New species of Miocene cytheracean Ostracoda from the Pohang Basin, SE Korea

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ABSTRACT – Seven new species of ostracods are described from the Miocene deposits of the Pohang Basin in southeastern area, Korea. Baffinicythere paiki is only the third record of the genus Baffinicythere in the world. In this study, the following new species are erected: Callistocythere kyongjuensis, C. seojongriensis, Baffinicythere paiki, Urocystheres pohangensis, Trachyleberis leeii, T. praenitisunai and Acanthocythereis koreana. J. Micropalaeontol. 16(1): 31–40, May 1997.

INTRODUCTION
The Miocene sedimentary sequences in the Pohang Basin of SE Korea contain numerous macro- and microfossils which are employed in elucidating its sedimentary environments and tectonic history. With these aims, many palaeontological and sedimentological studies have been carried out during recent decades. Relatively abundant fossil groups such as Mollusca (Yoon, 1976a, b; Lee, 1992), plants (Chun, 1982), foraminifera (Kim, 1965: Yoo, 1969: Kim & Choi, 1977: Jung, 1993), diatoms (Lee, 1984 unpublished doctoral thesis, Seoul University), palynomorphs (Bong, 1985 unpublished doctoral thesis, Seoul University; Chung & Choi, 1993), silicoflagellates (Koh, 1986 unpublished doctoral thesis, Seoul University), nannofossils (You, 1983) and dinoflagellates (Yun, 1981) are reported. All these studies have improved our understanding of the origin and evolution of the Pohang Basin.

Recently, studies on the Ostracoda of the Pohang Basin have been undertaken by Huh (1991, 1994), Huh and Paik (1992a, b) and Huh et al. (1994). Most of these studies have been focused mainly on palaeoenvironmental investigations of the Pohang Basin. This is the first detailed taxonomic study on new ostracods of the Pohang Basin.

GEOLOGICAL SETTING
The Pohang Basin, the largest sedimentary basin along the eastern coast of the Korean Peninsula, includes fossiliferous Miocene sedimentary rocks which are up to 10 km thick (Chough, 1983). The Miocene sedimentary sequences of the Pohang Basin consist of the Yeonil Group which unconformably overlies Cretaceous and Eocene sedimentary and volcanic rocks, and consists largely of clastic sediments including conglomerate, sandstone and mudstone. The age of this group is generally considered to be Middle Miocene and probably early to mid-Middle Miocene. Conglomerates are abundant in the western part of the Pohang Basin and are intercalated with sandstone and mudstone, which are abundant in the centre of the basin. Most of the samples which yielded ostracods are from the middle part of the Yeonil Group, where the unconsolidated sandstones referred to in the taxonomic part are best developed. The Yeonil Group comprises two units: a lower unit, mainly derived by mass flow deposits forming Gilbert-type fan delta, alluvial fan and steep-faced slope systems (Chough et al., 1993), and an upper unit, composed of hemipelagic to pelagic sediments. The stratigraphical division of the sequence is conventionally divided into several formations, the boundaries and the exact age of which are still debatable (Um et al., 1964; Kim, 1965; Yoon, 1975; Yun, 1986; Choe & Chough, 1988; Hwang, 1993 unpublished doctoral thesis, Seoul University).

MATERIAL AND METHODS
A total of nine sections from six areas containing fossil Ostracoda were collected and measured. The collected areas are given in detail with available palaeontological information and with the columnar sections in Huh (1991 unpublished doctoral thesis, Korea University) and Huh & Paik (1992a). The studied areas and sections are as follows: Daejeonri (section DJ), Seojongri (sections SJ1, SJ2), Danguri (Section DG), Hakjeondong (section HJ), Mulcheonri (sections MC1, MC2) and Odo-dong (sections OD1, OD2). In these areas, 63 samples were collected and examined, but only 24 samples yielded ostracods (Fig. 1).

The stratigraphical relationships of the various samples to one another are depicted in the following outline:

Lower

North Section DJ Sample DJ-1
Section SJ1 Sample SJ1-1
Section SJ2 Sample SJ2-1, SJ2-2, SJ2-3, SJ2-4, SJ2-5, SJ2-6
Section OD1 Sample OD1-1, OD1-2, OD1-3, OD1-4
Section OD2 Sample OD2-1
Section DG Sample DG-1, DG-2, DG-3
Section HJ Sample HJ-1, HJ-2, HJ-3
Section MC1 Sample MC1, MC2, MC3, MC4
South Section MC2 Sample MC2-1

Most ostracods occurred in the massive, fine to medium sandstone bed which also yields foraminifera, oysters and shell fragments. About 300 g portions of the dry samples were processed. Each dried sample was treated using the saturated sodium sulphate solution and naphtha method.

SYSTEMATIC DESCRIPTIONS
The following abbreviations are employed in the descriptions: J = juvenile, C = carapace, V = valve, RV = right valve, LV = left valve, L = length, H = height, W = width.

All the type specimens of the new taxa in this paper are deposited in the collections of the Palaeontology Laboratory of the Department of Geology, Chonnam National
University, Korea to which the catalogue numbers refer. Other specimens are deposited in the Micropalaeontology Museum at Aberystwyth.

Class Ostracoda Latreille, 1806
Order Podocopida Müller, 1894
Suborder Podocopina Sars, 1866
Superfamily Cytheracea Baird, 1850
Family Leptocytheridae Hanai, 1957
Genus Callistocythere Ruggieri, 1953

**Callistocythere kyongjuensis** sp. nov. (Pl. 1, figs 1–6)

1992b Callistocythere sp. A: Huh & Paik, pl. 3, fig. 11.
1994 Callistocythere sp. A: Huh et al., pl. 1, figs. 5, 6.

**Derivation of name.** From Kyongju, the city where the type locality of the species is situated.

**Diagnosis.** A species of Callistocythere characterized by its four anterior and four posterior marginal ribs and centrally coarsely reticulate carapace. The species, although clearly Callistocythere resembles many Leptocythere species.

**Holotype.** Female LV (CNU-O-501).

**Material.** 17 adults.

**Type locality and horizon.** Sample horizon MC2-1, Mulcheonri area of Weolseong-gun, near Kyongju. Unconsolidated sediment with foraminifera and numerous shell fragments; massive fine to medium-grained sandstone. Miocene.

**Description.** Carapace small, oblong, highest at the anterior cardinal angle. Sexual dimorphism fairly strong: male slightly narrower in side view, and more compressed in dorsal view, especially posterocentrally. Anterior margin obliquely rounded, with some projections at termination of radial pore canals, especially along lower half of anterior margin; posterior margin truncated above, rounded below. Dorsal margin gently arched and inclined backward; ventral margin moderately sinuous near middle. Surface coarsely reticulate centrally. Eye spot prominent. Four anterior and four posterior marginal ribs distinct; the second anterior rib extends from the eye spot to the mid-anteroventral area; the third posterior rib short and distinct. Hingement pseudoentomodont and of the Callistocythere japonica type. Calcified inner lamella broad anteriorly, moderate posteriorly. Vestibulum present, but very narrow anteriorly. Radial pore canals moderately numerous, repeatedly bifurcate and polyfurcate. Snap-knob present in right valve, corresponding snap-pit in left valve. Muscle scars located slightly below the centre. Four adductor scars in a vertical row; the dorsal subtriangular, the two median elongate, horizontal and the ventral subcircular. A slightly elongate, short frontal scar present. Fulcral point large and circular. Normal pores small, few, simple, scattered.

**Dimensions (mm).**

|                   | L  | H  |
|-------------------|----|----|
| Holotype, female LV (CNU-O-501) | 0.56 | 0.30 |
| Paratype, female LV (CNU-O-502) | 0.56 | 0.30 |
| Paratype, male RV (CNU-O-503) | 0.56 | 0.28 |
| Paratype, male LV (CNU-O-504) | 0.56 | 0.29 |

**Explanation of Plate 1**

**Figs 1–6. Callistocythere kyongjuensis** sp. nov. All specimens are from sample horizon MC2-1: figs 1–2. Holotype, female LV (CNU-O-501), 1) external lateral view (×82), 2) internal view (×80); fig. 3. Paratype, female LV (CNU-O-502), external lateral view (×80); figs 4–5. Paratype, male RV (CNU-O-503), 4) external lateral view (×82), 5) internal view (×80); fig. 6. Paratype, male LV (CNU-O-504), external lateral view (×80).

**Figs 7–10. Callistocythere seojongenssis** sp. nov. All specimens ×77: fig. 7. Holotype, female RV (CNU-O-505), external lateral view, sample SJ2-3; fig. 8. Paratype, female RV (CNU-O-506), internal view, sample SJ2-3; fig. 9. Paratype, female LV (CNU-O-507), external lateral view, sample SJ2-3; fig. 10. Paratype, male LV (CNU-O-508), external lateral view, sample SJ2-1.

**Figs 11–15. Bafficocythere punki** sp. nov. All specimens ×69: fig. 11. Holotype, female RV (CNU-O-509), external lateral view, sample SJ2-3; fig. 12. Paratype, female LV (CNU-O-510), external lateral view, sample SJ2-3; fig. 13. Paratype, male RV (CNU-O-511), external lateral view, sample SJ2-3; fig. 14. Paratype, male LV (CNU-O-512), external lateral view, sample MC2-1; fig. 15. Paratype, male RV (CNU-O-513), internal view, sample MC2-1.
Plate 1

Ostracoda from SE Korea
Remarks. This species somewhat resembles Callistocythere reticulata Hanai, 1957 in carapace outline and surface ornamentation, but differs in the finer details of ornamentation and the pattern of anterior and posterior ribs.

Distribution. Abundant at sample horizon MC-2-1, to which it is confined.

**Callistocythere seojeongriensis** sp. nov. (Pl. 1, figs 7–10)

Derivation of name. From Seojeongri village, the type locality of the species.

**Diagnosis.** A species of Callistocythere characterized by its finely reticulate surface ornament and numerous, various ribs, especially strong posterior marginal ribs.

**Holotype.** Female RV (CNU-O-505).

**Material.** 11 carapaces, 45 adults.

**Type locality and horizon.** Sample horizon SJ2-3, Seojeongri area of Yeongil-gun, near Pohang. Unconsolidated sediment with foraminifera and numerous shell fragments; massive fine-grained sandstone.

**Description.** Carapace small, subrectangular, highest at the anterior cardinal angle. Sexual dimorphism strong; female broader than male in posterocentral area, male slightly narrower than female in lateral outline. Anterior margin obliquely rounded; posterior margin truncated in upper half, gently rounded in lower half. Posterior cardinal angle distinct. Dorsal margin broadly arched; ventral margin broadly concave. Surface ornament with finely reticulation over most of the central part of the carapace. Two anterior marginal ribs prominent; outer rib weakly, very short, nearly vertical; inner rib narrow, distinct, broadly rounded, extending from lower terminal to upper terminal of anterior margin. Two posterior marginal ribs strongly prominent; outer rib subcircular, extending from the posterior fifth of dorsal margin to the ventral sinusosity; inner rib subrounded, distinct, starting from the posterior fourth of dorsal margin and terminates at mid-length. Numerous small ribs occur, and a sinuous posteroverentral rib is especially distinct. Eye spot distinct. Hingement pseudoentomodont and of the Callistocythere japonica type. Calcified inner lamella broadly anteriorly; moderate posteriorly. Anterior vestibulum narrow. Snap-knob and snap-pit distinct. Four adductor muscle scars in a vertical row and a frontal muscle scar in a row. Normal pore small, few, simple.

**Dimensions (mm).**

|                | L   | H   |
|----------------|-----|-----|
| Holotype, female RV (CNU-O-505) | 0.59 | 0.32 |
| Paratype, female RV (CNU-O-506)  | 0.59 | 0.34 |
| Paratype, female LV (CNU-O-507)  | 0.59 | 0.33 |
| Paratype, male LV (CNU-O-508)    | 0.59 | 0.31 |

**Remarks.** This species resembles Callistocythere subsetatensis Ishizaki, 1966 from the Miocene and Pliocene of the Sendai area of Japan, in shape and ornamentation, but the present species differs in its more finely reticulate surface ornament, presence of eye spot, more prominent marginal ribs and presence of numerous ribs. This species also resembles Callistocythere sp. (Yajima, 1988) from the Miocene of Japan in general appearance, but differs in details of the surface ornament.

**Distribution.** Abundant at sample horizon SJ2-3 and rare at SJ2-1, SJ2-2, SJ2-4, HJ-2, OD1-2, OD1-3 and OD1-4.

Family Hemicytheridae Puri, 1953

Subfamily Aurilinae Puri, 1953

Genus Buffinicythere Hazel, 1967

**Buffinicythere paiki** sp. nov. (Pl. 1, figs 11–15; Pl. 2, figs 1–2)

1992a Buffinicythere sp.: Huh & Paik, pl. 1, figs 14, 15.
1992b Buffinicythere sp.: Huh & Paik, pl. 1, figs 14, 15.
1994 Buffinicythere sp.: Huh et al., pl. 2, figs 1, 2.

Derivation of name. In honour of Professor Kwang Ho Paik of Korea University, Seoul in recognition of his important contribution to our knowledge of the Miocene deposits of the Korea Peninsula.

**Diagnosis.** A species of Buffinicythere characterized by its relatively small carapace, coarsely but regularly reticulate ornament conforming to a somewhat radiate pattern about the valve centre, two frontal muscle scars and sexual dimorphism with males shorter than females.

**Holotype.** Female RV (CNU-O-509).

**Material.** 9 carapaces, 48 valves, 3 juveniles.

**Type locality and horizon.** Sample horizon SJ2-3, Seojeongri area of Yeongil-gun, near Pohang. Unconsolidated sediment with foraminifera and numerous shell fragments; massive fine-grained sandstone.

**Description.** Carapace medium, elongate, subrectangular (male) to subtrapezoidal or auriform (female) in lateral view. Maximum height at the anterior cardinal angle. Anterior margin well rounded; posterior margin narrowly rounded; ventral margin more or less sinuous, anterior third slightly concave, behind midlength slightly convex. Dorsal margin virtually straight and inclined towards the posterior, or broadly convex; ventral margin more or less sinuous, anterior third slightly concave, behind midlength slightly convex. Surface coarsely, regularly reticulate with distinct ribs forming triangle in postero-lateral area but slightly less prominent than that of Buffinicythere howei. Less prominent submarginal curved rib extending from in front of eye tubercle, converging with anteroventral margin, and bending...
Plate 2
upwards posteriorly to meet anterior corner of posteroventral triangle of ribs. Slightly prominent posterodorsal and posteroverentral node, extending to nearly vertical ribs. Subcentral tubercle present but not prominent. Eye tubercle small, prominent. Marginal pore canals numerous, swollen at mid-length. Small anterior and posterior vestibulae. Hinge robustly holoapomphodont, with posterior tooth of the right valve reniform. Ocular sinus conspicuous. Normal pore canals scattered, sieve type. Adductor muscle scars; a single subrounded dorsal scar, two rounded dorso-median scars, an elongate ventro-median scar (in some cases, the right half is absent) and an elongate ventral scar. Two rounded frontal scars. Strongly sexual dimorphism; male more slender and shorter than female.

**Dimensions (mm).**

|                | L    | H   |
|----------------|------|-----|
| Holotype, female RV (CNU-O-509) | 0.67 | 0.39 |
| Paratype, female LV (CNU-O-510) | 0.65 | 0.39 |
| Paratype, male RV (CNU-O-511) | 0.63 | 0.35 |
| Paratype, male LV (CNU-O-512) | 0.61 | 0.36 |
| Paratype, male RV (CNU-O-513) | 0.63 | 0.35 |
| Paratype, female LV (CNU-O-514) | 0.63 | 0.36 |
| Paratype, female RV (CNU-O-515) | 0.65 | 0.40 |

**Remarks.** This species is superficially similar in general appearance to *Baffinicythere emarginata* (Sars, 1866) (Hazel, 1967), but differs in details of ornament, carapace outline, carapace size and frontal muscle scar pattern. This species is distinguished from *Baffinicythere howei* Hazel, 1967 (Hazel, 1967; Horne & Whittaker, 1983) in its different muscle scar pattern, size, sexual dimorphism and the distribution pattern of its ribs. Also, this species is distinguished from *Meridionalicythere discophora* (Skogsberg, 1928) from the S. W. Atlantic (Whatley et al., 1987) by its adductor muscle scar pattern and the nature of its surface ornament. This species seems to belong to *Baffinicythere* by virtue of its undivided ventro-median adductor muscle scar, strong sexual dimorphism and the triangle formed by ribs in the postero-lateral area. This species is also closely allied to the genus *Hemicythere* in having two frontal scars, but Hazel (1967) observed that the lower frontal muscle scar tends to be easily overlooked.

**Distribution.** Abundant at sample horizon SJ2-3 and rare at SJ2-2, SJ2-4, HJ-2 and MC2-1.

**Genus Urocythereis** Ruggieri, 1950

**Urocythereis pohangensis** sp. nov.

(Pl. 2, figs 3–9)

1992a *Urocythereis* sp.; Huh & Paik, pl. 1, figs 17, 18.
1992b *Urocythereis* sp.; Huh & Paik, pl. 1, figs 17, 18.
1994 *Urocythereis* sp.; Huh et al., pl. 2, fig. 7.

**Derivation of name.** From Pohang, the Tertiary sedimentary basin in Korea where the type locality of the species is situated.

**Diagnosis.** An inflated, elongate species of *Urocythereis* characterized by its coarsely reticulate surface ornament with numerous intramural spines, two subparallel ventro-lateral ribs and prominent subcentral tubercle.

**Holotype.** Male LV (CNU-O-516).

**Material.** 3 carapaces, 84 valves, 22 juveniles.

**Type locality and horizon.** Sample horizon SJ2-3, Scojeong-gri area of Yeongil-gun, near Pohang. Unconsolidated sediment with foraminifera and shell fragments rich; massive fine-grained sandstone.

**Description.** Carapace large, inflated, elongate and subrectangular in lateral view. Maximum height at anterior cardinal angle. Anterior margin well rounded; posterior margin dorsally and ventrally convex and centrally compressed. Posteroverentral margin more or less prominent, projecting posteriorly. Dorsal margin nearly straight, slightly inclined posteriorly; ventral margin with oval incurvative at mid-length. Surface coarsely reticulate with numerous intramural spines. Two subparallel ribs extend across the ventro-lateral surface. Slightly depressed postero-lateral area. Prominent subcentral tubercle. Eye tubercle ovate with post-ocular sulcus. Normal pore canals scattered, sieve type. Marginal pore canals numerous and straight. Calcified inner lamellar of median width. Anterior vestibulum moderately deep. Hinge holamphodont, with reniform posterior tooth in right valve which exhibits a wide aurine notch. Adductor muscle scar vertical row of four, of which the two middle scars are distinctly divided. Three frontal scars, of which the middle is distinctly smaller. Strongly sexual dimorphism, male more elongate and slender than female.

**Dimensions (mm).**

|                | L    | H   |
|----------------|------|-----|
| Holotype, male RV (CNU-O-516) | 0.93 | 0.50 |
| Paratype, female LV (CNU-O-517) | 0.88 | 0.51 |
| Paratype, female RV (CNU-O-518) | 0.86 | 0.49 |
| Paratype, male RV (CNU-O-519) | 0.96 | 0.49 |
| Paratype, female LV (CNU-O-520) | 0.87 | 0.52 |
| Paratype, female RV (CNU-O-521) | 0.90 | 0.52 |
| Paratype, juv. RV (CNU-O-522) | 0.62 | 0.37 |

**Remarks.** This species is closely similar to *Yezocythere hayashii* Hanai & Ikeya, 1991 from the Omma-Manangan Ostracoda fauna of Japan in the general lateral outline, distribution pattern of muscle scars and hinge structure. However, this species is distinguished from the latter by its reticulate ornament pattern with numerous intramural spines and prominent subcentral tubercle. The present authors regard *Yezocythere* Hanai & Ikeya, 1991 as a junior synonym of *Urocythereis*. This species resembles *Elofonella concinna* (Jones, 1857) from the Tomikawa Formation in Omma-Manangan Area of Japan (Cronin & Ikeya, 1987) in lateral outline and general surface ornament, but differs in its less conspicuous anterior marginal rim, reticulate ornament and absence of secondary reticulation. This species is also distinguished from *Baffinicythere ishizakii* (Irizuki, 1996) in lacking a denticulate posterior margin and in its larger size. (Irizuki's specimens measure Holotype L = 1.219, H = 0.569 and the paratypes range from 1.268 to 1.336 long, and 0.630 to 0.740 high). The present species is distinguished from other *Urocythereis* species by its surface ornament with intramural spines.
Ostracoda from SE Korea

Distribution. Abundant at sample horizons SJ2-3, SJ2-4, HJ-2 and rare at SJ2-2, SJ2-5 and MC2-1.

Family Trachyleberididae Sylvester-Bradley, 1948
Subfamily Trachyleberidinae Sylvester-Bradley, 1948
Genus Trachyleberis Brady, 1889
Trachyleberis leei sp. nov.

(Pl. 2, figs 10–15)

1992a Acanthocytherites sp.; Huh & Paik, pl. 2, fig. 10.
1992b Acanthocytherites sp.; Huh & Paik, pl. 2, fig. 10.

Derivation of name. In honour of Dr. Eui Hyeong Lee of Korea University, Korea, in recognition of his important contribution to our knowledge of Korean Miocene Ostracoda.

Diagnosis. A species of Trachyleberis characterized by its regularly, well-reticulated surface ornament, numerous conjunctive spines, and ocular rib which connects mid-anteriorly with a rib which parallels the anterior and ventral margins.

Holotype. Female LV (CNU-O-523).
Material. 21 carapaces, 61 valves, 6 juveniles.
Type locality and horizon. Sample horizon SJ2-3, Seocon-gri area of Yeongil-gun, near Pohang. Unconsolidated sediment with foraminifera and rich in shell fragments: massive fine sandstone.

Description. Carapace large, subrectangular, tapering posteriorly. Left valve is slightly larger than right valve. Strongly sexually dimorphic; male is longer and narrower than female in lateral view. Greatest length near mid-height, greatest height at anterior cardinal angle. Anterior margin broadly and obliquely rounded with tiny spines; posterior margin protruded posteriorly, posterodorsal margin slightly concave or straight, posteroventral margin broadly and obliquely rounded with small spines. Dorsal margin straight; with anterior hinge ear; ventral margin with more pronounced oral incurvature in male than in female. Surface reticulate ornament with conjunctive spines on intersections of lattice. Eye tubercle distinct, prolonged with ocular rib which extends to the mid anterior margin, from where it parallels the anterior and ventral margins. Anterior region compressed. Posterior lateral surface almost smooth with some small spines. Marginal denticles spinose numerous, small, along anterior and posteroventral margins. Internal features typical of genus with distinct snap-knob orally in RV.

Dimensions (mm).

|          | L    | H    |
|----------|------|------|
| Holotype, female LV (CNU-O-523) | 0.74 | 0.42 |
| Paratype, female RV (CNU-O-524) | 0.73 | 0.39 |
| Paratype, female LV (CNU-O-525) | 0.75 | 0.42 |
| Paratype, female RV (CNU-O-526) | 0.74 | 0.40 |
| Paratype, female RV (CNU-O-527) | 0.73 | 0.40 |
| Paratype, male LV (CNU-O-528) | 0.75 | 0.38 |

Remarks. The present species resembles Trachyleberis mizunamensis Yajima. 1992 from Mizunami in central Japan in shape and surface ornamentation, but the present species differs from the latter in its weak, shorter ocular rib, the nature of its anterior ornament and its v-shaped frontal muscle scar. This species differs from most other species of Trachyleberis because of its enhanced reticulate ornament. However, it clearly belongs in Trachyleberis because of its anterodorsal rib, subrectangular lateral outline, spinose ornament and oblique ocular rib. The type species, Trachyleberis scabrunculata (Brady), is more elongate, is postulate rather than spinose and has a very strong, sharp ocular rib.

Distribution. Abundant at sample horizon SJ2-3 and rare at SJ2-1, SJ2-2, SJ2-4, SJ2-5, HJ-1, HJ-2, OD1-2, OD1-3, OD1-4 and MC1-3.

Trachyleberis praeoitisumai sp. nov.

(Pl. 3, figs 1–5)

1992a Trachyleberis niitsumai Ishizaki; Huh & Paik, pl. 2, figs 6, 7.
1992b Trachyleberis niitsumai Ishizaki; Huh & Paik, pl. 2, figs 6, 7.
1994 Trachyleberis niitsumai Ishizaki; Huh et al., pl. 2, fig. 11.

Derivation of name. Latin, with reference to the probable ancestral relationship of the species to Trachyleberis niitsumai Ishizaki.

Diagnosis. A species of Trachyleberis characterized by its irregular surface ornament with blunt tubercles and well-developed anteroventral marginal rib.

Holotype. Female LV (CNU-O-529).
Material. 50 carapaces, 83 valves, 46 juveniles.
Type locality and horizon. Sample horizon SJ2-3, Seocon-gri area of Yeongil-gun, near Pohang. Unconsolidated foraminifera and shell fragments rich; massive fine sandstone.

Description. Carapace large, subrectangular, tapering posteriorly. Left valve is slightly larger than right valve. Strong sexual dimorphism; carapace of male is longer and narrower than that of female. Anterior margin broadly rounded with tiny spines; posterior margin narrowly protruded posteriorly, just below mid-height. Dorsal margin nearly straight in left valve, but broadly rounded in right valve; ventral margin slightly sinuous. Surface covered with weak irregular reticulae and moderately prominent, blunt tubercles. Subcentral tubercle prominent. Eye tubercle distinct, prolonged with anterodorsal oblique rib. Anterior marginal rib distinct, divided; upper part nearly straight inclined from anterior cardinal angle to mid-height; lower part broadly rounded prolonged to mid-length along the ventral margin. Caudal region smooth with some small spines. Internal features as for genus. Snap knob occurs orally in RV.

Dimensions (mm).

|          | L    | H    |
|----------|------|------|
| Holotype, female LV (CNU-O-529) | 0.76 | 0.44 |
| Paratype, female RV (CNU-O-530) | 0.76 | 0.41 |
| Paratype, female LV (CNU-O-530) | 0.77 | 0.44 |
| Paratype, female LV (CNU-O-531) | 0.80 | 0.44 |
| Paratype, female RV (CNU-O-532) | 0.79 | 0.42 |

Remarks. This species has a close affinity to Trachyleberis niitsumai Ishizaki, 1971 from Aomori Bay of Japan in general appearance. However, this species differs from the
latter in its well-developed anteroveltral marginal rib, less prominent spines and carapace shape. This species also resembles *Trachyleberis scabroculea* (Brady, 1880) from the Recent of Japan, the type species of *Trachyleberis*, in shape and inner features, especially in the presence of the well-developed anterodorsal rib, but this species is clearly different to the latter in surface ornamentation. This species somewhat resembles *Trachyleberis* sp. Yajima, 1988 from the Japanese Miocene, but differs in details of surface ornament.

**Distribution.** Abundant at sample horizon SJ2-1, SJ2-2, SJ2-3, OD1-3, OD1-4, and rare at SJ2-2, OD1-1 and OD1-2.

**Genus Acanthocythereis** Howe, 1963

*Acanthocythereis koreana* sp. nov.

(Pl. 3, figs 6–12)

1992a *Acanthocythereis matusensis* Ishizaki; Huh & Paik, pl. 2, figs 8, 9.

1992b *Acanthocythereis matusensis* Ishizaki; Huh & Paik, pl. 2, figs 8, 9.

1994 *Acanthocythereis matusensis* Ishizaki; Huh et al., pl. 2, fig. 12.

**Derivation of name.** From Korea, referring to the first occurrence of the species in the Korean Peninsula.

**Diagnosis.** A rather large, thick-shelled species of *Acanthocythereis* distinguished by its surface ornament with numerous small spines and tubercles superimposed on coarse web-like reticulation and lack of short vertical posterodorsal rib.

**Holotype.** Female, RV (CNU-O-533).

**Material.** 27 carapaces, 159 valves, 2 juveniles.

**Type locality and horizon.** Sample horizon DJ-1, Daejonri area of Yeongil-gun, near Pohang. Unconsolidated foraminifera and shell fragment rich; massive mudstone.

**Description.** Carapace rather large, thick-shelled, subtrapezoidal. In lateral view, carapace tapering slightly toward the posterior end. Sexual dimorphism distinct; male carapace is longer and narrower than female carapace. Maximum height at anterior cardinal angle. Anterior margin broadly rounded and nearly symmetrical with numerous marginal spines; posterior margin nearly vertical and obliquely rounded with small spines. Dorsal margin straight with numerous spines; ventral margin nearly straight in female, but slightly sinuous in male. Surface ornament with numerous, irregularly small spines superimposed on feeble web-like reticulation. Anterior marginal spines arranged concentrically about subcentral tubercle. Subcentral tubercle prominent. Eye tubercle distinct, just below anterior end of dorsal margin, and somewhat obliquely elongated. Calcified inner lamella moderately wide. Line of concrescence and inner margin coincide throughout the margin. Marginal pore canals numerous, simple, nearly straight, and numerous at anterior and posterior margins, and slightly inflated near the middle ventral margin. Hinge holamphidont, with slightly crenulate posterior tooth in right valve. Muscle scars consist of a v-shaped frontal scar and a vertical row of four adductor scars; dorso-median adductor scar elongate anterodorsally. Normal pores simple.

**Dimensions (mm).**

|          | L    | H    |
|----------|------|------|
| Holotype, female RV (CNU-O-533) | 0.97 | 0.61 |
| Paratype, female LV (CNU-O-534) | 0.91 | 0.60 |
| Paratype, female RV (CNU-O-535) | 0.99 | 0.63 |
| Paratype, female LV (CNU-O-536) | 0.96 | 0.61 |
| Paratype, male RV (CNU-O-537)  | 1.09 | 0.56 |
| Paratype, male LV (CNU-O-538)  | 1.01 | 0.54 |
| Paratype, male LV (CNU-O-539)  | 1.12 | 0.63 |

**Remarks.** This species resembles *Acanthocythereis matusensis* Ishizaki 1971 from the Aomori bay of Japan in general appearance, but differs in the developmental degree of spines, the reticulation on the surface, lack of a short vertical posterodorsal rib consisting of small spines and larger carapace size. This species differs from *Acanthocythereis danelensis* (Norman, 1865) from Quaternary of the Gulf of Alaska (Brouwers, 1993) in its less developed reticulate ornament, and numerous, irregularly small spines, and lack of a short vertical posterodorsal rib.

**Distribution.** Common at sample horizon DJ-1, SJ1-1, SJ2-5, SJ2-6, MC1-3, HJ-2, HJ-3, OD1-2, OD1-3, OD2-1 and rare at SJ2-4, OD1-1.

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