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# *GORGONISCUS INCISODACTYLUS*, A NEW ISOPOD OF THE EPICARIDEAN SUPERFAMILY CRYPTONISCOIDEA, PARASITIC ON AN ASCOTHORACICAN CIRRIPED FROM HAWAII

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*Abstract.*—A description of a cryptoniscoid isopod, *Gorgoniscus incisodactylus*, n. gen. et sp., is presented. This is the first isopod parasite to be described from an ascothoracican cirriped and the first cryptoniscoid from Hawaii. The new species is compared to representatives of other cirriped-infesting cryptoniscoid families, but its familial status remains uncertain. The significance of the first antennae, mandibles, pleopodal chitinous rings, and uropod setation of the cryptoniscus larva, and the posterior structures, and cuticular spicules of the female is discussed. It is suggested that this isopod is a parasitic castrator or an egg parasite, and that observed high infestation rates (up to 67%) may affect the reproductive success of the host population.

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Cryptoniscoidea is a superfamily of epicaridean isopods, various members of which are parasites of peracarids, ostracods, cirripeds (thoracicans and rhizocephalans), and copepods (as larvae). They are protandric hermaphrodites, and have a complex life cycle usually involving 2 larval stages parasitic on copepods, the "cryptoniscus" larva which seeks out the definitive host, the protandric male indistinguishable from the cryptoniscus larva, and the female, derived by more or less catastrophic metamorphosis from the protander. The term "cryptoniscus larva" will be used herein to refer to either the larva or the protander, while the term "cryptoniscoid" will refer to the superfamily as a whole. The cryptoniscus larva is relatively unmodified; the female, however, is commonly simplified to a large brood sac, though sometimes part of the cryptoniscus larval externum is retained.

Two published reports exist of isopods parasitic upon ascothoracican cirripeds (Ascothoracica is a primitive group of crustaceans whose members are parasites of echinoderms and anthozoans). Newman (1974) mentioned in his description of *Synagoga sandersi* that a gravid female was host to an isopod occupying the space of an egg. The isopod was given to Newman's student, the late Larry Ritchie, for study; it has not yet been possible to locate the specimen, but Newman is certain that it was a cryptoniscoid (personal communication). Pyefinch (1939) reported the discovery of cryptoniscoid parasites from three species of the zoanthid-infesting ascotho-

racican *Baccalaureus*. These specimens have not yet been described, but they are to be included in the Isopoda volume of the John Murray Expedition Reports (Boxshall, personal communication).

Gorgonians (USNM Acc. no. 330459) were collected by the *Star II* submersible at a site off Makapuu Point, Oahu, Hawaii, at 366 meters depth on 27 January 1978. Galls from specimens of several paramuriceid genera presumably containing barnacles were sent to Scripps Institution of Oceanography for identification. These galls contained representatives of the cirriped order Ascothoracica, which have been identified as a new species of *Gorgonolaureus* Utinomi, 1962. A description of the ascothoracican is in preparation. Several apparently mature, but not gravid specimens of *Gorgonolaureus* contained cryptoniscoid isopods in the dorsal brood chamber formed by the fusion of the carapace valves. A *Placogorgia* with *Gorgonolaureus* galls was collected at a later date at the same locality, and was dried. Some of the ascothoracicans from this gorgonian were also infested with cryptoniscoid isopods, including 2 post-metamorphic females.

The families of Cryptoniscoidea have historically been delimited by their hosts. However, a revision of these isopods is in progress (Strömberg, personal communication), so I will not now consider a new family for the present species despite the novel taxonomic position of its host. Nonetheless, it will be compared to representatives of those cryptoniscoid families known to parasitize cirripeds: Liriopsidae on rhizocephalans and Hemioniscidae and Crinoniscinae (formerly Crinoniscidae, but incorporated into Liriopsidae by Bocquet-Védrine, 1974) on thoracicans.

Isopods were prepared for study as follows. Dried material was reconstituted overnight in a 10% trisodium phosphate solution. Most specimens were studied whole in lactic acid mounts, but 1 cryptoniscus larva and 1 female were dissected and the parts mounted in Turtox CMC-10 with acid fuchsin. Drawings were done by the author with the aid of a camera lucida.

## Order Isopoda Latreille, 1817
## Suborder Epicaridea Latreille, 1831
## Superfamily Cryptoniscoidea
## (nom. transl. herein pro Cryptoniscinae Bonnier, 1900)
## Family incertae sedis
## Genus *Gorgoniscus,* new genus

*Diagnosis.*—Cryptoniscoid isopod parasitic on ascothoracican cirriped *Gorgonolaureus*. Cryptoniscus larva about 0.8–1.0 mm long, fusiform. Eyes absent. Prominent transverse cuticular striations on dorsum of body. Basal segment of first antenna with 5 posterior teeth, lateralmost tooth with pronounced shoulder. Second antenna extending posteriorly to third free thoracic segment. Oral cone pointing anteriorly; mandibles styliform. Epimeral

plates of pereon longitudinally ridged, posterior margins entire. Dactyli of pereopods 6 and 7 longer and narrower than others, claws notched. Pleopods with typical setation, endopodites with 5 setae (3 on fifth pair), exopodites with 5, lateralmost one-third length of others; endopodites with chitinous ring. Uropod endopodites twice as long as exopodites; endopodite dorsal setae not necessarily numerically symmetrical. Telson margin entire.

Females about 4 mm long, ellipsoidal to round in dorsal view, dorsoventrally compressed with anterior and posterior ends curled ventrally. Most appendages absent. Mouthparts varying, either spatulate mandibles or median proboscis.

*Etymology.*—From a shortened form of *Gorgonolaureus,* the ascothoracican host of the present species and Latin oniscus (=wood louse). Gender masculine.

*Type-species.*—*Gorgoniscus incisodactylus,* new species.

*Gorgoniscus incisodactylus,* new species
Figs. 1–4

*Material.*—Holotype, cryptoniscus larva at U.S. National Museum of Natural History (USNM 181126); Paratypes: 2 cryptoniscus larvae (1 dissected and mounted, USNM 181127-8); 2 cryptoniscus larvae at Museum of Comparative Zoology, Harvard University; 1 cryptoniscus larva retained at Scripps Institution of Oceanography; 2 ♀♀ (1 dissected and mounted, USNM 181129-30).

*Type-locality.*—Off Makapuu Point, Oahu, Hawaii (21°18′N, 157°32′W) at 366 meters depth, collected by B. Bartko and K. Muzik in *Star II* submersible 27 January 1978.

*Distribution.*—Type-locality and nearby location 10 kilometers off Makapuu Point, where B. Bartko collected more specimens at 366 meters depth with *Star II* submersible in 1979.

*Host.*—Found within brood chamber formed by carapace of *Gorgonolaureus* sp. (Cirripedia: Ascothoracica) living in galls on paramuriceid gorgonians. See Table 1 for distribution of isopods on *Gorgonolaureus* and various gorgonians.

*Etymology.*—From Latin inciso (=to cut in) and Latin dactylus (=digit), referring to the notched claws of pereopods 6 and 7.

*Description.*—Characteristics of genus with following amplifications.

Cryptoniscus larva (Figs. 1–3): Dorsal profile (Fig. 1A) tapering narrowly posteriorly, more broadly anteriorly, cephalon bluntly pointed. Length (not including uropods) 0.84–1.00 mm (Holotype longest); maximum width (at midlength) 0.25–0.35 mm (Holotype widest). Cross section of body convex dorsally, flat ventrally, with slight ventral curvature of body longitudinally. Body (Fig. 1A, B) divided into cephalon with 2 pairs of antennae and oral

Table 1.—Distribution of *Gorgoniscus incisodactylus* on its host, the ascothoracican *Gorgonolaureus* sp., from various gorgonians. The *Placogorgia* was collected in 1979, the other three gorgonians in January 1978.

| Gorgonian | *Gorgonolaureus* | Isopods |
|---|---|---|
| *Paramuricea* or *Placogorgia* | 1 mature | 2 cryptoniscus larvae (including Holotype) |
| | 1 immature | none |
| | 1 probably immature | not examined |
| *Villogorgia* | 1 mature | none |
| | 1 mature | none |
| | 1 nearly mature | none |
| *Muriceides* | 1 mature | none |
| | 1 mature | none |
| | 1 mature | none |
| *Placogorgia* | 1 nearly mature | 1 cryptoniscus larva |
| | 1 mature | 3 cryptoniscus larvae |
| | 1 mature | 1 ♀ (first female) |
| | 1 mature | 1 ♀ (second female) |
| | | 1 cryptoniscus larva (lost) |
| | 1 immature | none |
| | 1 mature | none |

cone, 7 free thoracic segments, seventh longer than others, each bearing pair of pereopods, 6 abdominal segments with 5 pairs of pleopods and 1 pair of uropods, and telson. Anterior end of body dorso-ventrally striated (Fig. 1C). Color white to gray in preserved specimens.

First antenna (Fig. 1D) not extending past cephalon; peduncle triarticulate, distal segment bearing 2 rami. Basal segment large (0.11 mm long); medial spines absent; medial posterior teeth originating more proximally than lateral teeth; teeth simple except for lateralmost; this tooth with 1 short seta at base, 1 at shoulder, 1 just proximal to shoulder; ventral surface of first segment covered with cuticular plates (Fig. 1C); 3 setae near anterior end, longest one medial, shorter 2 of subequal length; single large spine on dorsal surface between bases of all teeth. Second segment cylindrical, smaller than "palm" of first, bearing 3 setae on lateral side ventrally, 2 long, 1 short; possibly another long seta on medial side; large spine on dorsal side overlapping lateral edge of first segment. Third segment very short, arising from dorsal side of second; bundle of 14 aesthetascs apparently arising from it; also 2 setae, 1 lateral, other medial. Terminal rami uniarticulate; dorsal one with 4 long terminal setae, 2 aesthetascs apparently arising from shoulder near base; ventral one with 2 terminal setae and single terminal spinule.

Second antenna originating beneath teeth of first antenna's basal segment;

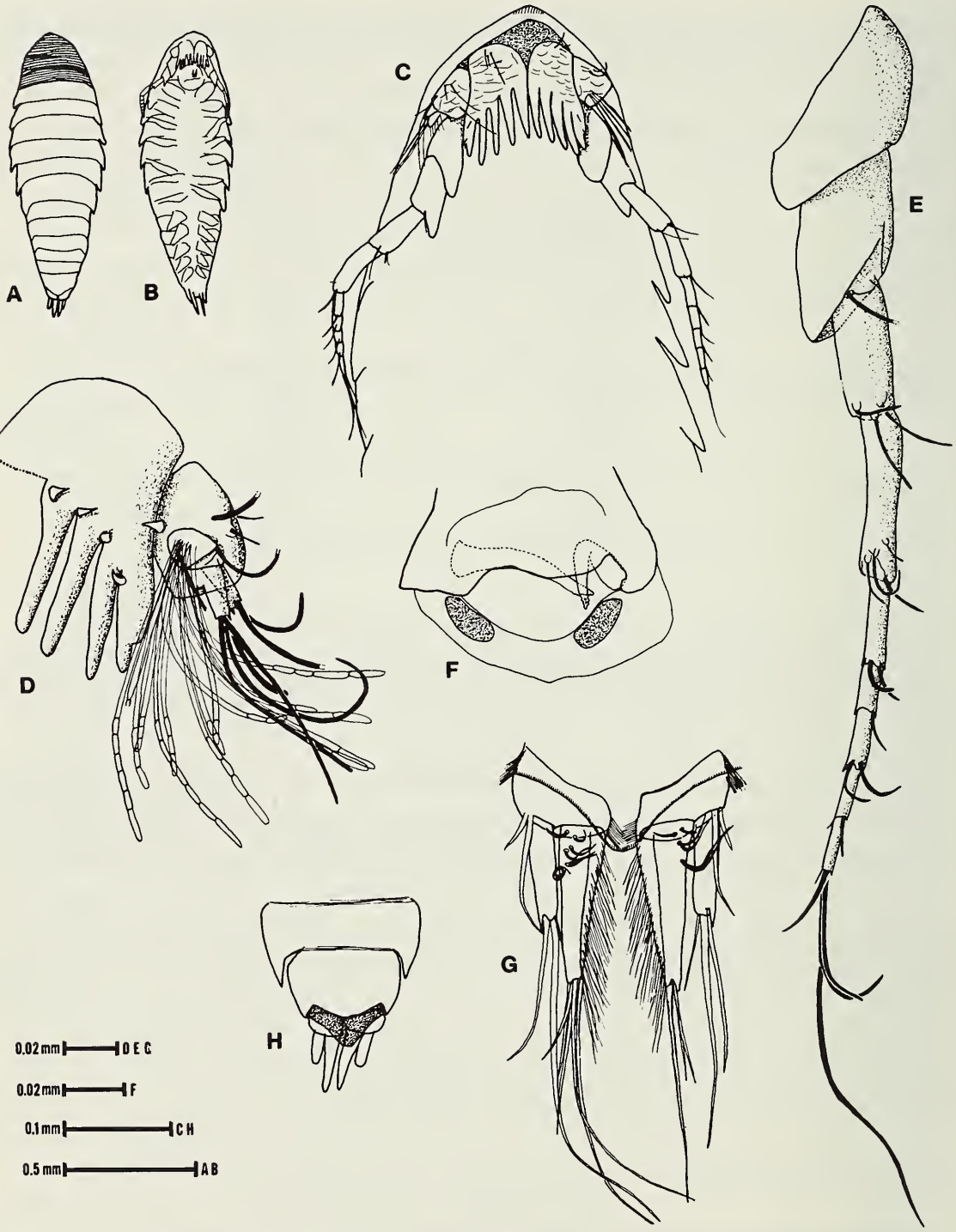


Fig. 1. Cryptoniscus larva of *Gorgoniscus incisodactylus*. A, Dorsal view of Holotype, cephalon and first free thoracic segment showing cuticular striation, uropod setae not shown; B, Ventral view of Holotype, bases only of pereopods and sympodites only of pleopods shown; C, Ventral view of cephalon showing positions of first and second antennae; D, Dorsal view of first antenna, medial posterior tooth missing, setae shown as solid, aesthetascs open; E, Second antenna, basal segment broken off proximally; F, Oral cone showing mandibles and posterior oval pieces (remnants of second maxillae); G, Dorsal view of uropods, hatched line near base representing posterior margin of telson; H, Dorsal view of abdominal segments 5 and 6, showing uropods without setae and telson (stippled).

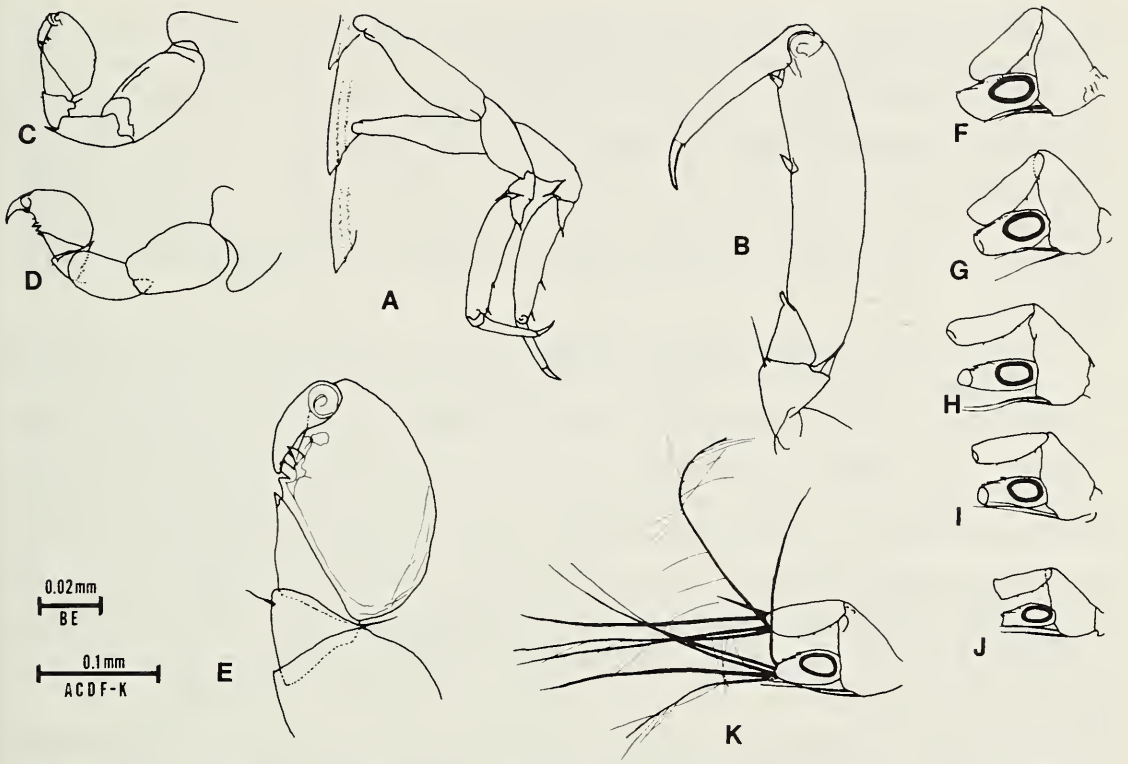


Fig. 2. Appendages of *Gorgoniscus incisodactylus* cryptoniscus larva. A, Pereopods 3 (above) and 4, showing relation to ridged epimeral plates; B, Detail of distal region of pereopod 5; C, Pereopod 1; D, Pereopod 2; E, Detail of pereopod 2 distal region; F–J, First through fifth pleopods showing size gradation and endopodite ring, terminal setae not shown; K, Typical pleopod showing terminal setation, not all setules shown.

4-segmented peduncle and 5-segmented flagellum, extending to third free thoracic segment (not including terminal setae). Setation apprently not consistent; description based on dissected specimen (Fig. 1E). First and second segments cylindrical with medial distal extension. No setae on first segment; 1 seta on second. Third segment cylindrical, same length as previous segments but half as wide, with 3 setae at tip. Fourth segment slightly narrower than third, bearing 4 setae. Flagellar segments cylindrical, distal ones narrower; first and third segments with 2 setae each; second and fourth with 1 each; 4 terminal setae on fifth segment, 3 quite long; lateral terminal spine on each flagellar segment, thinner and longer on distal segments.

Oral cone between bases of second antennae. Mouthparts (Fig. 1F) enclosed anteriorly by labrum, more or less exposed posteriorly near tip of cone. Mandibles arising at sides of cone's base, extending ventrally and bending slightly posteriorly; tip roughened with small knobs. Pair of oval plates at posterior base of cone probably representing second maxillae (Goudeau, 1969, 1977).

First 2 pairs of pereopods similar (Fig. 2C–E), with dactylus and propodus forming subchela. Basis cylindrical, twice as long (0.09 mm) as wide. Is-

chium two-thirds as long as basis, much narrower, bowed posteriorly. Merus triangular with large seta on lateral corner, small seta distally on medial side. Carpus an elongate triangle with stout spine distally. Propodus as long as ischium, attached firmly to long lateral side of carpus, with distal articulation of dactylus, latter modified as heavy claw. When closed, dactylus engaging 2 heavy spines on propodus, proximal one bifid, distal one trifid. Dactylus not opposing terminal spine of carpus, but gap between them small.

Five other pairs of pereopods similar to one another (Fig. 2A, B). Basis 0.12 mm long, narrow but clavate with expanded distal half. Ischium half as long as basis with lateral edge convex. Merus triangular with large seta on latero-distal angle and long, fine seta on medio-distal angle. Carpus also triangular with stout spine medio-distally. Propodus 0.1 mm long, slender, distal half bearing 2 stout spines (distal one bifid) opposing dactylus. Dactylus not forming subchela; long and narrow, tapering to slightly recurved claw at tip; small spine at base of claw more pronounced in posterior pairs. Pereopods 6 and 7 with dactyli 25% longer and more slender than those of other pairs (Fig. 3).

Five pairs of pleopods similar to one another, becoming gradually smaller posteriorly (Fig. 2F–J). Pleopods biramous, with sympodite, exopodite, and endopodite each uniarticulate. Sympodite triangular, about twice as wide as long, sharpest angle lateral; 2 setae on medio-distal apex. Endopodite rectangular, twice as long as wide, outline slightly convex; 3 short spines on lateral side; chitinous ring either on anterior surface or within. Exopodite slightly narrower and longer than endopodite, constricted basally with 3 spinules on medial side. Longer setae of each ramus (Fig. 2K) about 0.15 mm long; setules 0.04 mm long.

Uropods (Fig. 1G) biramous. Sympodite short, disc-shaped; 2 strong setae at latero-distal corner, medial one 3 times longer than lateral; lateral and medial sides of sympodite lined with fine hairs. Exopodites 0.04 mm long, cylindrical with short lateral spine, 2 long setae, and 1 shorter, narrow seta distally. Endopodite a tapering cylinder lined medially with fine hairs; few (3–5?) long and short terminal setae as long but weaker than those of exopodite; several short setae (6 on left, 8 on right of specimen examined for them) basally on dorsal side. Telson short (Fig. 1H), rear margin sinusoidal, medial part protruding posteriorly.

First female (Fig. 4A–C): Color in preserved state brownish-yellow. Slight left-right asymmetry (Fig. 4A, B), 4.55 mm long, 4.22 mm wide. About 10 segments visible dorsally, 3 short ones anteriorly, 7 large ones following. Bilobed labrum (Fig. 4C) 0.4 mm wide, nearly bisected by posterior incision; 3 translucent regions, 1 medial and pair lateral. Anteriorly directed proboscis 0.25 mm long, tapering distally. Two small papillae, possibly reduced mandibles or openings of maxillary glands, posterior and lateral to base of

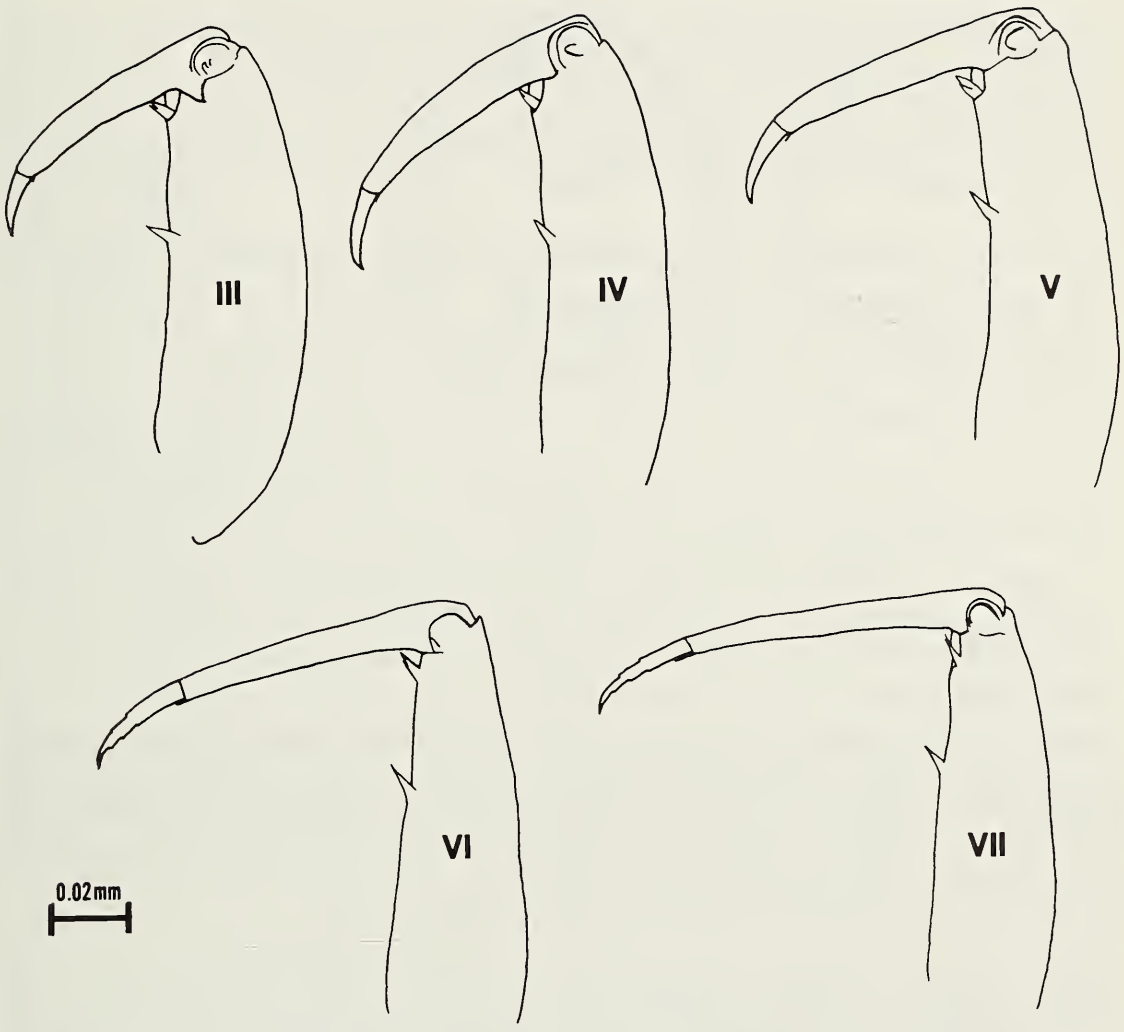


Fig. 3. Propodi and dactyli of pereopods 3–7 in cryptoniscus larva of *Gorgoniscus incisodactylus*, showing longer and narrower dactyli with notched claws in pereopods 6 and 7.

proboscis near posterior margin of labrum. Two featureless flaps of tissue just posterior to labrum. Other appendages absent. Telson not visible, though posterior end of body obscured by longitudinal folds in posteriormost segments (Fig. 4B). Eggs absent.

Second female (Fig. 4D, E): Color in preserved state dull yellow. About same size as first female, but more elongate. Anterior end squared off, hoodlike. Demarcations of few anterior segments visible, but most of body covered with fuzzy growth. Mouthparts near base of cephalic hood (Fig. 4D), consisting of anterior-pointing labrum and mandibles similar to those in cryptoniscus larva, but laterally flattened and relatively shorter with numerous small hooks on distal margins. Posterior conical structure (telson?) with distal depression (anus?) (Fig. 4E); uniarticulate structure at one side

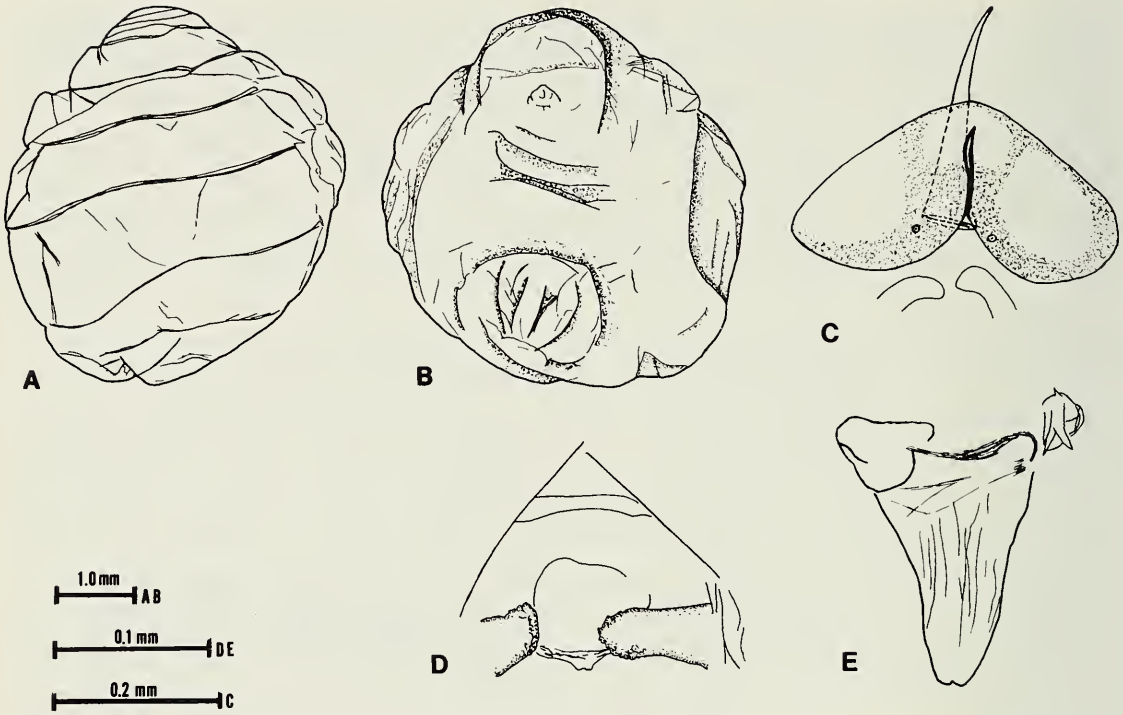


Fig. 4. Females of *Gorgoniscus incisodactylus*. A, Dorsal view of first female, anterior end above; B, Ventral view of first female showing oral region above, longitudinally folded posterior region below; C, mouthparts of first female showing labrum, proboscis, pair of papillae, and tissue flaps; D, Mouthparts of second female showing mandibles; E, Posterior body protrusion of second female with possible rudimentary uropod at base on right.

of base bearing 3 spines posteriorly, 1 anteriorly. Integument, where not fuzzy, studded with denticulate spicules in tight groups of 1–4. Eggs absent, large quantities of lipid or yolk present.

*Remarks*.—Nielsen and Strömberg (1965, 1973) have reviewed the families and genera within Cryptoniscoidea, and, in the latter paper, have listed pertinent diagnostic features of the cryptoniscus larvae for each family. It can be shown using these criteria and information from other authors that *Gorgoniscus* does not readily fit into any established genus or family of Cryptoniscoidea.

Liriopsidae (*sensu stricto*) have cryptoniscus larvae without dorsal cuticular ridges, with the posterior margin of the first antenna's basal segment entire, and with very short propodi on pereopods 6 and 7, conditions contrary to those in *Gorgoniscus*. The mature females in this family have their body divided into 2 parts connected by a thin waist, and the second pereopod is retained well into metamorphosis (Caullery, 1907). This description does not recall the characteristics of the present females.

Crinoniscinae have cryptoniscus larvae that differ from the present one only in having an entire posterior margin on the basal segment of the first

antenna. Two genera, *Crinoniscus* Pérez, 1900, and *Leponiscus* Gruvel, 1901, have adult females in which the body is a cruciform sac quite unlike *Gorgoniscus* (Bocquet-Védrine and Bocquet, 1972a, 1972b), while a transitional metamorphic form known in *Crinoniscus* and *Proteolepas* Darwin, 1854 retains the second pereopods as grasping organs (Bocquet-Védrine, 1972, 1979).

Among Hemioniscidae, only *Hemioniscus balani* Buchholz, 1866 is well enough known for comparison. The cryptoniscus larva of this species has recently been redescribed (Goudeau, 1970). Differences with the *Gorgoniscus* cryptoniscus larva include toothed posterior margins of the thoracic epimeral plates in *H. balani*; the latter also has more posterior teeth on the basal segment of the first antenna. The female retains the anterior portion (forward of fifth free thoracic segment) of the cryptoniscus larval body but expands the posterior part into a stellate sac during metamorphosis (Goudeau, 1967, 1977), producing a form dissimilar to *Gorgoniscus*.

The other cryptoniscoid families, Podasconidae, Asconiscidae, Cyproniscidae, and Cabiropsidae all parasitize hosts far removed from cirripeds and have many more differences distinguishing them from the present genus than have the families discussed above. Finally, according to the compilation of characters given in Nielsen and Strömberg (1973), the combination of a toothed first antennal basal segment and entire epimeral plate margins is unique to *Gorgoniscus*.

It is unlikely that *Gorgoniscus* can be synonymized with any known genus of cryptoniscoids. It is less certain whether a new family need be erected for it. Despite great differences in the morphology of the females, differences between the present genus and both Crinoniscinae and Hemioniscidae are minor in the cryptoniscus larval stage. Therefore, it may prove expedient to incorporate *Gorgoniscus* into one of these families. Until Strömberg's revision is published, it seems wisest to retain the genus separately, incertae sedis.

Goudeau (1972) showed that the first and second segments of the first antenna in the cryptoniscus larva of *H. balani* are independently articulated to the cephalon, independently movable, and not articulated with each other. She concluded that the second segment is the actual basal segment. The first segment (her "plaque aliforme"), once part of the first antenna, is now separated and partly fused to the body, a situation analogous to the transformation of pereopod coxae into epimeral plates. In my dissected specimen, the first antenna was removed in one piece. The first segment is evidently articulated to the cephalon near the base of the medial tooth, which was torn away, but there is no evidence of any articulation of the second segment directly to the cephalon. Having had no opportunity to observe live animals, I cannot say whether the segments are independently movable. If Goudeau's observations are correct, I agree that the "plaque aliforme"

must be derived from a first antennal segment; perhaps in *H. balani* a secondary attachment of the second segment has occurred. Such an arrangement does not seem to be present in *G. incisodactylus*.

Goudeau (1970, Fig. 9) shows rings in the pleopods of *H. balani* similar to those in *G. incisodactylus*, but she does not mention them in the text. References to these rings are made in the descriptions of certain other cryptoniscoids, but not all. This could be the result of the dearth of complete descriptions in this group, but Nielsen and Strömberg's otherwise exemplary description of the cryptoniscus larva of a cabiropsid (1965) includes no mention of these structures. The presence or absence of chitinous rings in the pleopods may be an unappreciated taxonomic character. I could not determine whether the rings are external features or internal. If external, they may be sucking discs for attachment to the host, but setae from anterior pleopods overlay posterior ones, presumably limiting the rings' utility for this purpose. If internal, they may serve as a kind of brace.

The styliform shape and roughened tips of the mandibles suggest that they are used both for piercing and trituration.

The asymmetry in the number of dorsal setae on the uropod endopodites is striking, for possession of 6 setae in this position has previously been considered a conservative feature of the superfamily (Nielsen and Strömberg, 1973).

The uniarticulate structure near the base of the posterior protrusion in the second female may be a rudimentary uropod. There is a scar opposite this structure which may show the location of the other uropod, ripped off during dissection. The cuticular spicules are similar to those described by Goudeau (1974) in *H. balani* females, though in the latter each spicule is rectangular in side view with a dentate distal margin. The fuzz covering much of the second female appears pathological, perhaps a fungal infestation; however, it is sticky, suggesting a secretion of the isopod, the ascothoracican, or the gorgonian.

The only *Gorgonolaureus* specimens infested were mature or nearly mature females without eggs (Table 1). Maturity was judged on the basis of comparisons with other, fecund, specimens. This fact suggests that the isopod is either a parasitic castrator or an egg parasite. The latter possibility is supported by the fact that isopods were never attached orally to their hosts, but could be removed with no difficulty from the brood chamber. There is a large difference in infestation rate between the 2 collection dates. As Table 1 shows, only 1 of 8 *Gorgonolaureus* specimens collected in 1978 was infested by *G. incisodactylus*, while 4 of 6 specimens collected from *Placogorgia* in 1979 were parasitized. Though the number of hosts examined is small, these data suggest that *G. incisodactylus* may at times have a large detrimental influence on the reproductive success of its host population.

The depth of collection (366 m) is greater than usual for cryptoniscoids, but other such instances have been reported; e.g., an undescribed deep-sea ostracod parasite (Nielsen and Strömberg, 1973) and the parasite from *Synagoga sandersi,* which was collected at 5000 m (Newman, 1974). Finally, *G. incisodactylus* is the first cryptoniscoid isopod recorded from Hawaii.

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Note added in proof: The various gorgonians listed in Table 1 represent a single undescribed species of *Placogorgia* (K. Muzik, pers. comm.). Nierstrasz and Brender à Brandis (1930, Proc. U.S. Natn. Mus. 77(9):1–9) described a supposed cryptoniscoid, *Faba glabra,* from a shrimp collected near Waikiki, Oahu, so *G. incisodactylus* may not be the first of this superfamily from Hawaii, as stated above.