

A Taxonomic Study on the Recent Conchostracans of Spinicaudata (Crustacea, Branchiopoda) from Korea

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The specimens of the recent conchostracans belonging to order Spinicaudata collected from freshwater habitats at 13 localities in South Korea during the period from May 1981 to May 1992 were examined. As a result of the present study, two species were identified: *Caenestheriella gifuensis* (Ishikawa, 1895), and *Eulimnadia braueriana* Ishikawa, 1895. The two species were described and figured in this paper. This is the first report of the recent conchostracan fauna from Korea.

KEY WORDS: Taxonomy, Recent Spinicaudata, Branchiopoda, Korea

Conchostracans are a group of the freshwater branchiopods and its members occur mostly in ephemeral pools, especially during spring and early summer. They are known from middle Devonian to Recent. The recent conchostracans comprise 2 orders, 5 families, 21 genera, and about 260 species (Fryer, 1987, and Hu, 1989). In East Asia, more than 20 recent conchostracans have been known from Japan and China (Ishikawa, 1895; Daday, 1915, 1923, 1926, 1927; Ueno, 1927, 1940; Hu, 1986, 1989, 1991), but none of which ever known from Korea.

In the present study we are dealing with two Korean recent conchostracans belonging to order Spinicaudata. This is the first record of the recent conchostracan fauna of Korea.

The materials were collected from the freshwater habitats such as ricefields, rice beds, temporal bogs and ephemeral pools at 12 localities in South Korea (Fig. 1) during the period from May 1981 to May 1992. The collections were made with a dipnet. The samples were

preserved in 70 percent ethanol. Drawing and measuring were made with the aid of a camera lucida. All specimens examined are deposited in the Department of Molecular Biology, Seoul National University.

Classification was based on Fryer (1987) and Schram (1986). 'Material Examined' section includes its locality, the date of collection and other informations. Collectors were referred when the specimens were not collected by authors. Terminology is after that of McLaughlin (1980), Martin *et al.* (1986) and Schram (1986).

Systematic Accounts

Class Branchiopoda Latreille, 1817 새각(鰓脚) 강

Order Spinicaudata Linder, 1945 극미(棘尾) 목(신칭)

Superfamily Cyzicoidea Stebbing, 1910 참조개벌레 상과(신칭)

Family Cyzicidae Stebbing, 1910 참조개벌레과(신칭)

Genus *Caenestheriella* Daday, 1915 뽕족코조개벌레 속(신칭)

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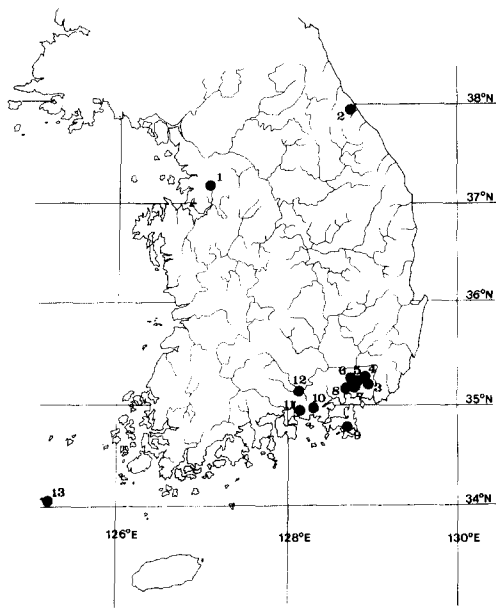


Fig. 1. Localities from which specimens of the present study were collected. 1, Such'ong-dong, Osan-shi; 2, Namae-ri, Hyonnam-myon, Yangyang-gun; 3, Obang-dong, Kimhae-shi; 4, Mangch'on-ri, Hanrim-myon, Kimhae-gun; 5, Shinbang-ri, Tong-myon, Ch'angwon-gun; 6, Hwayang-ri, Tong-myon, Ch'angwon-gun; 7, Kogum-ri, Chinyong-up, Ch'angwon-gun; 8, Tongjong-dong, Ch'angwon-shi; 9, Mangch'i-ri, Ilun-myon, Kojegun; 10, Tapch'on-ri, Ilbansong-myon, Chinyang-gun; 11, Hyangch'on-dong, Samch'onpo-shi; 12, P'yonggo-dong, Chinju-shi; 13, Sohuksan Is.

***Caenestheriella gifuensis* (Ishikawa,**

1895) 털줄뽕족코조개벌레 (신칭)

(Figs. 2-4)

Estheria gifuensis Ishikawa, 1895 (p. 10, Pl. 5, figs. 1-12).

Caenestheriella gifuensis: Daday, 1915 (p. 124, Fig. 22); Ueno, 1927 (p. 267).

Material Examined.-2 ♀♀, from a small bog of ricefield before rice-planting at Such'ong-dong, Osan-shi, Apr. 21, 1991; 1 ♂, from ricefields filled with water before rice-planting at Namae-ri, Hyonnam-myon, Yangyang-gun, May 24, 1981 (I. H. Kim); 4 ♂♂, 3 ♀♀, from rice beds and ricefields filled with water before rice-planting at Obang-dong, Kimhae-shi, May 27, 1992; 27 ♂♂, 18 ♀♀, from rice beds and ricefields filled with water before rice-planting at Mangch'on-ri,

Hanrim-myon, Kimhae-gun, May 29, 1991; 16 ♂♂, 21 ♀♀, from rice beds and ricefields filled with water before rice-planting at Shinbang-ri, Tongmyon, Changwon-gun, May 29, 1991; 11 ♂♂, 7 ♀♀, from rice beds and ricefields filled with water before rice-planting at Hwayang-ri, Tongmyon, Changwon-gun, May, 29, 1991; 12 ♂♂, 18 ♀♀, from ricefields after rice-planting at Kogum-ri, Chinyong-up, Changwon-gun; 16 ♂♂, 21 ♀♀, from ricefields filled with water before rice-planting at Tongjong-dong, Changwon-shi, May 5, 1990 (H.B. Kong); 28 ♂♂, 23 ♀♀, from rice beds and ricefields filled with water before rice-planting at Hyangch'on-dong, Samch'onpo-shi, May 28, 1991; 3 ♀♀, from rice beds and ricefields filled with water before rice-planting at P'yonggo-dong, Chinju-shi, May 15, 1990 (G.S. Min).

Male.-Carapace (Fig. 2a) length 7.76-10.08 mm, height 4.32-6.50 mm, oval, thin, yellowish brown, with many small spots of dark brown or black color denser on dorsal area, with 16-20 concentric growth lines bearing row of faint marks of protuberances on each line; marginal 6-7 growth lines with row of short plumose setae, three of these growth lines situated close to border at short distance. Umbo small but rather prominent, situated near straightened dorsal hinge at about two-sevenths from anterior margin. Ventral margin fringed with 2 rows of longer simple setae, each lined ventrally with marginal first and second growth lines, respectively (Fig. 2e).

Head (Figs. 2a, b, c) large, with distinct occipital notch; area dorsal to compound eyes with depression. Rostrum, in lateral view, produced into large projection terminated in acute point bearing internally ocellus variable in shape; lateral rostral borders well developed, rounded, extending anteriorly to tip of rostrum (Figs. 2b, c). Compound eyes nearly fused, located near ventral margin of head in lateral view.

Antennule arising from lateral surface of posterior side of rostrum, extending to about sixth segment of posterior antennal flagellum, and indistinctly segmented with 9-14 lobes of unequal size bearing short sensory papillae (Figs. 2a, f).

Antenna large, well developed, biramous (Fig. 2g). Basal peduncle with many plumose setae on

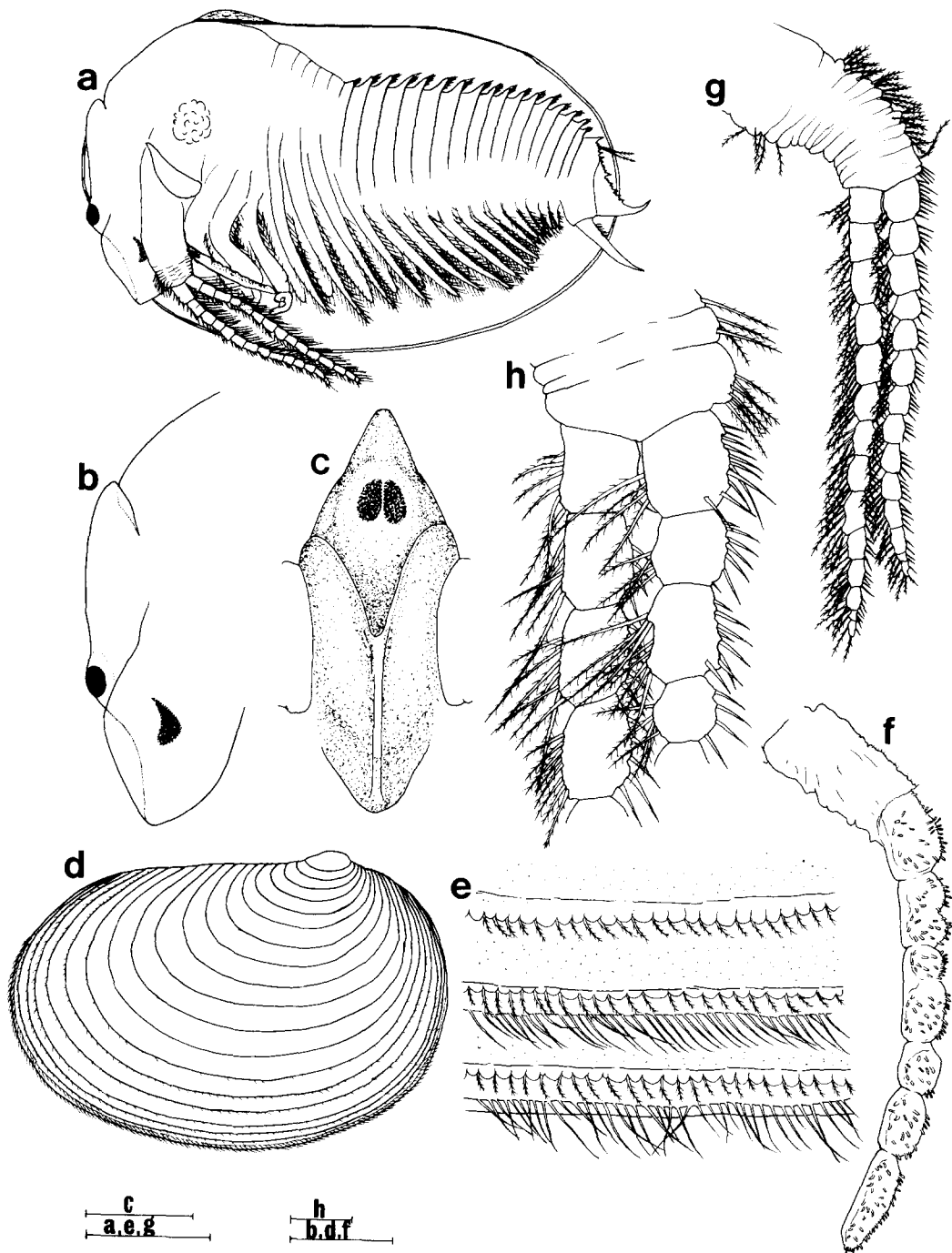


Fig. 2. *Caenestheriella gifuensis* (Ishikawa, 1895), male: a, habitus, lateral view; b, head, lateral view; c, head, ventral view; d, carapace, lateral view; e, ventral part of carapace; f, antennule; g, antenna; h, basal part of antenna. (Scales: e, h = 0.2 mm; f = 0.5 mm; b, g = 1 mm; a, c, d = 2 mm).

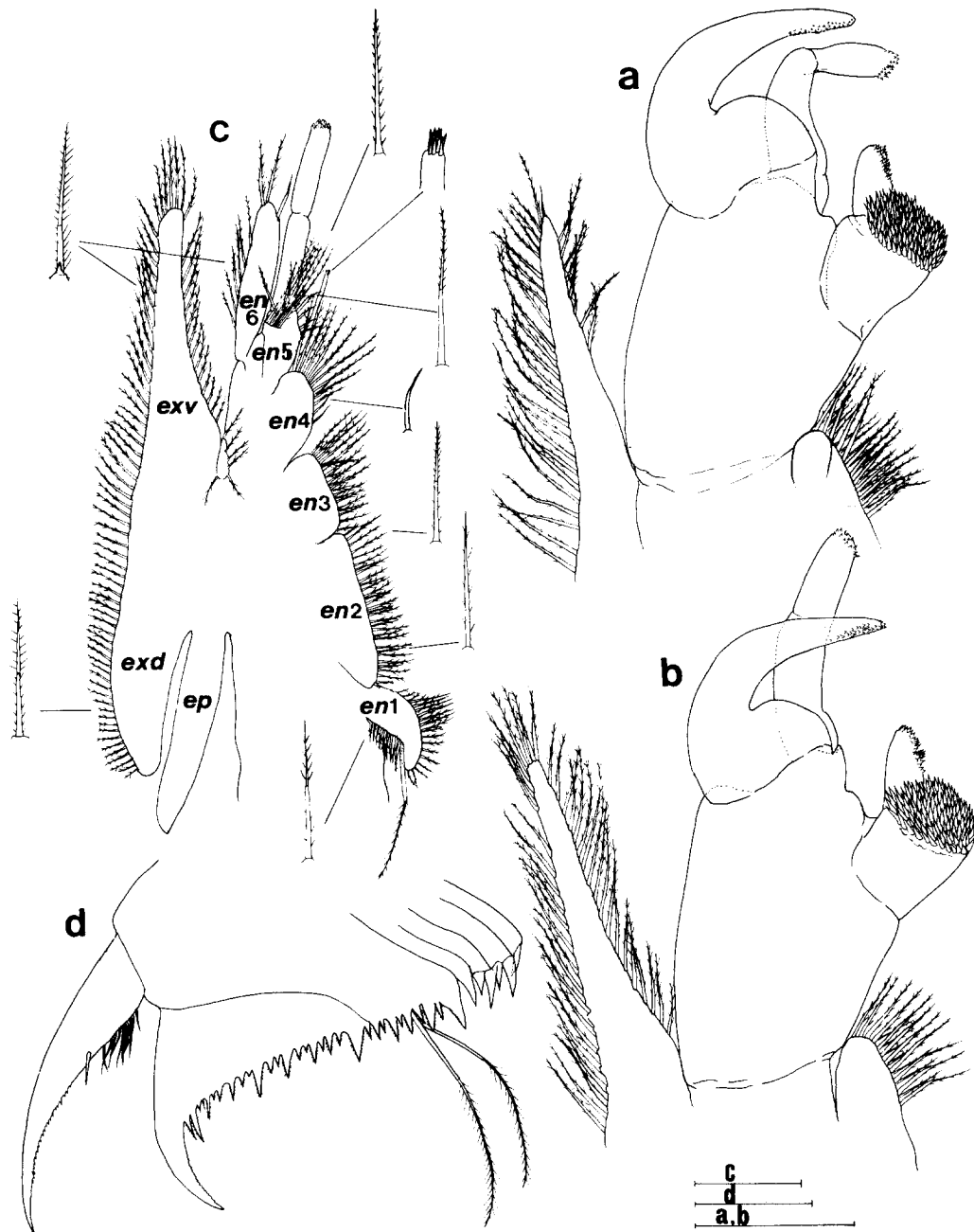


Fig. 3. *Caenestheriella gifuensis* (Ishikawa, 1895), male: a, left first thoracopod, anterior face; b, left second thoracopod, anterior face; c, left third thoracopod, anterior face; d, posterior region of trunk, lateral view. Abbreviations: en (1-6) = endites 1-6 of endopod; ep = epipod; exd = dorsal lobe of exopod; exv = ventral lobe of exopod. (Scales: a, b, c, d, e = 0.5 mm).

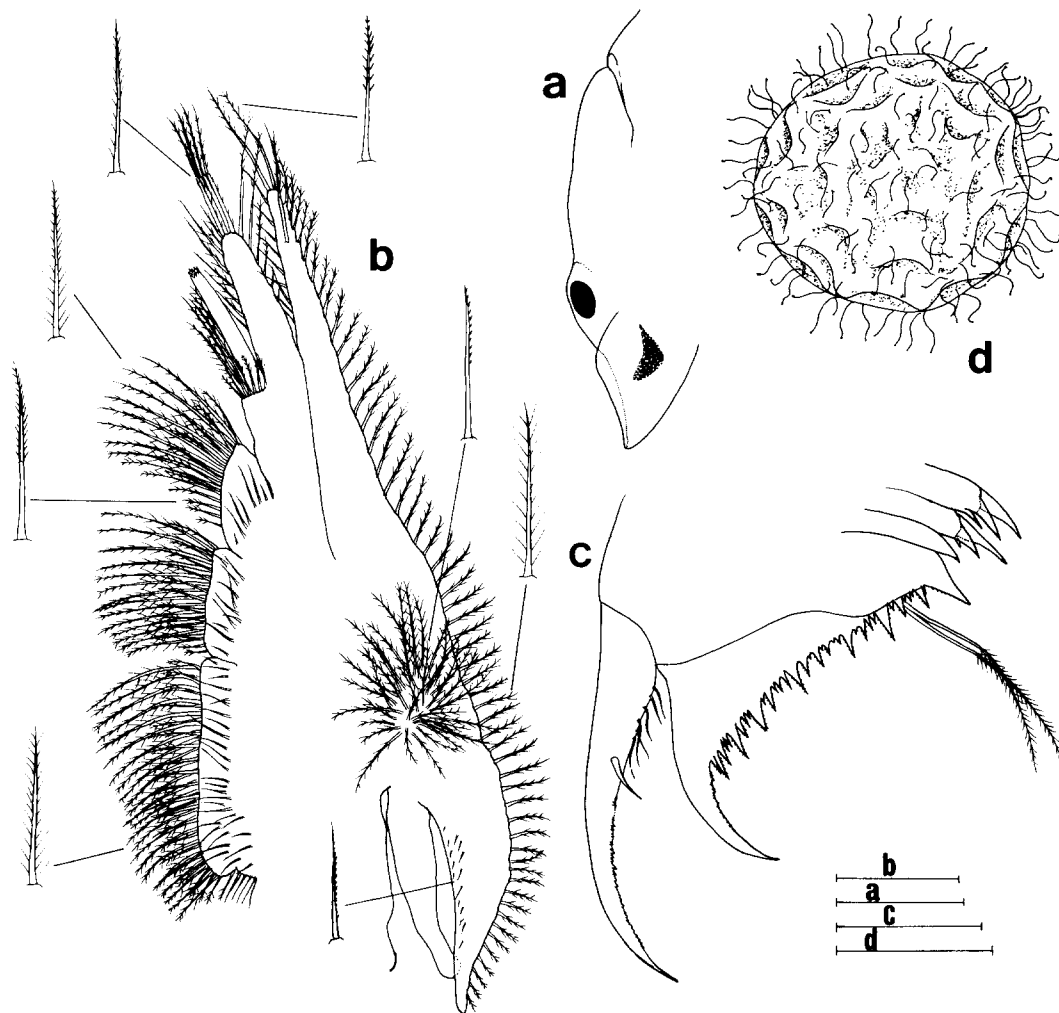


Fig. 4. *Caenestheriella gifuensis* (Ishikawa, 1895), female: a, head, lateral view; b, right first thoracopod, anterior face; c, posterior region of trunk, lateral view; d, egg. (Scales: b, c, d = 0.5 mm; a = 2 mm).

inner side, and divided into 2 poorly demarcated cylindrical segments; proximal segment with a few plumose setae on posterior edge distally; distal segment wrinkled, with dense plumose setae on anterior edge and inner side. Biramous flagella variable in number of segments from 15-18; each segment of both anterior and posterior flagella bearing shorter simple setae along anterior edge and longer lightly plumose setae along posterior edge (Figs. 2g, h).

First thoracopod modified as crasping appendage as in most conchostracans; fourth, fifth and sixth endites of exopod enlarged as

processes (Fig. 3a). Movable finger of clasper (fifth endite of exopod) smoothly curved, with many small teeth on clasping border distally; immovable finger with many larger stout teeth on clasping area. Fourth endite shorter, arising near immovable finger, with many small teeth on anterior side near immovable finger distally. Sixth endite curved, divided into two poorly demarcated segments, with many small teeth on distal end.

Second thoracopod (Fig. 3b) also modified as crasping appendage, similar in general shape and ornamentation to first thoracopod, but sixth endite nearly straightened, not segmented.

Twenty-two thoracopods, except first two among all twenty-four thoracopods, similar in shape each other as in most nonlynceid conchostracans, somewhat decreasing in size posteriorly, with diverse setation as shown in Fig. 3c of third thoracopod; first endite of endopod ornamented with pappose setae and intermediate types between pappose setae and spinose setae; second and third endites with pappose setae, spinose setae and pappose-spinose setae; fourth and fifth endites with simple setae, spinose setae and simple-spinose setae; sixth endite with plumose setae and simple-spinose setae; ventral lobe of exopod with plumose setae, each bearing stout spine on its base; dorsal lobe of exopod with plumose setae; palp segmented, with many small teeth on distal end; fourth endite of endopod with another small palp bearing about eight small teeth on its distal end.

Posterior region of trunk (Fig. 3d) with 32-35 sharp spines of unequal size, each minutely serrated, terminal spine of series much larger than preceding ones. Caudal furca well developed, with 6-10 plumose setae followed by one spine on proximal third along its straightened dorsal side, with numerous small spinules on concaved dorsal edge of remaining distal two-thirds. Telsonal filaments short, plumose only on distal two-thirds, arising from about level of fifth posterior spine.

Female.-Carapace length 5.20-9.85 mm, height 3.62-6.38 mm. Carapace, head region, antennule, antenna and posterior region of trunk similar in general shape to those of male, but rostrum somewhat slender than that of male (Figs. 4a, c).

Twenty-four thoracopods, including first and second thoracopods not modified as crasping appendages, similar in shape each other, with diverse setation as those of non-crasping appendages in male (Fig. 3b).

Egg (Fig. 4d) spherical, with irregular depressions, covered with many long and thin papillae.

Remarks.-The present species, previously reported only from Japan (Ishikawa, 1895; Ueno, 1927), is the only species of the genus *Caenestheriella* known from East Asia.

The present specimens are mostly well accorded

with the original description, but have some differences: (1) the number of the segments of antennal flagella varies from 15 to 18, while it is fixed in the original description as the posterior flagellum of 17 segmentes and the anterior one of 18, respectively, (2) the number of the growth lines bearing the row of setae varies from six to seven, while from seven to eight in the original description, (3) the caudal furca has the low of 6-10 plumose setae while six in the original description. These differences seem to be the variations as seen in many other conchostracan species.

The shape of egg, the ornagements of the growth lines and the setations of the thoracopods, which were described and figured in this paper, have not been noted yet in this species from original description or other works (Daday, 1915; Ueno, 1927).

Distribution.-Korea, Japan.

Superfamily Limnadioidea Baird, 1849 흑머리조개벌레 상과 (신칭)

Family Limnadiidae Barid, 1849 흑머리조개벌레 과 (신칭)

Genus *Eulimnadia* Packard, 1874 가시흑머리조개벌레 속 (신칭)

***Eulimnadia braueriana* Ishikawa, 1895**

밤가시흑머리조개벌레 (신칭)

(Figs. 5, 6)

Eulimnadia braueriana Ishikawa, 1895 (p. 15, Pl. 8); Daday, 1926 (p. 27, Fig. 132); Ueno, 1927 (p. 271).

Material Examined.-4♀♀, from ricefields filled with water before rice-planting at Mangch'i-ri, Ilun-myŏn, Kōje-gun, May 4, 1989; 1♀, from ricefields at Tapch'ŏn-ri, Ilbansŏng-myŏn, Chinyang-gun, June. 25, 1984 (G.S. Min); 17♀♀, from a small ephemeral pool near the summit of a mountain at Sohŭksan Is., Aug. 26, 1987 (M. K. Shin and C.B. Kim).

Male.-Not found from Korea.

Female.-Carapace (Figs. 5a, b) length 3.45-5.15 mm, height 1.97-3.28 mm, oval, very thin and nearly transparent, with four growth lines. Umbo lacking. Maxillary gland elongated and surrounding

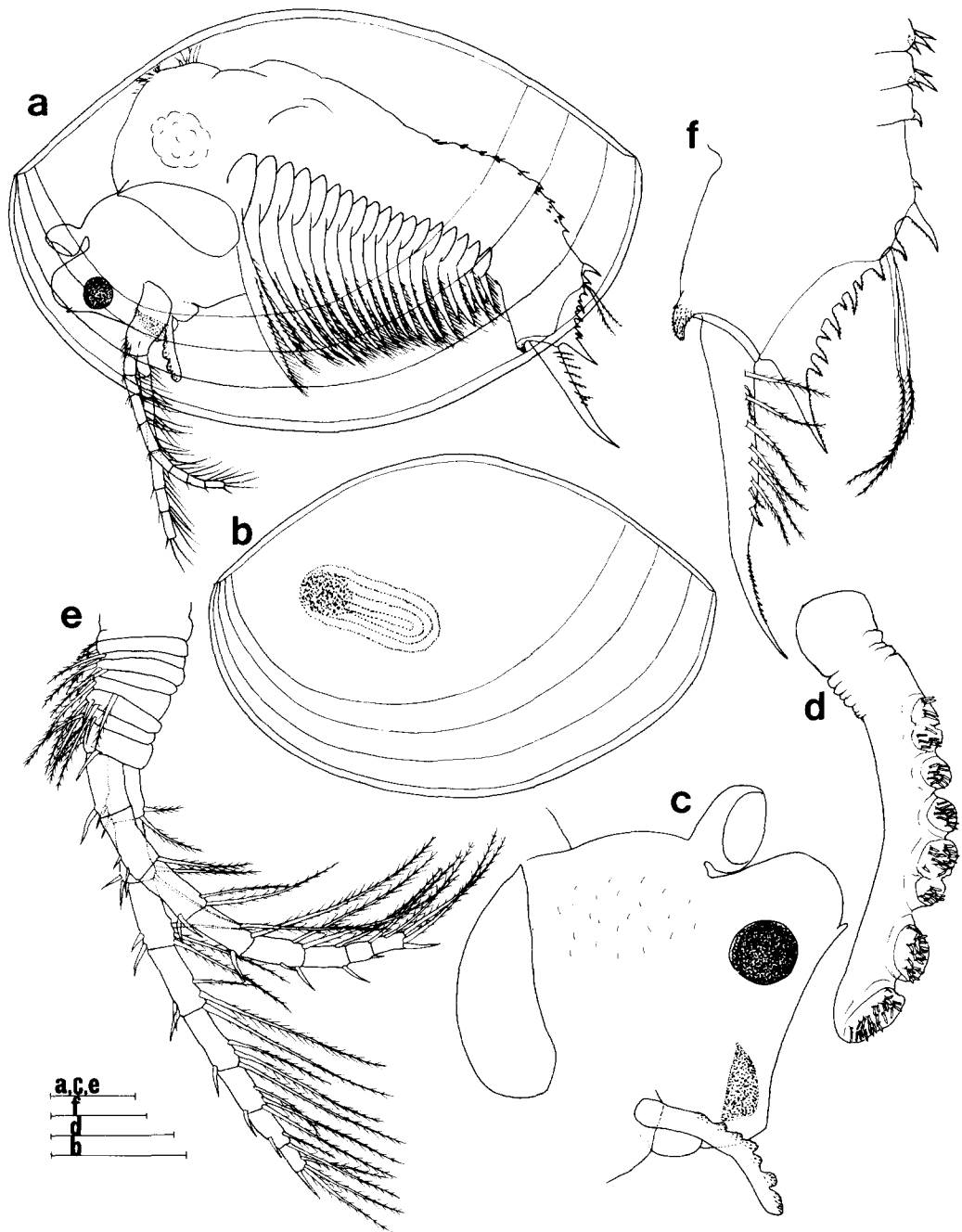


Fig. 5. *Eulimnadia braueriana* Ishikawa, 1895, female: a, habitus, lateral view; b, carapace, lateral view; c, head region, lateral view; d, antennule; e, antenna; f, posterior region of trunk, lateral view. (Scales: d = 0.1 mm; c, e, f = 0.2 mm; a = 1 mm; b = 2 mm).

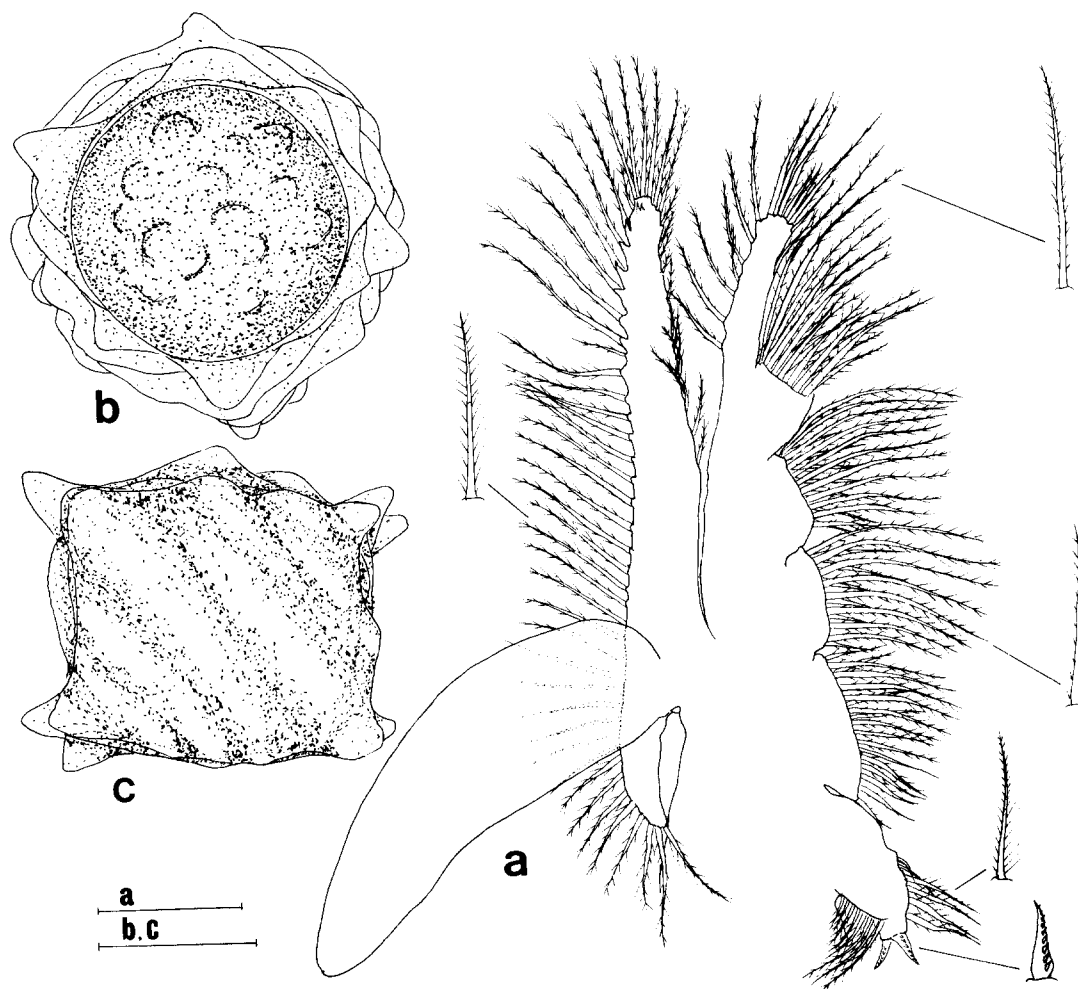


Fig. 6. *Eulimnadia braueriana* Ishikawa, 1895, female: a, right fifth thoracopod, posterior view; b, egg, dorsal view; c, egg, lateral view. (Scales: b, c = 0.05 mm; a = 0.2 mm).

adductor muscle.

Head region (Figs. 5a, c) with large frontal organ arising from protuberance just posterior to compound eye. Rostrum weakly developed, but produced large blunt projection, terminating in obtuse blunt angle, bearing internally large ocellus variable in shape. Compound eyes large, and located near ventral margin of head in lateral view.

Antennule arising from lateral surface of posterior side of rostrum, extending to about second segment of posterior antennal flagellum, indistinctly segmented with 6-8 unequal-sized lobes bearing short sensory papillae (Fig. 5d).

Antenna large, well developed, biramous (Fig.

5e). Basal peduncle divided into 2 poorly demarcated cylindrical segments; distal segment wrinkled, with much plumose setae on anterior edge. Each of biramous flagella divided into 8 segments; each segment of both anterior and posterior flagella bearing 1-2 long spines on anterior edge distally and 2-3 long plumose setae on posterior edge distally.

Eighteen thoracopods similar in shape each other, somewhat decreasing in size posteriorly, with diverse setation as that of fifth thoracopod as shown in Fig. 6a; first endite of endopod bearing two large serrated spines, ornamented with pappose setae and intermediate types between

pappose setae and spinose setae; second endite with pappose setae, spinose setae and pappose-spinose setae; third, fourth and fifth endites with pappose-plumose setae and intermediate types between plumose setae and simple-pappose setae; sixth endite with plumose setae; ventral lobe of exopod with plumose setae, each bearing stout spine on its base; dorsal lobe of exopod with plumose setae. Epipod large, well developed.

Posterior region of trunk (Fig. 5f) with 11 sharp spines of unequal size, each minutely serrated, terminated spine of series much larger than preceding ones. Caudal furca well developed, with 8 plumose setae followed by one spine bearing minute spinules along straightened dorsal side of proximal two-thirds, with numerous small spinules on concave dorsal side of remaining distal third. Telsonal filaments short, plumose on distal half, arising from about level of second posterior spine. Posteroventral margin of trunk below insertion of caudal furcae with well developed blunt spine (characteristic of genus) covered with many minute spinules.

Egg (Figs. 6b, c) nearly cylindrical, with inflated rims and many smoothly rounded ridges extending parallel to each other along length of twisted cylinder from rim to rim; lateral side weakly protruding; ends slightly protruding, with tubercles, its rims flaring out.

Remarks.-The present species is very similar to *Eulimnadia peckardiana* Ishikawa, 1895, but distinguishable from the latter by the number of the growth lines on carapace and the number of the spines on the posterior region of trunk. The shape of egg, illustrated by Daday (1926), is the most characteristic feature distinguishing this species from its most related congeners.

The present specimens well accorded with the original description of Ishikawa (1895) and Daday's (1926) redescription on the female. However, the presence of many minute spinules covering the spine on the posteroventral margin of the trunk, shown in most our specimens, has not been noted yet in the other species of the genus as well as in *E. braueriana* previously reported. This seems to be a variation, but the exact status of the present specimens will be

confirmed by the further study with the males.

Distribution.-Korea, Japan.

References

- Daday, E., 1915. Monographie systématique des phyllopoies conchostracés. *Ann. Sci. Nat. Zool.* (9), **20**: 39-330.
- Daday, E., 1923. Monographie systématique des phyllopoies conchostracés. Deuxième partie. *Ann. Sci. Nat. Zool.* (10), **6**: 255-390.
- Daday, E., 1926. Monographie systématique des phyllopoies conchostracés. Troisième partie (suite). *Ann. Sci. Nat. Zool.* (10), **9**: 1-81.
- Daday, E., 1927. Monographie systématique des phyllopoies conchostracés. Troisième partie (fin). *Ann. Sci. Nat. Zool.* (10), **10**: 1-112.
- Fryer, G., 1987. A new classification of the branchiopod Crustacea. *Zool. J. Linn. Soc.*, **91**: 357-383.
- Hu, W., 1986. Studies of clam shrimps (Crustacea: Conchostraca) I. Three species of Conchostraca of Shandong province China. *J. Shangdong Coll. Oceanol.*, **16**: 24-35 (In Chinese).
- Hu, W., 1989. Taxonomic studies of Chinese conchostracan (Crustacea: Eubranchiopoda). *J. Ocean Univ. Qingdao*, **19**: 1-11 (In Chinese).
- Hu, W., 1991. A taxonomic study on the living species of the genus *Caenestheria* Daday, 1914 (Crustacea: Conchostraca, Cyzicidae). *J. Ocean Univ. Qingdao*, **21**: 111-118.
- Ishikawa, C., 1895. Phyllopod Crustacea of Japan. *Zool. Mag.* (Tokyo), **7**: 1-154.
- Martin, J.W., B.E. Felgenhauer and L.G. Abele, 1986. Redescription of the clam shrimp *Lynceus gracilicornis* (Packard) (Branchiopoda, Conchostraca, Lynceidae) from Florida, with notes on its biology. *Zoologica Scripta*, **15**: 221-232.
- McLaughlin, P.A., 1980. Comparative Morphology of Recent Crustacea. W.H. Freeman and Co., San Francisco, 177pp.
- Schram, F.R., 1986. Crustacea. Oxford Univ. Press, New York, 606pp.
- Ueno, M., 1927. The freshwater Branchiopoda of Japan I. *Mem. Coll. Sci. Kyoto Imp. Univ.*, (B), **2**: 259-311.
- Ueno, M., 1940. Manchurian phyllopoies. In: Inland Water Fauna and Flora of the Manchuria (Kawamura T., ed.), pp.368-381 (In Japanese).

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한국산 현생 극미목 (갑각상강, 새각강) 패갑류의 분류학적 연구
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1981년 5월부터 1992년 5월 사이의 기간 동안에 남한의 담수역 13개 지점에서 채집된 극미목에 속하는 현생 패갑류 (조개벌레류)의 표본들을 검토한 결과 2종이 동정되었다: *Caenestheriella gifuensis* (Ishikawa, 1895), *Eulimnadia braueriana* Ishikawa, 1895. 본 연구에서는 2종에 대한 재기재와 도판을 작성하였는데 이것은 현생 패갑류에 대한 한국에서의 최초의 기록이다.