. The most recent reviews are those of Nielsen and Strömberg (1965, 1973, the former with an extensive bibliography), and many new species have been described since (e.g., Bourdon 1972; Grygier 1981; Menzies and George 1972; Schultz 1977).

These sequentially hermaphroditic isopods have complex life cycles involving up to 3 planktonic larval stages (Caullery 1908); the last of these, the cryptoniscus, seeks out the definitive host. With little or no morphological change, it matures to a protandric male. Internal organization may reflect a sex change soon thereafter, but, in any case, a catastrophic metamorphosis occurs in the molt to the adult female (e.g., Bocquet-Védrine and Bocquet 1972; Goudeau 1967, 1972a).

This paper presents, firstly, the description of a new cryptoniscid isopod parasitic on abyssal scalpellid barnacles from the South Atlantic. One specimen is a protandric male; 3 others appear to be transitional stages in the metamorphosis to the female and will be referred to as immature females throughout. Next is a redescription and reevaluation of *Cyproniscus binoculis* Menzies and George, discovered on a scalpellid barnacle in the Peru-

Chile Trench (Menzies and George 1972). Lastly, the affinities of these 2 species are discussed, and criteria for generic diagnoses in Cryptoniscidae are proposed.

Scalpelloniscus, new genus

Diagnosis.—Protandric males and immature females with body about 3 times longer than wide, widest at fifth pereonite. Basal article of first antenna with 8 posterior teeth. Eyes absent. Oral cone pointing anteriorly. Dactyli of first and second pereopods (gnathopods) not overextending palms of propodi. Third through seventh pairs of pereopods ambulatory; quadrate, distal end of propodus in third through fifth pairs with terminal lobe in notch toward medial side; propodi of sixth and seventh pairs tapering distally, dactyli relatively longer than in preceding pairs. Ambulopod ischia and pleopod protopodi with flanges. Uropod exopod cylindrical, at least half as long as conical endopod; endopod medial setation profuse, 6 dorsal setae proximally. Posterior pleotelson margin entire with rounded medial protrusion. Anal tube absent. Cuticular sculpturing pronounced. Mature females unknown.

Etymology.—From Scalpellidae, the family of barnacles these isopods infest, and Latin *oniscus*, woodlouse. Gender masculine.

Type-species.—*Scalpelloniscus penicillatus.*

Scalpelloniscus penicillatus, new species
Figs. 1–16

Methods and materials.—Host barnacles collected near Walvis Ridge in South Atlantic by the *Jean Charcot* during Campagne Walvis 1. Male and 1 immature female attached to same specimen of scalpellid barnacle (cf. *Arcoscalpellum* n. sp.) from St. CP06 (33°22.5′S, 2°35.9′E; 4550 m; 30 Dec. 1978). Two more immature females free in jar of preserved scalpellid barnacles (*Neoscalpellum*, *Mesoscalpellum*, and *Arcoscalpellum*; last not same species as above) from St. CP05 (33°22.8′S, 2°36.0′E or 33°26.2′S, 2°34.6′E; 4500 m; 30 Dec. 1978).

All specimens examined whole in lactic acid and measured (Table 1). One free immature female completely dissected, male partly dissected, parts mounted in Turtox CMC-10 with acid fuchsin or in glycerine jelly. Drawings done with aid of camera lucida.

Holotype.—Undissected immature female from CP05; allotype: male; paratypes: other 2 immature females. Holotype, allotype, 1 paratype (dissected) deposited in Muséum National d'Histoire Naturelle, Paris; other paratype in National Museum of Natural History, Washington, D.C. (USNM 184576).

Diagnosis.—Males and immature females 2.5–4 mm long, with unequal

Table 1.—*Scalpelloniscus penicillatus*, n. sp., sizes of specimens and relations to hosts.

Specimen—station	Length	Width	Relation to host
Immature ♀, holotype—CP05	4.00 mm	1.33 mm	Broken cirral setae in gnathopods
Immature ♀, paratype—CP05	4.2 mm*	1.45 mm*	Broken cirral setae in gnathopods
Immature ♀, paratype—CP06	2.83 mm	1.03 mm	Grasping cirral setae in gnathopods
♂, allotype—CP06	2.34 mm	0.90 mm	Attached to side of body by first antennae, oral cone, and gnathopods

* Extrapolated after dissection from sizes of large trunk pieces.

first antennal rami, nearly equally wide anterior and posterior ischial flanges on ambulopods, toothed coxal plates, no dorsal pores. Posterior genal flaps well developed in immature female, extending to middle of second pereonite; undeveloped in male. Sixth and seventh pereopods with distinctly shorter ischia and propodi than preceding pairs in immature female, but not male. Mature female unknown.

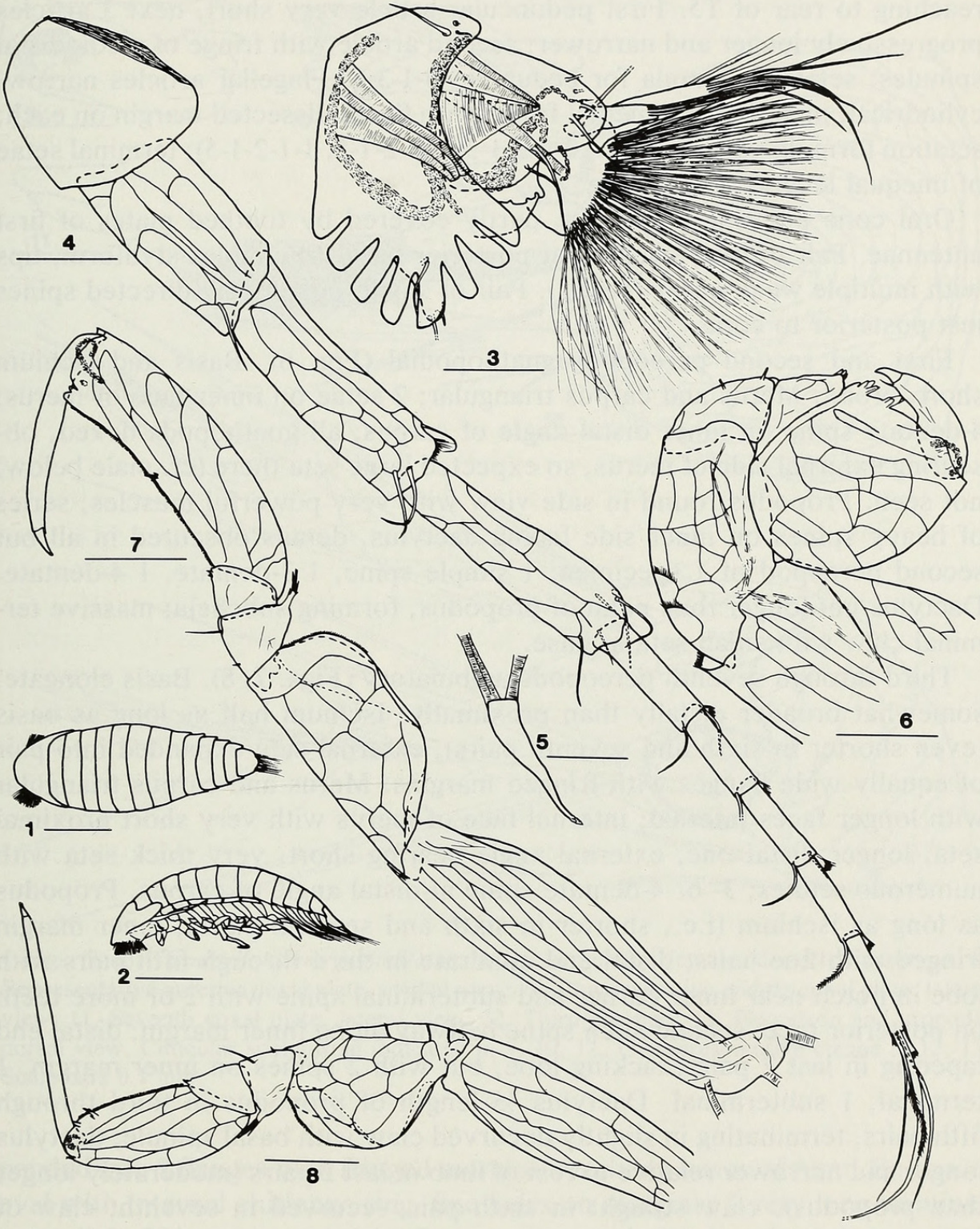
Etymology.—Specific name from Latin *penicillus,* a brush, referring to bundle of aesthetascs on first antennae of immature females.

Description of immature females.—Body fusiform, divided into cephalon (head and 1 fused thoracomere), 7 pereonites (T1–7), 5 pleonites, and pleotelson (Fig. 1); widest at T5. Body convexly lenticular in cross section, dorsal side more strongly curved; dorsum convex in side view, ventral side straight (Fig. 2). Anterior end of cephalon rounded, genal regions produced into pair of flaps reaching posteriorly to middle of T2. Eyes absent.

First antennae (Fig. 3) with 3-merous peduncle. First article plate-like, about twice as long as wide, concave laterally; posterior edge bluntly pointed, deeply incised forming 8 teeth; apical tooth (fifth from midline) bifid, longer, narrower part in plane of other teeth, other part dorsal to this plane; 2 setae arising in gap between parts of this tooth; 1 or 2 setae at its base on exposed face of article; 3 setae at anterolateral corner of exposed face, 1 long, 2 of medium length. Second article triangular, fitting into lateral concavity of first; 2 posterior setae on exposed face, 4 more near lateral apex. Third article short, bearing pair of 1-merous rami and large, ventrolateral bulb completely covered with brush-like bundle of capillary aesthetascs, lateralmost ones thicker than rest; single lateral seta on bulb; dorsal ramus twice as long as ventral, both tapering with terminal setae, 4 and 3 respectively.

First and second articles possibly articulating separately to cephalon (cf. Goudeau 1972b). Muscle in first article extending from articulation to lateral side; large muscle occupying much of second article attached to own articulation with cephalon, second muscle extending into aesthetasc bulb.

Second antennae (Fig. 4) with 4-merous peduncle and 5-merous flagellum



Figs. 1–8. *Scalpelloniscus penicillatus*, n. sp., immature females; 1–2, holotype; 3–8, dissected paratype. 1, Dorsal view of body; 2, Lateral view of body; 3, First antenna, exposed face; 4, Second antenna; 5, Mandible; 6, Second pereopod; 7, Fourth pereopod; 8, Seventh pereopod. Cuticular sculpturing indicated in 4, 6–8; representative ctenae in 6. Scale bars 10 mm in 1, 2; otherwise 0.1 mm.

reaching to rear of T5. First peduncular article very short, next 3 articles progressively longer and narrower; second article with fringe of mediodistal spinules; setation formula for peduncle: 0-1-3-5. Flagellar articles narrow, cylindrical; membranous medial fringe with finely dissected margin on each; setation formula variable (e.g., 2-1-2-1-3, 2-1-2-1-5, 1-1-2-1-5); terminal setae of unequal length, 1 very long.

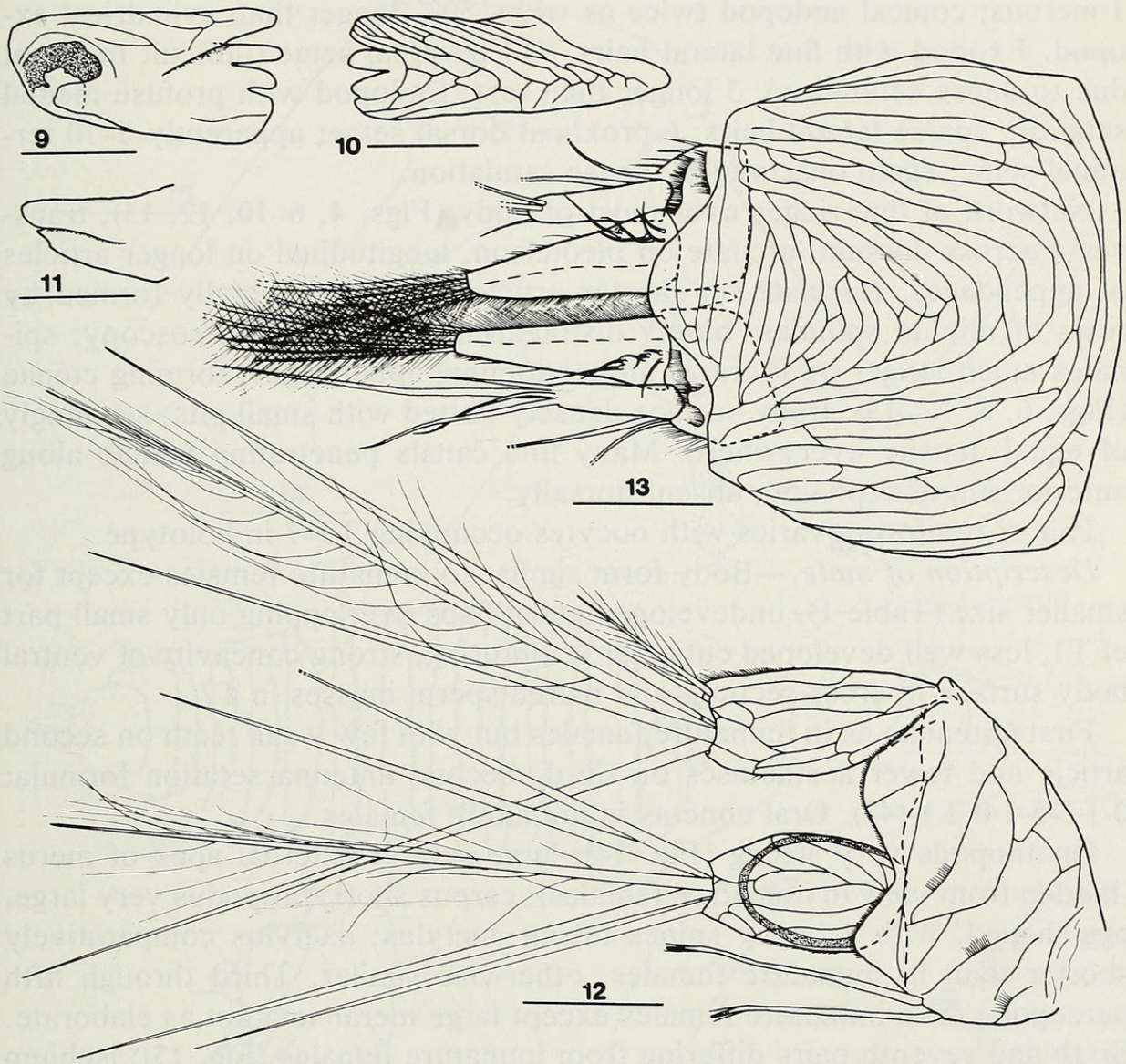
Oral cone pointing anteriorly, partly covered by toothed plates of first antennae. Pair of oval sclerites at posterior base. Mandibles styliform, tips with multiple weak barbs (Fig. 5). Pair of small, posteriorly directed spines just posterior to cone.

First and second pereopods gnathopodial (Fig. 6). Basis and ischium short, broad. Merus and carpus triangular; 2 setae on inner face of merus; 4-dentate spine on inner distal angle of carpus; all gnathopods flexed, obscuring external side of merus, so expected large seta there (cf. male below) not seen. Propodus round in side view with very powerful muscles; series of heavy spines on inner side facing dactylus, details obscured in all but second pereopod of 1 specimen: 1 simple spine, 1 3-dentate, 1 4-dentate. Dactylus not longer than palm of propodus, forming subchela; massive terminal claw with small seta at base.

Third through seventh pereopods ambulatory (Figs. 7, 8). Basis elongate, somewhat broader distally than proximally. Ischium half as long as basis (even shorter in sixth and seventh pairs), external side expanded into pair of equally wide flanges with fringed margins. Merus and carpus triangular with longer faces internal; internal face of merus with very short proximal seta, longer distal one, external angle bearing short, very thick seta with numerous setules; 3- or 4-dentate spine at distal angle of carpus. Propodus as long as ischium (i.e., shorter in sixth and seventh pairs); inner margin fringed with fine hairs; distal end quadrate in third through fifth pairs with lobe in notch near inner corner and subterminal spine with 2 or more teeth on posterior face, second such spine halfway along inner margin; distal end tapering in last 2 pairs, lacking lobe, but with 2 spines on inner margin, 1 terminal, 1 subterminal. Dactylus ⅔ length of propodus in third through fifth pairs, terminating in slightly decurved claw with basal spinule; dactylus longer and narrower relative to rest of limb in last 2 pairs (moderately longer than propodus), claw straight in sixth pair, recurved in seventh; claw of seventh lacking basal spinule.

Coxal plates of all 7 pereonites with rounded posterior teeth (Figs. 9–11); distalmost tooth widest, often with shoulder; tooth formula: 4-4-4-3-3-3-2.

Five pairs of almost identical pleopods (Fig. 12), second pair slightly larger than others, fifth markedly smaller. Protopod attached near midline of body, expanded laterally, almost twice as wide as long; 2 medial setae, distal one slightly longer than proximal, subterminal pair of fine, sharp setules on each, distal part of seta roughened; distal edge of protopod ex-



Figs. 9–13. *Scalpelloniscus penicillatus*, n. sp., immature female; dissected paratype. 9, Representative anterior coxal plate, medial view; 10, Representative middle coxal plate, lateral view; 11, Seventh coxal plate, lateral view; 12, Third pleopod; 13, Pleotelson and uropods, dorsal view. Cuticular sculpturing indicated in 9, 10, 12, 13; representative ctenae in 12, 13. Scale bars 0.1 mm.

panded into 2 flanges with fringed margins overlying bases of rami. Endopod oval with internal chitinous ring, fine hairs on margins; 5 very long terminal setae (3 in fifth pair), each with 2 rows of oppositely placed setules up to ¼ as long as seta. Exopods narrow basally, blade-like distally, lined with fine hairs; 5 terminal setae, medial 4 similar to those of endopod, lateralmost short, more densely setulose.

Pleotelson quadrate (Fig. 13); posterior margin entire, rounded with concave sides. Anal tube (Schultz 1980) absent.

Uropod (Fig. 13) protopod short, lined with fine hairs laterally and medially; 2 setae on laterodistal corner, medial one longer than lateral. Rami

1-merous; conical endopod twice as wide, 50% longer than cylindrical exopod. Exopod with fine lateral hairs, 4–7 terminal setae (difficult to count due to dense setulation), 3 longer than rest. Endopod with profuse medial setation, sparse lateral hairs; 6 proximal dorsal setae; apparently 6–10 terminal setae, again obscured by dense setulation.

Network of fine ridges over most of body (Figs. 4, 6–10, 12, 13), transverse across dorsum, arcuate on pleotelson, longitudinal on longer articles of appendages, tesselate on shorter articles. Ridges generally formed by rows of minute spinules, barely distinguishable by light microscopy; spinules much longer on thoracic and abdominal appendages, forming ctenae (Figs. 6, 8, 12, 13). Body surface densely dotted with small pits, seemingly of equal density everywhere. Many fine canals penetrating cuticle along anterior rim of cephalon, absent dorsally.

Pair of reniform ovaries with oocytes occupying T3–7 in holotype.

Description of male.—Body form similar to immature females except for smaller size (Table 1), undeveloped genal flaps overlapping only small part of T1, less well developed cuticular sculpturing, strong concavity of ventral body surface in cross-section, and paired sperm masses in T7.

First antennae as in immature females but with few weak teeth on second article and fewer aesthetascs on third. Second antenna setation formula: 0-1-3-5-1-0-2-1-(4?). Oral cone as in immature females.

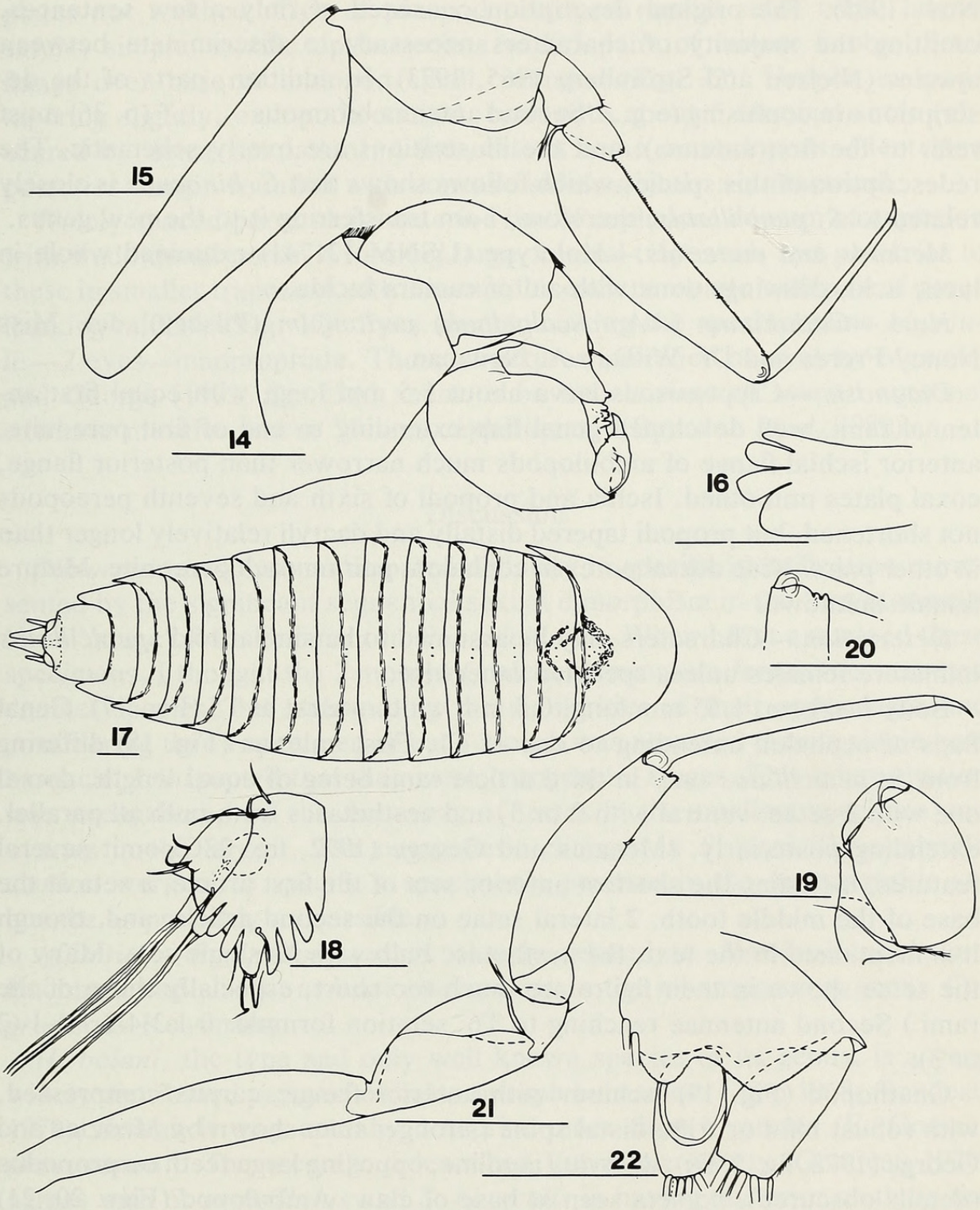
Gnathopods very strong (Fig. 14); large seta at external apex of merus (hidden from view in immature females); carpus short; propodus very large, egg-shaped, with 4 heavy spines facing dactylus; dactylus comparatively shorter than in immature females, otherwise similar. Third through fifth pereopods as in immature females except large meral seta not as elaborate. Sixth and seventh pairs differing from immature females (Fig. 15); ischium and propodus not shortened; propodus narrow distally, but relative positions of 2 spines not changed from other 3 pairs. Coxal plate tooth formula: 5-4-4-4-4-4-(2 or 3); teeth generally spatulate (Fig. 16).

Distal fringe on pleopod protopod clearly denticulate; short seta on exopod even shorter than in immature females. Pleotelson rear margin entire. Uropod endopod only 20% longer than exopod; terminal setal count of endopod and exopod 12 and 6 respectively; lateral setae on protopod lacking in mounted uropod, probably due to rough dissection.

Scalpelloniscus binoculis (Menzies and George), new combination
Figs. 17–22

Cyproniscus binoculis Menzies and George, 1972:36, fig. 23.

Notes.—The single known specimen of *C. binoculis* is a cryptoniscus larva attached externally to the capitulum of a scalpellid barnacle from the Peru-Chile Trench (*Anton Bruun* St. 169: 8°46′S, 80°44′W; 3909–3970 m; 2



Figs. 14–16. *Scalpelloniscus penicillatus*, n. sp., male; allotype. 14, Second pereopod; 15, Seventh pereopod; 16, Third coxal plate. Scale bars 0.1 mm.

Figs. 17–22. *Scalpelloniscus binoculis* (Menzies and George), cryptoniscus larva; holotype. 17, Dorsal view of body showing pores on cephalon and pereonites; 18, First antenna, exposed face; 19, Distal part of second pereopod; 20, Detail of propodus-dactylus articulation in fifth pereopod; 21, Seventh pereopod; 22, Third pleopod. Scale bars 0.1 mm.

Nov. 1965). The original description consisted of only a few sentences, omitting the majority of characters necessary to discriminate between species (Nielsen and Strömberg 1965, 1973). In addition, parts of the description are confusing (e.g., "Second antenna biramous . . . ," (p. 36) must refer to the first antenna), and the illustrations are overly schematic. The redescription of this species which follows shows that *C. binoculis* is closely related to *S. penicillatus*; therefore, I am transferring it to the new genus.

Methods and materials.—Holotype (USNM 121741) examined whole in lactic acid; drawings done with aid of camera lucida.

Host.—*Catherinum* (=*Arcoscalpellum*) *perlongum* (Pilsbry); det. Miss Nancy Freres and Dr. William A. Newman.

Diagnosis.—Cryptoniscus larva about 1.5 mm long, with equal first antennal rami, well developed genal flap extending to end of first pereonite, anterior ischial flange of ambulopods much narrower than posterior flange, coxal plates untoothed. Ischia and propodi of sixth and seventh pereopods not shortened, but propodi tapered distally and dactyli relatively longer than in other pairs. Nine dorsal pores in cephalon, pair on each pereonite. Mature female unknown.

Description.—Characters may be assumed to be similar to *S. penicillatus* immature females unless specified otherwise.

Body fusiform, 1.55 mm long, 0.5 mm wide, widest at T5 (Fig. 17). Genal flaps of cephalon extending to end of T1. First antenna (Fig. 18) differing from *S. penicillatus* only in third article rami being of equal length, dorsal one with 3 setae, ventral with 2 or 3, and aesthetascs from bulb all parallel, extending posteriorly. (Menzies and George (1972, fig. 23C) omit several features, including the shortest anterior seta of the first article, a seta at the base of the middle tooth, 2 lateral setae on the second article, and, though it is mentioned in the text, the aesthetasc bulb with its single seta. Many of the setae shown in their figure are much too short, especially those of the rami.) Second antennae reaching to T6; setation formula: 0-1-3-4-2-1-1-1-(2 or 3).

Gnathopod (Fig. 19) ischium with anterior flange; carpus compressed, with robust bifid or trifid distal spine (stronger than shown by Menzies and George (1972, fig. 23D)); dactylus aquiline, opposing large teeth on propodus (details obscured), no seta seen at base of claw. Ambulopod (Figs. 20, 21) ischia with posterior flange wider than anterior. Merus with single long seta medially, simple large seta on lateral angle. Carpus rounded with simple distal spine. Ischium and propodus not shortened in sixth and seventh pereopods. Propodus quadrate distally (Fig. 20), but more tapered and inner corner denticulate in sixth and seventh pairs; lobe present within notch as in *S. penicillatus*; 2 simple spines, 1 subterminal posteriorly, other slightly more than halfway distally along medial edge. Dactylus longer in last 2 pairs than in others (slightly longer than propodus), claw still decurved. Coxal

plates not toothed. Tips of pleopod protopod medial setae trifid, lateral setules simple, middle tip lanceolate with 5 pairs of minute knobs; distal flange over base of endopod small, rounded (Fig. 22). Uropod exopods tapering slightly, endopods conical, both with about 5 terminal setae (obscured by dense setulation); 4 fine, lateral setae on endopods. Pleotelson posterior margin rounded with concave sides, slightly asymmetrical.

Widely spaced pores along anterior rim of cephalon; dorsum of cephalon with 9 additional pores, 4 forming large, central trapezoid, rest posterior to these in smaller trapezoid with 1 in middle; each pereonite with pair of pores flanking midline (Fig. 17). Eyes absent, making the specific name *binoculis*—2 eyes—inappropriate. Those structures identified as eyes by Menzies and George (1972, fig. 23A) seem to be attachments of second antennal extrinsic muscles and/or "fentes céphaliques" (Bourdon *et al.* 1980).

Discussion

Dimorphism.—An unanticipated difficulty in specific identification is presented by the significant sequential sexual dimorphism in the "cryptoniscus larva" stage of development in *S. penicillatus*. When I first examined these specimens, I thought the 2 morphs (male and immature female) represented distinct species, but after noting the similarities of their appendages and considering that a specimen of each morph was removed from a single host barnacle, I suspected that they were ontogenetic stages. This interpretation was strengthened by the discovery of testes in the smallest specimen and ovaries in the largest. The ontogenetic changes in *S. penicillatus* should caution workers to specify a specimen's position in the metamorphic sequence as precisely as possible.

Affinities.—*Scalpelloniscus* is closely related to *Hemioniscus balani* Buchholz and also to at least one species in the inhomogenous genus *Cyproniscus* Kossmann.

H. balani, the type and only well known species of its genus, is a very widely distributed parasite of balanomorph barnacles (Crisp 1968; Goudeau 1970), though it may actually comprise more than 1 species (E. Gomez, pers. comm.). The recently redescribed European variety (Goudeau 1970) agrees with *S. penicillatus* and *S. binoculis* in having posterior teeth on the basal first antennal article, an anteriorly pointing oral cone, a characteristic pereopod facies, and an untoothed pleotelson margin. Many differences exist between the 2 genera, though. In *H. balani* the basal article of the first antenna has 7 sharp teeth. The second article is dentate, and the longer ramus has 2 aesthetascs not seen in *Scalpelloniscus*. Goudeau's description of a basal seta on one of the rami may be mistaken; this seta probably arises from the aesthetasc bulb as in *Scalpelloniscus*. The second antenna reaches only to T4 in *H. balani* and has more setae on the fourth article. The

gnathopod dactyli are armed with a scale not found in *Scalpelloniscus*. In the ambulopods the subterminal propodal spine is palmate, and the dactyli are fringed. The sharp teeth of the coxal plates agree in number with the male of *S. penicillatus* except for T1, which has 7. The pleotelson margin in *H. balani* is triangular, not rounded. This species also differs from *Scalpelloniscus* in having eyes and in not showing a marked sequential sexual dimorphism before metamorphosis.

Species of *Cyproniscus* also have posterior teeth on the first antennal basal articles and the coxal plates, but in other characters they differ considerably among themselves. The type-species, *C. cypridinae* (Sars), parasitic on an ostracod, is the most reminiscent of *Scalpelloniscus*. Close affinites of many of the other *Cyproniscus* species to *C. cypridinae* are doubtful, and they will not be considered here.

C. cypridinae resembles *Scalpelloniscus* in its oral cone, pereopods, coxal plates, and pleotelson (Sars 1899; Nielsen and Strömberg 1973). Significant differences include the first antennal basal article with its 6 teeth in one plane, the tips forming a straight line, and the coxal plate tooth formula: 4-4-5-5-5-4-4. *C. cypridinae* also has flanged bases on at least some pereopods and a squared-off cephalic margin with rounded corners.

Hemioniscus and *Cyproniscus* have been considered disparate enough to serve as type-genera for different families (Bonnier 1900), and are still placed in different subfamilies. That *Scalpelloniscus* seems fairly closely related to the type-species of these genera suggests that there is no strong morphological basis for such a distinction above the generic level.

Guidelines on generic diagnoses.—Modern systematic work on Cryptoniscidae has been hindered by the tendency of some early authors to establish new taxa based solely upon host organisms. This procedure resulted in numerous artificial groupings and discriminations. Even when morphological criteria alone have been employed, as has been the case for planktonic specimens with unknown hosts, generic assignments have been made either on the basis of a few general characters (e.g., Sars 1899; Hansen 1895, 1916; Menzies and George 1972) or by the establishment of numerous new genera (e.g., Schultz 1977).

The genus *Scalpelloniscus* deserves note because its 2 species are linked by very specific characters besides their common scalpellid hosts. The first antennae are almost identical in *S. penicillatus* and *S. binoculis*. Since the morphology of this appendage, particularly of its first article, is extremely diversified throughout the family (cf. examples in Schultz 1977), the identity of its structure in the present two species should offset doubts of their affinity engendered by the presence of toothed coxal plates in one species but not the other, or by differences in the setation of other appendages. The ambulopod propodi are also isomorphic in the two *Scalpelloniscus* species; however, pereopods have not generally been described in sufficient detail

to evaluate this identity as an indication of affiliation. Future revisions of Cryptoniscidae should include generic diagnoses incorporating a set of very precise characters, as has been possible for *Scalpelloniscus*. Such a procedure might upset classifications throughout the family, but would result in a more natural arrangement than the primarily host-based system now employed.

Acknowledgments

The scalpellid barnacles from which *Scalpelloniscus penicillatus* were removed had been sorted initially by the Centre National de Tri d'Océanographie Biologique and sent to Dr. William Newman (Scripps Institution of Oceanography) in whose laboratory I conducted this study. Dr. Thomas E. Bowman (USNM) lent me the holotype of *Cyproniscus binoculis*. Dr. Newman and Mr. George Wilson (S.I.O.) offered helpful suggestions during the course of the study and criticized the manuscript. This work, a Contribution of Scripps Institution of Oceanography, new series, was done during the tenure of an NSF Graduate Fellowship and partly supported by NSF Grant DEB78-15052.

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