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THE STOMATOPOD CRUSTACEA OF TAIWAN[1]

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ABSTRACT

A collection of stomatopods made by the senior author during February 1963 to April 1966 from the nets of trawler and gillnetting fishing boats from the coastal areas and the tide pools of reef shores of Taiwan was examined. The present study brings up to 20 species and 1 variety of the stomatopods known in Taiwan. Among them 4 species were not obtained, thus, 16 species and 1 variety are presented. Five species and 1 variety including *Clorida microphthalma* Milne-Edwards, *Squilla fasciata* de Haan, *S. leptosquilla* Brooks, *S. scorpio* Latreille, *S. mikado* Kemp & Chopra and *Lysiosquilla maculata* var. *sulcirostris* Kemp are recorded new to fauna of Taiwan. The diagnostic key to genera and species are provided and Chinese names are proposed in order to stimulate the recognition of the stomatopod fauna of Taiwan.

Until now, 12 species of stomatopod crustacea have been reported from Taiwan. Miers (1) firstly reported *Chloridella rotundicauda,* which was collected by R. Swinhoe, Esq., as a new species. Later, Fukuda (2-3) reported *Squilla affinis* from Suo and Pescadores Islands, Taiwan. Balss (4-5) recorded *Lysiosquilla multifasciata* and *Squilla raphidea,* and Kemp (6) recorded *Squilla interrupta* from Taiwan. Fukuda (7) further recorded 7 species as follows: *Pseudosquilla ciliata, Lysiosquilla acanthocarpus, L. multifasciata, L. maculata, Squilla raphidea, S. affinis* and *S. rotundicauda.* Komai (8-9) added 8 more species as following: *Squilla nepa, S. oratoria* (formerly as *S. affinis*), *S. oratoria* var. *perpensa, S. interrupta, S. woodmasoni, S. costata, Pseudosquilla empusa* and *Gonodactylus chiragra.*

As a result of the present study, *Squilla affinis of* Fukuda (2, 3, 7) are considered as *S. oratoria* de Haan (10); and *Pseudosquilla empusa* of Komai (8, 9, 11) as *Parasquilla haani* (Holthuis). The rest of the previously known species are mostly shifted to their appropriate genera according to the recent revision of stomatopod genera (12). Further, 5 species and 1 variety collected for the first time in the present study are considered as new record from Taiwan. Thus, the study brings up to 20 species and 1 variety of the stomatopods known in Taiwan. Among them 4 species including *Chloridella rotundicauda,*

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Squilla wood-masoni, *S. nepa* and *Pseudosquilla ciliata* were not obtained. Therefore, 16 species and 1 variety are presented in this work. They are:

Gonodactylus chiragra (Fabricius)
Parasquilla haani (Holthuis)
**Clorida microphthalma* Milne-Edwards
Squilla costata de Hann
**S. fasciata* de Haan
**S. leptosquilla* Brooks
**S. scorpio* Latreille
**S. mikado* Kemp & Chopra
S. perpensa Kemp
S. interrupta Kemp
S. oratoria de Haan
Harpiosquilla annandalei (Kemp)
H. harpax (de Haan)
Lysiosquilla maculata (Fabricius)
**L. maculata* var. *sulcirostris* Kemp
Acanthosquilla acanthocarpus (Miers)
A. multifasciata (Wood-Mason)
*New records from Taiwan.

The specimens examined under the present study were collected during February 1963 to April 1966 from the nets of trawler and gill-netting fishing boats from the coastal areas and the tide pools of reef shores of Taiwan.

The present paper provides diagnostic keys to genera and species, proposed Chinese names, descriptions, remarks, discussions, and figures for each species wherever possible in order to stimulate the recognition of our stomatopods and to be able to facilitate the further biological studies of stomatopods in Taiwan.

SYSTEMATIC ACCOUNTS

Order Stomatopoda

Family Squillidae

Key to the genera of stomatopods of Taiwan

1 Ischiomeral articulation of raptorial claw terminal; inferior surface of merus grooved throughout its length; dactylus not inflated at the base 2
1 Ischiomeral articulation of raptorial claw at a point anterior to the proximal end of merus; inferior surface of merus grooved, extending not for more than ¾ of its length; dactylus inflated at the base; and unarmed except for terminal tooth ..... *Gonodactylus*
2 Carapace and first five abdominal somites with well marked longitudinal carinae 3
2 Carapace and first five abdominal somites without a trace of carinae 5
3 Basal prolongation of uropod with 3 spines; at most 2 intermediate denticles on telson; anterolateral angle of carapace without spine and rounded; raptorial dactylus armed with 3 spines ..... *Parasquilla*
3 Basal prolongation of uropod with 2 spines; telson with more than 3 intermediate denticles; anterolateral angle of carapace with a spine; raptorial dactylus with 4 or more than 4 teeth 4
4 Eye-stalks dilated greatly at the middle portion ..... *Clorida*
4 Eye-stalks not dilated at the middle portion 6
5 Raptorial dactylus armed with 3 teeth; propodus pectinate proximally only; telson with sharp medial crest and 3 or 4 pairs of additional longitudinal carinae ..... *Pseudosquilla*
5 Raptorial dactylus armed with 5 or more teeth; propodus fully pectinated; telson without sharp median crest and additional longitudinal carinae 7
6 The upper margin of propodus with pecti-

nated teeth; without acute triangular lobe in front of the posterolateral angle of carapace ..... *Squilla*

6 The upper margin of propodus alternated with small and large spiniform teeth; an acute triangular lobe present in front of the posterolateral angle of carapace ..... *Harpiosquilla*

7 Eyes large; antennal protopod with 3 papillae (1 dorsal, 2 ventral); telson slightly raised at the mid-dorsal area and without dorsal spines; tips of submedian teeth immovable, submedian denticles absent ..... *Lysiosquilla*

7 Eyes small; antennal protopod with only 1 ventral papilla; telson not raised at the mid-dorsal area and with 5 or more dorsal spines arranged in fan-shape (*Fig. 8C*); tips of submedian teeth movable, submedian denticles present ..... *Acanthosquilla*

Genus *Gonodactylus* Latreille, 1825

1. Gonodactylus chiragra (Fabricius) 新稱 "大指蝦蛄"

Fig. 1 A—C.

Gonodactylus chiragra, Miers, 1880: 118 (1); 1880: 459 (13); Brooks, 1886: 56-58, pl. 15, fig. 4 (14); Borradaile, 1898: 34-35, pl. 5, fig. 4, pl. 6, fig. 8 (15); 1907: 211-212 (16); Fukuda, 1908: 510-511, pl. 3, fig. 1 (17); 1910: 141 (18); Kemp, 1913: 155-162, pl. 9, fig. 107 (6); Hansen, 1926: 24-26 (19); Komai, 1927: 338-339 (9); Tweedie, 1934: 41 (20); Holthuis, 1941: 277-281 (21); Manning, 1962: 2 (list only) (22).

Materials.—2 males, 38.0-72.0; Wan-Li-Tong, tide pools of reef shore; 29 March 1965. 1 female, 61.0; Mau-Pi-Tou, reef shore; 27 March 1965. 1 male, 79.0; Cheng-Kong, tide pools of reef shore; 4 April 1966.

Description.—Eye cylindrical, cornea not bilobed. Rostral plate (*Fig. 1A*) rectangular with long and finely pointed median spine and prominent, rounded anterolateral angles. Carapace (*Fig. 1A*) smooth, the anterolateral angles rounded. Raptorial dactylus (*Fig. 1B*) unarmed except the terminal tooth, with a thin saw-like edge along ½ of terminal portion of its upper margin. Dactylus segment inflated at the base. Lateral margin of first five abdominal somites carinated and that of sixth (*Fig. 1C*) armed with 6 equidistant longitudinal carinae of which each ends in a spine. The dorsal surface of telson (*Fig. 1C*) has 3 longitudinal carinae: 1 median which has small submedian keel on each side of the hind portion and 2 intermediates which do not terminate in spines. A pair of tubercles present at the anterolateral portion of the telson. The posterior margin of the telson with 3 pairs of teeth, among which the submedian lobes are the largest and of triangular shape; the outermost are somewhat obsolete. Each teeth provided with a crest on dorsal side running anteriorly. The tips of submedian teeth are movable. A small round lobe present between submedian teeth and intermediate teeth. No accessory carinae on the lateral side of telson. Denticles of telson: 13-14. 1-2, 0. Outer margin of penultimate segment of outer branch of uropod with 11 graded, movable spines.

Color (in alcohol).—Variable light to dark brown. With numerous pale spots scattered over the dorsal surface of the body; posterior margin of each somite with purplish red line.

Discussion.—The present species is close to *G. graphurus* in every character but except the telson. The details of their differences had been discussed by Miers (1). The present

species is also closely related to *G. falcatus,* but they differ in the following aspects. Both median and intermediate carinae of telson end in spine, and the bifurcated protopodite of uropod with a small lobe near the base of the outer spine in *G. falcatus* (23) while none of both structures present in *G. chiragra.*

Genus *Parasquilla* Manning, 1961

2. Parasquilla haani (Holthuis) 新稱"韓氏蝦蛄"

Fig. 2 A—D.

Squilla empusa de Haan, 1849: 224, tab. 51, fig. 6 (10).

Pseudosquilla empusa, Komai, 1914: 464-466 (8); 1938: 268-269 (11); Holthuis, 1941: 268 (21).

Pseudosquilla haani Holthuis, 1959: 179 (discussion only) (24).

Materials.—2 males, 75.0-134.0; captured by trawling; Keelung; date?. 1 male, 149.0; captured by trawling; 40-50 fathoms; Tungkang Fish Market; 9 May 1965.

Description.—Cornea (*Fig. 2A*) bilobed, with mesial lobe slightly larger than lateral lobe. Rostral plate (*Fig. 2A*) pentagonal with median notch, with tip pointed ventrally. Carapace (*Fig. 2A*) with a trace of short lateral and marginal carinae of which the latter are distinct at the posterolateral portion; cervical groove distinct at the lateral but obscure at the mid-plate; 2 distinct tubercles present, each located at the level of the junction of gastric and cervical grooves. Raptorial dactylus armed with 3 teeth; upper margin of propodus with a row of pectinated spinules; carpus (*Fig. 2B*) with 2 acute teeth on the dorsal ridge. Mandibular pulp and 3 epipods present. Fifth thoracic somite (*Fig. 2C*) smooth, with triangular lateral process. Sixth to seventh thoracic somites (*Fig. 2C*) with blunt intermediate carinae and blunt lateral processes. Eighth thoracic somite (*Fig. 2C*) with 2 subequal triangle lateral processes. Each abdominal somite has 3 pairs of longitudinal carinae. First 5 abdominal somites devoid of the submedian carinae. The following abdominal carinae end in spines: submedian 6, intermediate 5-6, lateral 6, marginal 3-5. Telson (*Fig. 2D*) with distinct median crest. A row of pits at the either side of the crest converges under the terminal spine. Intermediate carinae short and not broken. Denticles of telson: 10, 2, 1. Basal prolongation of uropod (*Fig. 2D*) with 3 spines of which outer one is the longest, serrates at the inner basal margin. Outer margin of penultimate segment of outer branch of uropod has 8 graded, movable spines.

Color (in alcohol).—Uniformly light brown.

Genus *Clorida* Eydoux & Souleyet, 1841

3. Clorida microphthalma (Milne-Edwards) 新稱"小眼蝦蛄"

Fig. 3 A—C.

Chloridella microphthalma, Miers, 1880: 14-15, pl. 2, figs. 1-4 (1).

Squilla microphthalma, Holthuis, 1941: 242 (21); Tiwari & Biswas, 1952: 350 (25); Stephenson, 1962: 39, fig. 2, a-f (26).

Materials.—2 males, 36.0-45.0; captured by trawling; 70-80 m. depth; Hsiah-Sang; 2 February 1965.

Description.—Eye stalk ovoid, cornea small and bilobed, not extending to the end

of the basal antennular segment. Ophthalmic process and plate are very distinct. Rostal plate (*Fig. 3A*) small, triangular with tip rounded. Carapace (*Fig. 3A*) greatly extended posteriorly; marginal carinae distinct at the posterior recurved portion. A longitudinal carina runs along and in the gastric groove. Anterolateral angle of carapace with spine. Raptorial dactylus (*Fig. 3B*) armed with 4 teeth; each tooth serrated on the upper edge. In addition, the lower edge of terminal tooth is faintly serrated. Lateral margin of fifth thoracic somite bears a small spine, directed outward, and without spinules at the inferior surface. Lateral margin of sixth and seventh thoracic somites slightly produced and rounded. Each of first 5 abdominal somites with 4 pairs of longitudinal carinae, but the submedian carinae faint and almost obsolete. The following abdominal carinae end in spines: submedian 6, intermediate 5-6, lateral 5-6, marginal 4-5. Telson is wider than long, with a median crest ending in sharp spine. Posterior marginal teeth 3 pairs: outer 2 are serrated at their outer margins. The middorsum of the telson with several irregular tubercles, from which radiate several granulated ridges. Denticles of telson: 2, 7, 1. Inner margin of basal prolongation of uropod with 7-8 small spines and 2 unequal spines between which a blunt lobe is present. Outer margin of penultimate segment of outer branch of uropod with 5-6 graded, movable spines.

Color.—Uniformly light brown. Rostral tip, carapace margin and each posterior margin of thoracic and abdominal somites are of black lines.

Discussion.—The present specimen is quite close to *S. merguiensis*. The differences between them were discussed in detail by Tiwari & Biswas (25). The present specimen checks very well with Kemp's account (6), but differs in the following features: 1) the antennular peduncle is shorter than the carapace; 2) the eyes are only 2/3 the length of the basal segment of the antennular peduncle; and 3) the antennal peduncle is not as long as the antennal scale (Manning, personal communication).

Key to the species of *Squilla* of Taiwan

1 Each of first 5 abdominal somites with more than 4 pairs of carinae; a number of minute tubercles on the body surface .... *S. costata*

1 Each of first 5 abdominal somites with 4 or less than 4 pairs of carinae; without minute tubercles on the body surface ... 2

2 Each of first 5 abdominal somites with 3 pairs of carinae; carapace without median carina; telson with many parallel carinae on the dorsum ..... *S. fasciata*

2 Each of first 5 abdominal somites with 4 pairs of carinae; carapace with median carina 3

3 Median carina of carapace before level of cervical groove not bifurcated anteriorly 4

3 Median carina of carapace before level of cervical groove bifurcated anteriorly ... 5

4 Rostral plate elongate-triangular; raptorial dactylus with 4 teeth; abdominal spine formula: submedian 6, intermediate 1-6, lateral 1-6, marginal 1-5; without a black spot at the base of lateral process of the fifth thoracic somite; telson with much slender terminal spine of median carina .. .. *S. leptosquilla*

4 Rostral plate subquadrate; raptorial dactylus with 5 teeth; abdominal spine formula: submedian 6, intermediate 5-6, lateral 5-6, marginal 4-5; with a black spot at the base of lateral process; terminal spine of median

carina shorter; telson with a row of black dots at either sides of median crest .... *S. scorpio*

5 Anterior spine of margin of fifth thoracic somite point ventrolaterally and subequal with posterior 1 in size; denticles of telson: 5-8, 12-14, 1 ..... *S. mikado*

5 Anterior spine of margin of fifth thoracic somites point anteriorly, and much larger than that of posterior 1 in size; denticles of telson: 3-4, 6-10, 1 6

6 Anterior bifurcation of median carina is not continuous; dorsal ridge of carpus is entire; posterior spine of margin of fifth thoracic somite slightly curved forward; telson is more or less rectangular in shape ..... *S. perpensa*

6 Anterior bifurcation of median carina of carapace is or is not continuous; dorsal ridge of carpus with 2 or 3 teeth; posterior spine of margin of fifth thoracis somite not curved forward; telson is somewhat squarish in configuration 7

7 Anterior bifurcation of median carina of carapace is not continues; anterior spine of seventh thoracic somite is long; anterior margin to the lobe at the longer spine of the bifurcated uropodal process is straight or convex ..... *S. interrupta*

7 Anterior bifurcation of median carina is continuous; anterior spine of margin of seventh thoracic somite is shorter than in *S. interrupta;* anterior margin to the lobe of the longer spine of the bifurcated uropodal process is concave ... *S. oratoria*

Genus *Squilla* Fabricius, 1787

4. Squilla costata de Haan 新稱 "脊條蝦蛄"

Squilla costata de Haan, 1849: 223, tab. 51, fig. 5 (10); Miers, 1880: 21 (1); Fukuda, 1909: 171, pl. 3, fig. 3 (2); 1910: 151 (18); Komai, 1927: 321-322 (9); 1938: 267 (11); Liu, 1949: 32-34, pl. 5, figs. 6-8 (27); Tiwari & Biswas, 1952: 354, fig. 2 (25).

Materials.—2 males, 60.0-63.0; captured by trawling; 40-50 fathoms; Tungkang Fish Market; 30 March 1965. 3 females, 62.0-64.0; captured by trawling; 40-50 fathoms; Tungkang Fish Market; 30 March 1965. 2 females, 58.0-78.0; captured by trawling, 10-20 fathoms; Ma-Sha-Kou Fish Market; 10 April 1965.

Description.—Dorsal surface of body with many scattered tubercles and carinae. Rostral plate elongate-trapezoid, with well marked median carina and marginal carinae. Median carina which bifurcated anteriorly before and behind level of cervical groove. Raptorial dactylus armed with 6 teeth. Mandibular palp and epipods absent. Lateral process of fifth thoracic somite bilobed, with the sharply pointed anterior lobe much longer than the obtuse posterior lobe. Thoracic, abdominal somites and telson with great numbers of parallel carinae. Two to 6 intermediate carinae of abdominal segments interrupt at anterior 1/3 of each segment. The following abdominal carinae end in spines: submedian 5-6, intermediate 2-6, lateral 1-6, marginal 1-5. Denticles of telson: 3, 7-8, 1. The inner margin of basal prolongation of uropod serrated; outer margin of penultimate segment of outer branch of uropod with 7-8 graded, movable spines.

Color (in alcohol).—Grayish brown. Telson with a purplish circle at the anterior portion of median crest.

5. *Squilla fasciata* de Haan 新稱"條尾蝦蛄"

Fig. 4 A—B.

Squilla fasciata de Haan, 1849: 224, tab. 51, fig. 4 (10); Miers, 1880: 29-30 (1); Brooks, 1886: 37-40, pl. 2, fig. 8; pl. 3, figs. 4-5 (14); Kemp, 1913: 34-36, pl. 1, figs. 21-23 (6); Fukuda, 1910: 149 (18); Hansen, 1926: 5-6 (19); Tweedie, 1934: 35-36 (20); Holthuis, 1941: 242-243 (21); Komai, 1938: 265 (11).

Materials.—3 males, 43.6-58.0; captured by trawling; 40-50 fathoms; Tungkang Fish Market; 3 September 1965.

Description.—Eyes small, cornea bilobed. Rostral plate (*Fig. 4A*) elongate-triangular, tip rounded off. Carapace (*Fig. 4A*) without median carina, but with a trace of intermediate carina on anterior portion of carapace and short lateral carina. Raptorial dactylus armed with 6 teeth. Lateral margin of fifth thoracic somite with a sharp spine which points anteroventrally. Each of first 5 abdominal somites with 3 pairs of longitudinal carinae. The following abdominal carinae end in spines; submedian 6, intermediate 3-6, lateral 1-6, marginal 1-5. Telson (*Fig. 4B*) with a sharp median crest and 6 pairs of additional carinae on dorsal surface. Denticles of telson: 4-5, 7-8, 1. Inner margin of basal prolongation of uropod with a row of spinules; outer margin of penultimate segment of outer branch of uropod with 8-9 graded, movable spines.

Color (when alive).—Brownish grey. Dorsum of the thoracic and abdominal somites have relatively dense pigmentation. Carapace also pigmented except the cervical region. Posterolateral portion of each abdominal somite has pink spots.

Remarks.—The dorsum of telson is similar to *S. ambigua* and *S. incerta,* having several pairs of additional carinae.

6. *Squilla leptosquilla* Brooks 新稱"四棘蝦蛄"

Fig. 5 A—B.

Squilla leptosquilla Brooks, 1886: 30-34, pl. 1, figs. 1-2 (14); Fukuda, 1909: 168, pl. 3, fig. 2 (2); 1910: 149 (18); Kemp, 1913: 46-48 (6); Hansen, 1926: 10 (19).

Materials.—3 females, 62.0-69.0; captured by trawling; 40-50 fathoms; Tungkang Fish Market; 30 March 1965. 1 male, 83.5; captured by trawling; 40-50 fathoms; Tungkang Fish Market, 9 May 1965. 2 females, 61.0-76.0; capturtd by trawling; 40-50 fathoms; Tungkang Fish Market, 9 May 1965.

Description.—Cornea bilobed. Rostral plate elongate triangular, tip rounded off. Ophthalmic process prominent and ophthalmic plate with both margins slightly curving upward. Carapace with fine median and marginal carinae. Raptorial dactylus armed with 4 teeth. Mandibular palp and epipods absent. Lateral process of fifth thoracic somite directed outward and its inferior surface with blunt spine, pointing anteriorly. Second to fifth abdominal somites with 2 well marked tubercles on the mid-dorsal line of each segment. The following abdominal carinae end in spines; submedian 6, intermediate 1-6, lateral 1-6, marginal 1-5. Telson much or noticeably wider in male (*Fig. 5A*) than in female (*Fig. 5B*). The ratio of width in length of telson is: 1.74-2.1 in male and 1.53-1.87 in female. Terminal spine of median carina and posterior marginal teeth of telson (*Figs. 5A* and *5B*) are sharp and long. Lateral teeth of male telson much shorter, distinctly or slightly inflated at its base; while that of female long and not inflated. Denticles

of telson: 11-14, 10-14, 1. Inner margin of basal prolongation of uropod saw-edged. Outer margin of penultimate segment of outer branch of uropod with 7-8 graded, movable spines.

Color (when alive).—Uniformly orange yellow. Carinae and medial tubercles of abdominal somites yellowish brown. Middorsum of telson ornaments with a large triangular red spot.

Remarks.—Among examined specimens telson of males and females are quite different as described above. However, these differences represent sexual dimorphism in the present species.

7. *Squilla scorpio* Latreille 新稱"蝎蝦蛄"

Squilla scorpio, Miers, 1880: 18, pl. 2, fig. 7 (1); Kemp, 1913: 42-44, pl. 2, fig. 30 (6); Komai, 1914: 460, pl. 6, figs. 2-2a (8); Tweedie, 1934: 36-37 (20); Holthuis, 1941: 243-244 (21); Liu, 1949: 27, pl. 4, figs. 1-2 (27); Tiwari & Biswas, 1952: 353 (25).

Materials.—2 females, 52.8-66.1; captured by gill-netting; 1-3 meters; Estuary of Chiang-Chun River; 29 May 1965.

Description.—Rostral plate semioval with well marked median carina. Lateral carina of carapace are interrupted at the middle portion. Raptorial dactylus armed with 5 teeth. Mandibular palp absent. Lateral process of fifth thoracic somite produced into semilunar spine, directed anterolaterally. The following abdominal carinae end in spines: submedian 6, intermediate 5-6, lateral 5-6, marginal 4-5. Denticles of telson: 2, 3-4, 1. Inner margin of basal prolongation of uropod saw-edged; outer margin of penultimate segment of outer branch of uropod with 6-7 graded, movable spine.

Color.—Light brown, scattered with many small dots of black pigments. A black transverse band on the dorsum of second abdominal somite and 3 black spots on the dorsum of each segment of third to fifth abdominal somites. Posterior margin of thoracic and abdominal somites with black line. A row of black dots on either side of median crest of telson converges under the terminal spine. Large black spot present at the semilunar spine of fifth thoracic somite.

Discussion.—The species is closely related to *S. bengalensis,* especially on the color pattern on the dorsum of second to fifth abdominal somites but they differs in following aspects; 1) Lateral carina of carapace is not interrupted at the middle portion, 2) the lateral semilunar spine of fifth thoracic somites is without black spot, 3) the following abdominal carinae end in spines:

	S. scorpio	*S. bengalensis*
Submediac	6	6
Intermediate	5—6	5—6
Lateral	5—6	(1—2)3—6
Marginal	4—5	(1)2—6

8. *Squilla mikado* Kemp & Chopra 新稱"擬蝦蛄"

Squilla stridulans, Komai, 1914: 463, pl. 6, fig. 6 (8).

Squilla mikado, Komai, 1927: 320 (9); Komai & Tung, 1930: 13 (29); Manning, 1965: 257-259, pl. 12, fig. a (28).

Materials.—3 males, 94.2-113.0; captured by trawling; 40-50 fathoms; Tungkang Fish Market; 30 Mach 1965. 2 females, 91.5-94.0; captured by trawling; 40-50 fathoms; Tungkang Fish Market; 30 March 1965.

Description.—Rostal plate squarish with well marked median and marginal carinae.

Carapace with 2 bifurcated median carinae: the length of bifurcated portion of anterior one, 3.73-4.8 in carapace length. Raptorial dactylus armed with 6 teeth. Mandibular palp and 3 epipods present. Lateral margin of fifth thoracic somite with 2 subequal spines; 1 lateral and 1 ventro-lateral. Sixth to eighth thoracic somites each with 2 flattened, equal spines at lateral except that of eighth with posterior 1 much reduced. First to fifth abdominal somites with bicarinated lateral carinae. The following abdominal carinae end in spines: submedian 5-6, intermediate 3-6, lateral 1-6, marginal 1-5. Denticles of telson: 5-6, 12-14, 1. Inner margin of basal prolongation of uropod concave and saw-edged at basal portion; outer margin of penultimate segment of outer branch of uropod with 9-11 graded, movable spines.

Color (when alive).—Orange yellow. Posterior margin of each thoracic and abdominal somites with black line; a blackish brown rectangular patch on the dorsum of the second and fifth abdominal somites.

Discussion.—The present specimens agree in most aspects with the account given by Manning (28) for the Japanese specimens; the following 2 differences were noted: 1) the anterior peduncle is usually slightly longer than carapace; 2) mandibular palp and 3 epipods present.

9. Squilla perpensa Kemp 新稱"白平蝦蛄"

Squilla perpensa, Komai, 1914: 462-463, pl. 6, figs. 4-4a (8).

Squilla oratoria var. *perpensa,* Kemp, 1913: 70-72, pl. 5, figs. 57-59 (6); Hansen, 1926: 11 (19); Komai, 1927: 318-319 (9); 1938: 267 (11).

Squilla oratoria var. *inornata,* Tweedie, 1934: 37: (20); Holthuis, 1941: 248-249 (21); Liu, 1949: 37-38, text-figs. 2a-b (27).

Materials.—1 female, 79.0; captured by trawling; 40-50 fathoms; Tungkang Fish Market; 6 June 1965.

Discussion.—*S. perpensa* is closely related to *S. oratoria* and *S. interrupta.* The differences among them are tabulated as TABLE I. Komai (8) proposed 9 characters which can separate *perpensa* from *oratoria.* His first 2 and seventh characters are stable; and the rest of characters are unstable and their variations are great.

10. Squila interrupta Kemp 新稱"短壯蝦蛄"

Squilla interrupta, Kemp, 1913: 72-74, pl. 5, figs. 60-62 (6); Komai, 1927: 319 (9); Tweedie, 1934: 38 (20); 1935: 48 (30); Chopra, 1934: 25-26 (31); Holthuis, 1941: 253-254 (21); Liu, 1949: 39-41, text-figs. 3 a-b (27).

Materials.—2 females, 74.2-76.0; captured by trawling; 40-50 fathoms; Tungkang Fish Market; 30 March 1965. 1 male, 94.0; captured by gill-netting; 1-3 meters; Estuary of Chiang-Chun River; 1 April 1965. 2 females, 95.0-108.0; captured by gill-netting; 1-3 meters; Estuary of Chiang-Chun River; 1 April 1965.

Discussion.—See TABLE I.

TABLE I.

The differences among S. perpensa, S. interrupta and S. oratoria.

	S. perpensa	*S. interrupta*	*S. oratoria*
Carinae of rostral plate	Distinct	None	Merely a trace
Anterior bifurcation of median carina	Not continuous	Not continuous	Continuous
Dorsal ridge of carpus	Entire	2 blunt denticles	3 blunt denticles
Posterior spine of margin of fifth thoracic somite	Shorter than anterior one; project anterolaterally	Shorter than anterior one; project laterally	Project laterally
Posterior spine of margin of seventh thoracic somite	Almost equal to anterior spine	Larger than anterior spine	Extremely larger than anterior spine
Abdominal spine formula:			
Submedian	5—6	5—6	5—6
Intermediate	4—6	4—6	3—6
Lateral	3—6	3—6	1—6
Marginal	1—5	1—5	1—5
Aspect of telson	More or less rectangular	Somewhat squarish	Somewhat squarish
Denticles of telson	3—4, 7—8, 1	3—4, 8—10, 1	3—4, 6—10, 1
Anterior margin to the lobe at the longer spine of bifurcated uropodal process	Concave	Convex	Concave

11. Squilla oratoria de Haan 蝦蛄

Squilla oratoria de Haan, 1849: 223-224, tab. 51, fig. 2 (10); Kemp, 1913: 66-70, pl. 5, figs. 54-56 (6); Hansen, 1926: 11 (19); Komai, 1927: 314-318, text-fig. 1 (9); Komai & Tung, 1930: 13 (29); Komai, 1938: 226 (11); Holthuis, 1941: 247-248 (21); Liu, 1949: 36-37, text-figs. 1a-b (27); Townsley, 1953: 404-406, figs. 2, 3a-k (32); Kubo, Hori, Kuemura, Nagazawa & Soedjono, 1959: 1-2, fig. 1 (33); Manning, 1965: 259-260 (28).

Squilla affinis, Bigelow, 1894: 538-539, fig. 22 (34); Fukuda, 1909: 169, pl. 4, fig. 2 (2); 1910: 150-151 (18); Chilton, 1911: 137-138, fig. 3 (35).

Materials.—2 males, 103.0-130.0; captured by gill-netting; 1-3 meters; Estuary of Chiang-Chun River; 20 April 1965. 1 female, 114.0; captured by gill-netting, 1-3 meters; Estuary of Chiang-Chun River; 20 April 1965.

Color (when alive).—Reddish brown. The second and fifth abdominal somites marked with a conspicuous rectangular dark patches. Carinae on body surface and median tubercles of abdomen reddish brown. Dorsum of telson generally black. Distal half of penultimate segment of outer branch of uropod with a large blackish spot.

Discussion.—*S. oratoria* is very closely related to *S. perpensa, S. interrupta* (see TABLE *I*). *S. oratoria* is also closely related

to *S. nepa,* but differs in some aspects. The differences with *S. nepa* had been discussed by Bigelow (34) in details.

Key to the species of genus *Harpiosquilla* of Taiwan

1 Lateral margin of fifth thoracic somite with a process; median crest of telson narrow and highly convexed and its anterior half convex in lateral view (*Fig. 6B*) .... *H. annandalei*

1 Lateral margin of fifth thoracic somites without a process; median crest of telson thicker and its anterior half not convex from lateral view (*Fig. 7*) ..... *H. harpax*

Genus *Harpiosquilla* Holthuis, 1964

12. Harpiosquilla annandalei (Kemp) 新稱"安氏豎琴蝦蛄"
Fig. 6 A—B.

Squilla annandalei, Kemp, 1913: 92-94, pl. 7, figs. 78-80 (6); Chopra, 1934: 27-28, text-fig. 2 (31).

Harpiosquilla annandalei, Manning, 1965: 250, pl. 11, fig. a (28).

Materials.—3 males, 87.0-89.0; captured by trawling; 40-50 fathoms; Tungkang Fish Market; 5 March 1965.

Description.—Width of cornea in carapace length 2.41-2.94. Rostral plate triangular with blunt tip. Raptorial dactylus armed with 8 teeth. Lateral process of fifth thoracic somite (*Fig. 6A*) bears an undivided triangular spine. Sixth to eighth thoracic somites with 2 pairs of carinae, submedian and intermediates; posteriorly end in spines on seventh and eighth thoracic somites. The ventral keel of eighth thoracic somite is a slender, sharp spine, inclined posteriorly. Abdominal submedian carinae distinct. The following carinae end in spines: submedian 5-6, intermediate 1-6, lateral 1-6, marginal 1-5. Posterior margin of telson bears 3 pairs of sharp spines of which their bases are not massive, median crest of telson narrow and highly convexed, end in a sharp spine terminally. Anterior half (*Fig. 6B*) of its dorsum convex from lateral view. Denticles of telson: 5-7, 11-12, 1. Inner submedian denticles are larger than the outers. Inner margin of basal prolongation of uropod serrated. Outer margin of penultimate segment of outer branch of uropods with 9 graded, movable spines.

Color (in alcohol).—Light brown. Posterior margin of thoracic and somites with a black lines. On either sides of the anterior base of median crest with a distinct black circular spot.

Discussion.—The present specimens is closely related to *S. raphidea* of Tiwari & Biswas, 1952, but differs in that the carinae supporting the posterior marginal teeth of telson are not strong and massive; on the other hand, the denticles are sharper. The ratio of the median length of carapace to the breadth of cornea varies from 3.8-5.3 for *S. raphidea* (25) while the present specimens varies 2.4-2.9.

13. Harpiosquilla harpax (de Haan) 新稱 "豎琴蝦蛄"
Fig. 7 A—F.

Squilla harpax de Haan, 1849: 222-223, pl. 51, fig. 1 (10); Tiwari & Biswas, 1952: 358-359, figs. 3, b, d, f (25); Ingle, 1963: 18, figs. 9 & 59 (23).

Squilla raphidea, Fukuda, 1913: 70-71, fig. 2 (7); Liu, 1949: 43-44, pl. 6, figs. 15-17 (27).

Materials.—1 male, 131.0; captured by trawling; 40-50 fathoms; Tungkang Fish Market; 10 February 1965. 1 male, 132.0; captured by trawling; 40-50 fathoms; Tungkang Fish Market; 6 June 1965. 1 female, 126.0; captured by trawling; 40-50 fathoms; Tungkang Fish Market; 6 June 1965.

Remarks.—The outer margin of dactylus usually strongly projected (*Fig. 7C*) or slightly convexed in male while those of females are smooth (*Fig. 7B*). This can be considered as the sexual dimorphism in this species.

Discussion.—The present species is very close to the former species *H. annandalei.* The differences of these 2 species can be found in TABLE II.

TABLE II.

Comparison of important characteristics between H. harpax and H. annandalei.

	H. harpax	*H. annandalei*
Rostral plate	Apex long and acute *(Fig. 7A)*	Apex blunt
Breadth of cornea in carapace length	2.5—2.8	2.4—2.9
Lateral margin of fifth thoracic somite	Triangular process obsolete *(Fig. 7D)*	Triangular process distinct *(Fig. 6A)*
Submedian carinae on the fifth and sixth thoracic somite	Obsolete	Distinct
Abdominal spines:		
Submedian	6	5—6
Intermediate	(1), 2—6	1—6
Lateral	1—6	1—6
Marginal	1—5	1—5
Lateral view of median crest of telson	Not convex at the anterior half of the crest *(Fig. 7E)*	Convex at the anterior half of the crest *(Fig. 6B)*
Cross section of telson	Median crest convex	Median crest finely ridged
Denticles of telson	5—7, 10—13, 1.	5—7, 11—12, 1.
Size	123—181 mm	75—128 mm

Genus *Lysiosquilla* Dana, 1852

14 Lysiosquilla maculata (Fabricius) 新稱"虎斑蝦蛄"

Squilla maculata, de Haan, 1849: 221-222 (10).

Lysiosquilla maculata, Miers, 1880: 5-7, pl. 1, figs. 1-2 (1); 1880: 458 (13); Brooks, 1886: 45-48, pl. 10, figs. 1-7 (14); Borradaile, 1898: 37-38 (15); 1907: 214 (16); Fukuda, 1909: 60, pl. 1, fig. 4 (2); 1910: 146, pl. 4, fig. 3 (18); Kemp, 1913: 111-116; pl. 8, figs. 86-91 (6); Tweedie, 1934: 41 (20); Chopra, 1934: 28-30 (31); Komai, 1927: 330 (9); 1938: 269 (11);

Schmitt, 1940: 190-192, figs. 21a, b (36); Holthuis, 1941: 269-272 (21); Townsley, 1935: 416-419, figs. 14, 15a-g (34); Stephenson, 1953: 44-45 (37); Manning, 1962: 2 (list only) (22); 1963: 317 (list only) (12).

Materials.—1 male, 170.0; captured by trawling; 10-20 fathoms; Chin-Kun-Sen Fish Market; 2 February 1963.

Description.—Raptorial dactylus armed with 10 teeth; upper margin of propodus fully pectinated. Posterior margin of the fifth and both anterior and posterior margins of the sixth abdominal somites without spinulation. Posterior margin of telson with 3 pairs of blunt teeth; the acute prelateral lobe present; submedian portion of the posterior margin of the telson is smooth and entire. Outer margin of penultimate segment of outer branch of uropod with 9 graded, movable spines.

Color (when alive).—Brownish yellow. carapace with 3 and telson with a black transverse band. The boundary between 2 successive somites of thoracic and abdominal somites with a broad transverse black band.

15. Lysiosquilla maculata var. *sulcirostris* Kemp 新稱"溝吻虎斑蝦蛄"

Lysiosquilla maculata var. *sulcirostris,* Kemp, 1913: 116, pl. 8, figs. 92-93 (6); Komai, 1914: 466, pl. 6, figs. 7-7a (8); 1927: 330-331 (9); 1938: 269 (11); Holthuis, 1941: 272 (21); Manning, 1963: 317 (list only) (12).

Materials.—1 male, 93.8; Fanliao; 10 June 1965.

Discussion.—A single specimen was examined, showing close resemblance to *L. maculata,* but they differ in the following 2 aspects: 1) rostral plate elongate-cordiform, its apical spine is long and slender, and with a longitudinal groove on either side; 2) raptorial dactylus armed with 8 teeth while that of *L. maculata* (*S. s.*) armed with 10 teeth; and *L. maculata* var. *tredecimdentata* of Holthuis (21) armed with 13 teeth.

Key to the species of *Acanthosquilla* of Taiwan

1 Cornea broadened; rostral plate square with median spine; lobes of dactyl margin subequal; denticles of telson: 6-8, 4, 1 .... *A. acanthocarpus*

1 Cornea flattened and bilobed; rostral plate bell-shape; distal lobe of dactyl margin is much larger than the proximal lobe; denticles of telson: 3-4, 4, 1 ... *A. multifasciata*

Genus *Acanthosquilla* Manning, 1963

16. Acanthosquilla acanthocarpus (Miers) 新稱"腕棘蝦蛄"

Fig. 8 A—C.

Lysiosquilla acanthocarpus, Miers, 1880: 11, pl. 1, figs. 7-9 (1); Fukuda, 1909: 59, pl. 1, fig. 3 (2); 1910: 146 (18); Kemp, 1913: 120-122 (6); Komai, 1927: 331-332 (9); 1938: 271 (11); Chopra, 1934: 30-31 (31); Tiwari & Biswas, 1952: 359-360 (25); Manning, 1962: 304 (38); 1963: 320 (discussion only) (12).

Materials.—6 females, 54.1-91.8; captured by trawling; 70-80 meters depth; Hsiah-Sang Fish Market; 10 February 1965. 1 male, 60.0; captured by trawling, 70-80 meters depth; Ma-Sha-Kou Fish Market; 10 April 1965.

Description.—Eyes small, cornea sub-

globular, bilobed. Rostral plate (*Fig. 8A*) nearly squarish with an sharp apical spine, lateral margin slightly concave proximally. Carapace (*Fig. 8A*) smooth. Raptorial dactylus (*Fig. 8B*) armed with 5 teeth, the penultimate tooth shorter than the antepenultimate tooth. Outer margin of raptorial dactylus with 2 subequal lobes. Telson (*Fig. 8C*) without carina but with 5 dorsal teeth above posterior margin. The posterior margin armed with 3 pairs of long teeth of which the submedian pair are movable. There are 6-8 pairs of graded, transversely arranged submedian denticles, outer one is larger than inner one. The largest outer submedian denticle is not as stout as inner (first) intermediate denticle. Third (outer) intermediate denticle slightly larger than the second. Denticles of telson: 6-8, 3, 1. A pair of tubercles at the anterolateral angle of telson and a pair of shallow grooves anterior to the latter across transversely. Outer margin of penultimate segment of outer branch of uropod with 6-8 graded, movable spines.

Color (when alive).—Yellowish brown. Each somite with a coarse transverse dark band, but 3 on carapace.

17. Acanthosquilla multifasciata (Wood-Mason) 新稱"條棘蝦蛄"

Lysiosquilla multifasciata, Kemp, 1913: 122-124 (6); Komai, 1938: 271 (11); Holthuis, 1941: 360, fig. 4 (21); Manning, 1962: 304 (38); 1963: 320 (discussion only) (12).

Materials.—1 female, 66.0; captured by trawling; 70-80 m depth; Hsiah-Sang Fish Market; 10 February 1965. 3 males, 56.0-70.8; captured by trawling; 40-50 fathoms depth; Tungkang Fish Market; 8 August 1965.

Color.—The present species is lighter and the band patterns are thinner than those of *A. acanthocarpus.*

Discussion.—The present species quite agrees to the table of Manning (38). *A. multifasciata, A. acanthocarpus* and *A. septemspinosa* are related species, and had been compared in detail by Manning (38).

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LEGEND OF FIGURES:

Fig. 1. *Gonodactylus chiragra* (Fabricius).
A. rostral plate and carapace, dorsal view;
B. dactylus and propodus segments of raptorial claw, lateral view;
C. the sixth abdominal somite and telson, dorsal view.

Fig. 2. *Parasquilla hanni* (Holthuis).
A. anterior portion of body, dorsal view;
B. carpus of raptorial claw, lateral view;
C. lateral margin of fifth to seventh thoracic somites, right side, dorsal view;
D. last abdominal somite, telson and uropod, dorsal view.

Fig. 3. *Clorida microphthalma* (Milne-Edwards).
A. rostral plate and carapace, dorsal view;
B. dactylus and propodus segments of raptorial claw, lateral view;
C. the sixth abdominal somite and telson, dorsal view.

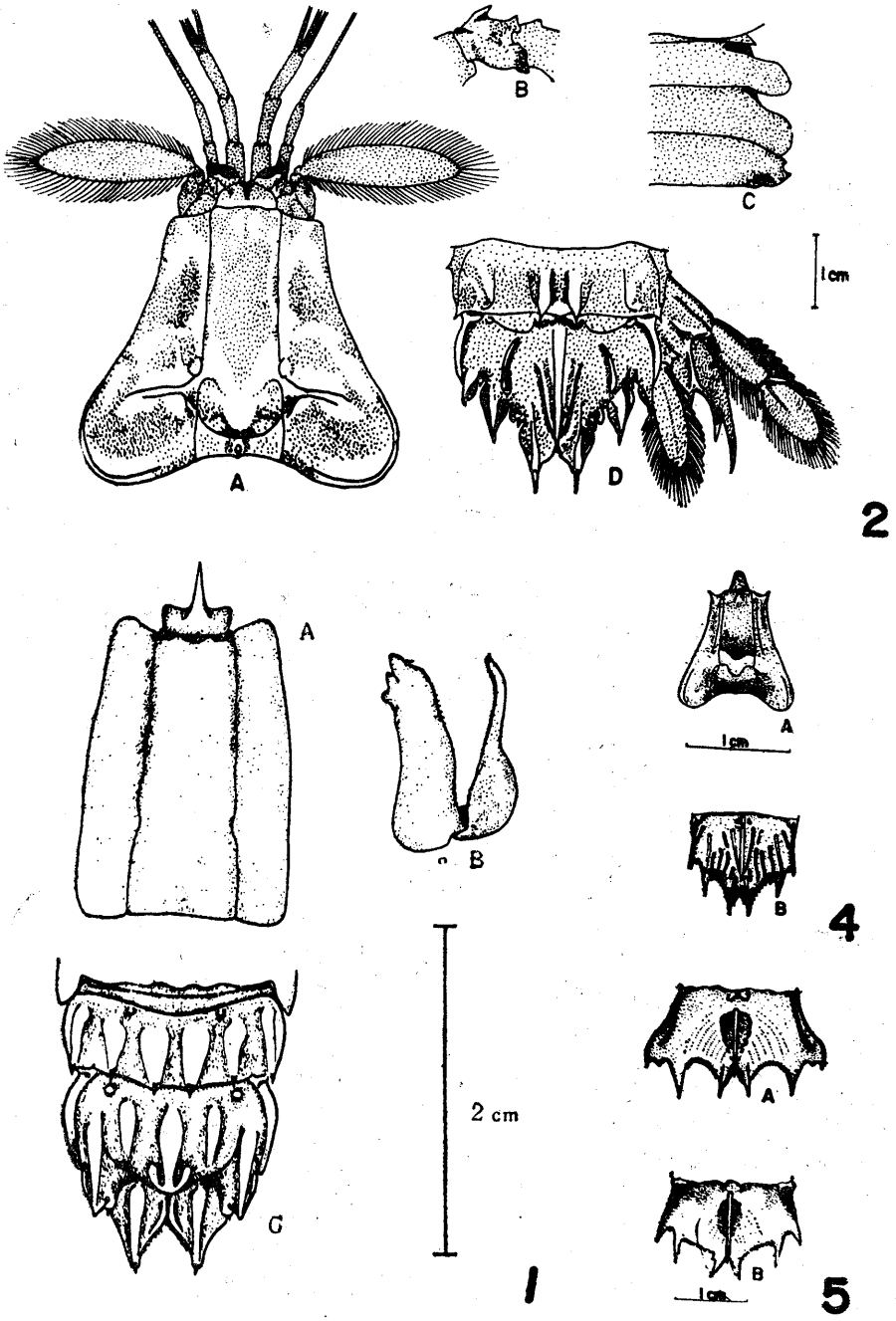
Fig. 4. *Squilla fasciata* de Haan.
A. rostral plate and carapace, dorsal view;
B. telson, dorsal view.

Fig. 5. *Squilla leptosquilla* Brooks.
A. male telson;
B. female telson, dorsal view, scale=1 cm.

Fig. 6. *Harpiosquilla annandalei* (Kemp).
A. lateral margin of fifth and sixth thoracic somites, right side, dorsal view;
B. median crest of telson, lateral view.

Fig. 7. *Harpiosquilla harpax* (de Haan).
A. anterior portion of body, dorsal view;
B. dactylus of raptorial claw, female, lateral view;
C. dactylus of raptorial claw, male, lateral view;
D. lateral margin of fifth and sixth thoracic somites, right side, dorsal view;
E. median crest of telson, lateral view;
F. last abdominal somite and telson, dorsal view.

Fig. 8. *Acanthosquilla acanthocarpus* (Gray).
A. rostral plate and carapace, dorsal view;
B. dactylus and propodus segments of raptorial claw, lateral view;
C. the sixth abdominal somite and telson, dorsal view.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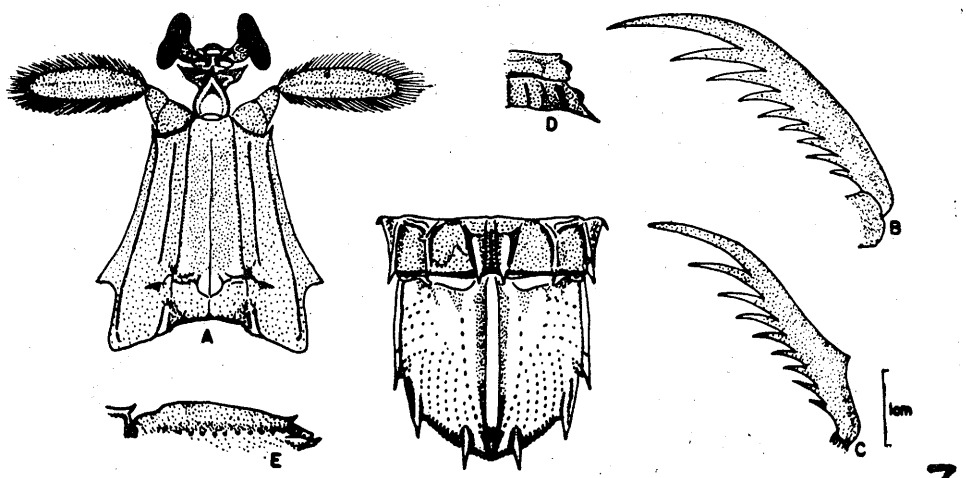

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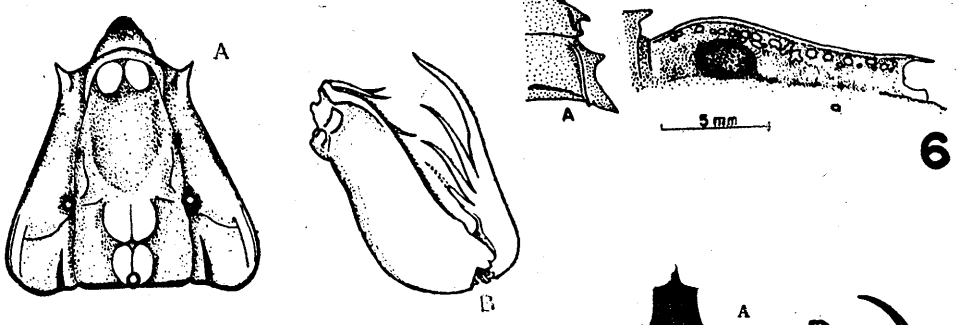

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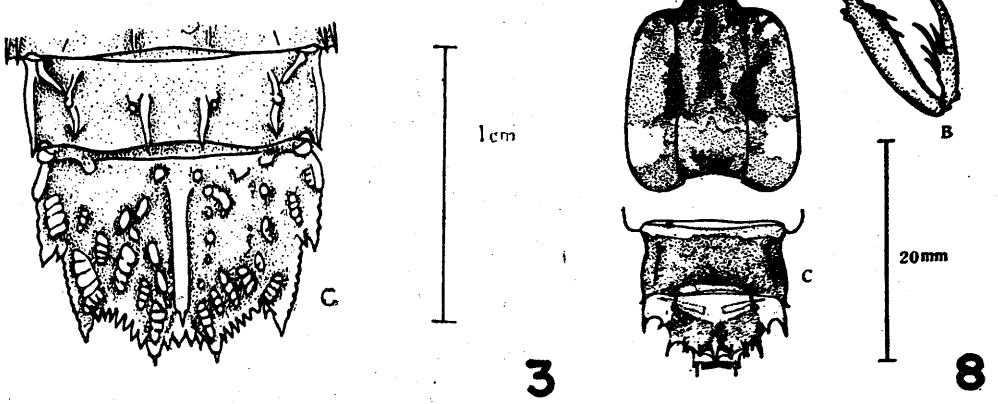

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