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Trachelipodidae (Crustacea, Isopoda, Oniscidea) from Taiwan

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ABSTRACT

Seven species of trachelipodid isopods are recorded from Taiwan. A new species, *Agnara ferrarai,* is described. *Nagurus verhoeffi* (Arcangeli, 1952) and *Lucasioides isseli* (Arcangeli, 1927) are redescribed and illustrated. Generic position of *Porcellio (Lucasius) delvecchioi* Arcangeli, 1927 is discussed.

Key words: Terrestrial Isopoda, Trachelipodidae, *Agnara ferrarai*, n. sp., Taiwan.

INTRODUCTION

In spite of the recent advances on the terrestrial Isopoda fauna of Taiwan (Kwon and Jeon, 1993; Wang and Kwon, 1993), the family Trachelipodidae (= Trachelipidae) has received very little attention. We could find only three papers which dealt with the trachelipodids of Taiwan. Budde-Lund (1913) recorded *Nagara nana* Budde-Lund, 1908 (= *Nagurus nanus*) from Takao (= Kaohsiung). Arcangeli (1927) recorded six species of terrestrial isopods from Taiwan, including a single trachelipodid, *Porcellio (Lucasius) delvecchioi*. The other contribution was given by Verhoeff (1928) who described *Nagara formosana* and *N. incisa* which have subsequently been synonymized with *Nagurus nanus* (Budde-Lund, 1908) and *N. cristatus* (Dollfus, 1889), respectively (Ferrara and Taiti, 1982).

This contribution deals with the trachelipodid material that was collected from Taiwan in 1992-1994 and is deposited in the Department of Biology, Inje University, Kimhae. The holotype of *Porcellio (Lucasius) delvecchioi* Arcangeli, 1927 (DEAP, Dipartimento di Entomologia Agraria dell'Università, Portici) was also re-examined.

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SYSTEMATIC ACCOUNT

Genus *Nagurus* Holthuis, 1949

***Nagurus nanus* (Budde-Lund, 1908)**

Nagara nana Budde-Lund, 1908, p. 285, pl. 14, figs. 40-47; Budde-Lund, 1913, p. 381.

Nagara formosana Verhoeff, 1928, p. 214, fig. 14.

Nagurus nanus: Arcangeli, 1963, p. 12; Ferrara and Taiti, 1982, p. 479, fig. 12B.

Nagurus formosanus: Arcangeli, 1963, p. 13.

Material examined. Taipei City: 29 ♂♂, 81 ♀♀, New Taipei Park, 16 Apr. 1992, leg. D. H. Kwon & I. K. Jang. Taipei County: 16 ♂♂, 15 ♀♀, Shihmen, 16 Apr. 1992, leg. D. H. Kwon & D. S. Jeon; 5 ♂♂, 8 ♀♀, 1 juv., Chinshan, 21 Mar. 1994, leg. D. H. Kwon & C.-H. Wang; 3 ♂♂, 9 ♀♀, Fulung, 3 Apr. 1993, leg. D. H. Kwon & C.-H. Wang. Keelung City: 46 ♂♂, 82 ♀♀, Patoutzu, 3 Apr. 1993, leg. D. H. Kwon & C.-H. Wang. Hsinchu City: 3 ♀♀, National Tsing Hua University, 1 Apr. 1993, leg. D. H. Kwon & C.-H. Wang; 1 ♂, 3 ♀♀, Hsiangshan, 1 Apr. 1993, leg. D. H. Kwon & C.-H. Wang. Ilan County: 1 ♀, Chiaohsi village, 22 Mar. 1994, leg. D. H. Kwon & C.-H. Wang; 1 ♂, Chingsui, near Lotung, 17 Apr. 1992, leg. D. H. Kwon & D. S. Jeon. Taichung County: 7 ♀♀, Kukuan, 25 Apr. 1992, leg. D. H. Kwon & D. S. Jeon. Nantao County: 15 ♂♂, 15 ♀♀, Jenai Village, Lushan, ca. 1,300 m in altitude, 31 Mar. 1993, leg. D. H. Kwon & C.-H. Wang. Hualien County: 3 ♂♂, 3 ♀♀, Hualien, 18 Apr. 1992, leg. D. S. Jeon; 7 ♂♂, 7 ♀♀, Pengpin village, 18 Apr. 1992, leg. D. H. Kwon & D. S. Jeon. Taitung County: 1 ♂, 1 ♀, Hsiaomawuchiao, ca. 15 km south from Chengkung, 19 Apr. 1992, leg. D. H. Kwon & D. S. Jeon; 2 ♂♂, 9 ♀♀, Tulan Bay, 24 Mar. 1994, leg. D. H. Kwon & C.-H. Wang; 4 ♂♂, 18 ♀♀, Peinan, near Taitung, 19 Apr. 1992, leg. D. H. Kwon & D. S. Jeon; 4 ♂♂, 6 ♀♀, Taitung, 20 Apr. 1992, leg. D. H. Kwon & D. S. Jeon; 1 ♂, 5 ♀♀, Lutao Is., 23-24 Mar. 1994, leg. D. H. Kwon & C.-H. Wang; 11 ♂♂, 13 ♀♀, Lanyu Is., 25 Mar. 1994, leg. D. H. Kwon & C.-H. Wang. Pingtung County: 2 ♂♂, 7 ♀♀, Machia, 29 Mar. 1993, leg. D. H. Kwon & C.-H. Wang; 1 ♂, Shihmen, 27 Mar. 1994, leg. D. H. Kwon & C.-H. Wang; 4 ♂♂, 13 ♀♀, 1 juv., Tanlu village, 27 Mar. 1994, leg. D. H. Kwon & C.-H. Wang; 1 ♂, 3 ♀♀, Hengchun, 21 Apr. 1992, leg. D. S. Jeon; 1 ♂, 1 ♀, 1 km south from Nanwan, north of Kenting, 22 Apr. 1992, leg. D. H. Kwon & D. S. Jeon; 5 ♂♂, 16 ♀♀, Kenting, 21 Apr. 1992, leg. D. H. Kwon & D. S. Jeon; 3 ♂♂, 3 ♀♀, Oluanpi, 28 Mar. 1994, leg. D. H. Kwon & C.-H. Wang.

Distribution. Pantropical.

Remarks. Ferrara and Taiti (1982) synonymized *Nagara formosana* Verhoeff, 1928 recorded from Taiwan with *Nagurus nanus* (Budde-Lund, 1908). *N. nanus is* morphologically very close to *N. sundaicus* (Dollfus, 1898). Kwon and Taiti (1993) mentioned that the ischium of male pereopod 7 of *N. nanus* beared 7-8 spines on obtusely angled tergal margin, while that of *N. sundaicus* beared 4-5 spines on rounded tergal margin. But, in Taiwanese specimens of *N. nanus,* the number of the spines shows a wide range of variation (4-7) though it is usually 6 or 7. Nevertheless, they can easily be distinguishable from each other by the morphology of the cephalon and pereopod 7 of male (S.

Taiti, in litt.). For figures of this species, see Ferrara and Taiti (1983) and Kwon and Taiti (1993).

***Nagurus cristatus* (Dollfus, 1889)**

Porcelio cristatus Dollfus, 1889, p. 91, pl. 5, figs. 2a-d.

Nagara incisa Verhoeff, 1928, p. 215, figs. 15-16.

Nagurus cristatus: Ferrara and Taiti, 1982, p. 479, fig. 12A.

Material examined. Hualien County: 3 ♀♀, Kongkou, south of Pengpin, 18 Apr.1992, leg. D. H. Kwon & D. S. Jeon. Taitung County: 1 ♀, Chihpin, 20 Apr. 1992, leg. D. H. Kwon & D. S. Jeon. Pingtung County: 3 ♀♀, Santimen, 29 Mar.1993, leg. D. H. Kwon & C.-H. Wang.

Distribution. Pantropical.

Remarks. This species was described as *Nagara incisa* by Verhoeff (1928) from Taiwan. Ferrara and Taiti (1982) synonymized it with *Nagurus cristatus* (Dollfus, 1889). For description and figures of this hermaphroditic species, see Radu (1960, 1961) as *Bifrontonia feminina* Radu, 1960, another junior synonym of this species (Vandel, 1973).

***Nagurus verhoeffi* (Arcangeli, 1952) (Figs. 1 and 2)**

Porcellio (Nagara) pallidipennis (non Dollfus): Arcangeli, 1927, p. 249 (in part: Macao).

Nagara (Nagara) Verhoeffi Arcangeli, 1952, p. 303 (in part: Macao).

Nagurus Verhoeffi: Arcangeli, 1963, p. 14 (in part: Macao); Kwon and Taiti, 1993, p. 37, figs. 134-147.

Material examined. Hualien County: 6 ♂♂, 8 ♀♀, Kongkou, south of Pengpin, 18 Apr. 1992, leg. D. H. Kwon & D. S. Jeon. Pingtung County: 7 ♂♂, 9 ♀♀, Kenting, 22 Apr. 1992, leg. D. H. Kwon & D. S. Jeon.

Description. Maximum length of ♂ 4.0 mm, of ♀ 4.3 mm. Brown color with usual pale muscle spots; lateral margins of pereonal and pleonal epimera pigmentless. Dorsum evenly convex, granulated, covered with numerous scale spines (Fig. 1C). Pereonite 1 with 2-4 gland pores at antero-lateral corners (Fig. 1F), pereonites 2-7 without gland pores. Noduli laterales on pereonites 2-4 much farther from lateral margins than the others (Fig. 1B). Eye with 8-11 ommatidia. Cephalon (Fig. 1E) with well developed triangular median lobe and rounded antero-lateral lobes; antero-lateral lobes not continuous with frontal line (Fig. 1D). Pereonites 1-3 with postero-lateral corners obtusely rounded, pereonite 4-7 progressively protruding backwards and more acute. Epimeron of pereonite 1 (Fig. 1F) with straight posterior margin. Telson (Fig. 1F) triangular with concave sides and rounded apex. Antennule as in Fig. 1H. Antenna (Fig. 1I) with peduncular article 5 slightly longer than flagellum; flagellum with distal article more than twice as long as proximal one. Mandible (Fig. 2A) with a multi-branched molar penicil arising from a single common stem; right mandible with 1 + 1 and left one with 2 + 1 penicils between incisor process and molar process. Maxillule with exopod bearing 9 teeth, 3 of which are cleft apically, and 2 minute ones; endopod bearing 2 unequal penicils and an acute outer-distal point (Fig. 2B). All pleopodal exopods without pleopodal lung. Uropodal protopod with Λ-shaped notch outer-distally; exopod about twice as long as protopod, and 1.6 times as long as endopod.

Male. Pereopod 1 carpus with a setular area on rostral surface; pereopods 1-3 carpi and meri with a brush of setae on sternal margins. Pereopod 7 without particular sexual modification. Pleopod 1

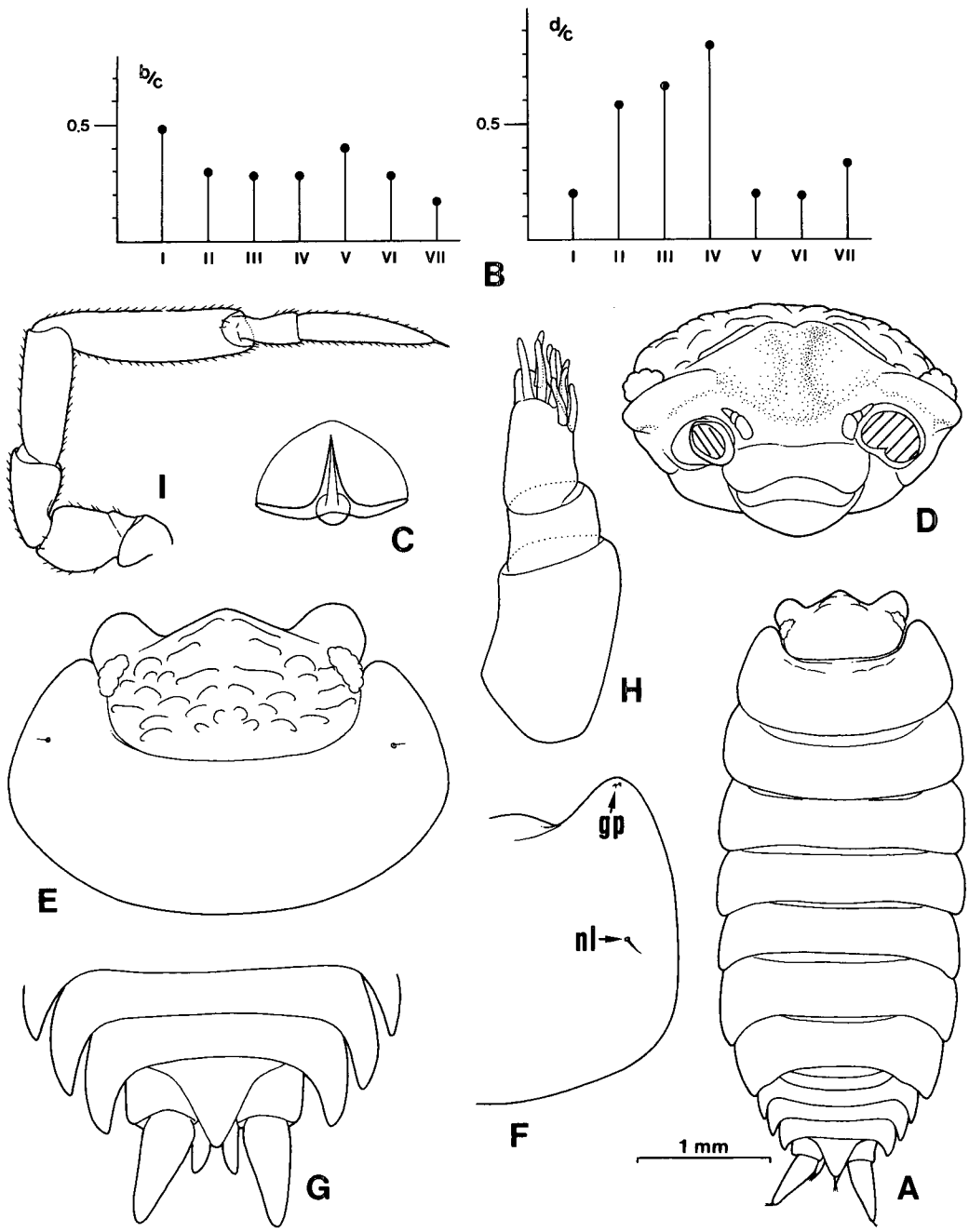

Fig. 1. *Nagurus verhoeffi* (Arcangeli, 1952): A, habitus, dorsal view; B, co-ordinates of noduli laterales on pereonites; C, dorsal scale-spine; D, cephalon, frontal view; E, cephalon and pereonite 1, dorsal view; F, right epimeron of pereonite 1 (gp, gland pores; nl, nodulus lateralis); G, pleonites 3-5, telson and uropods; H, antennule; I, antenna.

exopod ovoidal; endopod with almost straight apex. Pleopod 2 endopod styliform, much longer than exopod. Pleopod 5 exopod as in Fig. 2G.

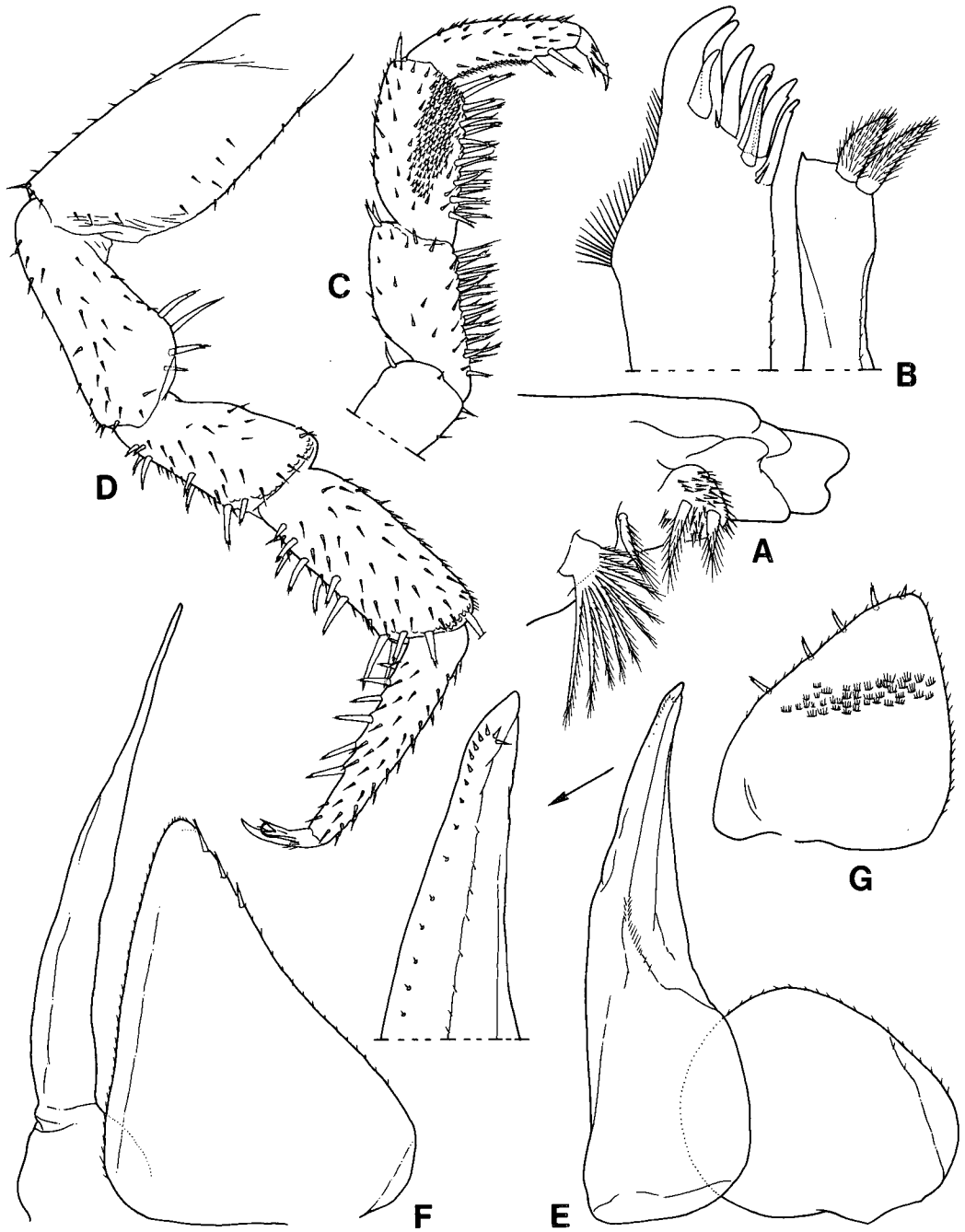

Fig. 2. *Nagurus verhoeffi* (Arcangeli, 1952): A, left mandible; B, maxillule; C, pereopod 1; D, pereopod 7; E, pleopod 1; F, pleopod 2; G, pleopod 5 exopod. (A and B, female; C-G, male)

Distribution. Taiwan, Hong Kong and Macao.

Remarks. Kwon and Taiti (1993) recorded *Nagurus verhoeffi* from Hong Kong and Macao, and discussed the generic status of the species. They described that the exopod of male pleopod 1 had a

small respiratory area (pleopodal lung), but in Taiwanese specimens all the pleopods have no pleopodal lung in both sexes. Kwon and Taiti (1993) included this species to *Nagurus* with doubt due to the lack of pleopodal lungs. But this species has the thinner outer part on the exopods of pleoods 1-5, which we believe to be the remnants of reduced *Nagurus*-type pleopodal lungs. So we still prefer to retain this species in *Nagurus* because this species seems to have lacked pleopodal lungs as a result of the secondary disappearance. *N. aegaeus* Schmalfuss, 1977, from the Aegaean island of Karpathos, also lacks pleopodal lungs except for reduced one on male pleopod 1 exopod. Schmalfuss (1982) said that the species lived in very wet surrounings. But our specimens were collected from the place where was not so wet.

Genus *Lucasioides* Kwon, 1993

***Lucasioides isseli* (Arcangeli, 1927) (Figs. 3 and 4)**

Porcellio (*Lucasius*) *isseli* Arcangeli, 1927, p. 232, fig. 8.

Lucasioides isseli: Kwon and Taiti, 1993, p. 40, figs. 158-170.

Material examined. Taipei County: 2 ♂♂, 1 ♀, Hsintien City, Kueishan, 2 Apr. 1993, leg. D. H. Kwon & C.-H. Wang. Keelung City: 1 ♀, Patoutzu, 3 Apr. 1993, leg. D. H. Kwon & C.-H. Wang.

Description. Maximum length of ♂ 7 mm, of ♀ 5.9 mm. Dark brown color with usual pale muscle spots; a large pale spot at base of each pereonal epimeron. Dorsum distinctly granulated, covered with numerous Y-shaped scale spines. No gland pores. Noduli laterales on pereonites 2-4 much farther from lateral margins than the others (Fig. 3B). Eye with about 18 ommatidia. Cephalon (Fig. 3D-E) with well developed triangular median lobe, dorsally concave and protruding upwards in middle; quadrangular antero-lateral lobes well developed. All pereonites and pleonites with epimera bent outwards. Epimeron of pereonite 1 (Fig. 3E) with sinuous posterior margin. Telson (Fig. 3F) triangular with concave sides and rounded apex. Antenna with peduncular article 5 as long as flagellum; flagellum with distal article more than twice (2.3 times) as long as proximal one. Buccal pieces typical of the genus (Fig. 3G-H). Uropod with exopod about 1.7 times as long as protopod, 1.4 times as long as endopod. All pleopodal exopods with *Protracheoniscus*-type pleopodal lungs.

Male. Pereopod 1 carpus with a setular area on rostral surface. Pereopods 1-4 carpi and meri with a brush of long setae on sternal margins. Pereopod 7 (Fig. 4A) ischium with a large setulose depression on rostral surface, 6-7 strong setae on tergal margin, sternal margin straight; carpus slightly expanded on tergal margin. Pleopod 1 (Fig. 4B) exopod with bilobed distal part of which outer lobe being larger than inner one; endopod with apex bent outwards. Pleopod 2 (Fig. 4C) endopod styliform, slightly longer than exopod. Pleopod 5 exopod as in Fig. 4D.

Distribution. Taiwan and southern China. Formerly known only from the type locality, Yolushan, Changsha, China.

Remarks. *Lucasioides isseli* is close to *L. gigliotosi* (Arcangeli, 1927) and *L. mazzarelli* (Arcangeli, 1927) in the sinuous posterior margin of pereonite 1 epimeron. But *L. isseli* is readily distinguished from *L. gigliotosi* and *L. mazzarelli* by the shape of the pleopod 1 exopod of male (larger outer lobe of distal part vs. larger inner one).

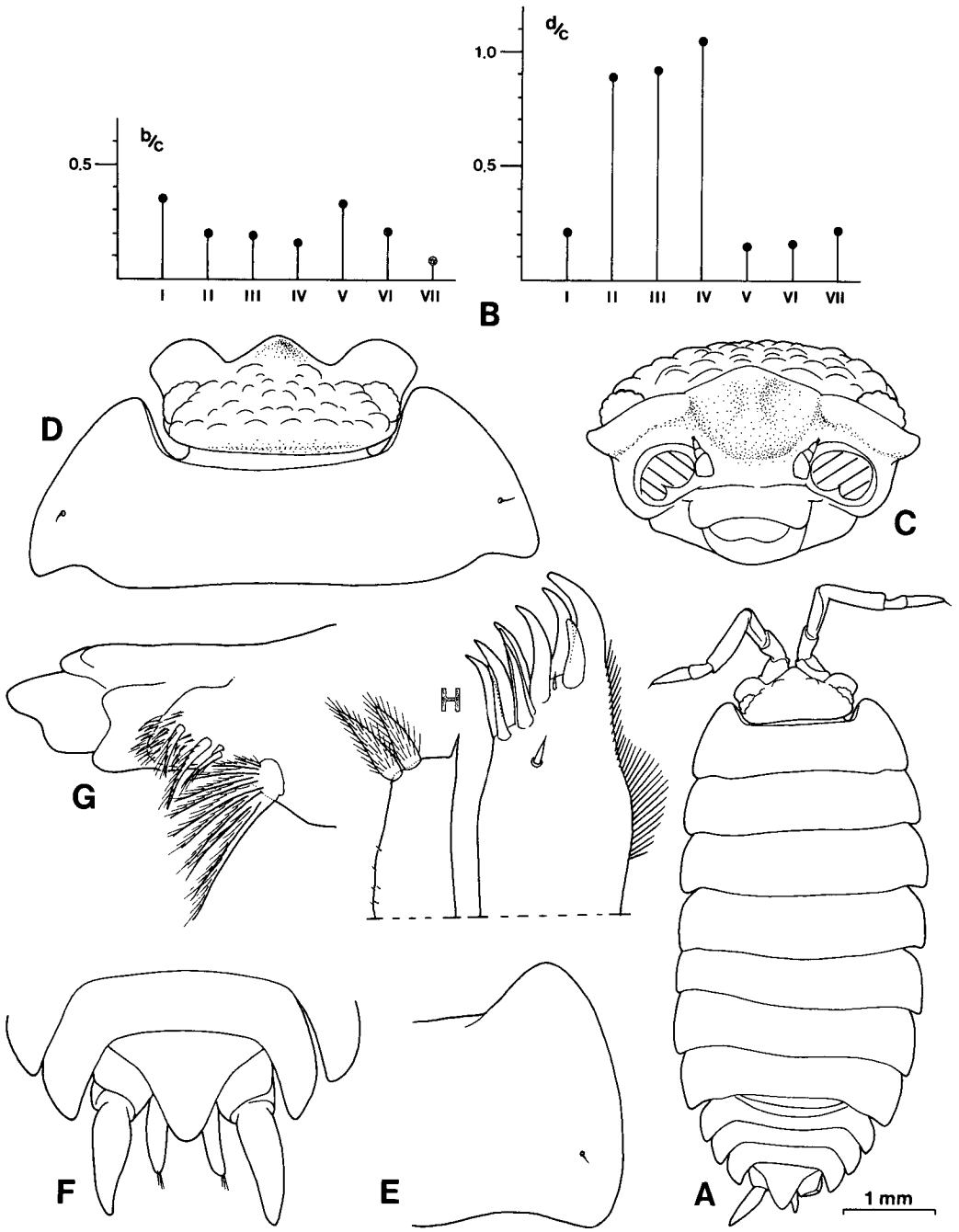

Fig. 3. *Lucasioides isseli* (Arcangeli, 1927): A, habitus, dorsal view; B, co-ordinates of noduli laterales on pereonites; C, cephalon, frontal view; D, cephalon and pereonite 1, dorsal view; E, right epimeron of pereonite 1; F, pleonites 4-5, telson and uropods; G, right mandible; H, maxillule.

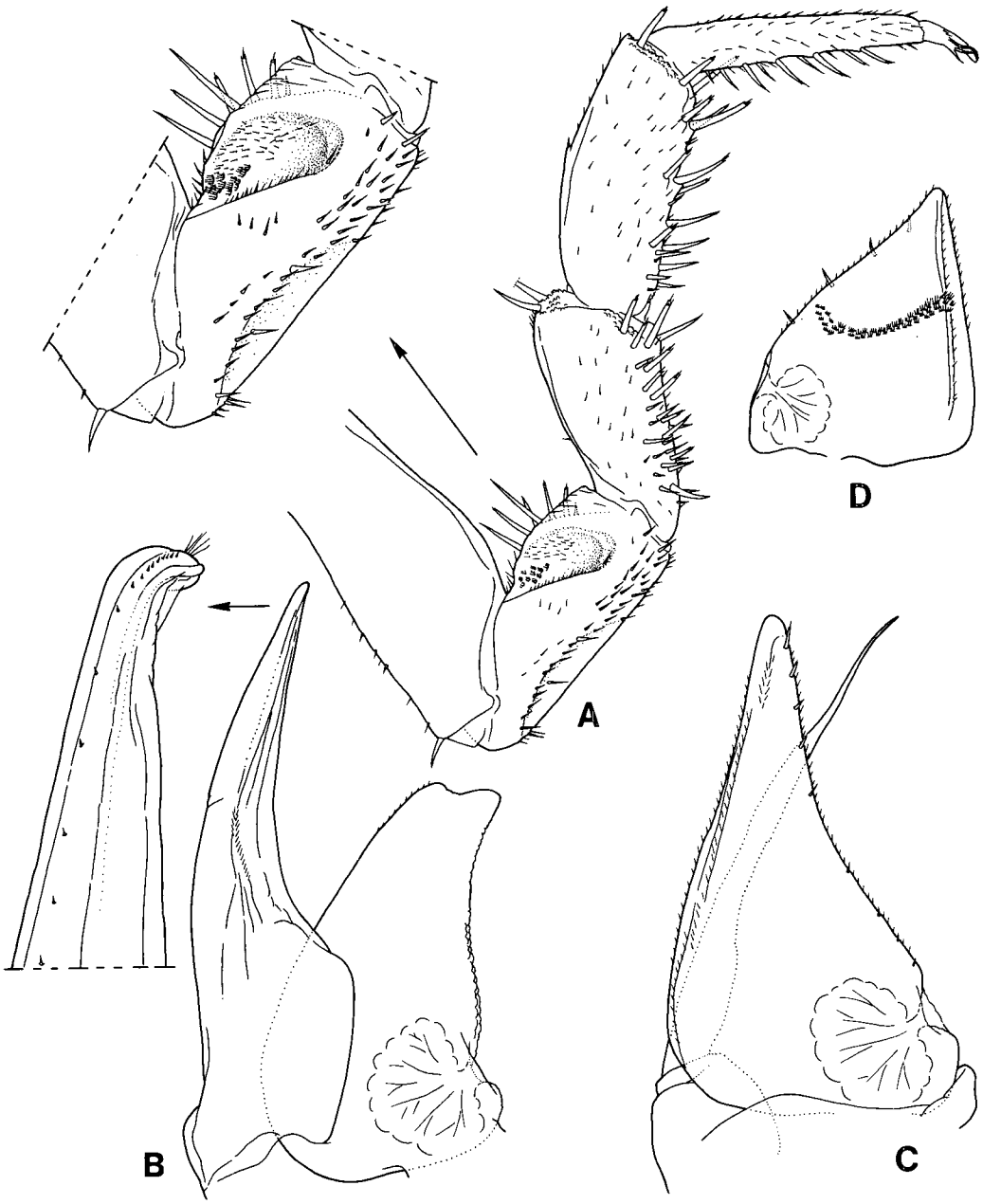

Fig. 4. *Lucasioides isseli* (Arcangeli, 1927), ♂: A, pereopod 7; B, pleopod 1; C, pleopod 2; D, pleopod 5 exopod.

Genus *Agnara* Budde-Lund, 1908

***Agnara madagascariensis* (Budde-Lund, 1885)**

Metoponorthus Madagascariensis Budde-Lund, 1885, p. 189.

Material examined. Pingtung County: 4 ♂♂, 11 ♀♀, 1 km south of Nanwan, north of Kenting,

22 Apr. 1992, leg. D. H. Kwon & D. S. Jeon; 4 ♀♀, Kenting, 21 Apr. 1992, leg. D. H. Kwon & D. S. Jeon.

Distribution. Guinea Bissau, Senegal, Madagascar, Saudi Arabia, Oman, southern China, Macao (?), and Taiwan.

Remarks. For description and figures of this species see Schumalfuss and Ferrara (1978) and Ferrara and Taiti (1985), both recorded as *Protracheoniscus inexpectatus* Schmalfuss and Ferrara, 1978, a junior synonym of *A. madagascariensis*.

***Agnara ferrarai*, n. sp. (Figs. 5 and 6)**

Holotype. ♂, body length 6.9 mm, Taitung County, Tulan Bay, 24 Mar. 1994, leg. D. H. Kwon & C.-H. Wang. Paratypes. 14 ♂♂, 20 ♀♀, same data as holotype.

Additional materials examined. Ilan County: 1 ♂, Lotung, 17 Apr. 1992, leg. D. H. Kwon. Pingtung County: 1 ♂, 1 ♀, Tanlu village, 27 Mar. 1994, leg. D. H. Kwon & C.-H. Wang; 11 ♂♂, 41 ♀♀, Kenting, 27 Mar. 1994, leg. D. H. Kwon & C.-H. Wang.

Description. Maximum length of ♂ 6.9 mm, of ♀ 8.6 mm. Dark brown color with usual pale muscle spots; postero-lateral corners of each pereonite pigmentless; a pale spot at the base of each pereonal epimeron. Dorsum distinctly granulated, covered with numerous Y-shaped scale spines. Pereonal epimera with 2-5 gland pores each at antero-lateral margins (Fig. 5E). Noduli laterales on pereonites 1-7 progressively nearer to posterior margin, while more or less at same distance from lateral margin (Fig. 5B). Eye with 20-21 ommatidia. Cephalon (Fig. 5C-D) with triangular median lobe, notched in middle, dorsally concave; antero-lateral lobes well developed with rounded inner angle, but not protruding beyond median lobe; frontal line bent downwards in middle. Pereonite 1 (Fig. 5D, E) epimeron with posterior margin straight; postero-lateral corners of pereonites 1-3 rounded; of pereonites 4-7 progressively more acute and protruding backwards. Telson (Fig. 5F) triangular with slightly concave sides. Antennule as in Fig. 5G. Antenna (Fig. 5H) with peduncular article 5 slightly longer than flagellum; flagellum with distal article as long as proximal one. Mandible (Fig. 6A) with 1 multi-branched molar penicil arising from a single common stem; right mandible with 1 + 3 and left one with 2 + 3 penicils between incisor process and molar process. Maxillule with exopod bearing 4 + 6 teeth and 1 minute accessory one, 1 short seta on dorsal surface (Fig. 6B); endopod bearing 2 large penicils and an acute outer-distal point. All pleopodal exopods with *Protracheoniscus*-type pleopodal lungs. Uropod with exopod about twice as long as protopod; endopod shorter than exopod.

Male. Pereopods 1-3 with a brush of long trifid spines on carpi and meri (Fig. 6C). Pereopod 7 (Fig. 6D) ischium with sternal margin straight; depression on rostral surface covered with numerous setae. Pleopod 1 (Fig. 6E) exopod pear-shaped; endopod with pointed outwardly bent apex. Pleopod 2 (Fig. 6F) with filiform distal part, slightly longer than exopod. Pleopod 5 exopod as in Fig. 6G.

Etymology. This species is named after Dr. Franco Ferrara, Florence.

Remarks. As far as we are aware, *Agnara* includes 6 species, viz. *A. immsi* (Collinge, 1914) and *A. carinatus* (Collinge, 1915) both from India, *A. fragilis* Budde-Lund, 1908 and *A. taprobanica* Ferrara and Argano, 1989 both from Sri Lanka, *A. gallagheri* (Ferrara and Taiti, 1988) from Oman, and *A. madagascariensis* Budde-Lund, 1908 widely distributed in the tropics. *Agnara ferrarai* is close to *A. gallagheri* in the shape of the median and antero-lateral lobes of cephalon, but readily

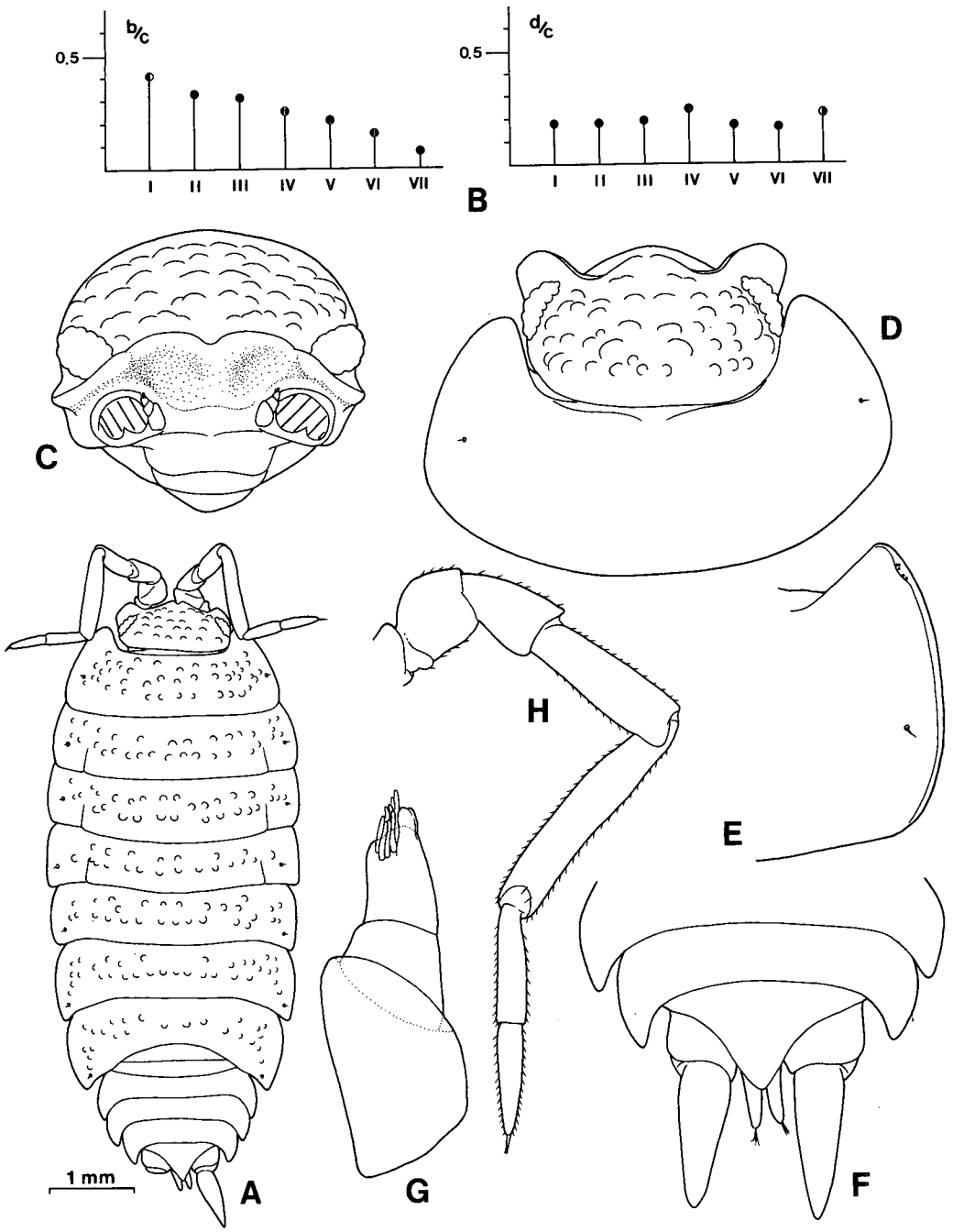

Fig. 5. *Agnara ferrarai,* n. sp.: A, habitus, dorsal view; B, co-ordinates of noduli laterales on pereonites; C, cephalon, frontal view; D, cephalon and pereonite 1, dorsal view; E, right epimeron of pereonite 1; F, pleonites 4-5, telson and uropods; G, antennule; H, antenna.

distinguished by d/c co-ordinates of noduli laterales on pereonites and male pleopod 1 exopod.

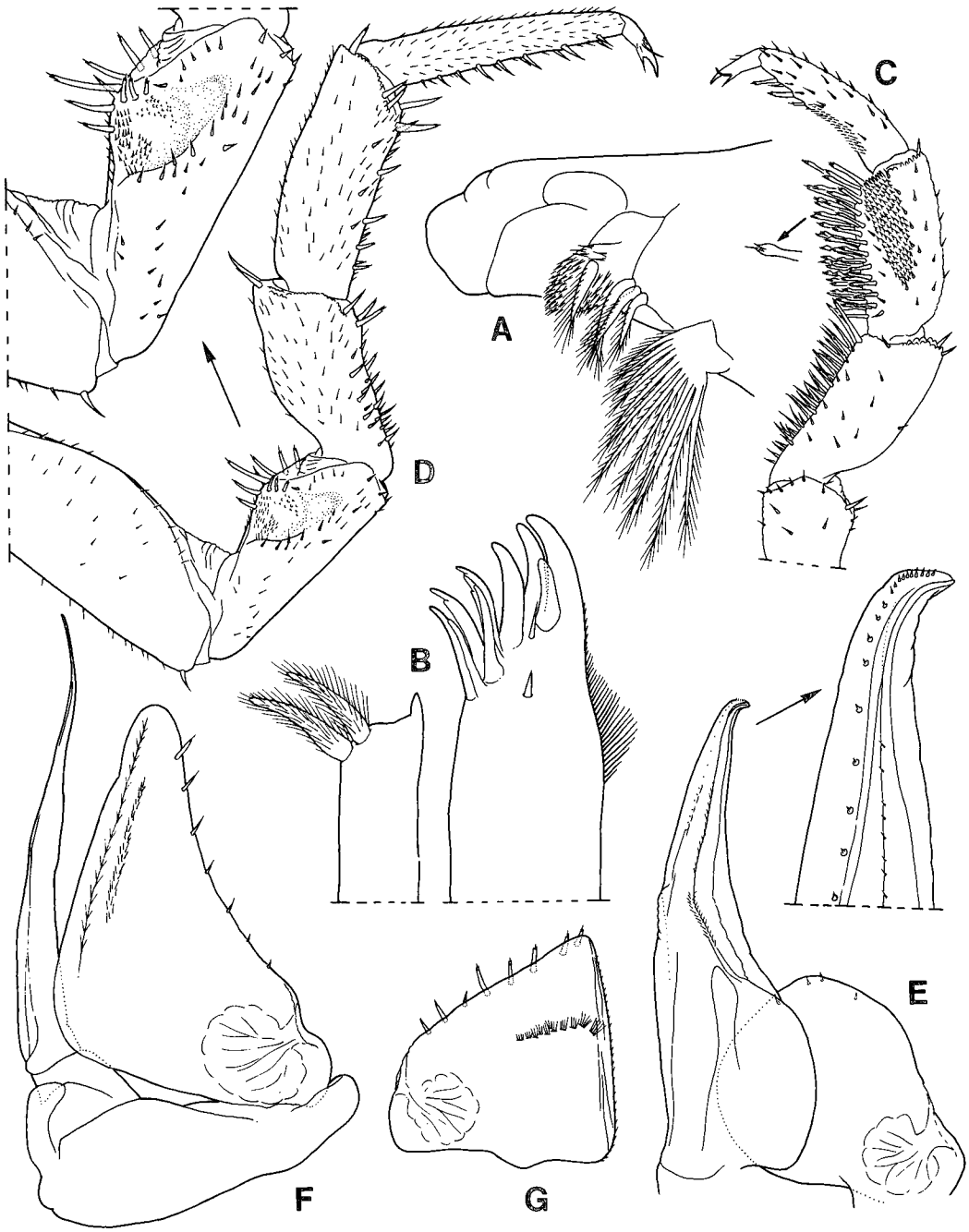

Fig. 6. *Agnara ferrarai,* n. sp.: A, right mandible; B, maxillule; C, pereopod 1; D, pereopod 7; E, pleopod 1; F, pleopod 2; G, pleopod 5 exopod. (A and B, female; C-G, male).

***Agnara* (?) *delvecchioi* (Arcangeli, 1927) (Figs. 7 and 8)**

Porcellio (*Lucasiuis*) *Del Vecchioi* Arcangeli, 1927, p. 238, fig. 11.

Lucasius (?) *delvecchioi*: Verhoeff, 1931, p. 267.

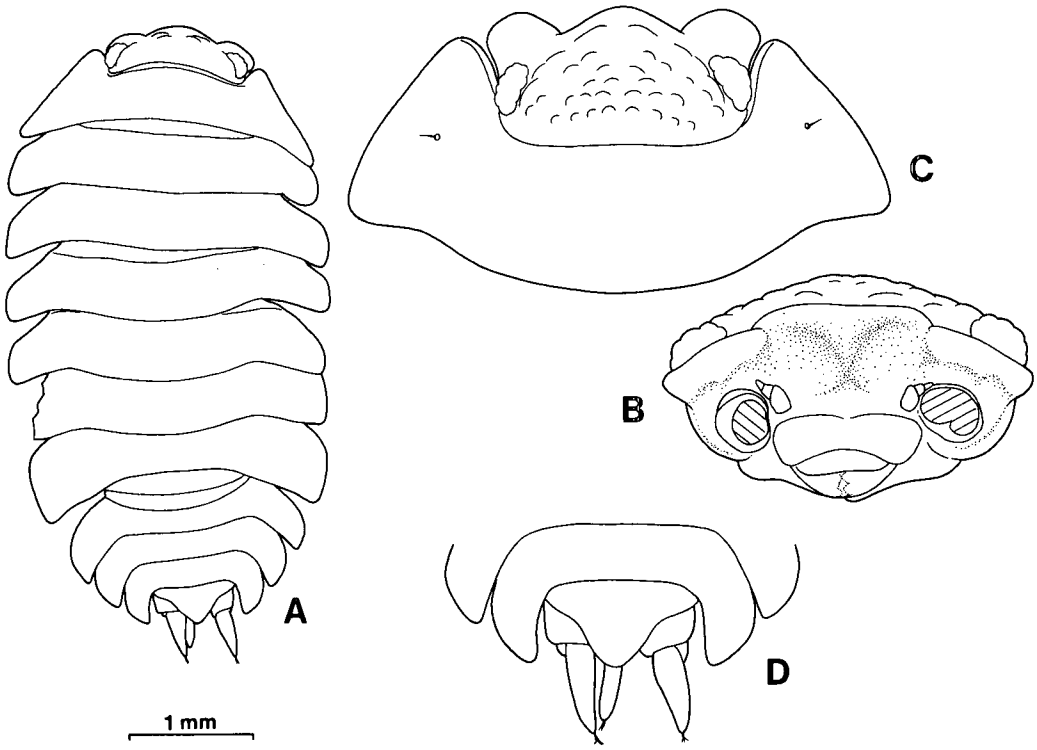

Fig. 7. *Agnara* (?) *delvecchioi* (Arcangeli, 1927), ♂ holotype: A, habitus, dorsal view; B, cephalon, frontal view; C, cephalon and pereonite 1, dorsal view; D, pleonites 4-5, telson and uropods.

Nagara (*Nagaroides*) *Del Vecchioi*: Arcangeli, 1952, p. 302; Arcangeli, 1963, p. 17.

Type specimen re-examined. ♂ holotype, Chiayi County, Funkiko (= Fenchihu), 17 Nov. 1924, leg. F. Silvestri (DEAP).

Distribution. Known only from the type locality.

Remarks. Arcangeli (1927) described *Porcellio* (*Lucasius*) *delvechioi* from Fenchihu (ca. 1,400 m in altitude) in Taiwan and *Porcellio* (*Lucasius*) *galleranii* from Japan. He subsequently transferred these species to the *Nagaroides*, a subgenus of the *Nagurus* (Arcangeli, 1952). But he considered they were not species of *Nagurus* (nor *Nagaroides*) and included them in *species inquirendae* because it possessed "rudimenti di sistema tracheale" on the exopods of pleopods 1 and 2 but lacked on pleopods 3-5 (Arcangeli, 1963). Re-examination of the holotype male of *P. delvecchioi* proved that this species had five pairs of *Protracheoniscus*-type pleopodal lungs which represent its relatedness to the north-western Asian genera, *Lucasioides, Koreoniscus*, and *Mongoloniscus*, the Oriental genus, *Agnara*, the Central Asian and eastern European genus, *Protracheoniscus*, and the central European and Balkan genus, *Porcellium*. But this species does not fit diagnostic features of any nominal genera of Trachelipodidae. This species has affinity to *Agnara* and possesses all the characters of the genus, including the co-ordinate of noduli laterales on pereonites, except for a outwardly bent epimeron of the pereonite 1 (Fig. 7C), which we believe to be an important generic character. In this respect, this species fits with *Lucasioides* and *Porcellium*. Probably this species might be assigned to a new genus, but for the moment here tentatively included in the genus *Agnara*.

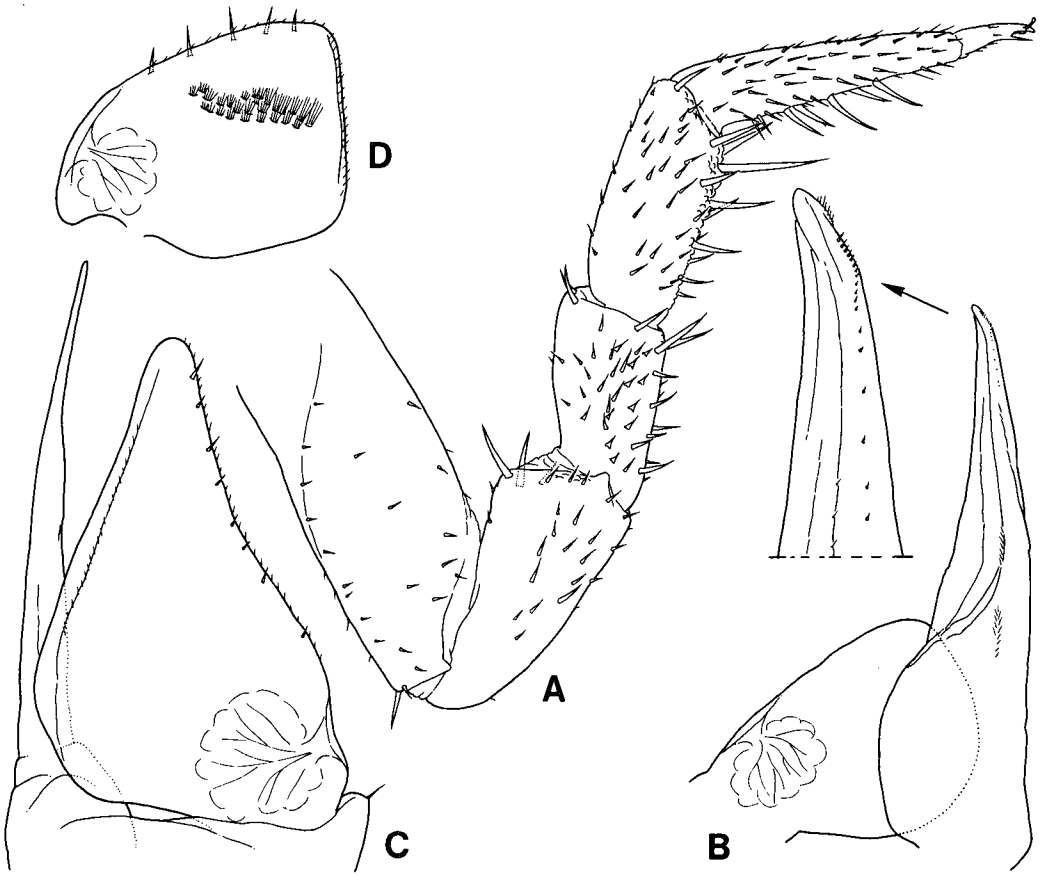

Fig. 8. *Agnara* (?) *delvecchioi* (Arcangeli, 1927), ♂ holotype: A, pereopod 7; B, pleopod 1; C, pleopod 2; D, pleopod 5 exopod.

Several important characers are illustrated in Figs. 7-8 based on the holotype. Re-examination of the syntypes (2 ♀♀, DEAP) of *P. gallerani* proved that this species belonged to the genus *Agnara*.

ACKNOWLEDGEMENTS

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臺灣産 쥐며느리科 (甲殼上綱, 等脚目, 쥐며느리亞目)의 分類學的 硏究

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요 약

臺灣에서 採集된 쥐며느리科 陸棲 等脚類 3屬 7種을 報告한다. 1新種(*Agnara ferrarai*)과 *Nagurus verhoeffi* (Arcangeli, 1952) 및 *Lucasioides isseli* (Arcangeli, 1927)를 記載하였다. *Porcellio* (*Lucasius*) *delvecchioi* Arcangeli, 1927의 所屬에 관하여 論議하였다.