

SYSTEMATICS AND DISTRIBUTION OF THE BATHYAL-ABYSSAL GENUS MESOSIGNUM (CRUSTACEA: ISOPODA)¹

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Abstract. A characterization of the genus *Mesosignum* Menzies, 1962, including a discussion of its affinities to other taxa of Paraselloidea, is the subject of this paper. Descriptions and diagnoses of the 5 known species (*M. kohleri*, *M. usheri*, *M. elegantulum*, *M. brevispinis*, and *M. vitjazi*) and 6 new species (*M. multidentis*, *M. magnadens*, *M. admirandum*, *M. ansatum*, *M. macrum*, and *M. asperum*) are included. A key to these species is provided. The depth and geographical distribution of each species are recorded. Morphological information has been summarized and is discussed in relation to depth and geographic data to determine the possible relationships of the species within the genus. The evidence leads to the conclusion, admittedly tentative, that speciation in *Mesosignum* is exceedingly slow, exceeding 11 million years.

INTRODUCTION

This study was suggested by collections made from the USNS *Eltanin* during its cruise to Antarctica in 1961. The specimens were in part sorted on board ship and further sorted, then studied at Duke University Marine Laboratory, Beaufort, North Carolina.

In most instances the character of the bottom is not available. Samples from the Pacific generally involve green ooze, and those from the deep Caribbean, red clay.

The following abbreviations appear in the text: AMNH, American Museum of Natural History, New York; USC, University of Southern California, Los Angeles; USNS *Eltanin*, United States Naval Ship *Eltanin*; V, R/V *Vema*, Research Vessel *Vema*, Lamont Geological Observatory, Columbia University, New York.

All USC stations referred to in this paper were made by the USNS *Eltanin* during cruises 3 and 5, 1962.

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SYSTEMATIC DISCUSSION

Genus *Mesosignum* Menzies, 1962³

Mesosignum Menzies, 1962a, pp. 184-185.—Wolff, 1962, pp. 63-64.—Birstein, 1963a, pp. 52-57.

Type-species: Mesosignum kohleri Menzies, 1962a.

Generic diagnosis: Cephalon subquadrate, without lateral expansions, eyeless. Peraeon composed of seven somites, first somite markedly shorter than others; somites 2-6 with one or more lateral expansions; somite 1 lacking lateral expansions; somite 7 with or without lateral expansions. Pleon consists of a single somite, with or without lateral expansions, anus outside of branchial chamber. First antenna longer than cephalon, flagellum multiarticulate. Second antenna about as long as peraeon, flagellum multiarticulate but shorter than last peduncular article; antennal scale lacking. All peraeopods very similar in struc-

³ Because we have not been able to place this genus within an existing family, we have provided a detailed description of the genus and have illustrated (Fig. 1) most of the generic characteristics. Many of the features included in the generic diagnosis probably would be more appropriate to a familial description, and consequently the generic diagnosis might be considerably reduced, once a familial assignment of the genus can be made.

ture, increasing in length from first to seventh, with first slightly more than $\frac{1}{2}$ the length of seventh. Dactyl of all pereopods provided with 2 terminal claws, superior claw larger than inferior claw. Uropods 2-jointed, uniramous; insertion ventrolateral. First pleopod of male with tapering sympods, apex simple without lateral expansions. Second pleopod of female broadly ovate with stout setae at apex. Male second pleopod with large curved, but uncoiled, superior ramus which equals the length of the exopod, inferior ramus bulbous and setiferous. Third pleopod biramous, endopod biarticulate, fleshy with plumose setae; exopod narrower than endopod, not fleshy, without plumose setae. Fourth pleopods biramous; each ramus biarticulate with distal articles longer than proximal articles, subequal in length; exopod narrow with pointed apex bearing single plumose seta; endopod quadrate, fleshy, lacking plumose setae. Fifth pleopods biramous, consisting of a single article, fleshy ovoid and devoid of plumose setae; broader than pleopods three and four. Mandible elongate, much longer than wide; molar tapering to a point, setiferous; palp as long as mandible, triarticulate with second article the longest, with lacinia, setal row, and toothed incisor present. Maxilliped with epipod extending beyond second article of palp and as wide as sympod; palp pentarticulate, all articles narrow and tapering and $\frac{1}{2}$ - $\frac{1}{3}$ the width of endite, apex of endite with only 2 short stout setae. First maxilla bilobed; outer lobe with 13 stout setae on apex; inner lobe lacks stout setae. Second maxilla trilobed, endite with 6 stout setae on apex, bilobed exopod has 4 stout setae at apex of each lobe. Genital apophyses paired, pointed, longer than wide, arising from posterior border of seventh pereopodal somite and projecting under anterior border of male first pleopods. Midventral tubercle present on males, located midventrally on seventh pereopodal somite.

Affinities within the Paraselloidea

The genus *Mesosignum* was first described by *Menzies* [1962a], who did not assign it to a family. *Wolff* [1962] also was uncertain of the affinities of the genus and in his discussion of it he included a tabular comparison of *Mesosignum* and the genera *Dentrotion*, *Acanthomunna*, *Dendromunna*, *Munella*, *Pleurocope*, *Antias*, *Kuphomunna*, *Abyssianira*, *Urias*, *Haplo-munna*, and *Mesosignum* [*Wolff*, 1962, table 4]. The last 3 genera *Wolff* assigned to *Incertae sedis*, the first 4 genera to *Dendrotionidae*, and the remaining 3 genera to *Antiasidae*. *Wolff* [1962, p. 63] said that

the first pereopod of *Mesosignum* was neither described nor figured; however, *Menzies* [1962a, Fig. 64F] figured it and described all the other pereopods as ambulatory [*Menzies*, 1962a, p. 184]. Even though the illustration of *Menzies* showed 2 claws, *Wolff* stated that the claw was single. Two claws have been demonstrated in all pereopods of all the species of *Mesosignum* that we have examined. Additional corrections to *Wolff's* table are needed to represent *Mesosignum* truly. The uropoda have 2 rather than 1 joint, and the outline of the apex of the maxillipedal epipod is rounded (when viewed laterally) or pointed (when viewed frontally).

Even with the corrections of *Wolff's* description, however, assignment to a family remains a problem for the genus. *Wolff* [1962, pp. 61-62] reduced *Pleurogoniini* of *Nordenstam* [1933] to a synonym of his all-embracing *Munnidae*. The broad concept of *Munnidae*, a family containing the 11 genera *Austrosignum*, *Munna*, *Echinomunna*, *Coulmannia*, *Paramunna*, *Notoxenus*, *Notoxenoides*, *Astrurus*, *Pleurogonium*, *Antennulosignum*, and *Pleurosignum*, is subject to serious question. *Birstein* [1963a] also placed *Mesosignum* in the *Munnidae*, but he considered it in the subfamily *Pleurogoniinae* (= *Pleurogoniini* *Nordenstam*).

As *Nordenstam* [1933] and *Menzies* [1962b] have shown, the taxa related to *Pleurogoniini* (*Pleurogoniini* [*Nordenstam*, 1933]; *Pleurogonidae* [*Menzies* 1962b]; *Pleurogoniini* [*Wolff*, 1962]) form a natural unit of isopods, united by similar mandibular, maxillipedal, and pleopodal structure. The mandibular molar process is pointed in all the species rather than broad and truncate. Articles 1 to 3 of the maxillipedal palp are as broad as the endite (except in *Antennulosignum*). The sympod of the male first pleopoda is broadly triangulate, never attenuate, and the second male pleopoda have a broad rather than attenuate exopod. Other common characteristics are that all uropoda⁴ are biramous, leaflike, and dorsolaterally inserted in the pleon. The pleon is composed of 2 distinct somites, a narrow first pleonite and a bulbous pleotelson.

The only genus listed by *Wolff* [1962, pl. 4, p. 64] with the articles of the maxillipedal palp broader than the endite is *Abyssianira*; its placement by *Wolff* in *Antiasidae* is subject to question. In *Abyssianira* the uropodal peduncle is minute, not stout and long as in

⁴ The possibility that the uropoda are provided with a short peduncle as illustrated for *Pleurogonium* [*Sars*, *G. O.*, 1898, pl. 48, fig. 1-2] requires restudy.

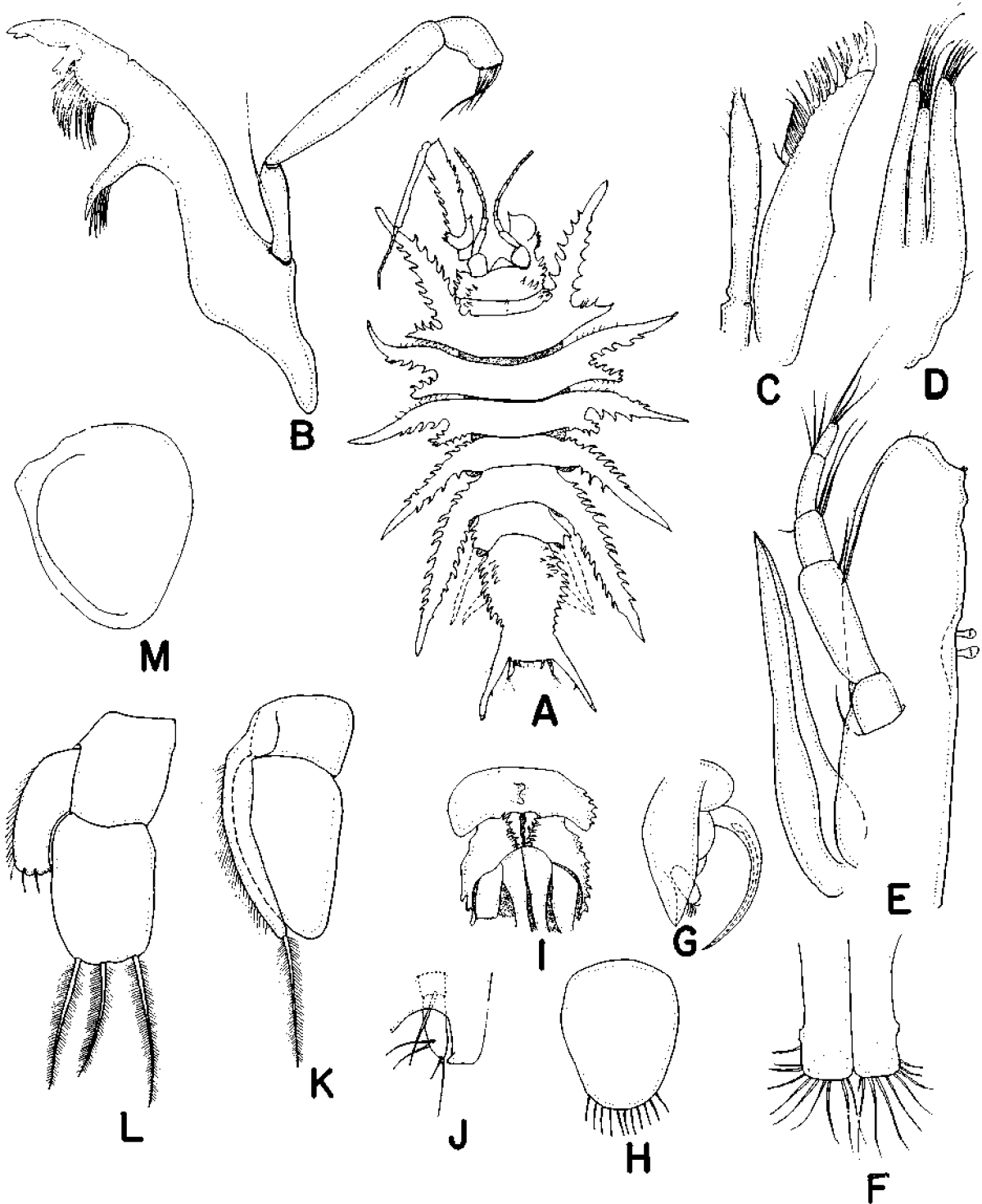


Fig. 1. Generic features of *Mesosignum* (drawings are from *M. multidentis*, new species, except F and I, which are from the male holotype of *M. usheri* Menzies, 1962). A, dorsal view (dotted lines indicate structures which vary within the genus); B, mandible; C, first maxilla; D, second maxilla; E, maxilliped; F, apex of first male pleopod; G, second male pleopod; H, female operculum; I, seventh pereopod, penes, and pleotelson, ventral view; J, uropod; K, third pleopod; L, fourth pleopod; M, fifth pleopod.

Antias, and the first and second male pleopoda are broadly triangulate like those of *Pleurogonium* (see Pleurogoniidae [Menzies, 1962b]) and are not attenuate as in *Antias*. It thus appears that *Abyssianira* should not be in Antiasidae nor even in the broadly defined Munnidae of Wolff.

It appears that *Mesosignum* can best be compared with *Ianirella* (Ianirellidae) and *Schistosoma* (Schistosomidae).

The small biarticulate uropoda of *Mesosignum* link it to *Ianirella* and *Schistosoma*. In *Schistosoma* and *Mesosignum* all peraeopods are ambulatory, but they are not in *Ianirella*. All 3 genera have lateral expansions on the peraeonal somites. Both *Schistosoma* and *Mesosignum* have elongated penes, structures which are probably unique to these 2 genera of the Paraselloidea. The penes may or may not be present in *Ianirella*. The first 3 articles of the maxillipedal palp of *Ianirella* and *Schistosoma* are as broad as the endite; all 5 articles are narrow in *Mesosignum*. The first, second, and third male pleopods are similar in *Mesosignum* and in *Ianirella*; the respective pleopods of *Mesosignum* and *Schistosoma* are very similar. The anus opens within the branchial chamber of *Schistosoma* and *Ianirella* but clearly opens to the outside of that chamber in *Mesosignum*. The mandibular molar process is blunt in *Ianirella* and *Schistosoma*. It is pointed in *Mesosignum*.

Wolff [1962] reduced Ianirellidae of Menzies to one of the many synonyms of the broadly defined Janiridae. Wolff [1962] also combined many genera under a broadened concept of the Munnidae. The reassignment of genera considered by other authors as belonging to several families to the Janiridae is comparable to his expansion of the definition of the Munnidae to include so many genera. Yet Wolff retained Hansen's Schistosomidae as an independent family. As can be seen from the foregoing discussion, *Ianirella* and *Schistosoma* are allied strongly in a number of important characteristics. Surely they are as close to each other as *Pleurogonium* is to *Munna*. Inconsistencies such as these make the use of the current classification of the Paraselloidea most difficult. Added to this, however, is the problem that much basic information is lacking regarding the characteristics of most genera and species of Paraselloidea. Of the 24 families examined we have found no information concerning the fourth pair of pleopoda in 18 families. The fifth pair of pleopoda have been described in only 3 families.

The complex problem of Paraselloidea classification

will not be resolved here, but we have looked at *Mesosignum* and the parasellioid genera in order to place it in a better position among its related genera. *Mesosignum* cannot be placed in an existing family without severe alteration of family diagnoses to the point that the present confusion will be compounded. The most conservative course would probably be the creation of a new family for *Mesosignum* but we will not create a new family at this time.

The Species of *Mesosignum*

We have found it possible to divide the genus *Mesosignum* into 2 reasonably distinct groups which may or may not represent distinct genera or even subgenera: *Group A*, represented by species having a pair of lateral projections at margin of the pleotelson; and *Group B*, represented by species having the lateral margin of the pleotelson entire, without a pair of projections. The posterolateral angles of the pleotelson bear a projection.

KEY TO THE SPECIES OF *MESOSIGNUM*

1. With a pair of lateral projections on pleotelson (Group A) 2
- Without a pair of lateral projections on pleotelson (Group B) 7
2. Seventh peraeonal somite with lateral expansions $\frac{1}{2}$ as long as pleotelson 3
- Seventh peraeonal somite with lateral expansions minute or absent 4
3. Fourth peraeonal somite, with 2 lateral expansions, and second peraeonal somite with 2 subequal lateral expansions *multidens*, p. 117
- Fourth peraeonal somite with single lateral expansion; second peraeonal somite with anterior lateral expansion much longer (approximately 5x) than posterior one *elegantulum*, p. 117
4. Posterolateral projections of pleotelson apex minute, uropoda extending to apex of projections 5
- Posterolateral projections of pleotelson apex well developed; about $\frac{1}{5}$ th the length of pleotelson *magnadens*, p. 117
5. Pleotelson (minus lateral expansions) is as long as wide *brevispinis*, p. 121
- Pleotelson (minus lateral expansions) twice as long as wide 6
6. Lateral expansions of pleotelson minute emerging from lateral border *kohteri*, p. 122
- Lateral expansions of pleotelson projecting much beyond lateral border and emerging from dorsum *admirandum*, p. 122
7. Lateral borders and dorsum lacking spines *ansatum*, p. 122
- Lateral borders with spines. Dorsum variously spiny 8
8. Lateral projections strongly developed on seventh peraeonal somite 9

- Lateral projections not developed on seventh peraeonal somite 10
9. Peraeonal somite 2 with lateral projections subequal in length, peraeonal somite 3 with lateral projections more than $\frac{1}{2}$ as long as body (exclusive of lateral projections) is wide. *vitjazi*, p. 125
- Peraeonal somite 2 with anterolateral projections about 3 times as long as posterolateral projections; peraeonal somite 3 lateral projections only about $\frac{1}{4}$ as long as body (exclusive of lateral projections) is wide. *macrum*, p. 129
10. Anterolateral expansion of second peraeonal somite broad near distal end with proximal end narrower than distal *asperum*, p. 130
- Anterolateral expansion of second peraeonal somite attenuate broadest at proximal end *usheri*, p. 125

***Mesosignum multidens*, new species**

Fig. 2-4

Diagnosis: Group A *Mesosignum* with lateral expansions on each side of pleotelson. Fourth peraeonal somite with 2 lateral expansions. Second peraeonal somite with lateral expansions subequal in length. Front of cephalon produced, with a convex border which is usually provided with stout spines. Posterior border of pleotelson with median area entire, lacking spines. Pleotelson distinctly longer than wide.

Measurements: Holotype male length 2.6 mm, greatest width 1.6 mm, width of pleotelson 0.38 mm, allotype length 3.0 mm, greatest width 1.9 mm, width of pleotelson 0.45 mm.

Type-locality: V-15-69; Pacific Ocean, off Peru, Peru-Chile Trench; Lat. 10°13'S, Long. 80°05'W; Dec. 9, 1958; 6324-6328 m; holotype male AMNH 12503, allotype (AMNH 12504), 1 male paratype, and 20 female paratypes (AMNH 12505).

Distribution: Peru-Chile Trench (by stations). In addition to specimens from the type-locality, specimens were also collected from the following stations: R/V *Vema*: V-15-64, 2 females, 1 juv., 1 frag. V-15-65, 1 female frag. V-15-70, 2 females, 1 juv. V-15-71, 4 males. V-15-74, 2 males, 1 female. USC-38, 9 males, 11 females, 2 frags. USC-40, 4 females, 2 frags. USC-43, 3 males, 1 female empty marsupium, 1 frag.

Variation: The specimens which we have assigned to this species are variable in a number of characteristics. Some of this variability is illustrated in Fig. 4. The most obviously variable characteristics include the degree of spination on the front of the cephalon and on the dorsal surface, the lateral margins, and the interuropodal borders of the pleotelson; the exposed length of the uropods and the hidden or exposed na-

ture of the uropodal peduncle. There are also 2 obvious characteristics which appear to vary with growth—the number of articles of the first antennae (the number increases with increasing size of the specimens) and the length of the posterolateral expansions on the seventh peraeonal somite (the length increases with increasing size of the specimens).

Affinities: This somewhat variable species appears most closely related to *Mesosignum elegantulum* Birstein from the eastern Pacific. The relationship is not too close, however, because the species are easily distinguished from each other. Thus *M. elegantulum* Birstein has only 1 lateral expansion on each lateral border of the fourth peraeonal somite; whereas *M. multidens* has 2; and *M. elegantulum* has the anterior lateral projection of the second peraeonal somite about 5 times as long as the posterior one; whereas *M. multidens* has the 2 projections subequal in length.

***Mesosignum elegantulum* Birstein, 1963**

Fig. 5A

Mesosignum elegantulum Birstein, 1963a, pp. 53-56, fig. 23-24.

Diagnosis: Group A *Mesosignum* with lateral projection on each side of the pleotelson. Fourth peraeonal somite with a single lateral expansion on each side. Second peraeonal somite with anterior lateral expansion about 5 times the length of the posterior one. Lateral expansion of seventh peraeonal somite at least $\frac{1}{2}$ the length of the pleotelson. Pleotelson not much longer than wide. Posterior margin of pleotelson with medial area provided with spines (diagnosis based on illustration given by Birstein).

Measurements: Female holotype length 1.9 mm.

Type-locality: *Vitjaz* Station 3520; South of Osaka, Japan; Lat. 28°53.5'N, Long. 137°21.1'E; 1955; 4000-4150 m.

Distribution: Known only from the type-locality.

Affinities: This species appears to be related to the preceding species, *M. multidens*, but not closely so.

***Mesosignum magnadens*, new species**

Fig. 6

Diagnosis: Group A *Mesosignum* with a lateral projection on each side of pleotelson. Seventh peraeonal somite without posterolateral expansions. Posterolateral projections of pleotelson well developed, uropoda scarcely reaching the posterior margin of the pleotelson. Dorsum of body without spines. Spines along lateral margins of pleotelson stout and subequal in

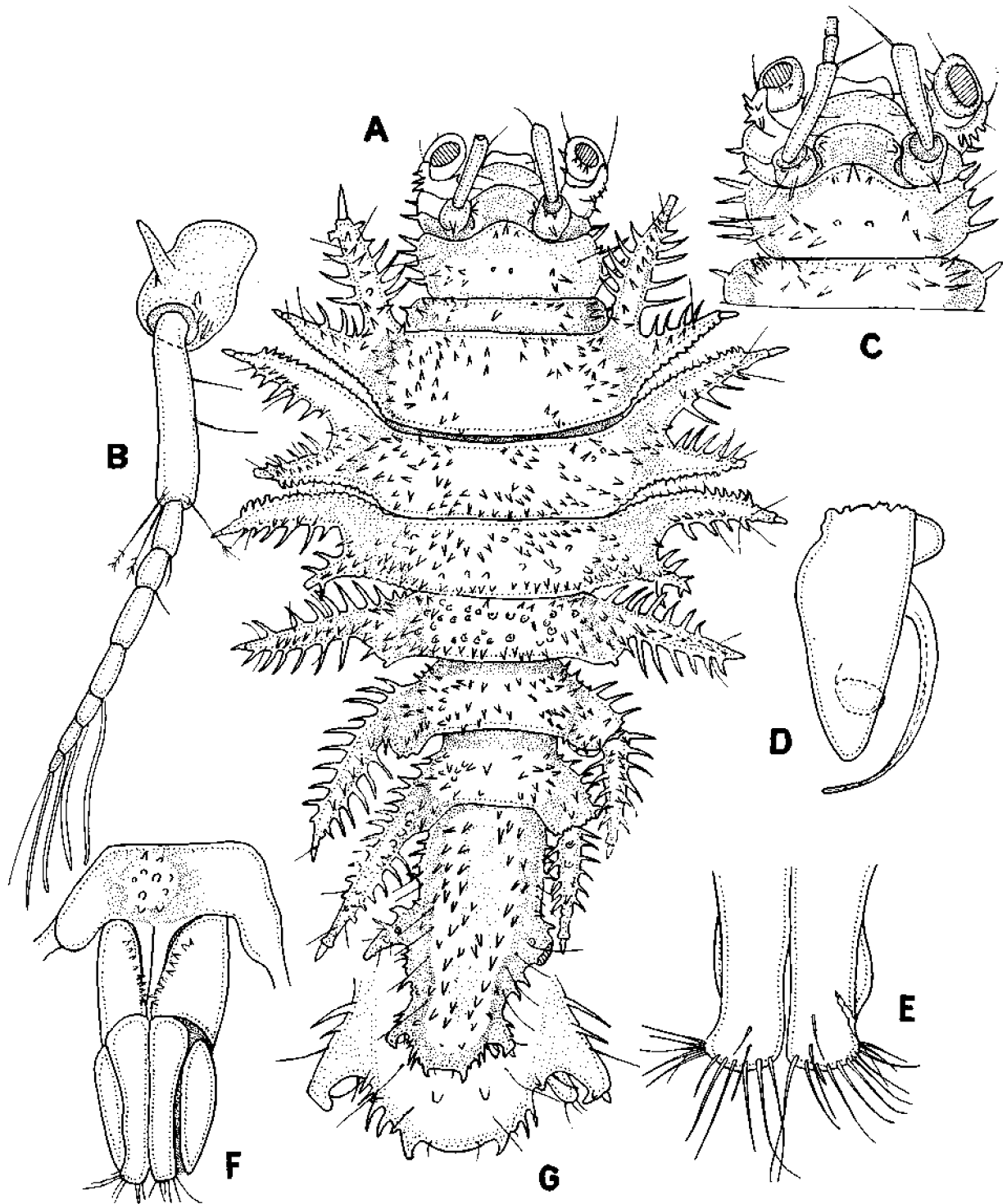


Fig. 2. *Mesosignum multidentis*, new species. A, male holotype, length 2.6 mm, width 1.6 mm; B, first antenna; C, cephalon and first peraeonal somite; D, second male pleopod; E, apex of first male pleopod; F, seventh peraeonal somite, penes, and pleotelson; G, apex of pleotelson.

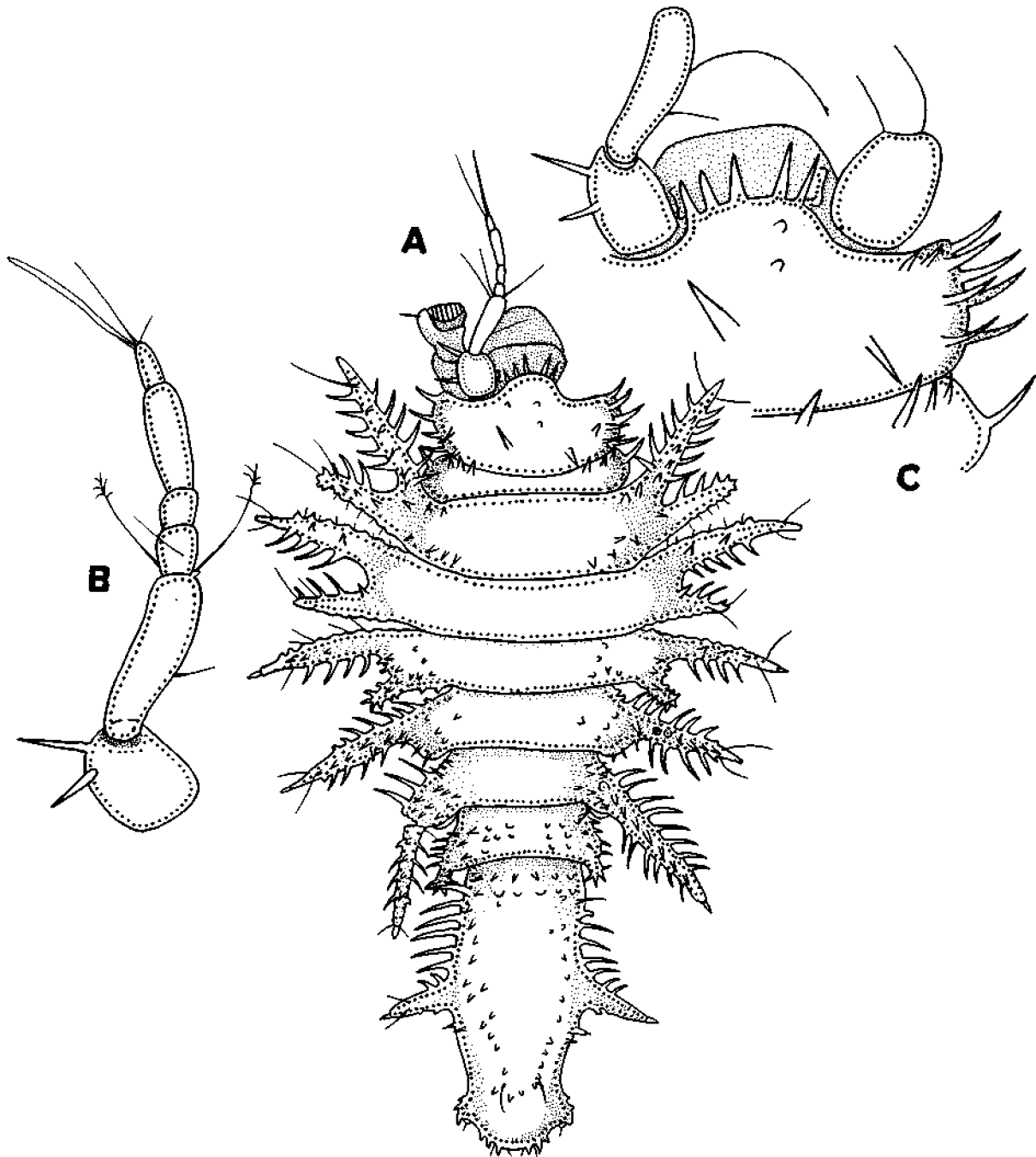


Fig. 3. *Mesosignum multident*, new species. A, Immature female, length 1.45 mm, width 1.0 mm; B, first antenna; C, detail of cephalon and first peraeonal somite.

length. Medial margin of posterior border of pleotelson spiny, with about 8 spines between the uropods.

Measurements: Holotype female length 2.6 mm, width (widest part) 1.4 mm, width of pleotelson 0.4 mm.

Type-locality: V-15-5; Atlantic Ocean, Caribbean Sea, near Windward Passage; Lat. 20°30'N, Long.

73°16'W; Nov. 4, 1958; 3378 m; 1 female holotype (AMNH 12491).

Distribution: Known only from the type-locality.

Affinities: This species appears related to *M. usheri* Menzies, also from the Caribbean. It differs most markedly in having paired lateral expansions on the pleotelson. Otherwise the 2 species are similar.

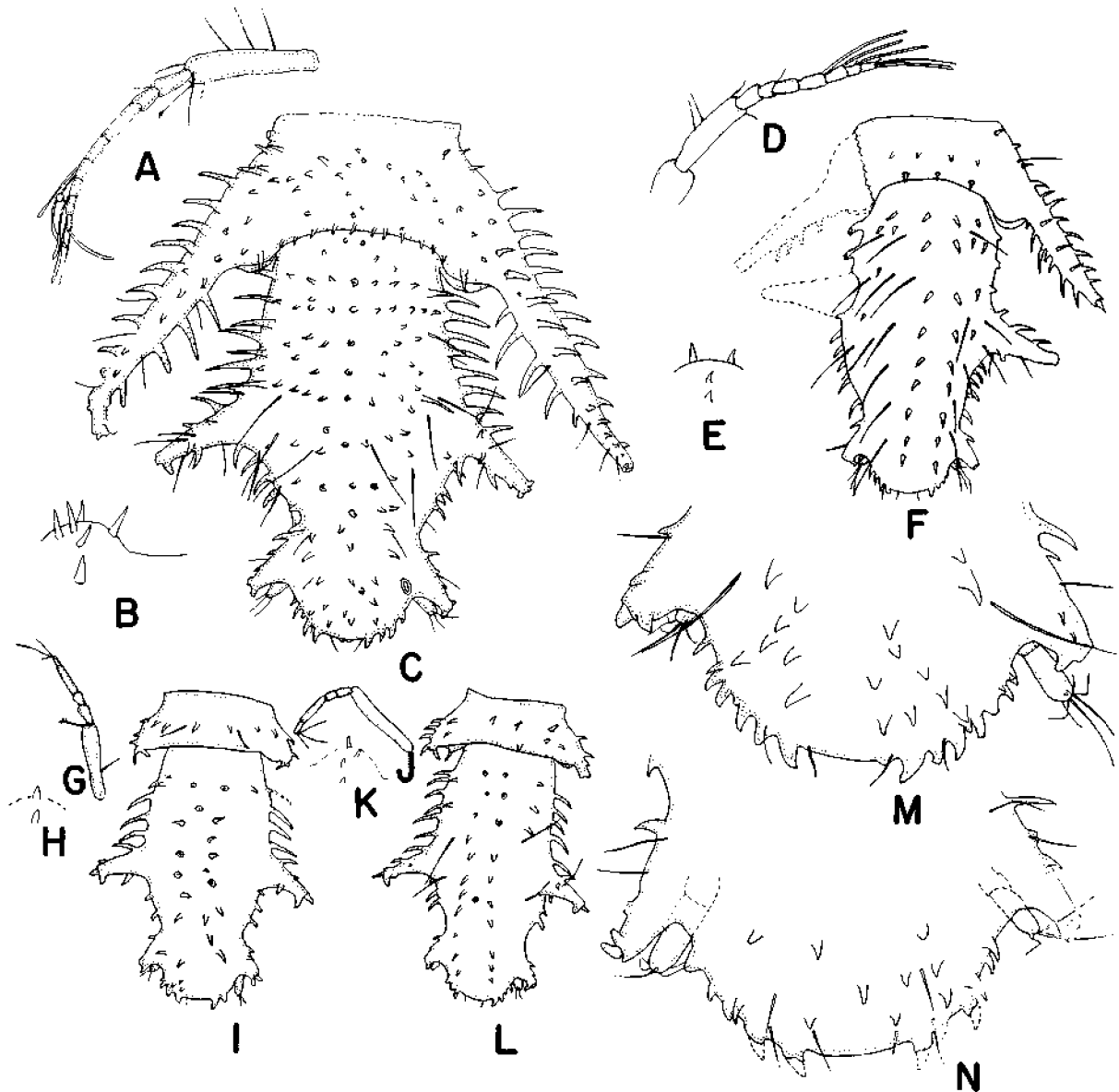


Fig. 4. A-N: *Mesosignum multidens*, new species, variations. A-C, adult male, length 2.5 mm: A, first antenna; B, median apex of cephalon; C, seventh peraeonal somite and pleotelson. D-F, subadult male, length 1.9 mm: D, first antenna; E, median apex of cephalon; F, seventh peraeonal somite and pleotelson. G-I, juvenile, length 1.6 mm: G, first antenna; H, median apex of cephalon; I, seventh peraeonal somite and pleotelson. J-L, juvenile, length 1.65 mm: J, first antenna; K, median apex of cephalon; L, seventh peraeonal somite and pleotelson. M, adult female, length 2.9 mm: apex of pleotelson. N, adult female, length 2.1 mm: apex of pleotelson.

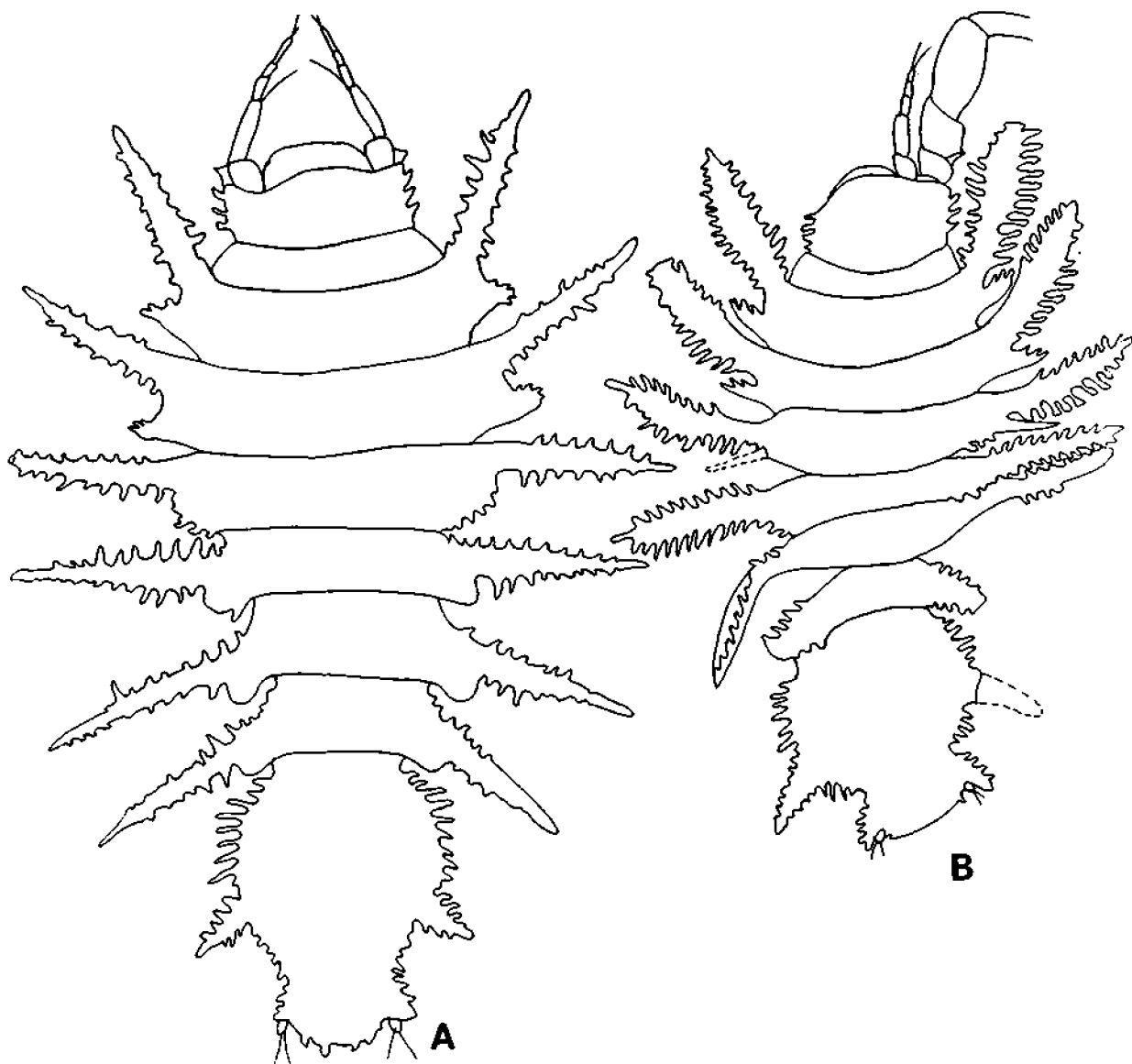


Fig. 5. A, *Mesosignum elegantulum* Birstein, 1963, female holotype, length 1.9 mm; B, *Mesosignum brevispinis* Birstein, 1963, female holotype, length 1.6 mm. (Both drawings copied from Birstein, 1963.)

***Mesosignum brevispinis* Birstein, 1963**

Fig. 5B

Mesosignum brevispinis Birstein, 1963a, pp. 56–57, fig. 25.

Diagnosis: Group A *Mesosignum* with an expansion on each lateral border of the pleotelson. Posterolateral projections of pleotelson minute, with the uropoda extending to the apex. Lateral projections of seventh peraeonal somite less than $\frac{1}{4}$ the length of the pleon. Pleon broadly ovoid, being about as long as wide. Apex of pleon without medial spines. (Diagnosis based on illustrations given by Birstein.)

Measurements: Female holotype length 1.6 mm.

Type-locality: Vityaz Station 3114; Southeast of Kurile Islands; Lat. 48°50.8'N; Long. 160°01'E; 1954; 5670–5680 m; 1 female.

Distribution: Known only from the type-locality.

Affinities: This species appears most closely related to the preceding species, *M. magnadens*, from which it differs in having the posterolateral projections of the pleotelson minute instead of $\frac{1}{3}$ the length of the pleotelson. In *M. magnadens* the pleotelson is longer than wide instead of being as long as wide. Further-

more, the anterolateral projections of *M. brevispinis* Birstein are broader near their distal end than at the proximal end. These projections in *M. magnadens* are attenuate at the distal end.

***Mesosignum kohleri* Menzies, 1962**

Fig. 7A-G

Mesosignum kohleri Menzies, 1962a, pp. 184-185, fig. 64A-G.

Diagnosis: Group A *Mesosignum* with lateral expansions of pleotelson minute and emerging from lateral border. Pleotelson (minus lateral expansions) twice as long as broad. Bulbous swollen area located dorsal to the rounded apex of pleotelson. Posterolateral projections of pleotelson minute with uropod extending beyond their margin. Seventh peraeonal somite without elongate lateral expansions. Anterolateral expansion of second peraeonal somite $1\frac{1}{2}$ the length of posterolateral expansion. Apex of male first pleopod rounded, with 10 marginal setae. (Modified from Menzies 1962a.)

Measurements: Male holotype length 2.5 mm; width pleotelson 0.35 mm; allotype gravid female length 2.3 mm; width pleotelson 0.30 mm.

Type-locality: V-15-11; central part of Colombian Plain; Lat. $14^{\circ}05'N$; Long. $75^{\circ}25'W$; Nov. 7, 1958; 4076 m; holotype, allotype, one male, 3 female paratypes.

Distribution: Caribbean Sea: 3 males, 2 females, 2 juv., 1 frag., V-15-9, Nov. 7, 1958, 4071 m; 3 males, V-15-10, Nov. 7, 1958, 4071 m; 1 female, V-15-12, Nov. 8, 1958, 2868-2875 m; 2 males, V-15-13, Nov. 8, 1958, 2875-2941 m, and at type-locality, V-15-11.

Affinities: When only 2 species were known [Menzies, 1962a] this species had only one "relative." Added collections reveal that this species is most closely related to *M. admirandum* from the Pacific Ocean. The latter species shows a stronger development of the lateral expansions of the pleotelson and dorsal spination of the body, which is very weak in *M. kohleri*.

***Mesosignum admirandum*, new species**

Fig. 8

Diagnosis: Group A *Mesosignum* with lateral projections on pleotelson. Posterolateral projections of apex of pleotelson minute with uropoda extending to their end. Lateral expansions absent from seventh peraeonal somite. Pleotelson twice as long as wide (excluding lateral expansions). Lateral expansions

of pleotelson emerge from dorsal surface of pleotelson instead of the lateral border. Apex of pleotelson with 2 stout spines on either side of medial border. Apex of each male first pleopoda rounded, with about 17 marginal setae. Female operculum with swollen area on midline at proximal end. Body of animal strongly spinose dorsally.

Measurements: Holotype male length 3.15 mm, width 2.25 mm, width of pleotelson (exclusive of lateral expansions) 0.6 mm, allotype length 3.8 mm, width 2.7 mm, width of pleotelson (exclusive of lateral projection) 0.65 mm.

Type-locality: V-15-60; Pacific Ocean, off Costa Rica; Lat. $6^{\circ}21'N$; Long. $85^{\circ}17'W$; Nov. 30, 1958; 1892-1016 m; holotype (AMNH 12497), allotype (AMNH 12498), and 2 female paratypes (AMNH 12499).

Distribution: In addition to the type-locality, the species was also collected in the eastern Pacific Ocean off Ecuador, V-15-62, Lat. $1^{\circ}30'S$, Long. $82^{\circ}19'W$, Dec. 3, 1958 1363-1369 m, 3 males and 1 juvenile and at the equator, USC 30, Lat. 00° , Long. $81^{\circ}45'W$, Apr. 6, 1962; 1174-1196 m, 1 specimen.

Affinities: This species appears to be closely related to *M. kohleri* Menzies, from which it differs in having strongly developed lateral expansions on the pleotelson and in having the dorsum of the body strongly spinose. Also the lateral expansions of the peraeonal somites are wider in this species than in *M. kohleri*. Notwithstanding these differences, the 2 species are probably very closely related, especially in the marked similarity of the male first pleopods.

Remarks: The ventral surface of the pleotelson of female specimens of this species shows indications of primitive segmentation suggesting 3 pleonites plus a pleotelson. These indications are not evident in dorsal view and the somites are completely coalesced.

***Mesosignum ansatum*, new species**

Fig. 9

Diagnosis: Group B *Mesosignum* without a lateral expansion (projection) on each side of the pleotelson. Body smooth, devoid of spines. Seventh peraeonal somite without lateral expansions. Anterior expansion of second peraeonal somite directed forward, parallel to midline of body. Posterolateral projections of pleotelson directed at 70° angle from midline, with uropoda shorter than the projection. Body sparsely covered with setae.

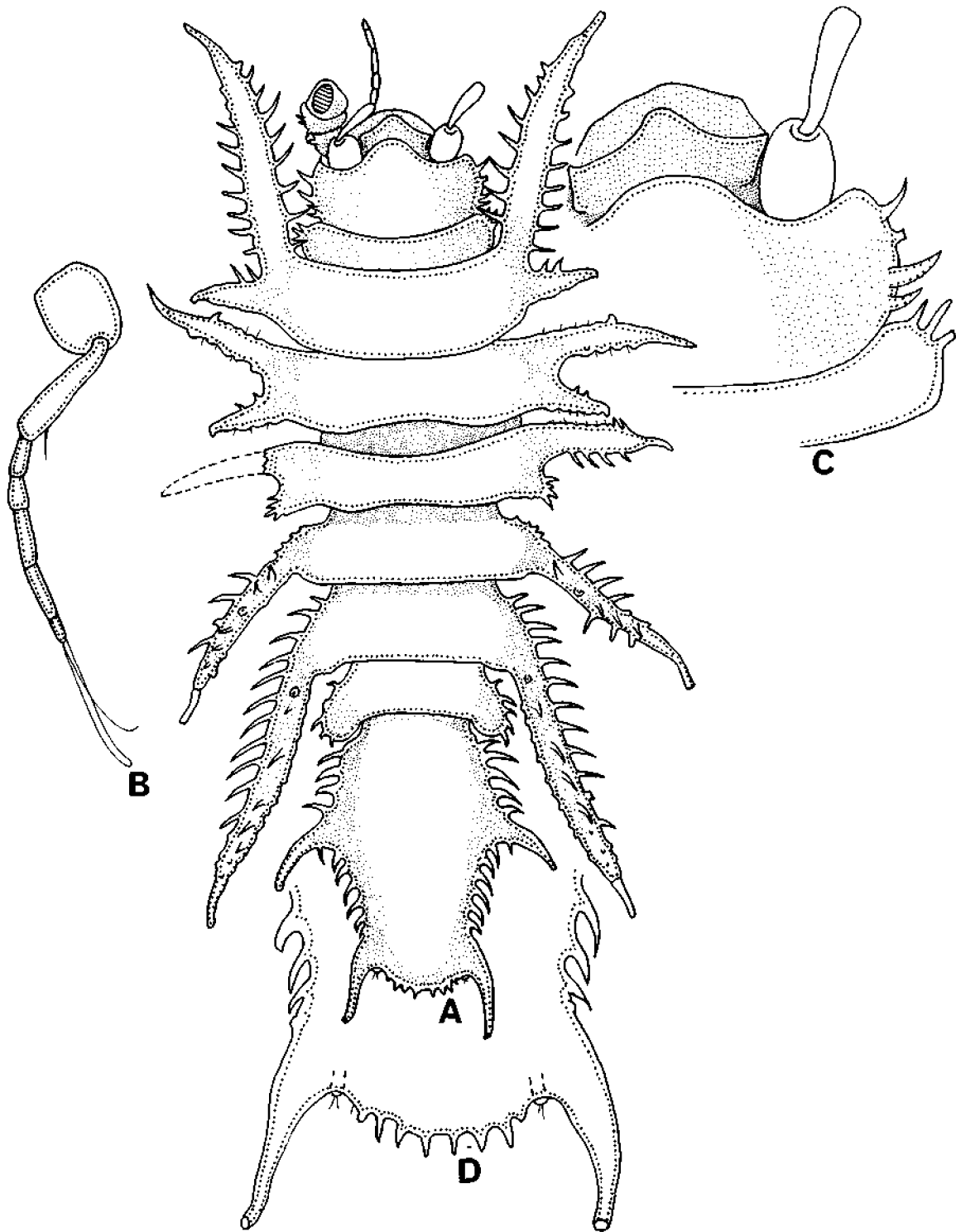


Fig. 6. *Mesosignum magnadens*, new species. A, female holotype, length 2.6 mm; B, first antenna; C, detail of cephalon and first pereopodal somite; D, apex of pleotelson.

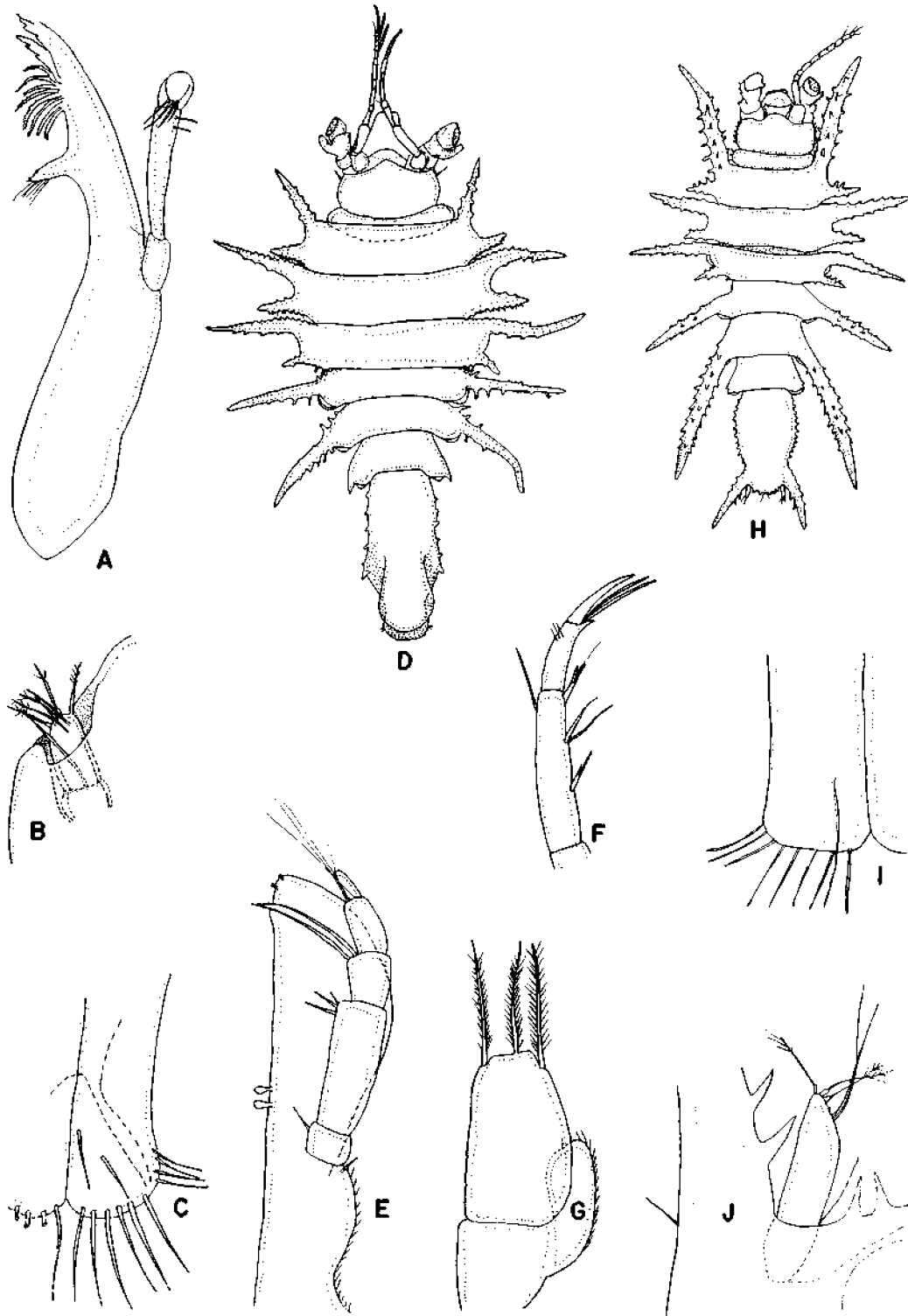


Fig. 7. *Mesosignum kohleri* Menzies, and *M. usheri* Menzies, 1962. *M. kohleri*: A, mandible; B, uropod; C, first pleopod; D, dorsal view male holotype; E, maxilliped; F, first peraeopod; G, third peraeopod. *M. usheri*: H, dorsal view male holotype; I, first pleopod; J, uropod. Figures after Menzies [1962, Fig. 64 A-G., p. 185].

Measurements: Holotype female length 2.1 mm, width (at widest part) 1.2 mm, width of pleotelson 0.4 mm.

Type-locality: V-15-55; Pacific Ocean off Nicaragua; Lat. 12°45'N; Long. 88°38'W; Nov. 24, 1958; 3950-3777 m; holotype (AMNH 12501) and 1 female paratype with well developed oostegites (AMNH 12502).

Distribution: Known only from the type-locality.

Affinities: The affinities of this species are with those species assigned to Group B of this genus. The body is glabrous and, because of this, the species is not closely related to any single species in Group B. It is unique.

***Mesosignum vitjazi* Birstein, 1963**

Fig. 10

Mesosignum vitjazi Birstein, 1963b, p. 320, fig. 4.

Diagnosis: Group B *Mesosignum*. Lateral borders of body and pleon with stout spines, dorsum with few spines. Lateral projections strongly developed on the seventh peraeonal somite. Lateral projections of second peraeonal somite subequal in length. Posterolateral projections of pleon nearly parallel to midline. (Diagnosis based on illustration given by Birstein.)

Measurements: Male length 3 mm.

Type-locality: Vityaz Station 3655; New Britain Trench; Lat. 05°94'4''S, Long. 152°53'4''E; 1957; 6920-7954 m (Birstein).

Distribution: Known only from the type-locality.

Affinities: This species appears most closely related to the eastern Pacific species, *M. macrum*. It differs from *M. macrum* mainly in that the expansions of the second peraeonal somite are subequal in length rather than the anterior one being much larger than the posterior one.

***Mesosignum macrum*, new species**

Fig. 11

Diagnosis: Group B *Mesosignum* with lateral borders of pleotelson entire, lacking a lateral expansion on each side. Lateral borders and dorsum of body spinulose. Second peraeonal somite with anterolateral expansions about 3 times as long as posterolateral expansions. Posterolateral expansion of seventh peraeonal somite well developed. Posterolateral projections of pleotelson directed caudad and roughly parallel to midline.

Measurements: Holotype female length 2.8 mm, width 1.4 mm, width of pleotelson 0.45 mm.

Type-locality: V-15-61; Pacific Ocean, off Costa Rica; Lat. 4°15'N; Long. 85°06'W; Dec. 1, 1958; 3260-3254 m; holotype (AMNH 12492) and one paratype female (AMNH 12493).

Distribution: Known only from the type-locality.

Affinities: This species appears to be most closely related to *M. vitjazi* Birstein, from which it differs primarily in the relative lengths of the lateral expansions on the second and third peraeonal somites (see key) and in its greater spination. *M. macrum* and *M. vitjazi* appear to be unique in having the posterolateral projections of the pleotelson extending roughly parallel to the midline of the body.

***Mesosignum asperum*, new species**

Fig. 12

Diagnosis: Group B *Mesosignum* with lateral border of pleotelson entire, lacking lateral expansions on each side. Lateral borders and dorsum of body spiny. Seventh peraeonal somite without lateral projections. Anterolateral expansion of second peraeonal somite broader near distal end than proximal end. Apex of male first pleopoda rounded, bearing about 6 setae.

Measurements: One young male holotype length 1.6 mm, width 1.05 mm, width of pleotelson 0.4 mm.

Type-locality: V-15-48; Pacific Ocean, off Costa Rica; Lat. 10°07'N; Long. 89°50'W; Nov. 21, 1958; 3718 m; holotype (AMNH 12494).

Distribution: Also taken from Sta. V-15-46, also off Costa Rica, Lat. 09°22'N, Long. 89°33'W, 3517-3528 m, 1 male, and from V-15-55, off Nicaragua, Lat. 12°45'N, Long. 88°38'W, 3950 m, 1 fragment.

Affinities: This species appears closely related to *Mesosignum usheri* Menzies from the Caribbean but differs mainly in the shape of the anterolateral expansion of the second peraeonal somite. This expansion is broader near its distal end than at its proximal end in *M. asperum* and is attenuate in *M. usheri* Menzies.

***Mesosignum usheri* Menzies, 1962**

Fig. 7H-J; Fig. 13-15

Mesosignum usheri Menzies, 1962a, p. 185, fig. 64H-J.

Diagnosis: Group B *Mesosignum* lacking pair of lateral projections on pleotelson, the lateral border entire but provided with small spines. Anterolateral ex-

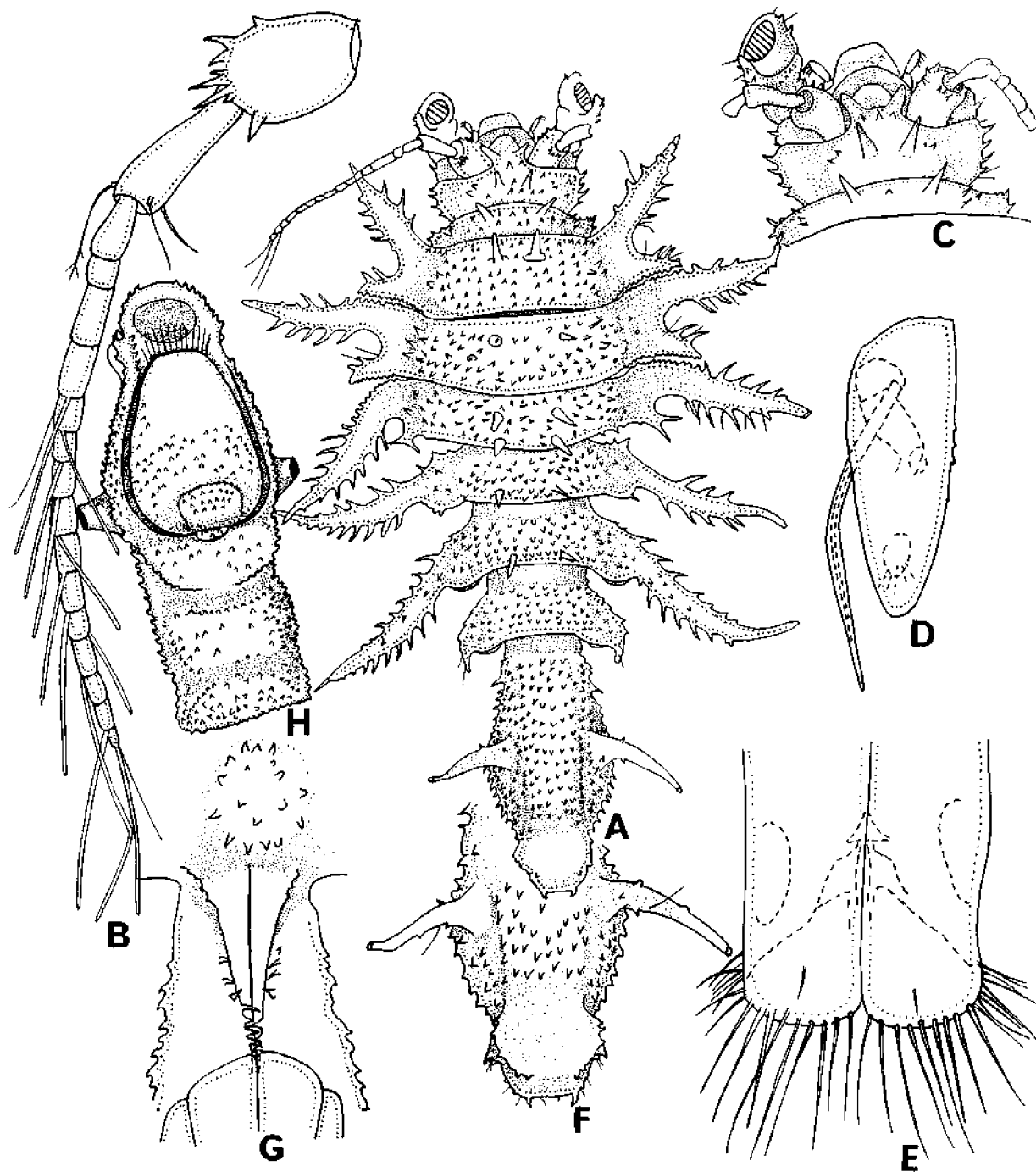


Fig. 8. *Mesosignum admirandum*, new species. A, male holotype, length 3.15 mm, width 2.25 mm; B, first antenna; C, cephalon and first pereopod; D, second male pleopod; E, apex of first male pleopod; F, apex of pleotelson; G, seventh pereopod, pleotelson, and penes, ventral view; H, pleotelson of female allotype, ventral view, length 3.8 mm.

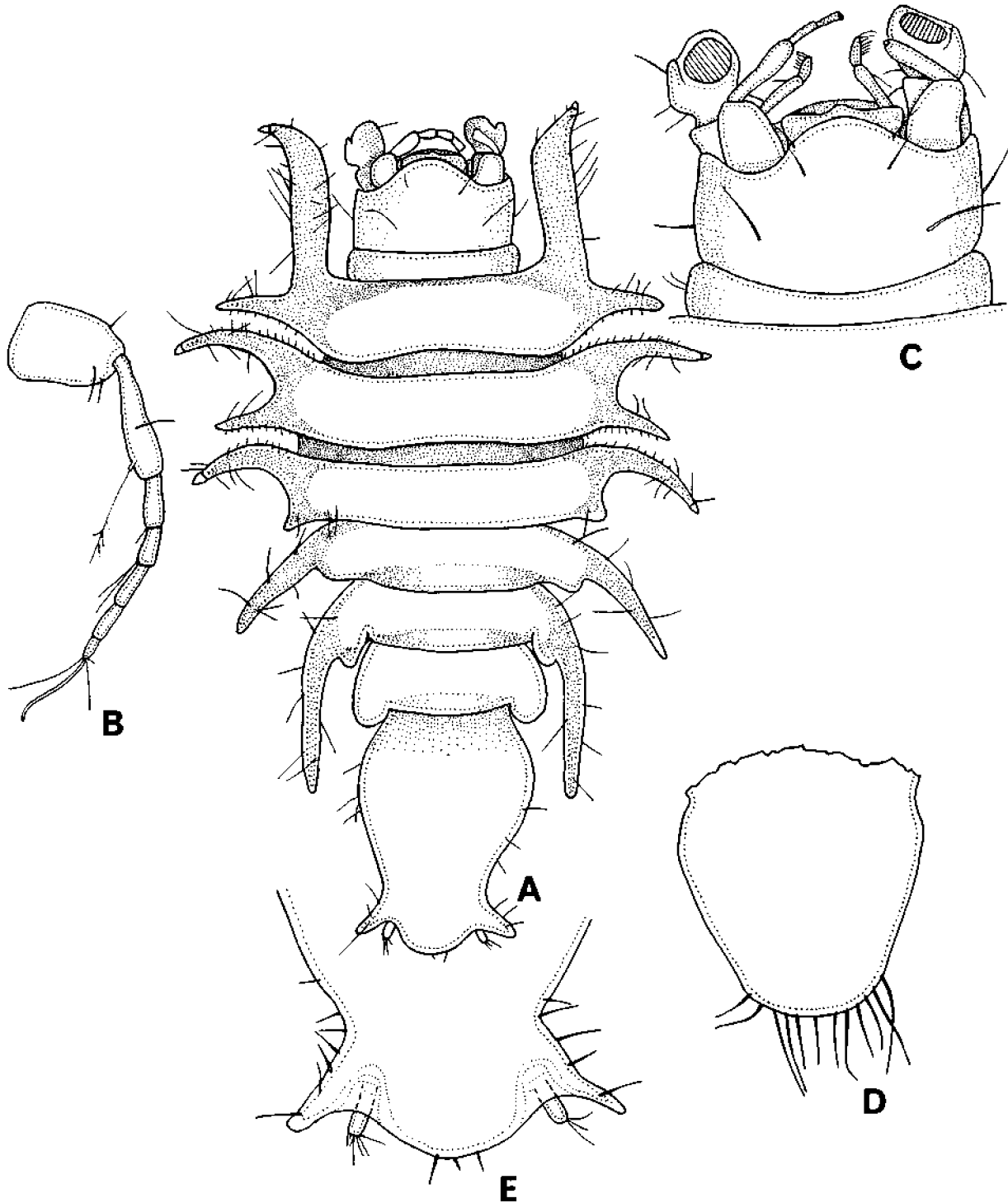


Fig. 9. *Mesosignum ansatum*, new species. A, female holotype, length 2.1 mm, width 1.2 mm; B, first antenna; C, cephalon and first peraeonal somite; D, operculum; E, apex of pleotelson.

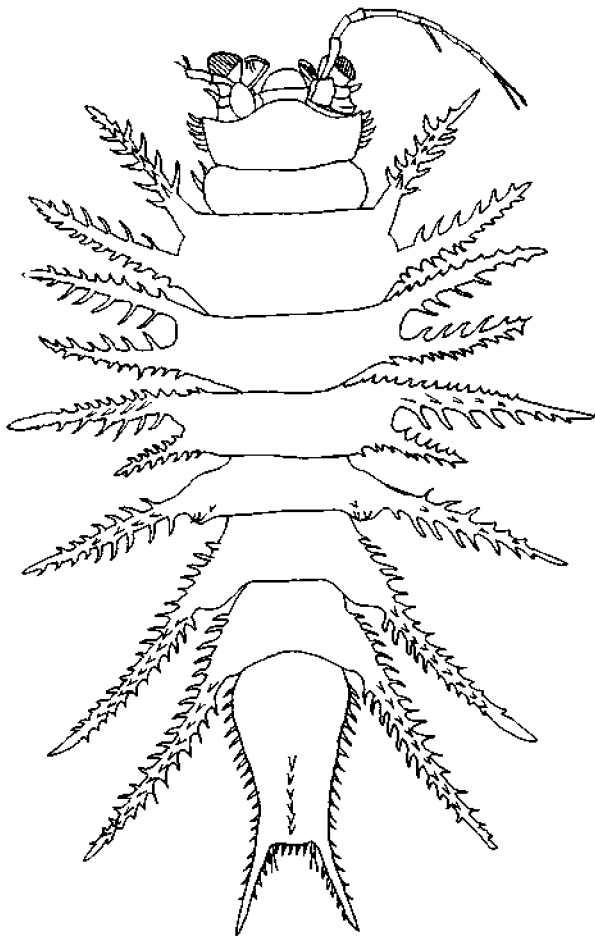


Fig. 10. *Mesosignum ritjazi* Birstein, 1963; male holotype, length 3 mm (drawing copied from Birstein, 1963).

pansion of second peraeonal somite attenuate, being broadest at proximal end, about 5 times the length of posterolateral expansion. Lateral borders of body with spines. Posterolateral expansions of pleon stout and elongate and extending beyond apex of uropoda. Apex of male first pleopod straight, with 8 marginal setae. (Modified from Menzies [1962a].)

Measurements: Holotype male length 2.0 mm; width pleotelson 0.3 mm, allotype length 2.1 mm, width pleotelson 0.4 mm.

Type-locality: V-15-13; Continental Rise northwest off Cartagena, Colombia; Lat. 11°30'N; Long. 70°50'W; Nov. 18, 1958; 2875-2941 m; holotype and allotype plus 1 female.

Distribution: Originally this species was known only from the type-locality. The collections which we have studied suggest that it is also distributed in the Pacific Ocean from off Costa Rica to off Patagonia. Carib-

bean Sea: V-15-16, 1 female, var "A". Eastern Pacific Ocean: off Ecuador, V-15-60, 1 male, 1 juv. var "C"; off Peru, USC-63-41, 1 male, 1 frag. var "B". illustrated; off Chile, V-15-87, 1 specimen, var "A" USC-65-55, male, illustrated, var "A"; off Patagonia. USC-322-25, 1 juv., var "B".

Variation: The specimens which we have assigned to this species show a considerable amount of variation. The variants do not appear to form discrete units, however, and consequently we believe it would be unwise to establish smaller, less inclusive species at our present state of knowledge. We have illustrated 3 varieties of this species to give an indication of the morphological variation within the group, but these varieties which are separate geographically may or may not represent interbreeding entities.

Variety A is characterized by an elongate pleotelson (about 1.7 times as long as wide exclusive of posterolateral expansions), elongate uropods with peduncles concealed beneath posterior border of pleotelson, an interuropodal border of the pleotelson with 6 spines and 3 bristles, a nonspinous area between the spines on the lateral border of the posterolateral expansion of the pleotelson and the spines on the pleotelson itself, and a few spines on the cephalon and first and second peraeonal somites.

Variety B is characterized by a less elongate pleotelson (about 1.5 times as long as wide, exclusive of posterolateral expansions); elongate uropods with distinct peduncles which project beyond border of pleotelson, an interuropodal border of the pleotelson with 2 spines and 4 bristles; an absence of spines on the lateral borders of the posterolateral expansions of the pleotelson, and a few spines on the dorsal surface of the cephalon, the first peraeonal somite, and the pleotelson.

Variety C is characterized by a pleotelson with a length/width ratio intermediate between varieties A and B, elongate uropods with a distinct peduncle; an interuropodal border of the pleotelson with 8 spines and 2 bristles, an uninterrupted row of lateral spines along the pleotelson and one-third the length of the posterolateral expansions, and numerous spines on the dorsal surface of the entire animal.

Affinities: This species appears related to the preceding species, *M. asperum*.

AFFINITIES AND GEOGRAPHIC DISTRIBUTION

Fig. 16

Utilizing the assumption that species which look alike

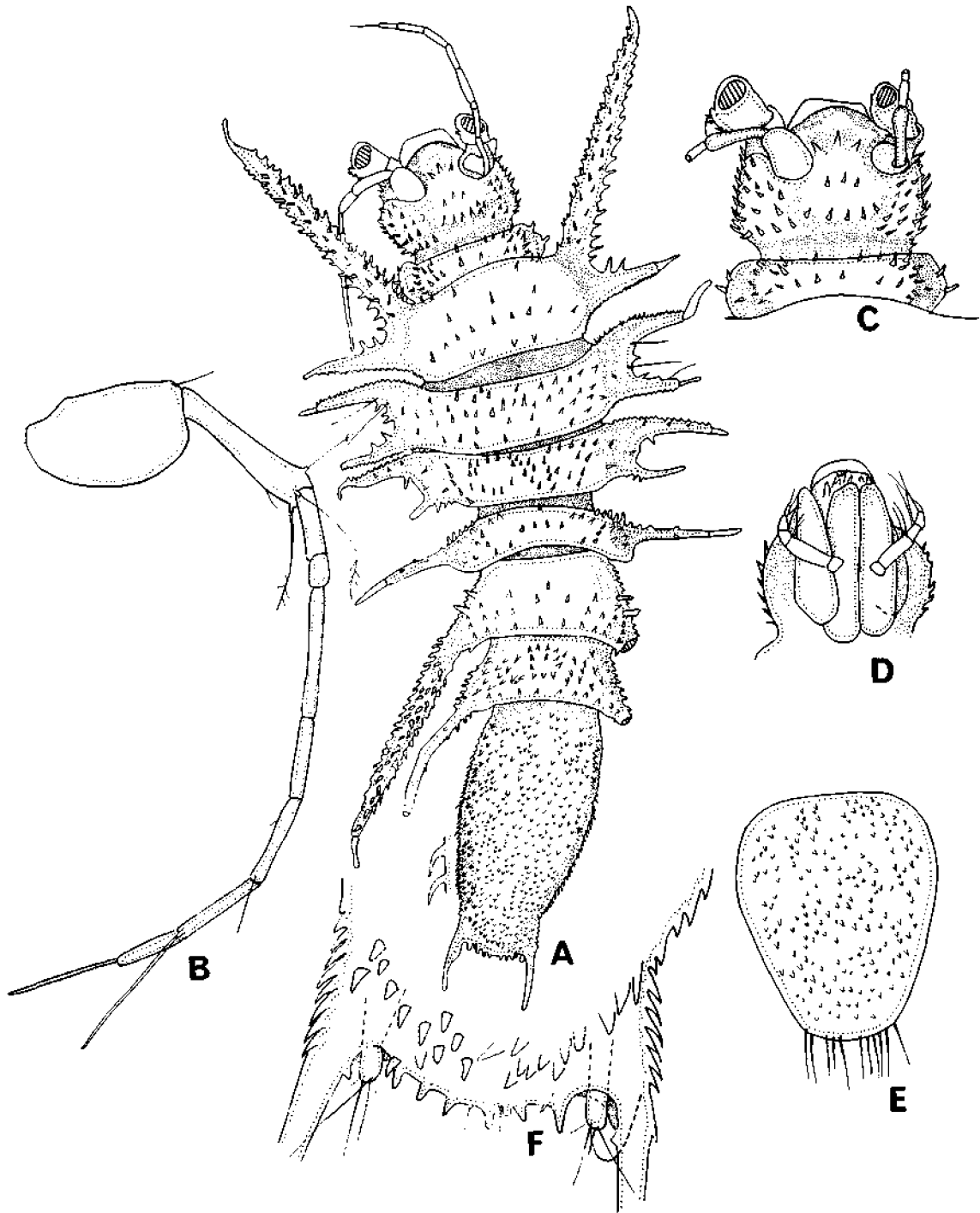


Fig. 11. *Mesosignum macrum*, new species. A, female holotype, length 2.8 mm, width 1.4 mm; B, first antenna; C, cephalon and first pereopodal somite; D, cephalon, ventral view showing mouthparts; E, operculum; F, apex of pleotelson.

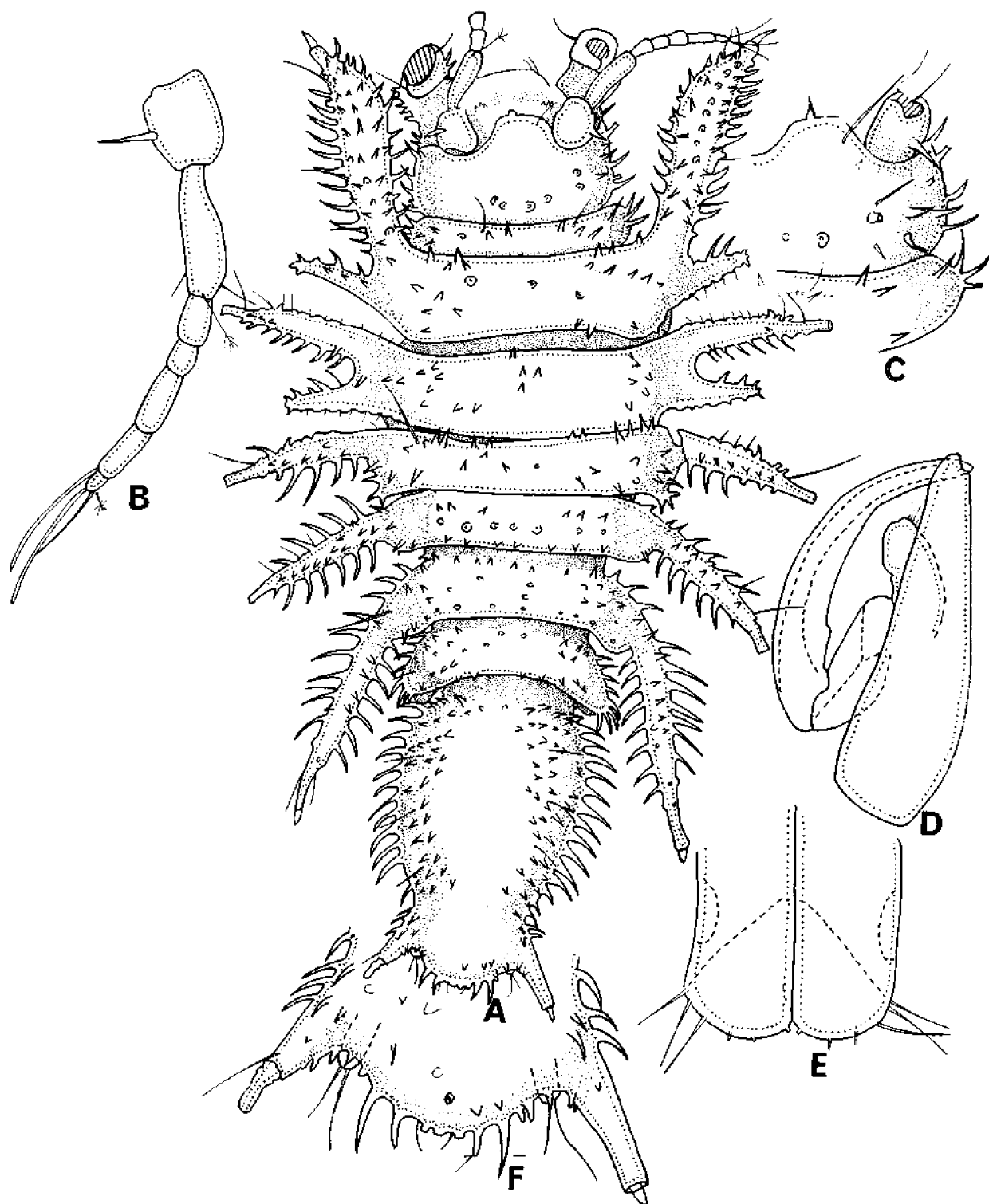


Fig. 12. *Mesosignum asperum*, new species. A, male holotype, length 1.6 mm, width 1.05 mm; B, first antenna; C, detail of cephalon and first peraeonal somite; D, second male pleopod; E, apex of first male pleopod; F, apex of pleotelson.

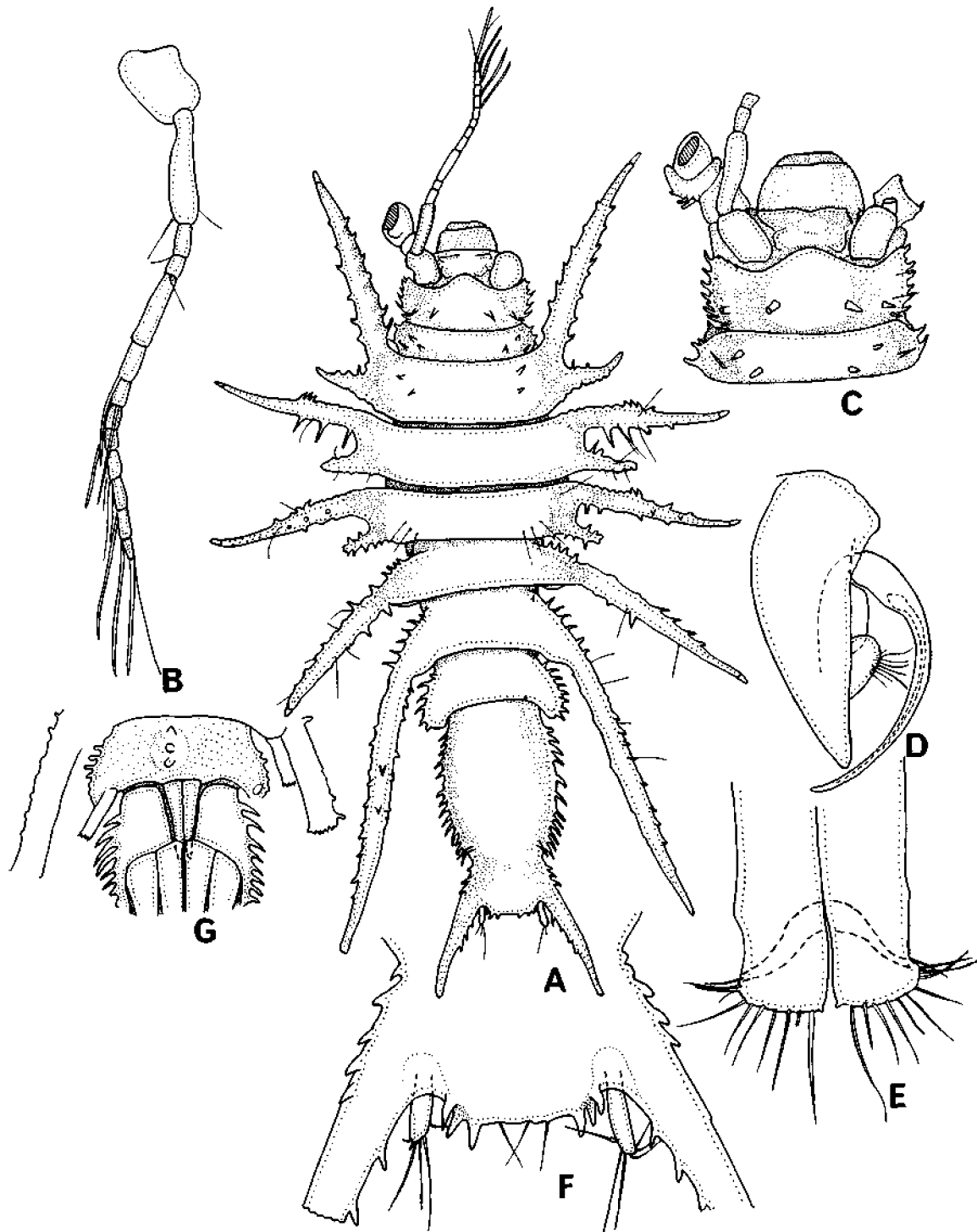


Fig. 13. *Mesosignum usheri* Menzies, 1962, Variety A. A, male, length 3.2 mm, width 2 mm; B, First antenna; C, cephalon and first pereopodal somite; D, second male pleopod; E, apex of first male pleopod; F, apex of pleotelson; G, seventh pereopodal somite, pleotelson, and penes, ventral view.

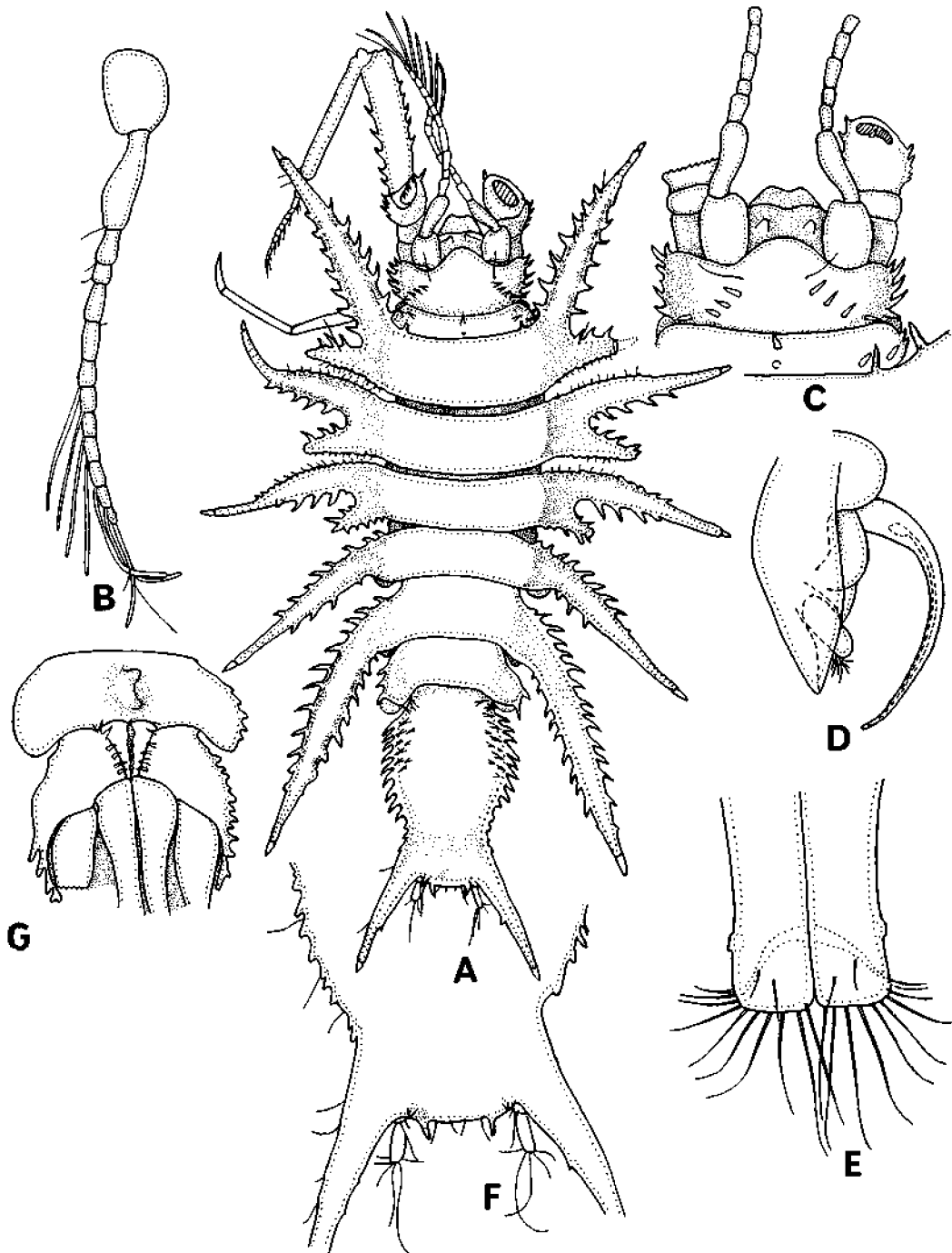


Fig. 14. *Mesosignum usheri* Menzies, 1962, Variety B. A, male, length 2.7 mm, width 1.9 mm; B, first antenna; C, cephalon and first pereopodal somite; D, second male pleopod; E, apex of first male pleopod; F, apex of pleotelson; G, seventh pereopodal somite, pleotelson, and penes, ventral view.

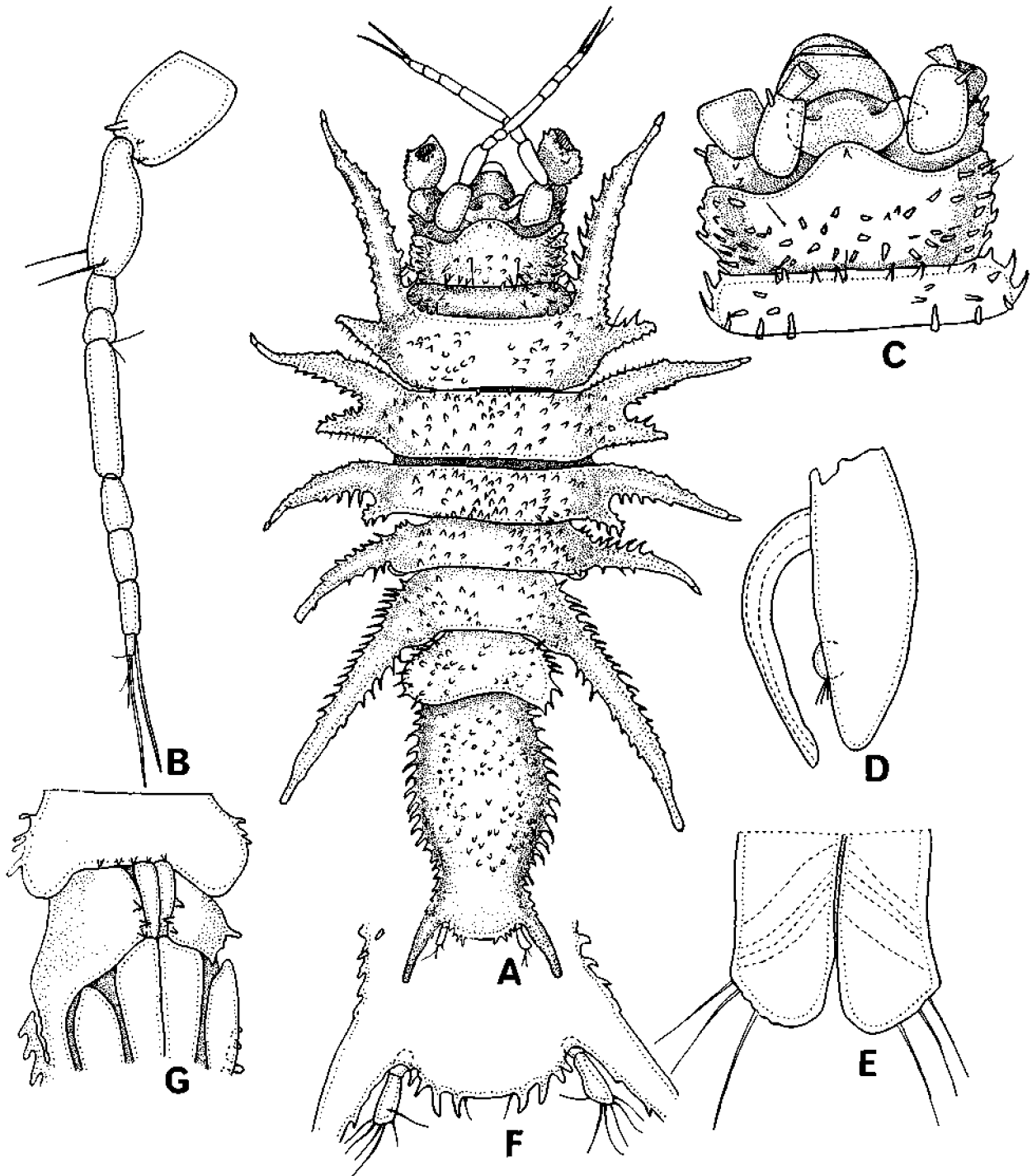


Fig. 15. *Mesosignum usheri* Menzies, 1962, Variety C. A, male, length 2.1 mm, width 1.3 mm; B, first antenna; C, cephalon and first pereopodal somite; D, second male pleopod; E, apex of first male pleopod; F, apex of pleotelson; G, seventh pereopodal somite, pleotelson, and penes, ventral view.

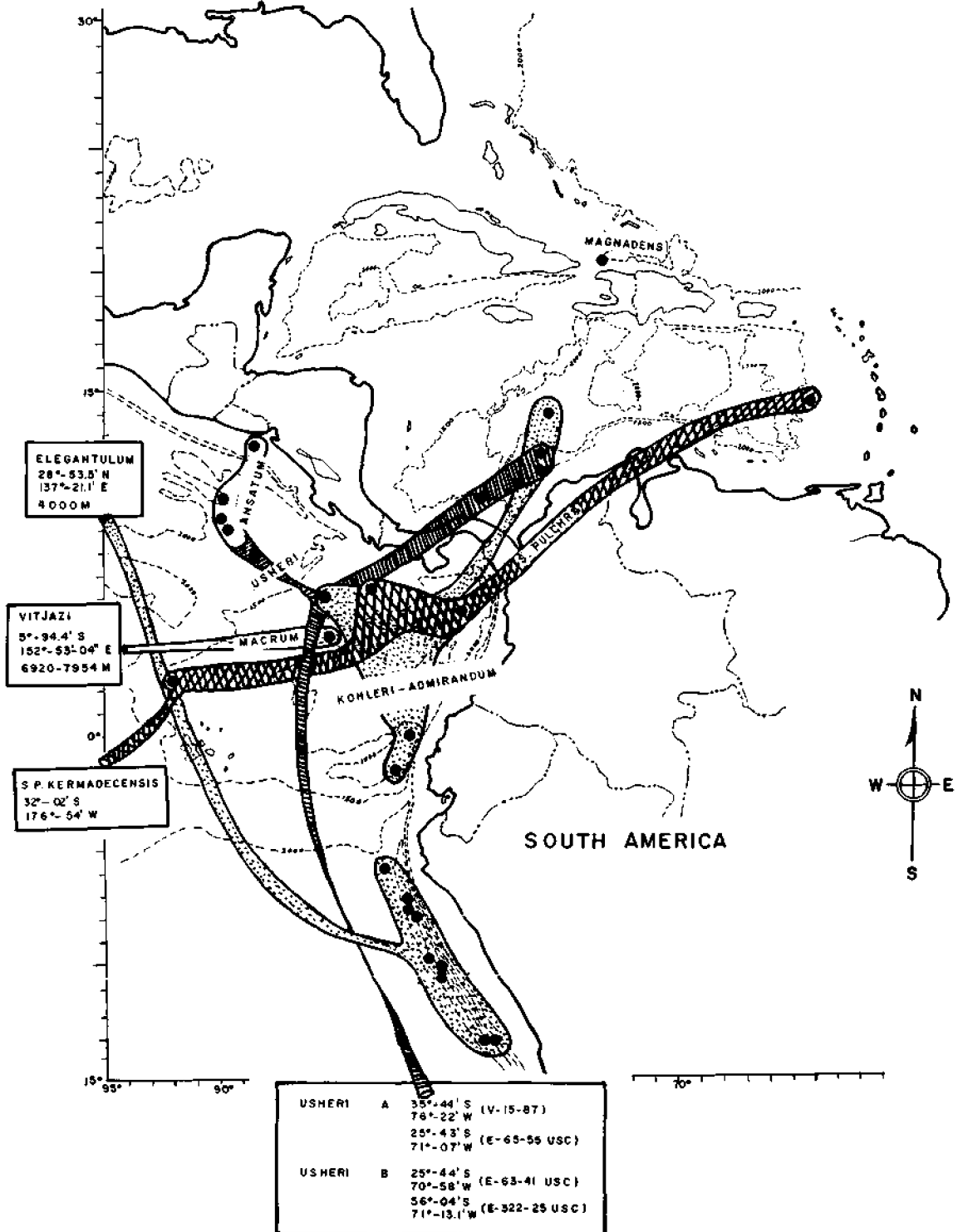


Fig. 16. Distribution of related species, subspecies, and varieties of *Mesosignum* and *Storthyngura*.

TABLE 1. Tabulation of Taxonomic Characters of *Mesosignum* Group A

	"A" Character	Lat. expansion, 7th peraeonite obsolete	Posterolateral apex of pleotelson minute or absent	Pleotelson narrow, longer than broad	Pleotelson ovoid, about as long as broad	Degree of Relationship
1. <i>multidens</i>	X	X	X	O	X {	related
2. <i>elegantulum</i>	X	X	X	O	X }	
3. <i>magnadens</i>	X	O	O	O	X	unique
4. <i>brevispinis</i>	X	O	X	O	X	related
5. <i>kohleri</i>	X	O	X	X	O {	
6. <i>admirandum</i>	X	O	X	X	O }	

are more closely related than species which do not look alike, we can arrive at a number of groupings of related species. Presumably these species have had a common evolution. From a study on the distribution of related species one might arrive at reasonable ideas of the spread of species in an ocean and some concept of evolutionary trends and evolutionary rates. We have had access to descriptive data on all known contemporary species but it is likely that other, as yet undescribed species, exist. Conclusions regarding affinities reflect the degree of completeness of information regarding all related species, and ideas can be expected to change as more data become available.

In all events there is little doubt that the known species of *Mesosignum* are all closely related morphologically. Similar mouth parts, pleopoda, ambulatory appendages, uropoda, etc. were found. The differences that were used for species definition were projections or lateral expansions on the peraeonal somites of the body and pleotelson and spines along the body and at the apex of the pleotelson.

Species are arranged in groups A and B in Tables 1 and 2. Morphological subgroupings are also possible as can be seen by inspection.

The fact that morphologically allied species are found in 2 different oceans, one in the Atlantic and

the other in the Pacific, suggests that there existed a close genetic continuity or flow of genes between these in the geological past. Close affinities in morphology are suggested between species in the abyssal Caribbean Sea and the abyssal eastern Pacific, and between abyssal species in the eastern and western Pacific.

Caribbean-Pacific Affinities

In group A, the species *Mesosignum kohleri* (2868–4076 m) from the Caribbean has its closest affinities with *Mesosignum admirandum* (1016–1892 m) from the Pacific Ocean off Colombia. In group B, *Mesosignum usheri* from the Caribbean is closely related to *Mesosignum asperum* (3517–3950 m) from the Pacific Ocean off Costa Rica. In addition, the populations of *Mesosignum usheri* from the Caribbean appear to be identical with populations of the same species in the Pacific from Central America to the tip of Patagonia. Thus, in *Mesosignum* one sees an affinity between the abyssal Caribbean fauna and the abyssal fauna of the eastern Pacific Ocean. The spatial affinities are verified by many collections and through instances of 3 close relationships between species and subspecies in *Mesosignum* and hence are probably not accidents of collection or mistakes in labels.

The least differentiated species of *Mesosignum* ap-

TABLE 2. Tabulation of Taxonomic Characters of *Mesosignum* Group B

	"B" Character	Lat. border of pleotelson with spines	Lat. border of pleotelson without spines	Lat. projection on 7th peraeonite	Lat. projection 7th peraeonite obsolete	Degree of Relationship
1. <i>ansatum</i>	X	O	X	O	X	unique
2. <i>vitjazi</i>	X	X	O	X	O {	
3. <i>macrum</i>	X	X	O	X	O }	related
4. <i>asperum</i>	X	X	O	O	X {	
5. <i>usher</i>	X	X	O	O	X }	related
Var. A	X	X	O	O	X	
Var. B	X	X	O	O	X	
Var. C	X	X	O	O	X	

pears to be *M. ansatum*. It belongs to Group A but lacks the lateral body spines characteristic of the species in Group A. This species is known from a single locality off Costa Rica in the eastern Pacific.

Further support to the above relationships between the abyss of the Caribbean and the Pacific is shown through the species of another isopod genus *Storothyngura*. The species *Storothyngura pulchrum* is believed by Wolff [1962] to have one subspecies, *S.p. caribbea*, in the abyss of the Caribbean and another, *S.p. pulchrum*, in the abyss of the Pacific off Central America.

The distribution of the species of *Mesosignum* and *Storothyngura* constitutes the first evidence of an interrelationship between the abyssal Caribbean and the abyssal Pacific fauna among the isopods. The species "pairs" involved all also have 1 shallow water representative extending up to 1000 m depth, as well as deeper water representatives. Other species "pairs" in the genus *Mesosignum* which are known only from water of 2000 m or greater lack Caribbean representation. A 1000-m depth across the present Isthmus of Panama would be adequate for intercommunication between Pacific and Caribbean populations. Species may have lived at shallower depths in the past.

Evolutionary rate. The presence of related species on either side of a barrier such as the Isthmus of Panama coupled with a reasonably well defined history of emergence and submergence of the Isthmus [Ekman, 1953 and references] provides one with evidence regarding evolutionary rate in a group of organisms which lack a fossil record.

In order to apply these known barriers to a concept of evolutionary rate one must accept the idea that contemporary species were derived from 1 or more ancestral types. The last or former confluence (Pliocene, 11 million years ago) between the Caribbean and the Pacific is generally accepted as a fact.

One need only imagine a similar confluence of genetic material across the Isthmus represented in the case of *Mesosignum* by 2 ancestral species, *Mesosignum* sp. "A" (belonging to group A) and *Mesosignum* sp. "B" (belonging to group B), both distributed in the Pacific and in the Caribbean. Since the formation of the last isthmian barrier *Mesosignum* sp. A (Pliocene) gives rise to *usher*i in the abyss of the Pacific and *usher*i in the abyss of the Caribbean as well as *asperum* in the Pacific abyss. Similarly *Mesosignum* sp. "B" (Pliocene) gives rise to *admirandum* in the Pacific and *kohleri* in the Caribbean.

The morphological evidence suggesting, as it does, that populations of *usher*i are the same in both oceans and that *admirandum-kohleri* represent one pair of closely related species, while *usher*i-*asperum* represents another comparable pair, is evidence for such a possible evolutionary event.

Accepting this train of thought and evidence one arrives at the emergence of 4 species from 2 species in a period of 11 million years—an average rate of species formation of two per 11 million years. Because populations of *usher*i do not appear to have differentiated we may identify *usher*i as a species having a slower evolutionary rate than *admirandum-kohleri*.

If *Mesosignum* were the only genus showing such trends one might dismiss the entire argument as due to a collection of evidence by "chance." The presence of *Storothyngura p. pulchra* in the Pacific abyss and of *S. p. caribbea* in the Caribbean abyss suggests another instance of species separation since the Pliocene. Due to the presence of small morphological features separating *S. p. pulchra* from *S. p. caribbea* and the obvious absence of contemporary gene interchange, one might effectively argue that these Pacific and Caribbean populations are specifically distinct. However, this argument forces one to conclude similarly that the Pacific and Caribbean populations of *Mesosignum usher*i are also specifically distinct even in the absence of taxonomic characteristics. The species of *Mesosignum* and *Storothyngura* thus appear to require more study before this question can be answered.

The foregoing conclusions are based upon the assumption that the species of *Mesosignum* have evolved since the last Pliocene confluence of Pacific and Caribbean water. Although this is reasonable to believe there remains the fact that the two bodies of water were similarly confluent in the Miocene, Eocene, the Cretaceous, and the Paleozoic. Thus, the differences which one sees today could result from Post Pliocene events in which case the rate of evolution in *Mesosignum* would have to be considered very slow indeed. With the present data there is no way to decide the appropriate time interval and one can, therefore, deal effectively only with the minimum figure of 11 million years.

Notwithstanding these problems it seems reasonably clear that populations of the Caribbean-Pacific species, *Mesosignum usher*i Menzies, do not appear to differ much from each other and hence have shown very little evolution since the Pliocene or some earlier geologic time.

TABLE 3. Depth-Size Correlation of *Mesosignum* Species

Species of <i>Mesosignum</i> measured	Size range of specimens measured, mm	Depth range of species, m	Number of specimens measured
<i>admirandum</i>	2.1-3.2	1016-1892	9
<i>usheri</i>	1.8-3.1	1016-4065	8
<i>kohleri</i>	2.3-2.5	2868-4076	2
<i>macrum</i>	2.8	3254-3260	1
<i>magnadens</i>	2.6	3378	1
<i>asperum</i>	1.4-1.6	3517-3950	2
<i>ansatum</i>	2.0	3777-3950	2
<i>elegantulum</i>	1.9	4000-4150	1
<i>multidens</i>	1.2-3.5	3372-6328	70
<i>brevispinis</i>	1.6	5670-5680	1
<i>vitjazi</i>	3.0	6920-7954	1

Eastern-Western Pacific Affinities

Of the 3 known abyssal species of *Mesosignum* from the western Pacific, 2 are related fairly closely to species from the eastern Pacific abyss. Thus, *elegantulum* is apparently a close relative of *multidens* and *macrum* to *vitjazi*. The third species, *brevispinis*, does not appear to be closely related to other species. The species *macrum* and *vitjazi* both belong to Group A whereas *brevispinis* and *elegantulum* belong to Group B. Wolff indicates a comparable east-west Pacific relationship between *Storothyngura p. pulchra* from the eastern Pacific and *S. p. kermadecensis* from the Kermadec Trench in the western Pacific. It is difficult to account for the close relationship of species from the eastern and western Pacific Ocean unless it is assumed that the genus was once distributed on the slope from Central America to the Philippines, or that one presumes an even less likely possibility that there exists a yet unreported deep-sea continuum of the species of the genus across the abyssal Pacific Ocean red clay from the west to the east or vice versa.

Depth and Size

Several investigators have mentioned that isopod species collected at great depths were greatly larger than the average for their genus [Wolff, 1956; Zenkevich and Birstein, 1956; Birstein, 1957; Wolff, 1962]. Several investigators also made the same observation on other abyssal animal groups [Wolff, 1962, p. 229]. No correlation indicating larger than average size was found for *Mesosignum* (Table 3). Large species were taken both in relatively shallow water (*M. admirandum*) and at great depth (*M. multidens* and *M. vitjazi*). Other isopod genera, including *Haploniscus*,

Desmosoma, *Janira*, and others mentioned by Wolff [1962] also show no apparent increase in species size correlated with depth.

Size ranges for each species, rather than simply largest body length on record (the technique used by Wolff [1962] would perhaps be better for comparative purposes. This is so because many deep sea species have been described from a single specimen. Single specimens would most probably be of intermediate sizes rather than the largest or the smallest. If only the largest recorded specimen of each species of *Mesosignum* had been considered, an apparent decrease in size at mid-depths would be found for the genus since most species from mid-depths are based on a single specimen.

It is also clear from Table 3 that *Mesosignum* is primarily a bathyal-abyssal genus, since 9 of the 11 species occur between 3000 to 6000 m deep. No species have been collected on the continental shelves, or in less than 1000 m of water. Three species occur on continental slopes between 1000 and 3000 m deep and 9 species occur on continental rises between 3000 to 6000 m deep. Only 1 species, *M. vitjazi*, was taken below 6000 m.

Latitude and Species Number

A relationship exists between latitude and species number. The majority of the species of *Mesosignum* occur between 30°N and 30°S latitude. North of 30°N there is only 1 species, *Mesosignum brevispinis* (Group B, spiny). South of 30°S there is also only 1 species, *Mesosignum usheri* (Group A, spiny). All known species except *M. brevispinis* occur between 30°N and 30°S latitude. The apparent absence of species from the continental slopes of the western Pacific Ocean is probably due to a limited amount of collecting with appropriate bottom trawls. It seems unlikely that the genus is absent there when it is well represented in the abyss of the eastern Pacific.

THE HABITAT OF MESOSIGNUM

Fig. 17 A-G

Very little is known about the habitat of *Mesosignum* or of any other abyssal creatures. During *Eltanin* Cruise 3, bottom photographs were taken coincident with 2 trawl stations which also yielded the species *Mesosignum multidens* Menzies and Frankenberg. These photographs, which are shown in Fig. 17A-G, give one at least a concept of the abyssal habitat.

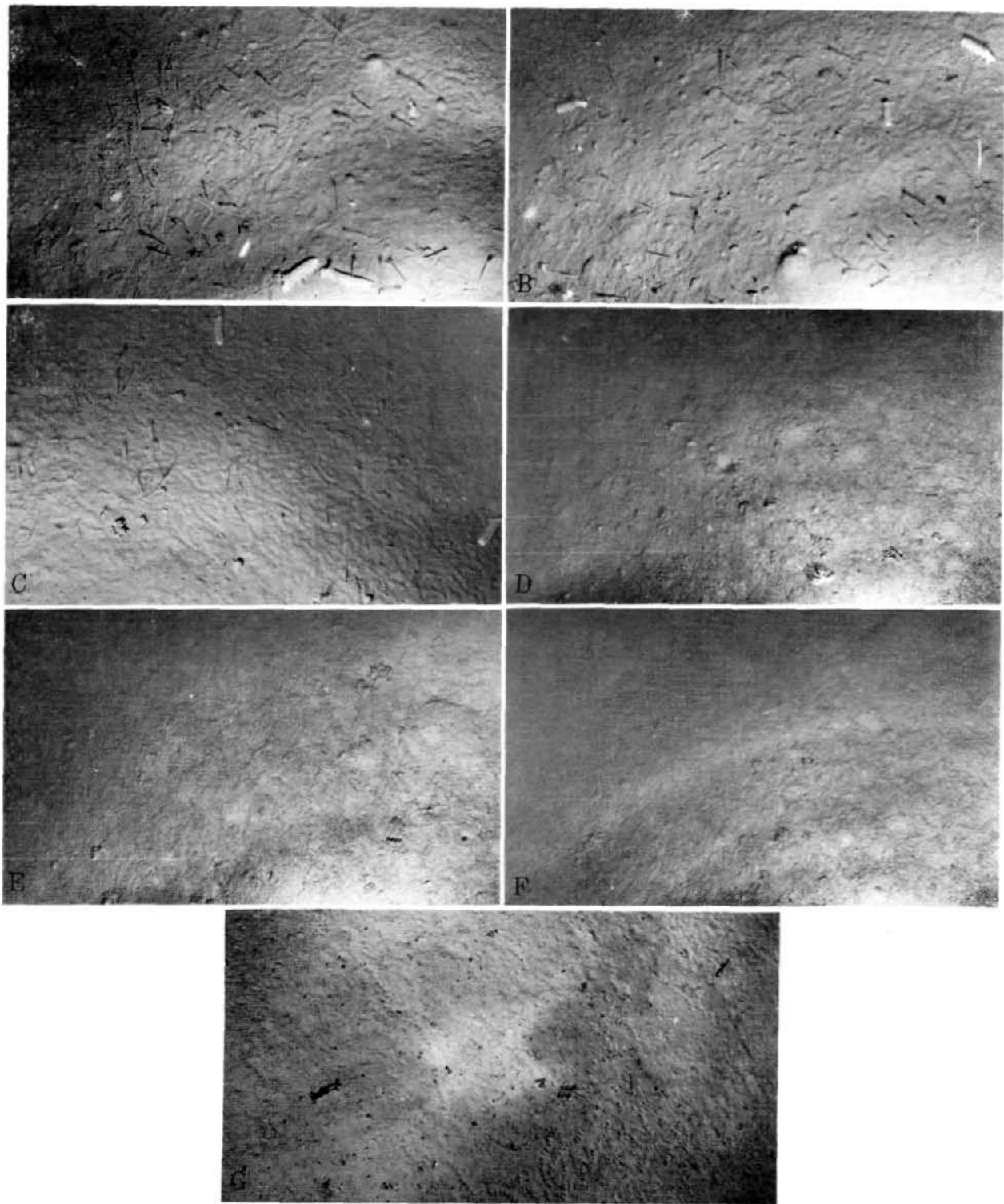


Fig. 17, A-G: Bottom photographs of the habitat of *Mesosignum*. A-C, *Eltanin* Camera Sta. 1, Cruise 3: A, frame 26 showing "maximum" abundance of life; B, frame 2 with "mean" abundance of life; C, frame 11, "least" abundance of large living things. D-F, *Eltanin* Camera Sta. 2, Cruise 3: D, frame 23, showing large animal life; E, frame 19 showing mean bottom character; F, frame 5 showing least abundance of large living things. G, *Eltanin* Camera Sta. 30, Cruise 5: Frame 13 showing average conditions.

In the description of the photographs the extremes and average conditions are represented by only 3 prints out of 24 at each station. This way one has a visual impression of the magnitude of variation in the habitat, without the necessity of having to present each photograph.

Camera Sta. 1, Cruise 3 (6026 m) coincides with Menzies Trawl, USC *Eltanin* Sta. 38-25 (5944 m). This series of 24 photographs is from the flat floor of the Peru-Chile Trench. The bottom consists of green ooze and shows polychaete tubes dominating the sea floor. The most evident large organism is a species of holothurian, *Peniagone*. Tracts and trails of various kinds are abundant. This is also a *Neopilina* locality. Figure 17A appears to show the "maximum" abundance of animal life; Fig. 17B a "mean" amount (most photos) and Fig. 17C the apparent "least" amount. None of these is significantly different from each other in general aspect and this absence of variation between photographs is a dominant feature of photographs at this station.

Camera Sta. 2, Cruise 3 (3447 m) coincides with Menzies Trawl, USC *Eltanin* Sta. 40 (3372-3493 m). Figure 17D shows one of the few exposures having an example of large animal life, Fig. 17E shows an approximate "mean" condition, and Fig. 17F shows a "minimal" view of indications of living things. As with Sta. 1, the 24 photographs showed little in the

way of significant variation. The photos from Sta. 2 were taken along the eastern wall of the Peru-Chile Trench. The sediments appear generally coarser here than those from the floor of the trench and show holes as well as considerable abundance of large clumps of organic or inorganic materials. The density of animal life and the abundance of animal life shown at Sta. 1 are much more than that at Sta. 2. In Sta. 2 tracks were infrequent.

The species *Mesosignum multidentis* was found at both stations, showing a depth range from 3447 to 5944 m as well as a faunal association that must be very different at the 2 stations.

Camera Sta. 30, Cruise 5, coincides with a sample from which *Mesosignum usheri* Menzies Var. "B" (Sta. USC 322-25) was obtained. Only one photo from 1767 m (Fig. 17G) has been reproduced here because each exposure was about the same in showing an abundance of animal tracks and considerable debris. One exposure showed a bottom fish and another a shrimp (Fig. 17G), suggesting a high benthic productivity. The sediments consisted of foraminiferal silt with 64.32% sand and 17.08% clay. The organic carbon was 0.74% and the C/N ratio 66.9.

Acknowledgments. This research has been supported by the Sapelo Island Research Foundation of the University of Georgia and, in addition, by funds from NSF Grant G-71 to the senior author.

LIST OF STATIONS AND SPECIES OF *MESOSIGNUM* FOUND AT EACH

(A Menzies Trawl was the gear used at each of the listed *Vema* and *Eltanin* Stations)

Vema Stations, Cruise 15, 1958-1959:

- V-15-5; Atlantic Ocean, Caribbean Sea, near Windward Passage; Lat. 20°30'N, Long. 73°16'W; Nov. 4, 1958; 3378 m. *M. magnadens*.
 V-15-9; central part of Colombian Plain; Lat. 14°05'N, Long. 75°25'W; Nov. 7, 1958; 4071 m. *M. kohleri*.
 V-15-10; central part of Colombian Plain; Lat. 14°05'N, Long. 75°25'W; Nov. 7, 1958; 4071 m. *M. kohleri*.
 V-15-11; central part of Colombian Plain; Lat. 14°05'N, Long. 75°25'W; Nov. 7, 1958; 4076 m. *M. kohleri*.
 V-15-12; Continental Rise northwest of Cartagena, Colombia; Lat. 11°30'N, Long. 75°50'W; Nov. 8, 1958, 2868-2875 m. *M. kohleri*.
 V-15-13; Continental Rise northwest of Cartagena, Colombia; Lat. 11°30'N, Long. 75°50'W; Nov. 8, 1958; 2875-2941 m. *M. kohleri*; *M. usheri*.
 V-15-16; Atlantic Ocean, Caribbean Sea, off Colon, Panama; Lat. 10°11'N, Long. 78°30'W; Nov. 9, 1958; 1615-1533 m. *M. usheri*, Var. "A."
 V-15-46; Pacific Ocean, off Costa Rica; Lat. 09°22'N, Long. 89°33'W; Nov. 20, 1958, 3517-3528 m. *M. asperum*.

- V-15-48; Pacific Ocean, off Costa Rica; Lat. 10°07'N, Long. 89°50'W; Nov. 21, 1958; 3718 m. *M. asperum*.
 V-15-55; Pacific Ocean, off Nicaragua; Lat. 12°45'N, Long. 88°38'W; Nov. 24, 1958; 3950-3777 m. *M. ansatum*; *M. asperum*.
 V-15-60; Pacific Ocean, off Costa Rica; Lat. 06°21'N, Long. 85°17'W; Nov. 30, 1958; 1892-1016 m. *M. admirandum*; *M. usheri*, Var. "C."
 V-15-61; Pacific Ocean, off Costa Rica; Lat. 04°15'N, Long. 85°06'W; Dec. 1, 1958; 3260-3254 m. *M. macrum*.
 V-15-62; Pacific Ocean, off Ecuador; Lat. 01°30'S, Long. 82°19'W; Dec. 3, 1958; 1363-1369 m. *M. admirandum*.
 V-15-64; Pacific Ocean, off Peru, Peru-Chile Trench; Lat. 06°08'S, Long. 82°41'W; Dec. 5, 1958; 4052-4050 m. *M. multidentis*.
 V-15-65; Pacific Ocean, off Peru, Peru-Chile Trench; Lat. 07°35'S, Long. 81°24'W; Dec. 6, 1958; 5825-5841 m. *M. multidentis*.
 V-15-69; Pacific Ocean, off Peru, Peru-Chile Trench; Lat. 10°13'S, Long. 80°05'W; Dec. 9, 1958; 6324-6328 m. *M. multidentis*.

- V-15-70; Pacific Ocean, off Peru, Peru-Chile Trench; Lat. 10°02'S, Long. 80°21'W; Dec. 10, 1958; 5490-5666 m. *M. multidentis*.
- V-15-71; Pacific Ocean, off Peru, Peru-Chile Trench; Lat. 10°07'S, Long. 80°57'W; Dec. 11, 1958; 4661-4723 m. *M. multidentis*.
- V-15-74; Pacific Ocean, off Peru, Peru-Chile Trench; Lat. 07°32'S, Long. 81°26'W; Dec. 19, 1958; 5759-5760 m. *M. multidentis*.
- V-15-87; Pacific Ocean, off Chile; Lat. 35°44'S, Long. 76°22'W; (no date); 4065 m. *M. usheri*, Var. "A."
- Eltanin* Stations, Cruises 3 and 5, 1962:
- USC-30-8; Pacific Ocean, off Ecuador; Lat. 00°00'; Long. 81°45'W; June 4, 1962; 1174-1196 m. *M. admirandum*.
- USC-38-25; Pacific Ocean, off Peru, Peru-Chile Trench; Lat. 08°04'S, Long. 81°09'W; June 8, 1962, 5944 m. *M. multidentis*. At approximately this position, photographs of the bottom were taken, *Eltanin* Camera Sta. 1, Cruise 3, Lat. 08°17'S, Long. 81°06'W; June 7, 1962; 6026 m. Fig. 17A-C pictures the animal life present on a green ooze bottom.
- USC-40; Pacific Ocean, off Peru, Peru-Chile Trench; Lat. 13°10'S, Long. 77°56.5'W; June 11, 1962; 3372-3493 m. *M. multidentis*. At approximately this position, photographs of the bottom were taken, *Eltanin* Camera Sta. 2, Cruise 3, Lat. 13°10'S, Long. 77°56.5'W; June 11, 1962; 3447 m. Fig. 17D-F pictures the animal life present on a yellowish olive-green ooze bottom.
- USC-43; Pacific Ocean, off Peru, Peru-Chile Trench; Lat. 13°18.5'S, Long. 78°03.7'W; June 12, 1962; 5138-5328 m. *M. multidentis*.
- USC-63-41; Pacific Ocean, off Chile; Lat. 25°44'S, Long. 70°58'W; June 21, 1962; 1861 m. *M. usheri*, Var. "B."
- USC-65-55; off Taltal, Chile; Lat. 25°43'S, Long. 71°07'W; June 21, 1962; 3255-3147 m. *M. usheri*, Var. "A."
- USC-322-25; off southwest coast of Patagonia; Lat. 56°04'S, Long. 71°13.1'W, to Lat. 56°04.5'S, Long. 71°09.1'W; Nov. 7, 1962; 1805-2012 m. *M. usheri*, Var. "B." At approximately this position, photographs of the bottom were taken, *Eltanin* Camera Sta. 30, Cruise 5, Lat. 56°04'S, Long. 70°20.5'W; Nov. 7, 1962; 1767 m. Fig. 17G pictures the animal life present on a foraminiferal silt bottom.
- Vitjaz* Stations (Russian), 1954-1957:
- 3114; southeast of Kurile Islands; Lat. 48°50.8'N, Long. 160°01'W; 1954, 5670-5680 m. *M. brevispinis*.
- 3520; south of Osaka, Japan; Lat. 28°53.5'N, Long. 137°21.1'W; 1955; 4150-4000 m. *M. elegantulum*.
- 3655; Bougainville Trench; Lat. 05°94'04"S, Long. 152°53'04"E; 1957; 6920-7954 m. *M. vitjazi*.

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