

Three New Species of Cirripedia (Crustacea) from Korea

Kim, Il Hoi* and Kim, Hoon Soo**

*Department of Biology, Kangreung National University, Kangreung 210-702, Korea; **Department of Zoology,
College of Natural Sciences, Seoul National University, Seoul 151-742, Korea)

한국산 따개비류(갑각 강) 3신종

김 일 회*, 김 훈 수**

(*강릉대학 생물학과 · **서울대학교 자연과학대학 동물학과)

적 요

한국 남해에서 채집된 성계에 부착한 유병 만각류 1신종 *Paralepas phyllacanthusi*와 해변속에 사는 무병 만각류 2신종 *Acasta paraspinifera* 및 *A. chejudoensis*를 기재한다.

Key words: Three New Species, Cirripedia, Crustacea, Korea

INTRODUCTION

Our knowledge of the cirripeds inhabiting the Korean seas is very scanty. Although there are a number of records on Korean cirripeds, most published works are the collecting lists.

While engaged in working out the cirriped materials collected from around the Korean seas, we found several dozens of species. Of these three species are found to be new to science and described here beforehand. One is *Paralepas phyllacanthusi* attached to a spine of a sea urchin collected from Sögwip'ö in Chejudo Island, and the others are sponge-inhabiting *Acasta* species, that is, *A. paraspinosa* imbedded in *Phakellia elegans* from Chejudo Island and Kömundo Island, and *A. chejudoensis* imbedded in *Ceratopsis* species from Mosülp'ö in Chejudo Island.

All type specimens are deposited in the Department of Biology, Kangreung National University.

DESCRIPTIONS

Family Heteralepadidae Nilsson-Cantell, 1921

Genus *Paralepas* Pilsbry, 1907

1. *Paralepas phyllacanthusi*, n. sp.

(Fig. 1)

Material examined: A single specimen (holotype: NP71020901), attached to a spine of a sea urchin, *Phyllacanthus dubius* (Brandt), together with *Solidobalanus hawaiiensis* (Pilsbry), 7/II/1971, off Sógwip'o in Chejudo Island, depth unknown, H.S. Kim.

Size: Capitulum: height 8.5mm, width 5.1mm, depth 8.0mm; peduncle: length 4.0mm, largest diameter 4.0mm.

Description: Capitulum nearly globular in lateral view and elliptical in frontal view, not much compressed at apical portion. Epidermis thick, hard, transparent, and pale yellow in alcohol preservation. Orifice straight, not protuberant, obliquely inclined to the longitudinal axis of capitulum, about as long as a third of capitular length. Scutum present as a chitinous rudiment, wide trigonal and deeply imbedded in the epidermis. Frontal margin below the orifice roundedly protuberant, smooth. Carinal margin gently curved with a weak carinal ridge. Around the carinal and basal margins, there are several wide warts which are low and smooth.

Peduncle strongly wrinkled transversely, infolded into capitulum, hence, clearly defined from capitulum, not longer than half the height of capitulum; attaching plane furrowed, oblique, therefore frontal margin much longer than the posterior.

Labrum depressed medially; teeth low and blunt at near median portion, but become gradually longer and sharper laterally, with their sizes and separations irregular; no seta on crest. Palp gradually narrower toward its end, but not pointed; upper margin smooth without bristles. Mandible with 4 distinct teeth; second tooth positioned near the middle of anterior margin; fourth tooth adjoined to, but not fused into, inferior angle; inferior edges of first and second tooth smooth, whereas, that of the third armed with 2, small and pointed denticles. Maxilla I with a narrow and deep notch; above the notch, there are 3 spines and a bristle, of which the uppermost spine long, very thick and bent downward at near its end, and median spine based on the side of anterior margin; below the notch, anterior margin marked in 3 tiers; inferior angle slightly protuberant; upper margin not setose. Maxilla II with broad frontal edge; each upper and lower angle round, each with tuft of bristles; the bristles are also present at posterior upper edge.

First cirri with outer rami longer and much thicker than the inner. Cirri II to VI similar in shape, each with outer rami slightly longer and thicker than the inner, and segments of the outer rami become increasingly pentagonal toward their extremities; each segments with a obliquely tranverse row of bristles anteriorly; on posterodistal angle of each segment, there are thick and stiff bristles which are more or less longer than each segment and are of the numbers of 2-4 at outer rami or 3-7 at inner rami. Proximal segments of cirri not clearly divided. Propodites very long. The numbers of segments of cirri are I: 11 (outer ramus), 9 (inner ramus); II: 18, 16; III: 20, 17; IV: 21, 17; V: 21, 18; VI: 20, 17.

Filamentary appendages are missed.

Penis slightly longer than caudal appendages, tapering to its extremity which is setose, annulated all over.

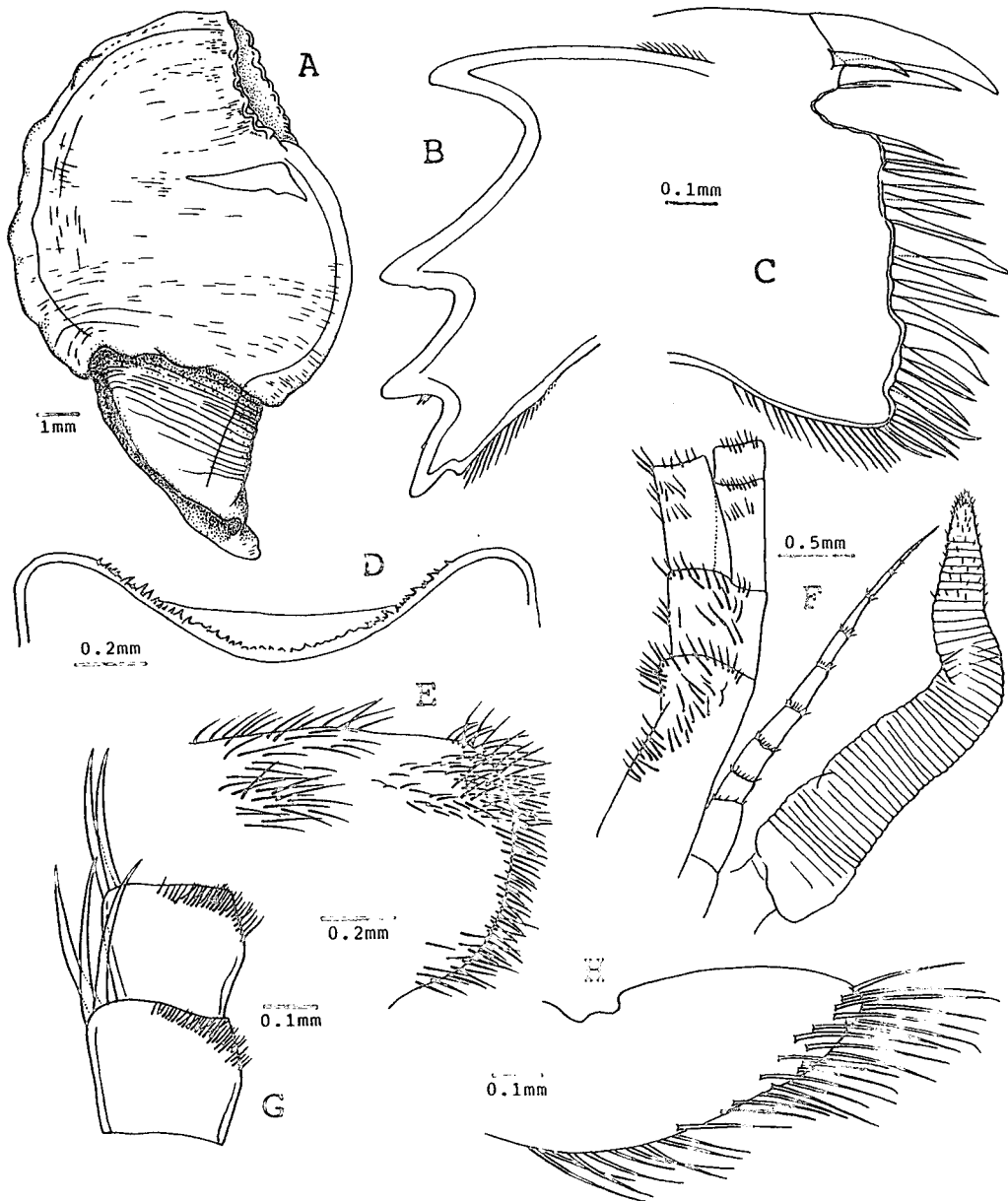


Fig. 1. *Paralepas phyllacanthusi*, n. sp. A, animal in side view; B, mandible; C, maxilla I; D, labrum; E, maxilla II; F, penis, caudal furca and proximal part of sixth cirrus; G, segments of inner ramus of fifth cirrus; H, palp.

Caudal appendage 13-segmented, as long as half the length of cirri VI, tapering to its extremity which is very thin and obscure; lengths of segments irregular; a circular row of weak and short hairs bears along the borderline of each segments.

Etymology: Named from the generic name of the host.

Remarks: Two genera, *Heteralepas* and *Paralepas* representing Heteralepadidae, are clearly separable from each other by the differences of internal structures (Newman, 1960). However it cannot be said that all the species within a genus are clearly defined. This may be due to not only the poorness of

taxonomic characters resulted from the simple external structure with the absence of plate, but also incomplete descriptions, incorrect descriptive expressions of the species, and also may be due to the less frequent opportunities to find the materials owing to their relative deep-water dwellings.

There are about 24 species or subspecies described within the genus *Paralepas* of which more than a half have not been seen since they were originally described, and 6 were established on a single type specimen. Because of that the records on the morphological variations of the individuals within a given species are very scarce, therefore it is very difficult to make morphological comparison with one another. If someone has a chance to examine an enough amount of materials from various localities, it is possible that a number of nominal species may be found and will be synonymized. Several previous authors have used the presence or absence of the scutum as a convenient character in distinguishing the species. It should be pointed out, however, that the descriptive expressions about the scutum are far from uniform and are unreliable. Hoek recorded the absence of scutum for all his *Paralepas* species as "scuta wanting" in his description (Hoek, 1883) of *P. pedunculata* or as "no scuta" in his descriptions (Hoek, 1907) of *P. intermedia*, *P. lithotryae* and *P. morula*. But much later, Rosell (1972) described the above-mentioned, *P. lithotryae* as having the distinct scutum. The presence or absence of the scutum might be an important character, nevertheless, it possibly was described as absent only because it was very faint or hardly visible. Other expressions are: "Scutum apparently absent, leaving the trace of adductor muscles as a white patch" (Utinomi, 1949, in the original description of *P. distincta*); "scuta absent, but their position marked by smooth patches" (Barnard, 1924, in the original description of *P. palinuri*); "scutum present as a chitinous rudiment" (Hiro, 1933, in the description of *P. minuta*; Broch, 1922, in the original descriptions of *P. nodulosa* and *P. scutigera*; Hiro, 1938, in the original description of *P. rosea*). Nilsson-Cantell (1921) describes the scutum of his *P. typica* as "Chitinrudimente der Scuta vorhanden (scutum present as chitinous rudiment)"; whereas, Utinomi (1958) put *P. scutigera* (Broch, 1922) into synonymy with *P. typica* and redescribes this as "apparently no scuta".

In summarizing these descriptions about the scutum, some states as "scutum absent" for the reason of lack of calcified one (there is no species having calcified scutum in the genus *Paralepas*). Whereas others state as "scutum absent, only leaving chitinous rudiment" or "scutum present as a chitinous rudiment" for the reason of the presence of the chitinous rudiment of scutum, though it is not calcified. These different descriptions could possibly be established upon an identical structure. Therefore, the identifications and comparisons of species using the previous descriptions about the scutum seem quite unreliable and should be avoided.

P. phyllacanthusi agrees in many characters with *P. intermedia* (Hoek, 1907). In both species the teeth of labrum are acute, irregularly sized, and much developed at both sides of crest. The step-like anterior margins of maxilla I in both are also similar. But the unclear delimitation between capitulum and peduncle, pectinate teeth of mandible and weakly developed inner rami of 5th and 6th cirri in *P. intermedia* are the unequal characters to the new species.

Like the new species there are tubercles or protuberances on the surfaces of capitulum of such species as *P. morula* (Hoek, 1907), *P. percarinata* (Pilsbry, 1907), *P. reticulata* (Annandale, 1914), *P. nodulosa* (Broch, 1922), *P. tuberosa* (Nilsson-Cantell, 1932), *P. robusta* Rosell, 1981 and *P. spinisegma* Foster, 1981, of which only *P. tuberosa* is similar internally with the new species. The shape of peduncle, clearly discriminated capitulum and peduncle, and the structure of mandible in which only the 3rd tooth is armed with minute spinules and 4th tooth is not fused into inferior angle, in both species are similar characters. But the tubercles on the capitulum of the new species are large, low and restricted

to the carinal and basal margins, whereas, those of *P. tuberosa* are smaller, distinct, abundant and scattered all over. The new species is distinguished from *P. tuberosa* also by much longer orifice, slightly convexed lower margin of palp and dissimilar structure of maxilla I. Although it is difficult to compare the scuta of different species because of incorrect descriptions of previous authors as discussed above, Nilsson-Cantell's species undoubtedly has no scutum as inferred from his descriptions of other species; this is another different character.

Family Archaeobalanidae Newman & Ross, 1976

Genus *Acasta* Leach, 1817

2. *Acasta paraspinifera*, n. sp.

(Fig. 2)

Material Examined: Holotype: NA84071301, 13/VII/1987, Kōmundo I., about 15m depth, I.H. Kim. Paratypes: 2 specimens, 16/VIII/1969, Sōgwip'o in Chejudo I., H.S. Kim; about 10 specimens inbedded in the host sponge, 8/II/1971, Sōgwip'o, H.S. Kim; 2 specimens, 18/VIII/1984, Mosūlp'o in Chejudo I., about 50m depth, I.H. Kim; 1 specimens, same host as holotype. Host sponges are all *Phakellia elegans* Tiele.

Size (holotype): Basis diameter 1.4mm; rostrum height 6.3mm; rostrum width 3.4mm; carina height 5.5mm; carina width 2.9mm; lateral height 6.6mm; lateral width 2.8mm; carinolateral height 6.1mm; carinolateral width 1.5mm.

Description: Shell tubular, pink-tinted on white ground. Shell surface faintly striated transversely, with many calcareous projections which are longer than wide, blunt or pointed, and directed downward. Plates rather thin; rostrum widest; lateral and carina nearly equal in width; carinolateral rather wide, as wide as half width of rostrum. R radii very wide, continued to basis, with many, longitudinal and transverse striae; summits oblique at an angle of 45°; sutural edges slightly septate. Alae less wide than or as wide as radii. Sheath 0.4 times as long as pariete, with distinct and hairy growth lines; lower margin of sheath overhanging except at carina. Inner lamina of pariete strongly ribbed; the ribs a little winding, sometimes ramified or disappeared on the way, with its lower ends slightly separated from basal margin. Basis flat or slightly convex, not cup-shaped, with prominent growth lines and somewhat irregular curvatures on exterior; interiorly, radial ribs strong except near central part; on periphery of basis, extremities of radial ribs, which are the interlocking portions with parietal ribs, are slightly bifurcated, but those corresponding to sutures of plates are wide, thick and trifurcated.

Scutum with straight occludent and articular margins; basal margin arched, longer than or as long as articular margin. External surface with strong, widely interspaced growth ridges which are crossed by 5-6 longitudinal ridges; long, yellow hairs are arranged below growth ridges; external surface near articular margin with straight growth ridges, not crossed by longitudinal ridges. In basal view, scutum strongly arched outwardly. Articular ridge long, 3/4 times as long as articular margin, with angular lower end. Articular furrow deep. Adductor ridge short, but distinct, situated near articular margin. Adductor muscle pit shallow, feebly outlined. Pit for the lateral depressor rather shallow, but wide and distinctly outlined. Occludent margin crenulate, with large, triangular occludent ridges.

Tergum strongly arched, with concave scutal margin and convex carinal margin. Basiscutal angle blunt. Basal margin between carinal angle and spur concave. Growth lines distinct, widely interspaced and hairy. Spur as long as its width and 1/3 times as wide as basal margin, with both sides parallel; spur end truncate. Distance from basiscutal angle to spur shorter than a half width of spur. Spur furrow deep and wide. Articular ridge invisible. Crests for lateral depressor muscle faint or absent.

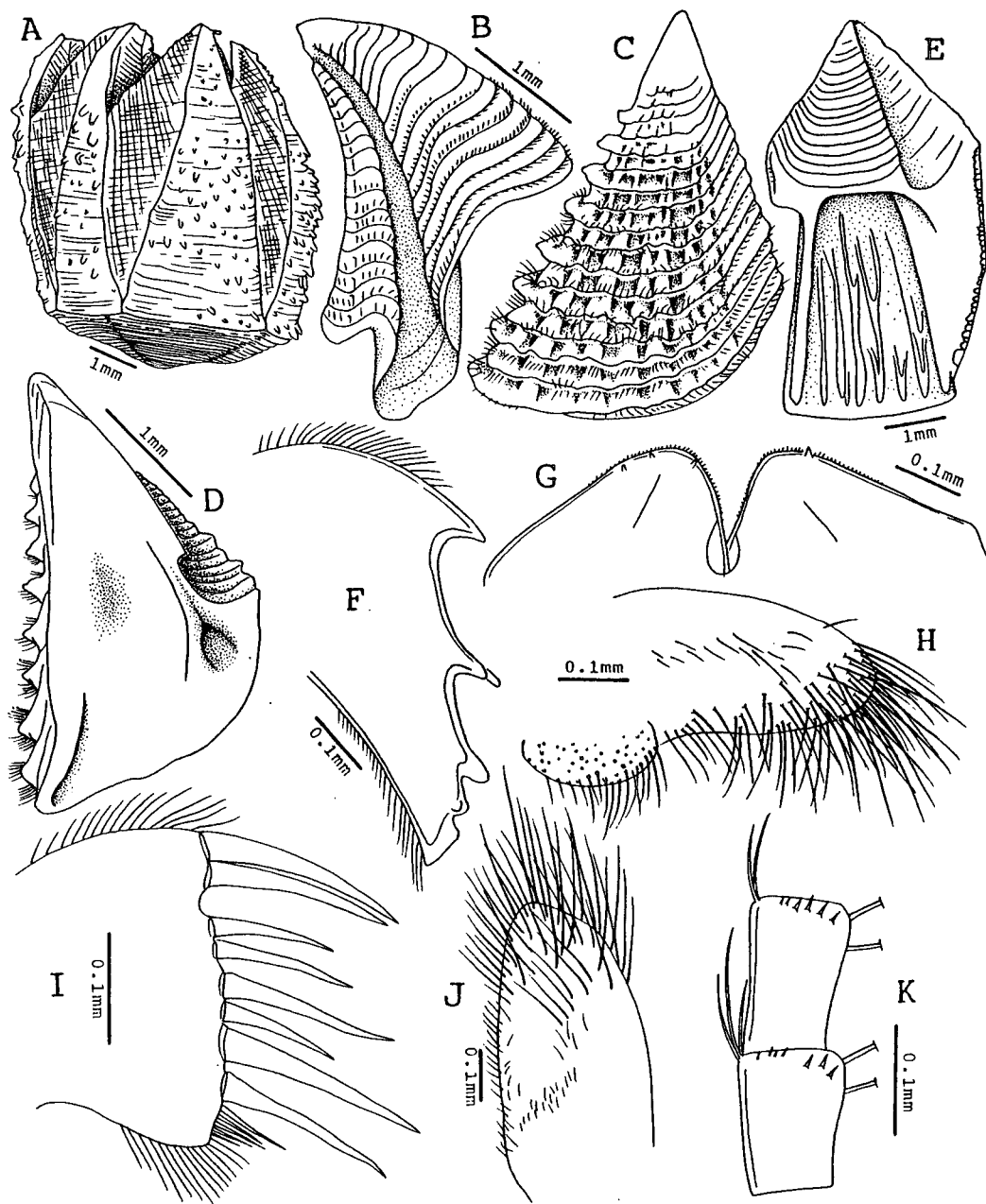


Fig. 2. *Acasta paraspiniifera*, n.sp. A, animal in lateral view; B, outer view of tergum; C, outer view of scutum; D, inner view of scutum; E, inner view of lateral; F, mandible; G, labrum; H, maxilla II; I, maxilla I; J, palp; K, intermediate segments of inner ramus of fourth cirrus.

Labrum with 0-3, widely interspaced teeth on each crest; central notch rather deep; crest hairy and roundly raised near central notch. Palp with nearly straight lower margin; proximal part not protuberant; upper margin convex; extremity with long bristles. Mandible with 4 or 5 teeth; 5th tooth weak or fused into inferior angle; 2nd tooth with extra denticle; 3rd tooth with or without extra denticle; fourth tooth very small, closed to inferior angle which is smooth without spinule; superior and

inferior margins with many setae. Maxilla I with broad anterior margin; notch wide, but shallow, usually with 2 small spinules; lowermost spine smaller than just upper one; interval between lower pair of spines and inferior angle wide and pectinate, with small spinules; intermediate margin between upper and lower pairs of spines with 4 or 5 spines of which lowest one is smallest and just upper one is largest. Maxilla II thumb-like, with distal lobe gradually narrower toward extremity which is circular, not pointed; proximal lobe prominent and long; bristles are on inner margin and extremity.

First cirrus with outer ramus long, 2.5 times as long as inner ramus. 2nd and 3rd cirri with outer rami slightly longer than the inner. 3rd cirrus armed with more or less than 4 denticles distally on each segment of outer ramus and with much smaller, 5 or 6 denticles on those of posterior ramus. 4th to 6th cirri armed also with such denticles, but fewer in inner rami. Propodites of cirri without any denticle or hook, only with setae on distal corner. Segments of 4th to 6th cirri long, with 2 or 3 pairs of spines near distal anterior corner. The numbers of segments of cirri are:

Cirri	I		II		III		IV		V		VI	
	out.	inn.	out.	inn.	out.	inn.	out.	inn.	out.	inn.	out.	inn.
Left	16	5	10	8	12	12	19	22	26	28	29	29
Right	19	8	11	8	12	13	22	21	27	24	24	26

Penis rather short, about as long as 6th cirri, with a tuft of small hairs on its extremity. Basidorsal point rudimentary.

Etymology: The specific name *paraspinifera* is from the Latin "par" (like) and from *spinifera*, implying the resemblance with *Acasta spinifera*.

Remarks: *Acasta paraspinifera*, n. sp. resembles *A. cyathus* Darwin, 1854 from the Atlantic and Indian Ocean, and *A. spinifera* Utinomi, 1967 from Tokyo Bay, Japan. In these three species, the orifice and the radii are wide, the basis is nearly flat, and the shell surface is armed with thick calcareous projections. *A. cyathus* has different shapes of opercular valves, without deep spur furrow and has hooks on the segments of the 4th cirri, thus it cannot be confused with the other two species. The new species very close to *A. spinifera* in the external structures, especially in the forms of opercular valves, and in nearly identical host selections. However, the new species differs from *A. spinifera* in following points. The carinolateral is wider than that of *A. spinifera*. The inner lamina of parietes of the new species are distinctly ribbed, whereas those of *A. spinifera* are smooth without any rib. In the new species the exterior surface of scutum is longitudinally grooved and the 3rd to 6th cirri have erect denticles on each segments, whereas in *A. spinifera* the exterior surface of scutum is not grooved and the cirri have no denticle.

3. *Acasta chejudoensis*, n. sp.

(Fig. 3)

Material examined: 3 specimens (holotype: NA84081802; paratype 1: NA84081802-2; paratype 2: NA84081802-3), imbedded in the *Ceratopsis*-like sponge, 18/VIII/1984, Mosŭlp'o in Chejudo Island, depth unknown, I.H. Kim.

Size (holotype): Basis diameter 4.1mm; basis depth 1.3mm; lateral height 4.7mm; lateral width 3.0mm; carina height 4.8mm; carinolateral width 0.6mm.

Description: Shell white wholly. Orifice small and toothed. Plates gently curved inward. Shell surface faintly striated transversely, with calcareous projections which are longer than wide and usual-

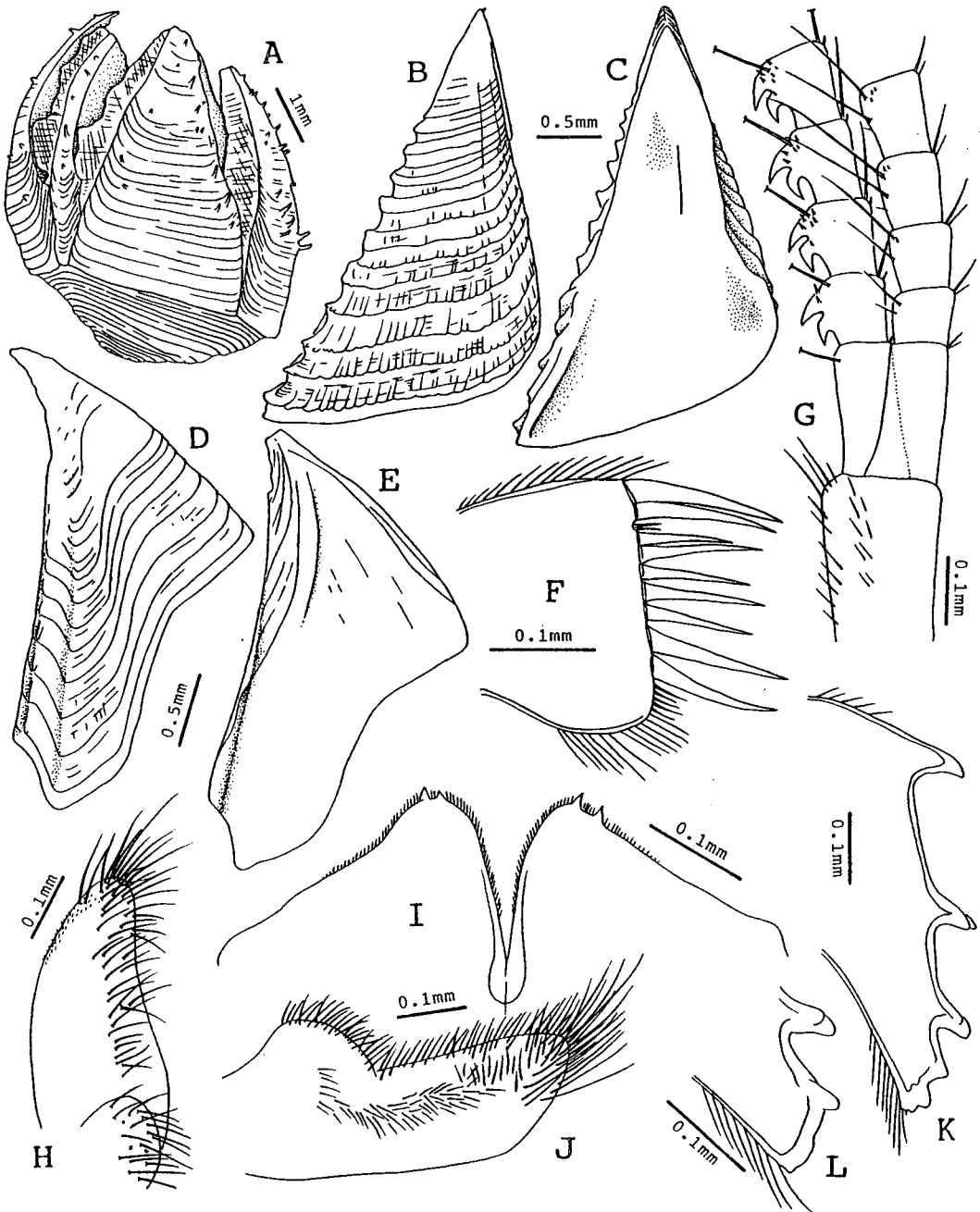


Fig. 3. *Acasta chejudoensis*, n. sp. A, animal in side view; B, outer view of scutum; C, inner view of scutum; D, outer view of tergum; E, inner view of tergum; F, maxilla I; G, proximal part of fourth cirrus; H, maxilla II; I, labrum; J, palp; K, mandible; L, inferior part of a mandible.

ly bent downward. Of the plates, rostrum widest; caina highest and as wide as or narrower than lateral. Radii rather wide, very thin, not reach basis, with summits steeply oblique. Alae as wide as or slightly wider than radii, with summits steeply oblique. Sheath slightly longer than half height of plate, with lower margin fused into inner lamina of pariete. Parietal ribs very feeble, restricted to near basis.

Basis circular, moderately deep, with faintly crenulate periphery.

Scutum flat, 1.3 times as high as its width, right-angled triangular, with straight margins. Growth ridge of exterior thin, widely spaced and crenulate, with weak longitudinal striations. Articular ridge very short and weak, with uncertain lower end. Adductor ridge very short, faint and situated high. Adductor muscle pit rudimentary, situated at upper third of scutum. Pit for the lateral depressor shallow, unclearly outlined. Basitergal angle round, not angular. Tergum with apex narrow, thin and curved to scutal side. Articular margin straight except for apical portion. Basal margin straight. Carinal margin slightly convex. Spur adjoined to basiscutal angle, with its proximal width nearly twice as wide as its length, gradually narrower to the end which is truncated. Scutal side of spur short, but carinal side long, obliquely straight, more than twice as long as scutal side. Scutal side of basal margin short and vague, but carinal side straight and clearly defined from spur. Spur furrow wide and shallow. Borderline of scutal side of spur furrow distinguishable, but that of carinal side obscure.

Labrum with deep central notch; 0-3, large and sharp teeth on each tips of hairy, pointed crests near central notch. Palp with straight inferior margin, but its proximal portion strongly protuberant; superior margin straight, but suddenly curved distally; distal portion armed with long bristles; inferior margin with small bristles; superior margin not setose. Mandible with 4 or 5 teeth; in case having 5 teeth, 5th tooth very small or fused into inferior angle; 2nd tooth bifid; 3rd tooth bifid or with extra denticle; 4th tooth small; inferior angle smooth or with 1-2, minute spinules. Maxilla I with straight anterior margin; Upper and lower pairs of spines distinct and equal-sized; notch below the upper pair relatively distinct, with 2 or 3 spinules; intermediate spines between the upper and the lower pair 5 in number; inferior angle round, weakly pectinate. Maxilla II with distal lobe gradually narrower and incurved distally; inner margin of distal lobe concave and setose; proximal lobe nearly circular.

First cirrus with outer ramus 2.5 times as long as inner ramus. Outer rami of 2nd and 3rd cirri distinctly longer than the inner. Outer ramus of 4th cirrus shorter than the inner, with segments of lower proximal half armed each with 2 large hooks of which lower one curved downward at a right angle; besides the hooks, each segment armed with acute denticles near anterodistal corner; Inner ramus of 4th cirrus armed only with several denticles; proximal segment and propodite simple, without hook or denticle. The numbers of segments of cirri (holotype) are:

Cirri	I		II		III		IV		V		VI	
	out.	inn.	out.	inn.	out.	inn.	out.	inn.	out.	inn.	out.	inn.
Left	18	7	10	7	12	9	13	21	21	22	21	22
Right	20	7	11	7	12	9	15	20	20	21	—	—

Penis slightly longer than 6th cirri. Basidorsal point rather distinct, slightly longer than wide.

Etymology: Named for the type locality.

Remarks: *Acasta chejudoensis*, n. sp. is similar to *A. foraminifera* broch, 1931 in the structure of cirri, to *A. fenestrata* Darwin, 1854 in the forms of cirri and mouth parts, and to *A. dofleini* Krüger, 1911 in the shapes of opercular valves. The new species is easily distinguished from the former two species by the lack of "window-like" hole at the basal junctions of the plates and also distinguished from *A. dofleini* by the lack of chitinous, flexible hairs on the shell surface.

The new species resembles *A. sulcata* in many aspects. These two species are hardly distinguishable from each other in the external shape. They have similar shapes of opercular valves and mouth parts,

but not the case in the cirri. Especially the fourth cirri of both species are very different. In *A. sulcata* the propodite of cirri is armed with hooks that are absent in the new species, and the number of hooks on the segments of outer rami is 3-5, whereas that of the new species is only 2 and the hooks are much larger. *A. chejudoensis* has such characters differ from those of *A. sulcata* as: sheaths are perfectly fused into the inner lamina of the plate, scutum is distinctly narrower, the spur is longer and narrower, the carinal side of the spur is much longer, and the labrum have larger teeth on the highly elevated crests.

ABSTRACT

A new sea urchin-attached pedunculate cirriped *Paralepas phyllacanthusi* and two new sponge-inhabiting balanomorph cirripeds *Acasta paraspinifera* and *A. chejudoensis* are described from southern sea of Korea.

REFERENCES

- Annandale, N. 1914. New and interesting pedunculate cirripedes from Indian seas. *Rec. Ind. Mus.*, **10**: 61-137.
- Barnard, K.H. 1924. Contribution to the crustacean fauna of South Africa. No. 7. Cirripedia. *Ann. S. Afr. Mus.*, **20**: 1-103.
- Broch, H. 1922. Studies on Pacific cirripeds. Papers from Dr. Th. Mortensen's Pacific Expedition 1914-1916, no. X. *Vidensk. Medd. Dan. Naturhist. Fore.*, **73**: 215-358.
- Hiro, F. 1933. Report of the Cirripedia collected by the surveying ships of the Imperial Fisheries Experimental Station on the continental shelf bordering Japan. *Rec. Oceanogr. Works Japan*, **5**, **1**: 11-84.
- Hiro, F. 1938. Notes on the animals found on *Macrocheira kaempferi* de Haan. I. Cirripeds, II. Molluscs. *Annot. Zool. Japon.*, **17**, 3/4: 465-474.
- Hoek, P.P.C. 1883. Report on the Cirripedia collected by H.M.S. Challenger during the years 1873-1876. *Rep. Sci. Res. Voyage H.M.S. Challenger, Zool.*, **8**, 25: 1-169.
- Hoek, P.P.C. 1907. The Cirripedia of the Siboga Expedition. A, Cirripedia Pedunculata. *Siboga Expeditie Monogr.*, **31a**: 1-27.
- Newman, W.A. 1960. Five pedunculate cirripeds from the western Pacific, including two new species. *Crustaceana*, **1**, 2: 100-116.
- Nilsson-Cantell, C.A. 1921. Cirripeden-studien. Zur kenntnis der biologie, anatomie und systematik dieser gruppe. *Zoo. Bidrag.*, **7**: 75-395.
- Nilsson-Cantell, C.A. 1932. Cirripeden aus Japan. *Ark. Zool.*, **24A**, **4**: 1-29, pl. 1.
- Pilsbry, H.A. 1907. Hawaiian Cirripedia. *Bull. Bur. Fish.*, **26**: 179-190, pls. 4, 5.
- Rosell, N.C. 1972. Some barnacles (Cirripedia, Thoracica) of Puerto Galera found in the vicinity of the U.P. Marine Biological Laboratory. *Natur. Appl. Sci. Bull.*, **24**, **4**: 143-285.
- Utinomi, H. 1949. Studies on the cirripedian fauna of Japan. *Mar. Biol. Lab.*, **1**, 2: 19-37.
- Utinomi, H. 1958. Studies on the cirripedian fauna of Japan. VII. Cirripeds from Sagami Bay. *Ibid.*, **6**, 3: 281-311.

RECEIVED: 23 July 1988

ACCEPTED: 28 July 1988