

Copepod Parasites of Commercial Bivalves from Korea
I. Two New Poecilostomatoid Species from *Solen grandis* Dunker
in the Yellow Sea

Kim, Il-Hoi and Ho, Ju-Shey*

(Department of Biology, Kangreung National University, Kangreung 210-702, Republic of Korea;

* Department of Biology, California State University, Long Beach, California 90840, U.S.A.)

한국산 식용 이매패류에 기생하는 요각류 1. 황해의 죽합
(*Solen grandis* Dunker)에 기생하는 요각류 2신종

김 일 회 · 주세이 호*

(강릉대학 생물학과 · *미국 롱비치 캘리포니아주립대학 생물학과)

요 약

전라북도 동진강 어귀의 황해 연안에서 잡힌 식용 이매패류인 죽합, *Solen grandis* Dunker에 기생하는 요각류 2신종, *Leptinogaster digita* n. sp. 및 *Herrmannella soleni* n. sp.를 기재한다.

Key words: *Leptinogaster digita* n. sp., *Herrmannella soleni* n. sp., Poecilostomatoidea, Copepoda.

Recently, Suh & Choi (1990) recorded two species of copepods, *Pseudomyicola spinosus* (Raffaele & Monticelli) and *Modiolicola bifidus* Tanaka, from the blue mussel *Mytilus galloprovincialis* taken from the estuary of Yongsan River located near southwestern tip of Korean Peninsula. As far as we know, it was the first report of copepods from Korean molluscs.

In the past few years, one of us (IHK) has examined more than 50 species of Korean molluscs and

*This is a part of the study that was supported by a grant (901-0409-001-1) from the Korea Science and Engineering Foundation.

has found nearly half of them being infested with copepods, which consisted of about 30 species, including many new or incompletely described species.

In this paper, we shall deal with two new species that were recovered from the bivalve *Solen grandis* Dunker collected from muddy shore near the Tongjin River located in the southwest Korea (facing the Yellow Sea).

The specimens were dissected and measured in lactic acid. All figures were drawn with the aid of a camera lucida.

Order Poecilostomatoidea Thorell, 1859

Family Clausidiidae Embleton, 1901

Leptinogaster digita, new species

(Figs. 1-3)

Material examined: 23 ♀♀ and 6 ♂♂ recovered from washings of 50 specimens of *Solen grandis* Dunker bought from fish market at Puan (located in mid-southern Korea facing Yellow Sea), on Oct. 22, 1990, by I.-H. Kim. Holotype ♀, allotype and undissected paratypes (17 ♀♀, 3 ♂♂) are deposited in the U.S. National Museum of Natural History, Smithsonian Institution.

Female: Body (Fig. 1A) 4.23 mm long (3.97-4.50 mm, excluding setae of caudal rami) and greatest width 1.05 mm (1.00-1.13 mm), based on 6 specimens. Body 9-segmented, elongate and flattened dorsoventrally. Cephalosome slightly wider than long, covered with numerous spinules ventro-laterally, with several discoid structures (sucking discs?) on each side of oral region (Fig. 2A). Rostral area broad and flat. Urosome 5-segmented, 1.2 times longer than prosome. Somite bearing leg 5 with transverse group of spinules on ventral surface (Fig. 1B). Genital somite wider anteriorly, 1.1 times as wide as long, with peculiar protrusion in genital area (Fig. 1C). This protrusion appearing finger-like in dorsal view (Fig. 1C), but broadly expanded ventrally at basal portion (Fig. 1D), leaving only dorsal part protruding out into a knob; posterior surface of expanded area covered with minute granules. Genital area (Fig. 1C) located dorso-laterally at anterior one-third of the somite, with 2 small setae. Anal somite about 1.75 times as long as wide, armed ventrally with 2 patches of spinules on both proximal and distal areas.

Caudal ramus (Fig. 1E) elongate, about 7.5 times as long as wide and about 1.4 times as long as anal segment, with a patch of spinules on distal portion of ventral surface. All 6 setae naked. Outer lateral seta positioned at anterior 0.43 of rami. Of the two terminal setae inner one 1.27 mm long, about twice as long as the outer.

First antenna (Fig. 1F) 6-segmented, segments gradually narrowing toward terminal end. Setal formula: 4, 15, 9, 4+1 aesthete, 2+1 aesthete, and 7+1 aesthete. All aesthetes weakly developed and tapering. Terminal segment longer than penultimate segment.

Second antenna (Fig. 1G) 4-segmented. First segment with 1 seta on inner distal corner, a group of setules on inner median margin, and a tubercle on outer median margin. Second segment with 1 short seta on antero-ventral margin and a number of obtuse spines on anterior margin of distal half. Third segment with 2 strong, clawlike spines; proximal spine curved ventrally and accompanied basally by a small seta; anterior margin armed with obtuse spines. Terminal segment short, 1.2 times as broad as long, with 3 long recurved setae and 1 short seta.

Labrum (Fig. 2B) with crenated ventral margin.

Mandible (Fig. 2C) with 2 denticulate, crown-like elements and 1 long distal, spinule-covered element.

Paragnath (Fig. 2D) bearing a trifurcate group of leaf-like spines.

First maxilla (Fig. 2E) with 3+2 setae.

Second maxilla (Fig. 2F) large, 2-segmented. First segment with patch of spinules on outer surface. Second segment hook-like, with 1 short, thick seta on ventral margin, 1 pointed process on inner dorsal margin,

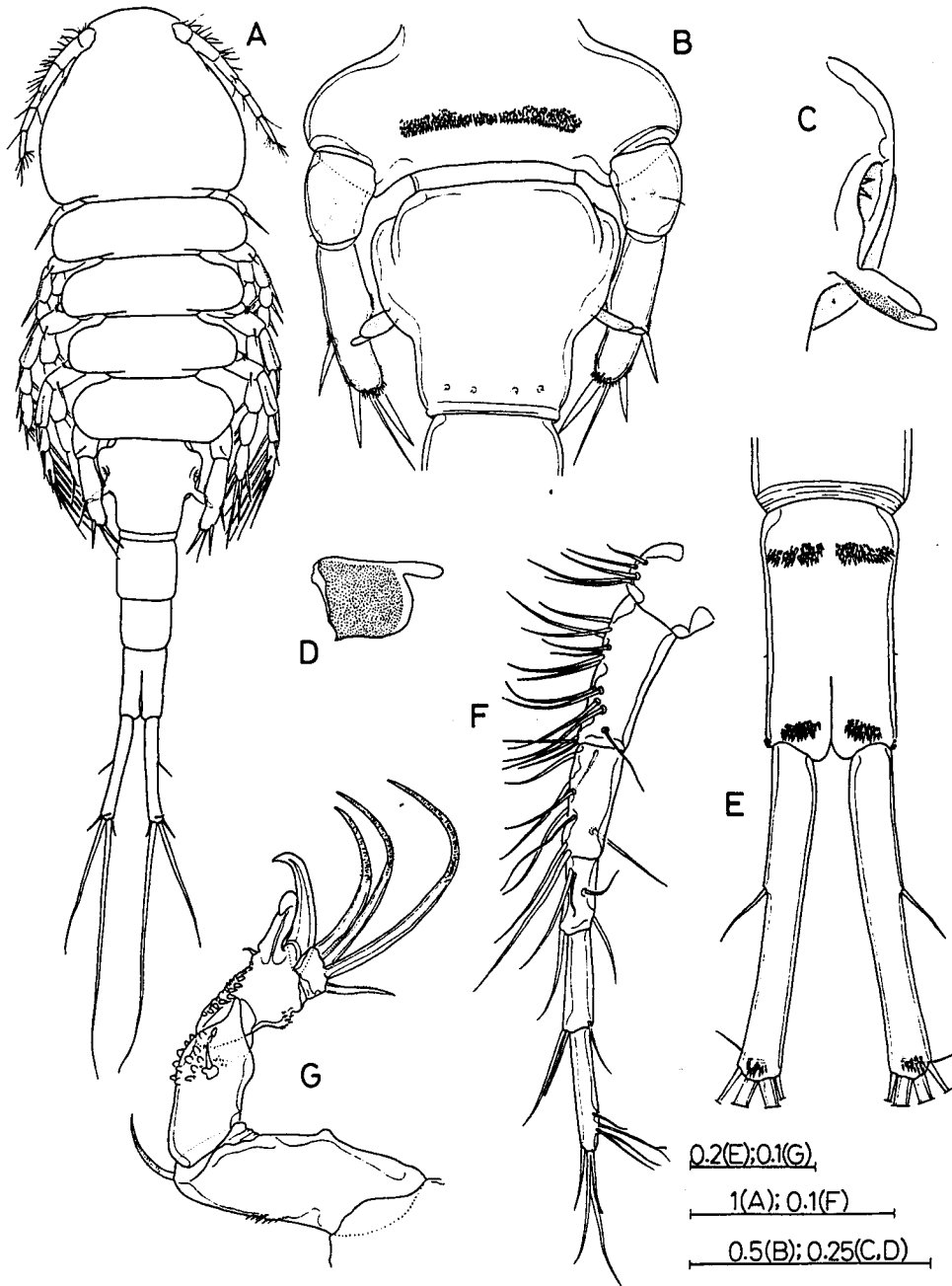


Fig. 1. *Leptinogaster digita* n. sp. Female. A, habitus, dorsal; B, segment bearing leg 5 and genital somite; C, genital area, right dorsal; D, protrusion on genital somite, posterior; E, anal somite and caudal rami, ventral; F, first antenna; G, second antenna. Unit of scales: mm.

and row of 5-6 minute spinules on both dorsal and ventral sides of distal area.

Maxilliped (Fig. 2G) rudimentary, but discernible, 70-90 μm long, and indistinctly 3-segmented. Both first and second segments with 1 seta on inner margin. Terminal segment variable in shape, usually tapered and longer than wide.

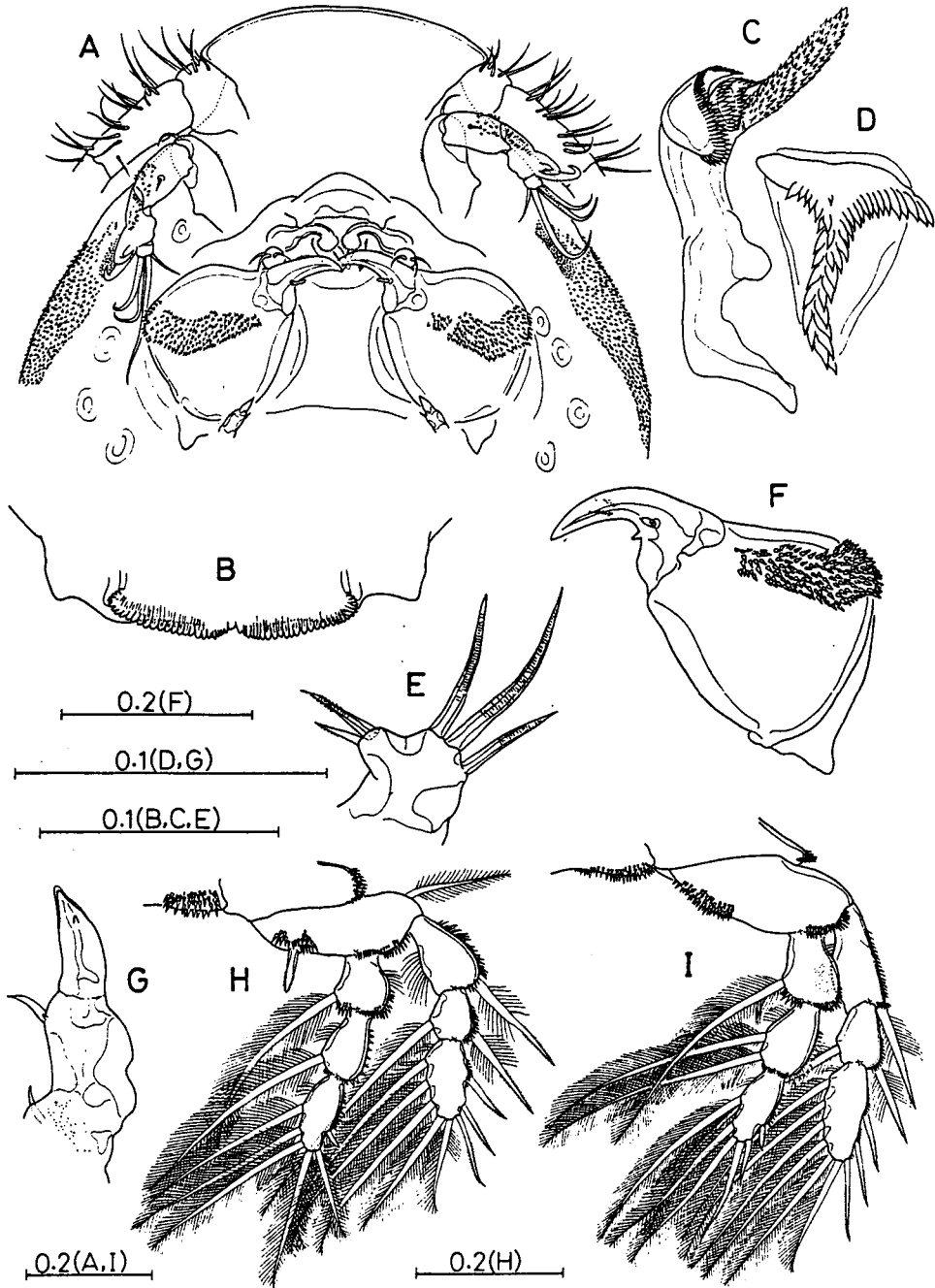


Fig. 2. *Leptinogaster digita* n. sp. Female. A, cephalic area, ventral; B, labrum, ventral; C, mandible; D, paragnath, ventral; E, first maxilla; F, second maxilla; G, maxilliped; H, leg 1; I, leg 2. Unit of scales: mm.

Legs 1-4 (Figs. 2H-I: 3A, B) with 3-segmented exopods and endopods. Intercoxal plates armed with several rows of spinules on ventral margin. Coxae with outer distal spinules. Basis with spinules on inner ventral and outer ventral margins. Leg 1 conspicuously smaller than remaining 3 pairs. Armature of legs 1-4 as follows (Roman numerals indicate spines, and Arabic numerals, setae).

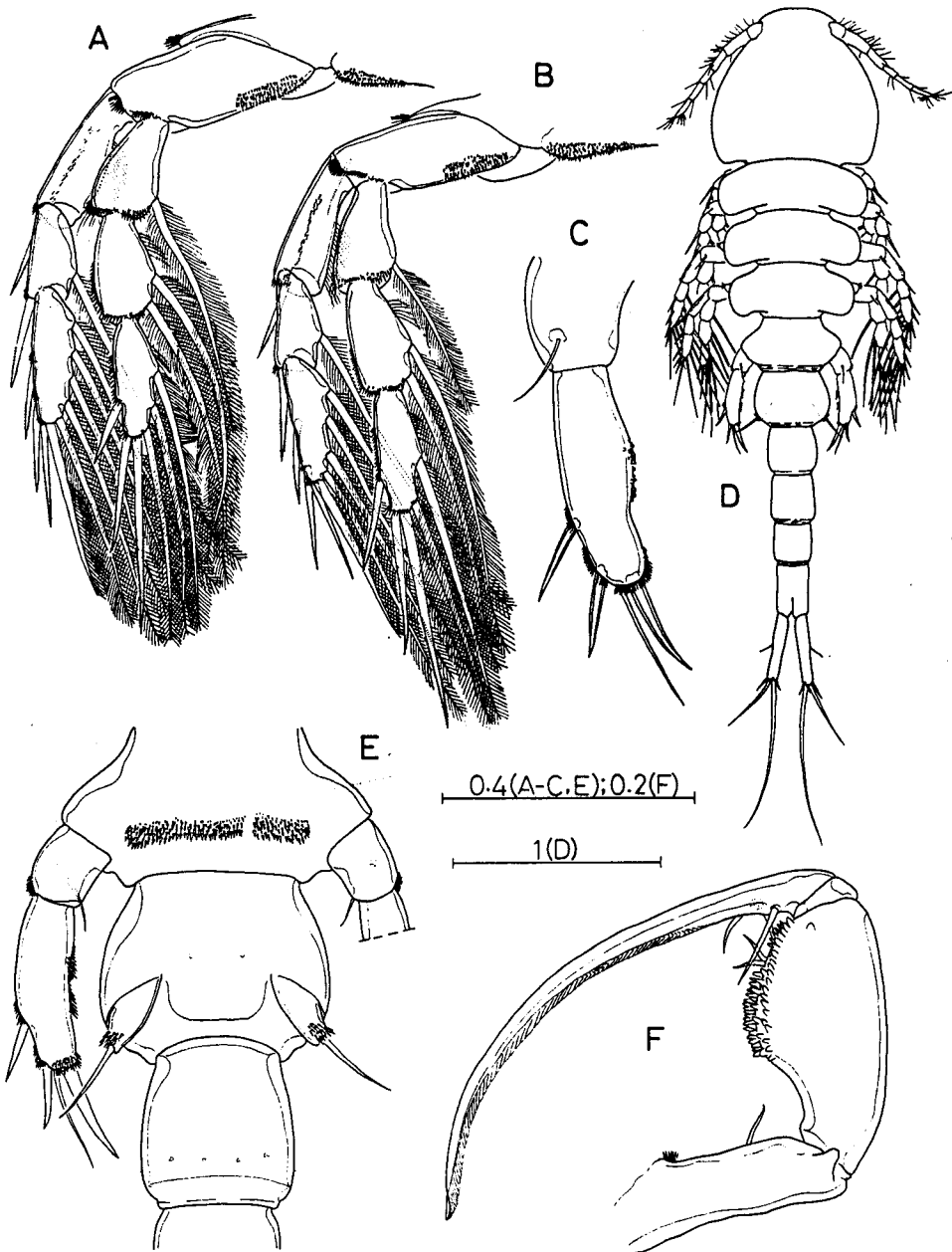


Fig. 3. *Leptinogaster digita* n. sp. Female. A, leg 3; B, leg 4; C, leg 5. Male. D, habitus, dorsal; E, anterior part of urosome, ventral; F, maxilliped. Unit of scales: mm.

- P1: Prp 0-0; 1-1 Exp I-0; I-1; III, 5
 Enp 0-1; 0-1; I, 5
- P2 & P3: Prp 0-0; 1-0 Exp I-0; I-1; III, 6
 Enp 0-1; 0-2; III, 3
- P4: Prp 0-0; 1-0 Exp I-0; I-1; III, 5
 Enp 0-1; 0-2; III, 3

Leg 5 (Fig. 3C) 2-segmented. First segment as long as wide, with smooth outer seta. Second segment elongate, 3 times as long as wide, widest at middle, with 3 smooth spines and 1 long seta; Distal half of second segment with spinules on outer and distal margins; inner median margin with obtuse spinules.

Leg 6 (Fig. 1C) represented by 2 setae on genital area.

Male: Body (Fig. 3D) 3.26 mm long (2.97-3.91 mm), based on 4 specimens. Body form similar to that of female but 10-segmented. Ratio of prosome to urosome 1:1.2. Genital somite (Fig. 3E) about 1.3 times as wide as long. First and second antennae, labrum, mandible, paragnath, first and second maxillae, and legs 1-4 as in female.

Caudal rami as in female but with different ratio of length to width (5.4:1).

Maxilliped (Fig. 3F) 3-segmented excluding claw. First segment with 1 inner seta and proximal setules. Second segment convex on inner side, with 2 setae and 4 or 5 rows of spines. Third segment short and unarmed. Claw longer than preceding 3 segments combined, with 3 proximal setae. Concave margin of claw striated.

Etymology: The specific name *digita* (from Latin *digitus* = finger) alludes to the presence of digitiform protrusion on the female genital segment.

Comparison with other species: This is the first species of *Leptinogaster* from the Western Pacific. Of the eight known species, following four have 5 elements (3+2) on the first maxilla as in the new species: *L. californiensis* Gooding, 1963, *L. dentata* (Humes & Cressey, 1958), *L. inflata* (Allen, 1956) and *L. major* (Williams, 1907). Two of these four species have 2 claws on the third segment of second antenna as in *L. digita*. These two species, *L. dentata* and *L. major*, are known from the Atlantic, with relatively smaller body. Their body lengths in the female are 0.984-1.200 mm in *L. dentata* (Humes and Cressey, 1958) and 1.92-2.45 mm in *L. major* (Humes, 1986), whereas it is 3.97-4.50 mm in the new species. Moreover, these two species have only 1 seta on the second endopod segment of leg 4, rather than 2 as in the new species. The possession of a digitiform protrusion on the female genital segment in *L. digita* is unique in *Leptinogaster*, although its function is unknown. It is noteworthy that *L. digita* has the most developed maxilliped for the female *Leptinogaster*.

Family Sabelliphilidae Gurney, 1927

Herrmannella soleni, new species

(Figs. 4, 5)

Material examined: Twenty-six ♀♀ and 9 ♂♂ recovered from washings of 50 specimens of *Solen grandis* (together with *Leptinogaster digita* n. sp.). Collection data same for *Leptinogaster digita* n. sp. Holotype ♀, allotype and paratypes (23 ♀♀ and 7 ♂♂) and deposited in the U.S. National Museum of Natural History, Smithsonian Institution.

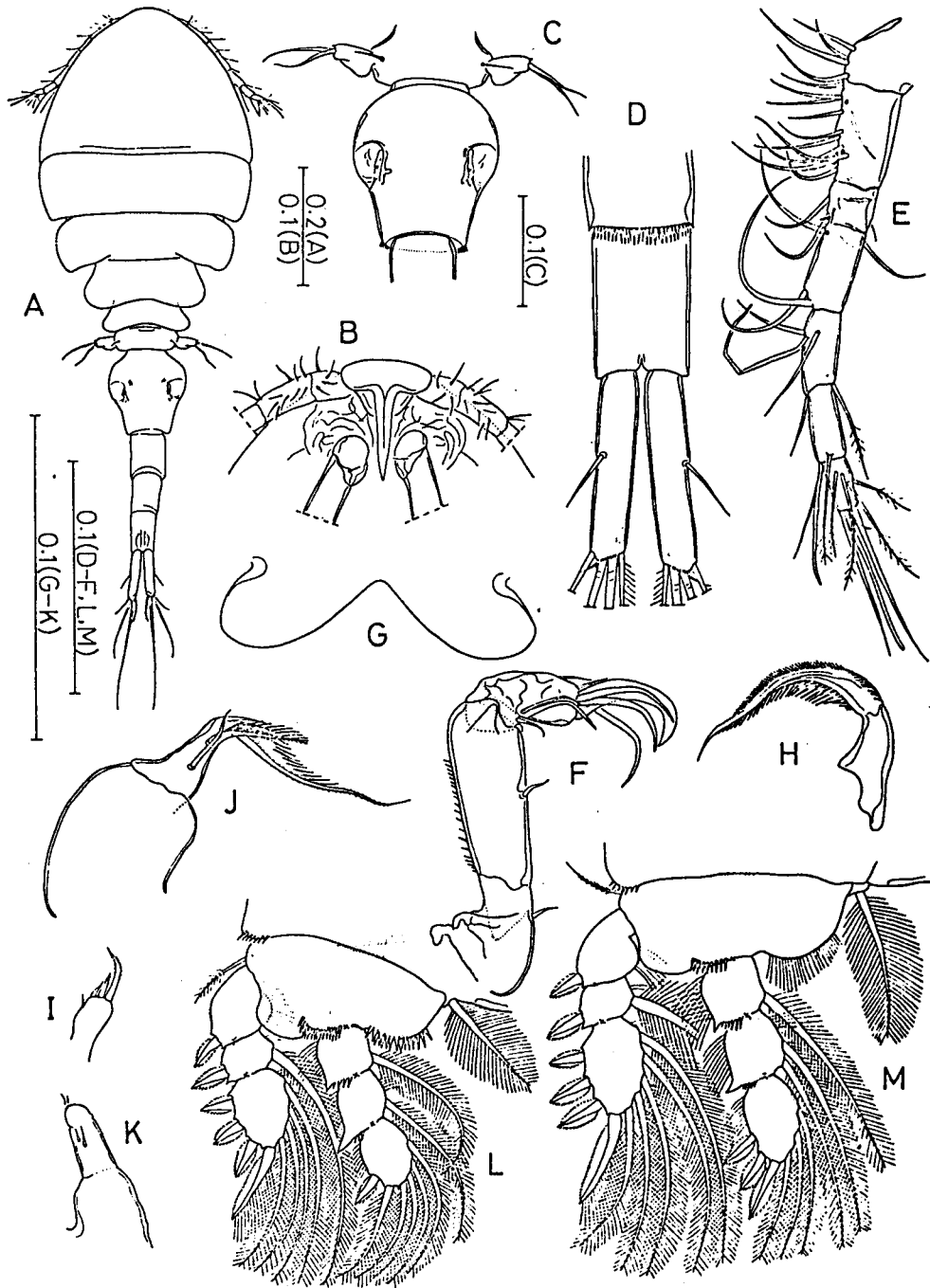


Fig. 4. *Herrmannella soleni* n. sp. Female. A, habitus, dorsal; B, rostral area, ventral; C, segment bearing leg 5 and genital somite, dorsal; D, anal somite and caudal rami, ventral; E, first antenna; F, second antenna; G, labrum; H, madible; I, first maxilla; J, second maxilla; K, maxilliped; L, leg 1; M, leg 2. Unit of scales: mm.

Female: Body (Fig. 4A) 0.98 mm long, excluding setae on caudal rami, based on 5 specimens. Maximum width 0.35mm. Ratio of length to width of body 2.80:1. Ratio of length of prosomes to that of urosome

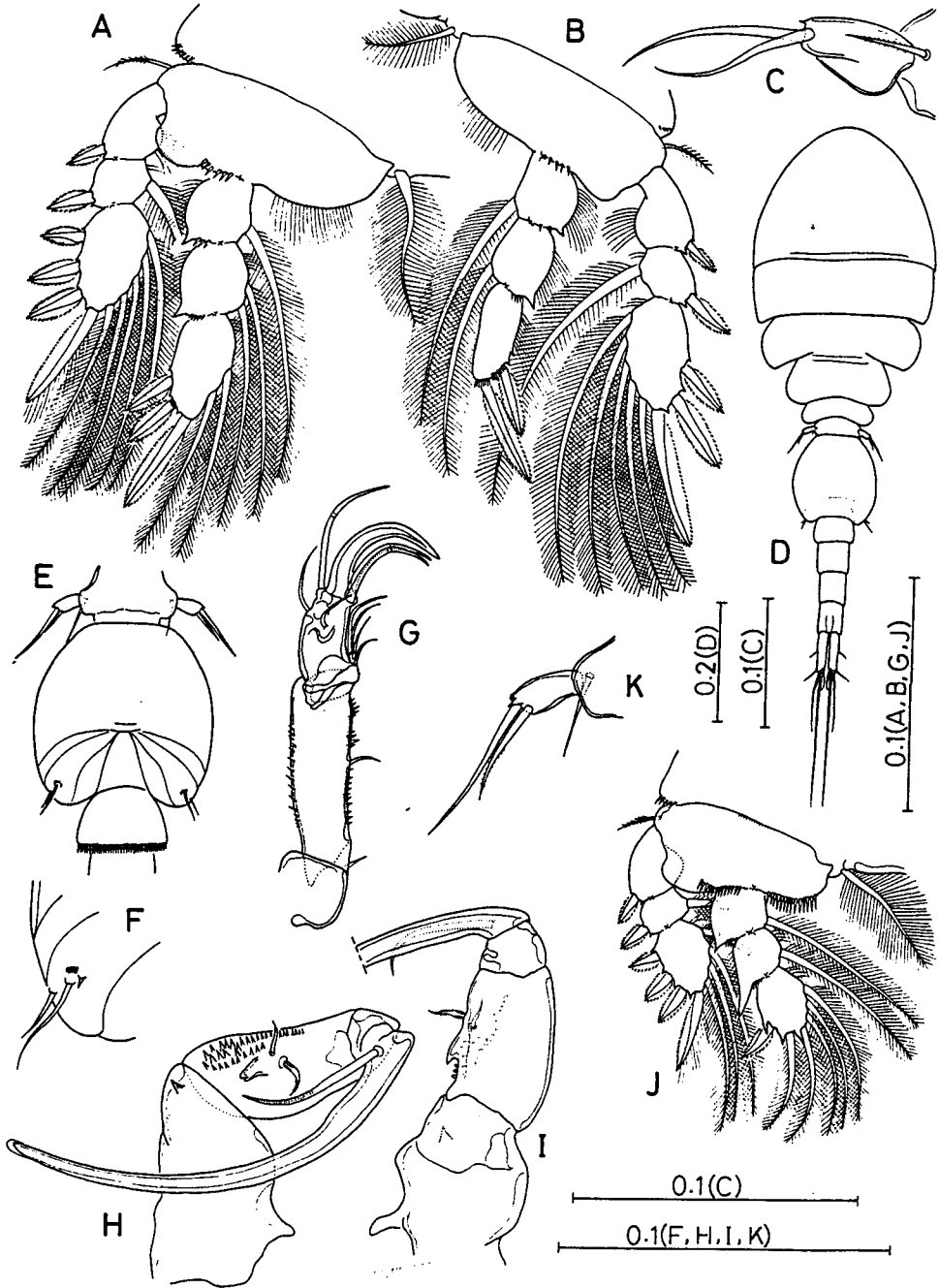


Fig. 5. *Hermannella soleni* n. sp. Female. A, leg 3; B, leg 4; C, Leg 5, dorsal. Male. D, habitus, dorsal; E, genital somite, ventral; F, area of leg 6; G, second antenna; H, I, maxilliped; J, Leg 1; K, leg 5, ventral. Unit of scales: mm.

1.20:1. Rostrum (Fig. 4B) with pointed beak of 770 μ m long. Genital segment (Fig. 4C) 1.15 times as long as wide, with maximum width at anterior two-fifths. Genital area located dorso-laterally, with 1 seta and 1 minute spinule. Three postgenital somites with ratios of length to width 1.13:1, 1.50:1, and 1.50:1, respectively, from anterior to posterior. Posteroventral borders of genital somite and first two postgenital somites fringed with row of spinules.

Caudal ramus (Fig. 4D) about 5.3 times as long as wide. Outer lateral seta 40 μ m long, located at anterior 0.45 of ramus. Dorsal seta 22 μ m. Outermost terminal seta 33 μ m. Innermost terminal seta 47 μ m. All setae naked except for innermost terminal seta which is plumose on inner side. Two median setae measuring 105 μ m (outer) and 195 μ m (inner). Distoventral border of ramus finely spinulate.

First antenna (Fig. 4H) slender and bipectinate. First maxilla (Fig. 4I) with 4 elements. Second maxilla (Fig. 4J) with unornamented first segment; second segment with 1 seta and 1 barded spine, and terminated in spinulate lash. Maxilliped (Fig. 4K) indistinctly 3-segmented; second segment with 2 setules; third segment globular, with 2 setules.

Legs 1-4 (Figs. 4L, M, 5A, B) with 3-segmented exopods and endopods. Inner margin of basis with a row of hairs, but in leg 1 this area spinulated. Leg 4 with 2 spiniform processes on outer lateral margin of terminal endopod segment. Armature of legs 1-4 as follows:

P1: Prp 0-1; 1-0 Exp I-0; I-1; III, I, 4
 Enp 0-1; 0-1; I, 5
 P2: Prp 0-1; 1-0 Exp I-0; I-1; III, I, 5
 Enp 0-1; 0-2; III, 3
 P3: Prp 0-1; 1-0 Exp I-0; I-1; III, I, 5
 Enp 0-1; 0-2; III, 2
 P4: Prp 0-1; 1-0 Exp I-0; I-1; II, I, 5
 Enp 0-1; 0-1; II

Leg 5 (Fig. 5C) with 1 spiniform process on anterodistal corner of free segment. Free segment expanded proximally. Two terminal setae naked, almost equal in length, one of which slightly twisted.

Leg 6 represented by 1 seta and 1 minute spinule in area of egg sac attachment.

Male: Body (Fig. 5D) as in female but slightly shorter, length 0.87 mm and greatest width 0.29 mm. Ratio of length to width of body 3.0:1. Ratio of length of prosome to that of urosome 1.18:1. Genital somite (Fig. 5E) almost globular, 1.15 times longer than wide. Caudal ramus 6.8 times longer than wide, all setae naked.

First antenna similar to that of female, but 3 aesthetes added (at points indicated by dark spots in Fig. 4E). Formula of armature: 4, 13 + 2 aesthetes, 6, 3 + 1 aesthete, 4 + 1 aesthete, 2 + 1 aesthete, 7 + 1 aesthete.

Second antenna (Fig. 5G) with formula of 1, 2, 4, 5 + 1 claw. Second segment with row of spinules on both inner and outer margins.

Labrum, mandible, first and second maxillae as those of female. Maxilliped (Figs. 5H, I) with 1 process near inner distal corner of proximal segment. Second segment with 2 setae, 3 rows of spinules, and 1 conspicuous process ramified at tip. Third segment unarmed. Claw longer than preceding 3 segments combined, with 1 proximal seta.

Leg 1 (Fig. 5J) as that of female, but inner processes on second and third segments of endopod more

developed. Legs 2-4 as in female. Free segment of leg 5 (Fig. 5K) smaller and broader distally, with 1 spiniform process and setules near anterodistal corner; two distal setae unequal in length. Leg 6 (Fig. 5F) represented by 1 longer (inner) and 1 shorter (outer) setae; longer seta accompanied with 1 spiniform process and 1 transverse row of minute spinules near base of the seta.

Etymology: The specific name *soleni* is taken after the generic name of the host species, *Solen grandis* Dunker.

Comparison with other species: Humes and Stock (1973) recognized 16 species of *Herrmannella* in their revision of Lichomolgoidea, and thereafter 3 species were added by Avdeev (1975). Thus the new species should be compared with these 19 species.

Herrmannella soleni n. sp. can be easily differentiated from other known species with the following set of diagnostic characters: (1) small body (not more than 1.1 mm in length); (2) rostrum with pointed beak; (3) long caudal rami (ratio of length to width more than 5:1); (4) slender second antenna; (5) terminal segment of leg 4 with 2 lateral spiniform processes; (6) free segment of female leg 5 with proximal expansion and 2 distal, nearly equal, naked setae.

Seven species of *Herrmannella*, other than the new species, have their free segments of female leg 5 with proximal expansion, they are: *H. barneae* (Pelseneer, 1929), *H. dissidens* (Humes, 1970), *H. longicauda* Avdeev, 1975, *H. inflatipes* (Humes & Cressey 1958), *H. perplexa* (Illg, 1949), *H. rostrata* Canu, 1891 and *H. saxidomi* (Illg, 1949). Four of them (*H. dissidens*, *H. longicauda*, *H. rostrata* and *H. saxidomi*) have their rostrum equipped with a pointed beak as the new species. However, these four species can be easily separated from the new species in the following manners: shorter caudal rami (ratio 2.58:1) and broader second antenna in *H. dissidens*; larger body (2.15 mm in female) and longer leg 5 in *H. longicauda*; broader second antenna and the nature of the setae on free segment of leg 5 (one of the two is compound seta) in *H. rostrata*; and no spiniform process on the terminal segment of endopod of leg 4 and having proximal 4 segments swollen in the first antenna in *H. saxidomi*.

ABSTRACT

Two new poecilostomatoid copepods, *Leptinogaster digita* n. sp. and *Herrmannella soleni* n. sp., parasitic in a bivalve *Solen grandis* Dunker, are described from the Yellow Sea coast of southwest Korea.

REFERENCES

- Avdeev, G. V., 1975. Tri novykh vida kommendal'nykh copepod roda *Herrmannella* Canu (Cyclopoida, Sabelliphilidae) ot Bivalvia v zalive Petra Velikogo. Izv. tikhookean. nauchno-issled. Inst. ryb. Khoz. Okeanogr., **88**: 222-232, figs. 1-6 (in Russian).
- Humes, A. G., 1986. copepodids and adults of *Leptinogaster major* (Williams, 1907), a poecilostomatoid copepod living in *Mya arenaria* L. and other marine bivalve mollusks. Fishery Bulletin, **85**, 2 : 227-244.
- Humes, A. G. and R. F. Cressey, 1958. Copepod parasites of mollusks in West Africa. Bull. Inst. Fr. Afr. Noire, **20** (A): 921-942.

- Humes, A. G. and J. H. Stock, 1973. A revision of the family Lichomolgidae Kossmann, 1877, cyclopoid copepods with marine invertebrates. *Smithson. Contrib. Zool.*, **127**: 1-368.
- Suh, H. L. and S. D. Choi, 1990. Two copepods (Crustacea) parasitic on the blue mussel, *Mytilus galloprovincialis*, from the Yongsan River Estuary in Korea. *Bull. Korean Fish. Soc.*, **23**, 2 : 137-140.

RECEIVED: 19 FEBRUARY 1991

ACCEPTED: 27 APRIL 1991