

Stomatopoda of Japan and Adjacent Localities

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With Plates XIII & XIV and 2 Text-figures

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INTRODUCTION

Our knowledge of the Stomatopoda inhabiting the seas around Japan and the adjacent localities, namely, Korea, Formosa, the Ogasawara (Bonin) Islands and the Micronesia, we owe largely to the works by DE HAAN (1849), RATHBUN (1903), BALSS (1910), PARISI (1922) and myself (1908-1909, 1910, 1911, 1911a 1913, 1914),* besides works by MIERS (1880), BROOKS (1886), DE MAN (1907), KEMP (1913), KEMP and CHOPRA (1921) and others who have recorded a few species together with stomatopods from certain other localities, or with some other group of animals. Through these works a good many species of this group are already known. In addition to these I can enumerate certain other species from this area which have hitherto been unknown. And now we have in all 34 species 3 varieties of stomatopods found in the localities named, which are distributed in five genera, thus:

<i>Squilla</i>	16 spp. I var.,	<i>Pseudosquilla</i>	4 spp.,
<i>Lysiosquilla</i>	5 spp. I var.,	<i>Odontodactylus</i>	2 spp.,
<i>Gonodactylus</i>	7 spp. I var.		

* The author's surname was formerly FUKUDA.

Of these I have been able to examine specimens of 31 species and 3 varieties, the remaining 3 species being known to me only through works by previous workers.

In the present paper I propose to record all these species and varieties, following the order of succession adopted in the excellent monograph by KEMP. Many of these species have already been described rather fully in my previous papers, some in Japanese and some in English. But, since my Japanese papers, which usually contain more detailed descriptions often with figures appended, will be accessible to foreign workers only with some difficulty, I shall repeat here some accounts in those papers when I feel it necessary.

Before going further, I must not forget to mention my indebtedness to all who have helped me in gathering the material. Especially plentiful material were furnished me from the collections in the Tokyo Imperial Household Museum, Zoological Institutes of the Departments of Science and Agriculture of the Tokyo Imperial University, and also from the private collections of Mr. I. KANEKO from Nagasaki, Mr. R. SAITO chiefly from Misaki and environs, and Mr. M. MAKI from Formosa. My sincere thanks are due to all to whom I owe valuable material for this study.

DESCRIPTION

Genus *Squilla*

Squilla latreillei (EYDOUX et SOULEYET)

Squilla latreillei, BIGELOW (1894), KEMP (1913).

Chloridella latreillei, MIERS (1880), WOOD-MASON (1895).

Specimens examined:

2 m. 56—64.5 mm. Nagasaki. Mr. I. KANEKO.

The specimens conform very well with the descriptions and figures

given by previous authors. The marginal spines of the telson are not swollen in either specimen, appearing more like those in the female than in the male shown in KEMP's monograph (Pl. I, figs. 1,2).

Color: The specimens preserved in formalin, which retain probably much of the original coloration, have no conspicuous marking. The lateral and posterior margins of the carapace are bordered narrowly with a black band of pigment. The gastric area is mottled with a dark pigment. The posterior margin of each of the exposed thoracic somites and of the abdominal somites is also narrowly bordered with a black pigment.

Distribution: *Squilla latreillei* has been recorded from Singapore (EYDOUX and SOULEYET), Bengal (WOOD-MASON and KEMP), Madras (WOOD-MASON and KEMP) and from the Persian Gulf (KEMP).

Squilla rotundicauda (MIERS)

Squilla rotundicauda, BIGELOW (1894), KEMP (1913).

Chloridella rotundicauda MIERS (1880).

MIER's type specimen came from Formosa. No further example has ever since been recorded.

Squilla fasciata DE HAAN

Squilla fasciata DE HAAN (1849), MIERS (1880), BROOKS (1886),

BIGELOW (1894), FUKUDA (1909, 1910), KEMP (1913).

Chloridella fasciata, RATHBUN (1903), DE MAN (1907).

Specimens examined:

1 m. (partly broken) & 2 f.	56—59 mm.	Iesima, Prov. Harima.
1 f.	48 mm.	Prov. Awa in Sikoku. Mr. K. NAKAZAWA.
1 f.	75 "	Tokyo Bay. Z. I., Agr. D., Tokyo I. U.
1 m.	67.5 "	Nagasaki. "
1 f.	—	Tusima. Mr. I. KANEKO.
1 m. 1 f.	—	Nagasaki. "

In the male from Nagasaki preserved in the Zoological Institute of the Agricultural Department of Tokyo Imperial University, the following secondary sexual characters are found: In the raptorial limb the merus is distinctly stouter than in the female of corresponding size; the propodus is broadest at the distal extremity instead of near the basal end, as in the female and younger male; the teeth of the dactylus are swollen. All the carinae of the sixth abdominal somite and the median carina and the carinae on the marginal spines of the telson, as well as the parts on the bases of the denticles between the marginal spines, are swollen.

The female from Prov. Awa which was obtained at the end of May, carries an egg-cluster among the maxillipeds.

Color: The color in fresh individuals is described in my former papers (1908, 1909).

Distribution: This species is by no means rare around Japan. Besides DE HAAN (1849), BROOKS (1886) has recorded it from the Inland Sea, RATHBUN (1903) from Turuga on the coast of the Japan Sea and from Nagasaki, DE MAN (1907) from the Inland Sea, KEMP (1913) from Tokyo Bay and KEMP and CHOPRA (1921) from Tomo on the north coast of the Inland Sea.

As pointed out by KEMP (1913), this species has been recorded outside of Japan rather rarely. It is known from Chusan, the Chinese Seas, Holothuria Bank (POCOCK) and from the Bay of Bengal (KEMP).

Squilla lata BROOKS

(Pl. XIV, figs. 1—1b)

Squilla lata BROOKS (1886), BIGELOW (1894), KEMP (1913), KOMAI (1914).

Specimen examined:

1 f. 36 mm. Nagasaki. Mr. I. KANEKO.

The unique specimen has most of the features characteristic of BROOKS'S *Squilla lata*, namely, the median and intermediate carinae of the carapace are absent, as also the submedian carinae of all the

thoracic and first five abdominal somites; the raptorial dactylus has six spines including the terminal and also an acute lobe at the base of the outer margin; the fifth thoracic somite is armed on each side with an acute and almost straight spine with the tip directed antero-laterally; the appendages of the ambulacral legs are flattened and broadened; the abdomen is much wider than the carapace especially in the posterior somites; and lastly, the basal segment of the uropoda is provided with a series of (seven) sharp spines on the inner margin and also with a prominent lobe on the outer margin of the inner process.

The specimen, however, does not agree with KEMP's description in that it has no mandibular palp and post-anal carina, and also in that none of the carinae on the thoracic and first four abdominal somites ends in a spine, whereas, the carinae on the fifth and sixth abdominal somites all terminate in spines.

Color: The color in formalin is not very conspicuous. Dark purple chromatophores are scattered over the entire dorsal surface. The chromatophores are denser in parts along the cervical groove and posterior margin of the carapace, and in the median parts of the thoracic and abdominal somites, as well as in the regions at the base of the median carina and along the row of small pits on the telson and in the distal part of the basal segment of the exopodite of the uropod. The following parts are pinkish in color: the raptorial dactyli, the ischia of all the maxillipeds, the spaces between the intermediate carina and the lateral margin of all the exposed thoracic and abdominal somites, the tip of the marginal spines of the telson, the endo- and exopodites and the tips of the basal spines of the uropod.

Distribution: Arafura Sea (BROOKS) and Gulf of Martaban, Burma (KEMP).

Squilla scorpio LATREILLE

Squilla scorpio, MILNE-EDWARDES (1837), DE HAAN (1849), MIERS (1880), HENDERSON (1893), BIGELOW (1894), BALSS (1910), KEMP (1913, 1915, 1915 a), KOMAI (1914).

This species seems to be rather common in the Japanese seas.

Specimens examined:

1 m.	66	mm.	Kozima Bay in Inland Sea.	
			Tokyo Women's High. Norm. School.	
1 m.	83	,,	Tu, Prov. Ise.	Tokyo Imp. H. Mus.
1 m. 1 f.	69—74	,,	Kanazawa in Tokyo Bay.	,,
1 f.	39.5	,,	Misaki.	,,
2 m.	36.0—43.5	,,	Tokyo Bay.	,,
1 m.	85	,,	,,	—

Color: The characteristic dark patch at the base of the lateral spine of the fifth thoracic somite is well preserved even in alcohol.

Distribution. BALSS has recorded this species from Okayama in the Inland Sea. Outside of Japan *S. scorpio* has been recorded from various localities of the Pacific and Indian Oceans extending from Australia to the west coast of India.

Squilla leptosquilla BROOKS

Squilla leptosquilla BROOKS (1886), JURICH (1904), FUKUDA (1909, 1910), KEMP (1913).

Specimens examined:

5 m.	59-96 mm.	Kagosima fish-market.	Z. I., Sc. D., Tokyo I. U.
1 m.	—	Kagosima Bay.	—
1 f.	43 mm.	Nagasaki.	Mr. I. KANEKO.

Color: In the fresh specimen from Kagosima the dorsal side is of a bright red-orange color. This shows probably that the species lives on a fairly deep bottom. A conspicuous dark red patch occurs on either side of the median carina of the telson in the space between the carina and the submedian row of pits.

Distribution: Celebes Sea near Philippine Is. (BROOKS), Nicobars (JURICH), Andamans (ALCOCK & ANDERSON, KEMP), East of Madura-Strait (SUNIER).

***Squilla hieroglyphica* KEMP**

Squilla hieroglyphica KEMP (1911, 1913, 1915), KOMAI (1914).

Specimen examined:

1 m. 48.5 mm. Nagasaki. Mr. I. KANEKO.

This specimen of the rare species agrees closely with KEMP's original description of the type, except that the length of the carapace including the rostrum is greater than twice the anterior width of the carapace [(2+11): 5.5], there are prelateral denticles in the telson, and the distal portion of the propodus of the raptorial limb is more broadened than in KEMP's figure. The difference mentioned last is probably a secondary sexual difference—while his two specimens are both females, mine is a male.

Distribution: The locality of KEMP's type-specimen is unknown; his second specimen came from the Philippines.

***Squilla boops* KEMP**

Squilla boops KEMP (1911, 1913).

Squilla quadraticauda FUKUDA (1911, 1911A).

Specimen examined:

1 f. 40 mm. Matuwa, Prov. Sagami.

I agree with KEMP in the view that my *S. quadraticauda* is identical with his *S. boops*. My Japanese paper appeared in the April number of the "Dôbutugaku Zassi" of 1911. But, since this journal used to appear some days after the date put on each number, it is difficult to decide now whether KEMP's paper which appeared in May or mine was issued first. Besides, my article is written in Japanese, though figures are appended, and hardly accessible to foreign workers. Thus, it is probably better to take KEMP's name and discard mine as the synonym.

Distribution: KEMP's specimen is from Burma.

Squilla nepa LATREILLE

Squilla nepa, DE HAAN (1849), MIERS (1880), BIGELOW (1894), KEMP (1913), SUNIER (1918).

Specimens examined:

1 f.	112 mm.	Takao, Formosa.	Mr. M. MAKI.
1 f.	108 „	Keelung, „	„
1 f.	102 „	Kizangun, „	„

This specimen conforms closely with the descriptions of previous writers.

Distribution: Indo-Pacific Ocean from Natal and Madagascar to Hawaiian Is. Formosa may be almost the northern limit of distribution of this species. I have not seen any specimen coming from the seas around Japan proper.

It is interesting to note that one of the specimens before me (from Kizangun) came from a quite inland water up the River Tamsui, at least twenty miles from the sea. KEMP (1918) also reports the occurrence of this form from brackish water of Siam.

Squilla oratoria DE HAAN

Squilla oratoria DE HAAN (1849), KEMP (1913), EDMONDSON (1921).

Squilla affinis, HENDERSON (1893), BIGELOW (1894), DE MAN (1902),

NOBILI (1903), FUKUDA (1909, 1910), BALSS (1910).

Chloridella affinis, RATHBUN (1903), DE MAN (1907).

A great number of specimens of sizes ranging between 27 and 182 mm. came under my examination. They are from the following localities: Otaru on west coast of Hokkaidô, Mutu Bay between Hokkaidô and Honsyû, Noto, Niigata and Maiduru on the coast of the Japan Sea; Rikuzen, Tôkyô Bay, Awa, Misaki, Siduoka, Ise and Kii on the Pacific coast of Honsyû; Harima, Okayama, Nagato and Beppu on the coast of Inland Sea; Nagasaki and Saga on west side of Kyûsyû; Hsiungyoch'ông in Manchuria; Ryûkyû Is., Ogasawara Is.; Kagi, Suô,

Ampin, Ensui, Bôkotô (Pescadores), etc. in Formosa.

This is by far the commonest species of all the stomatopoda of Japan and is well-known as "syako" or "syaku." It is found in especial abundance in the mud bottoms of bays and inlets, for instance, Tokyo Bay, some parts of the Inland Sea, and Ariake Bay in Kyûsyû.

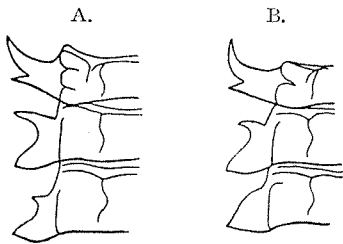
S. oratoria is a rather variable species, and the variation is apparently in correlation with the difference of localities. The most variable structures are the marginal processes of the exposed thoracic somites (*Text-figure 1*); but no less marked variation is found in the coloration of the body. In the examples from the more southern localities, Formosa, Ryûkyû and Kyûshû, as well as the Inland Sea, as compared with those from the northern localities, Tôkyô Bay, Mutu Bay and Hokkaidô, the following differences are to be noted:

	<i>Southern forms.</i>	<i>Northern forms.</i>
<i>Marginal processes of fifth thoracic somite :</i>	Anterior process strongly curved, tip directed anteriorly, sometimes slightly internally.	Anterior process not so strongly curved, tip directed antero-laterally.
<i>Marginal processes of sixth thoracic somite :</i>	Anterior process much shorter than posterior, and triangular in outline.	Anterior process only slightly shorter than posterior, and linear in outline.
<i>Marginal processes of seventh thoracic somite :</i>	Anterior process obsolete.	Anterior process distinct and acuminate.
<i>Color :</i>	Conspicuous dark patches occur on second and fifth abdominal somites; distal part of first segment of exopodite of uropoda is bluish black.	The patches are only rudimentary; first segment of exopodite of uropoda is uniformly light green.

The examples from the coast of the Japan Sea and also from

Manchuria belong to the northern type. KEMP's specimens from Amoy (1913) remind one of the southern type mentioned here.

Habitat, etc.: In the neighborhood of Kasaoka on the coast of the Inland Sea, where I once made some observations on the habit of this species, the bottom is covered with very sticky mud at least a foot deep. The mantis-shrimps make their homes in this mud in the shape of a tunnel, with the entrances 1.5—2.5 feet apart from each other and about a foot deep in the mud in the middle part. The tunnel apparently has nearly the same diameter throughout, one to two inches across. With a little experience, one can tell without any difficulty an inhabited tunnel from one discarded, by the difference in the shape of the entrances. When one treads on one of the entrances of the inhabited tunnel, the water flows out of the other entrance, and drives out the mantis-shrimp. I did not observe the manner in which the shrimp digs the tunnel; but



Text-figure I. Lateral processes of thoracic somites 5th. to 7th. of *Squilla oratoria*. A. Specimen from Tokyo Bay B. Specimen from Ariake Bay $\times 2$.

my collector told me that he had often seen it digging the hole with the raptorial limbs. When one holds the mantis-shrimp between fingers or forceps, it makes a kind of stridulating sound by rubbing the pieces of its exoskeleton against one another. This habit has evidently originated the specific name of *S. stridulans* for another form akin to *S. oratoria*.

The breeding season of *Squilla oratoria* begins in April and ends in July. During this season, the ovary attains to an enormous size, filling the greater part of the body of the animal, from the thorax to the telson, the yellowish mass showing through the external skeleton. After spawning, the female holds the egg-cluster with the maxillipeds until the eggs hatch: hence the notion prevailing among the fishermen of the villages around Tokyo Bay that the mantis-shrimp spawns from the mouth. As I have mentioned elsewhere (1924), brood-caring mantis-shrimps begin to appear in that bay in the middle of May and become commoner

towards the end of the same month, until the maximum number is attained in the month of June. They become rarer from the beginning of July and have practically disappeared by the end of the same month, although a few exceptional ones may be caught as late as August. In other localities where this species is common, namely near Okayama and Kasaoka in the Inland Sea and in the Ariake Bay in Kyûsyu also, the breeding season is at about the same time as in Tokyo Bay.

The youngest larvae measuring about 3.5 mm. in total length, which correspond with the first pelagic stage of GIESBRECHT (1910), appear in the plankton of Tokyo Bay and vicinity at the beginning of July. The larvae of later stages are found commonly in the plankton in July and August. The largest larvae I have collected in that bay are about 20 mm. in length and correspond with GIESBRECHT'S ninth or tenth pelagic stage. However, occasionally overgrown larvae of very large sizes are caught; for instance a larva of apparently this species collected at Misaki by Mr. SAITO, measures 57 mm. in length.

Squilla oratoria is one of the chief objects of fisheries in Tokyo Bay. Each of the fishing villages around the bay sends out a number, sometimes hundreds, of sailing boats every day throughout the year. The boats use a kind of dredge and catch mantis-shrimps together with certain kinds of prawns, crabs, plaice, etc. inhabiting the bottom of the bay. When the boats return in the evening, the mantis-shrimps are sorted out on the beach and all put into a kettle of boiling water for a few minutes. The spines and legs are then removed with scissors from the cooked shrimps and these are all packed in small boxes and sent to the markets in Tokyo and Yokohama, to be distributed to the restaurants and homes in those cities. Although the mantis-shrimp is caught all the year round in the bay, the catch is subject to much seasonal fluctuation, the largest catch being during the period from March to May and the smallest in August.

The market price of mantis-shrimp is lower than that of other crustaceans and fried "syako" is served largely in the cheaper restaurants. The raptorial dactyli are used sometimes as a material for making toys

or other little things sold as souvenirs on bathing beaches like Kamakura, two dactyli with a small connecting piece making a figure of a flying white crane. The dried mantis-shrimp is often found hung at the entrance of fisherman's houses in their belief of keeping off the evil spirits with the spinous armature of the shrimp.

In no other place is the mantis-shrimp caught in such quantity and it does not attain to any economic importance.

Distribution: *Squilla oratoria* has a rather limited distribution. Outside of Japan authentic records are only from Vladivostok (BALSS), Chemulpho in Korea (BALSS), various spots of the Chinese coast from Cheefoo to Hongkong (KEMP), the Philippines (BALSS, KEMP), Guam (EDMONSON), Singapore (PARISI) and the Hawaiian Islands (KEMP).

Squilla oratoria var. *perpensa* KEMP

Squilla oratoria, var. *perpensa* KEMP (1911, 1913, 1915), PARISI (1922).

Squilla perpensa, KOMAI (1914).

Specimens examined:

12 f.	70.5 mm.	Formosa.	Z. I., Sc. D., Tokyo I. U.
1 f.	89 "	Ryūkyū.	"
1 f.	60 "	Palau.	Mr. E. HORII.

These specimens which are evidently referable to *var perpensa*, differ from *S. oratoria* (s. str.) in the following points:

1. The dorsal surface of the body shows a more polished appearance.
2. The cornea is longer and the peduncle is shorter.
3. Antennular peduncles are longer than the carapace excluding the rostrum (in *S. o.* shorter, rarely equal).
4. The rostrum is longer than broad (in *S. o.* broader than long).
5. In the carapace the width between the antero-lateral spines is less than half the length excluding the rostrum (in *S. o.* more than half the length).
6. The median carina of the carapace is interrupted behind the bifurcated portion.

7. The anterior marginal process of the seventh thoracic segment is somewhat longer than in *S. o.*
8. The dorsal carina of the carpus of the raptorial limb is continuous and not broken into tubercles.
9. The outer margin of the raptorial dactylus is less sinuate and the spines are longer and more slender.
10. The color is as described by KEMP (1913), and different from that of *S. o.*

These differences may warrant the establishment of a species distinct from *S. oratoria* (s. str.). However, at the same time it is likely that individuals connecting those two forms are found. In fact, the other two specimens (f. 89 mm., m. 79 mm.) contained in the same bottle as the specimen of *perpensa* from Formosa mentioned above, have all the characteristics of *S. oratoria*; nevertheless, the median carina of the carapace in those specimens is interrupted.

Distribution: This variety has been recorded from the Indo-Pacific south of the Philippines.

Squilla interrupta WOOD-MASON

Squilla interrupta KEMP (1911, 1913, 1918).

Specimens examined:

9 m. & 6 f. 54-112 mm. Rokkô, Tôseki, Ampin Mr. M. MAKI
& Takao in Formosa. and his pupils.

These specimens conform well with KEMP's description and figure. All the features given by him as characteristic of this species are apparently fairly constant. In addition to these, a distinct round patch of dark color which occurs at the base of the median carina of the telson, forms another distinctive feature.

Distribution: Arabian Sea, Persian Gulf, various spots of the coast of the Indian Ocean, Hongkong, Penang, Sumatra and Borneo.

Squilla wood-masoni KEMP*Squilla wood-masoni* KEMP (1911, 1913), KOMAI (1914).*Specimens examined:*

1 m. 120 mm. Formosa (Pescadores?). Z. I., Sc. D., Tokyo I. U.
 1 m. ca. 95 ,, (broken). Formosa. Mr. M. MAKI.

These specimens agree well with KEMP's description and figures.

Distribution: "An Area ranging from Hongkong and the Australian Coast to the Persian Gulf, Aden and Zanzibar" (KEMP) "Western Java-Sea" (SUNIER).

Squilla mikado KEMP & CHOPRA.*Squilla mikado* KEMP & CHOPRA (1921).*Squilla stridulans* KEMP (1913, partim.), KOMAI (1914).*Specimens examined:*

4 m. 2 f. 135-165 mm. Nagasaki. Mr. I. KANEKO.
 1 m. 1 f. 151, 89 ,, Sagami. Mr. K. HOSOYA.
 1 f. 190 ,, Bosyú. Mr. R. SAITO.

KEMP (1913) referred with some doubt to *S. stridulans* a single specimen from Misaki, which showed some differences from the specimens of that species coming from the Indian localities. Later he and CHOPRA, obtaining a second specimen from the same locality, created a new species which they named *S. mikado* on the basis of those two specimens. The differences of this new species from *S. stridulans*, according to them, are:

S. mikado.

1. Undivided portion of mid-dorsal carina of carapace, anterior to dorsal pit, about half as long as bifurcated portion.

S. stridulans.

- less than one-third as long as bifurcated portion.

- | | | |
|----|--|--|
| 2. | Rostrum with a well defined median carina. | an obtuse mid-dorsal tubercle. |
| 3. | Cornea less dilated and set much less obliquely on eyestalk. | much dilated and set very obliquely on eyestalk. |
| 4. | Surface of abdominal somites coarsely rugose. | finely rugose. |

Moreover, *S. mikado* is larger in size and the shape of the marginal processes of the exposed thoracic somites is different in the two species. The examples before me have all the above features of *S. mikado*, except that the undivided portion of the mid-dorsal carina of the carapace, anterior to the dorsal pit, is about one-third, or less than one-third, as long as the bifurcated portion. I have no specimen of *S. stridulans* from India with me, and I follow here the decision of KEMP and CHOPRA to justify the specific distinction between the Indian and Japanese forms.

Color: The ground color is paler than that of the related species, for instance *S. oratoria*. Very conspicuous patches of dark reddish-purple color occur on the middle part of the second abdominal somite and the parts between the submedian and intermediate carinae of the fifth abdominal somite. These patches do not fade away in alcohol, and make a reliable distinctive feature of this species. The dorsal surface of the telson is shaded dark. In the uropod the distal parts of the endopodite and of the first segment of the exopodite, as well as the two spines of the basal prolongation, are dark.

Squilla costata DE HAAN

Squilla costata DE HAAN (1849), MIERS (1880), BIGELOW (1849),
 FUKUDA (1909, 1910), KEMP (1913), KEMP & CHOPRA (1921).
Chloridella costata, RATHBUN (1903).

Specimens examined:

1 m. 72 mm. Atumi, Prov. Uzen, west coast of Honsyû. Dr. M. SASAKI.

1 m.	79 ,,	Tateyama, Prov. Awa.	Tokyo High. Norm. S.
1 m.	72 ,,	Misaki.	Z. I., Sc. D., Tokyo I. U.
1 m.	66 ,,	„	Mr. R. SAITO.
1 f.	78 ,,	Akiya, Prov. Sagami.	Mr. K. HOSOYA.
3 m. 2 f.	66-95 ,,	Toba, Prov. Sima.	Dr. T. MINOURA.
1 m.	—	Nagasaki.	Mr. I. KANEKO.
8 m. 6 f.	51-83 ,,	Tôseki, Kagi, Ampin & Tôkô in Formosa.	Mr. M. MAKI.

Color: This species has no conspicuous coloration. In all of the thoracic and abdominal somites the parts between the submedian carina and the intermediate carina, as also the parts between the latter and the lateral carina, are pinkish in color. A dark spot is present at the base of the mid-dorsal carina of the telson. The second segment of the exopodite, as well as the endopodite of the uropod, is yellowish.

Distribution: RATHBUN has recorded this species from Wakanoura, Prov. Kii and Nagasaki, and KEMP from Okitu, Prov. Suruga. Outside of Japan, only two doubtful specimens from the Burmese coast have been described by KEMP.

Squilla multicarinata WHITE

Squilla multicarinata WHITE (1848, 1849), MIERS (1880),
BIGELOW (1894), NOBILI (1903), KEMP (1913).

A single male, a 'very small and badly-preserved one,' according to WHITE, has been described from Nagasaki. This was collected by H. M. S. "Samalang" and is preserved in the British Museum (WHITE, 1848, MIERS, 1880). I have never seen any specimen of this species.

Distribution: *Squilla multicarinata* has been recorded from the Philippine Is. (WHITE, MIERS), Hongkong (KEMP), Singapore (KEMP & CHOPRA, PARISI), Western Java Sea (SUNIER) and Burma (KEMP).

Squilla raphidea FABRICIUS

Squilla raphidea, MILNE-EDWARDS (1837), MIERS (1880), BIGELOW (1894), DE MAN (1898), BALSS (1910), FUKUDA (1913), KEMP (1913, 1918), SUNIER (1919), PARISI (1922).

Squilla harpax DE HAAN (1849).

Chloridella raphidea, RATHBUN (1903).

Specimens examined:

1 m.	135	mm.	Misaki.	Mr. M. UENO,
1 m. 5 f.	160—213	,,	Seto, Prov. Kii.	Seto Mar. Biol. Lab.
2 m.	180—195	,,	Kasiwazima, Prov. Tosa.	
2 m. 1 f.	156—215	,,	Nagasaki.	Mr. I. KANEKO.
2 m.	133—136	,,	Northern part of Formosa.	Mr. M. MAKI.

Color: When fresh, the entire surface is pale and slightly ochraceous, besprinkled with minute dark spots. A pinkish color is found on the carapace, raptorial limbs and on the thoracic and abdominal somites. A conspicuous round patch of chestnut-brown color occurs on either side of the base of the mid-dorsal carina of the telson.

Distribution: Miss RATHBUN has reported this species from Wakamura, Prov. Kii, BALSS from Nagasaki and Takao, KEMP from Suruga Bay and PARISI from Nagasaki and Suruga Bay. This has also been known from the Philippines, the East Indies, Hongkong and various spots on the Indian Ocean from the Malay Peninsula to Zanzibar (KEMP, SUNIER).

Genus Pseudosquilla

Pseudosquilla ciliata (FABRICIUS)

Pseudosquilla ciliata, MIERS (1880), BROOKS (1886), BIGELOW (1894), DE MAN (1898), BIGELOW (1901), NOBILI (1906), KEMP (1913), EDMONDSON (1921).

Pseudosquilla styliifera, DANA (1852).

Specimens examined:

1 m.	57	mm.	Misaki (?)	Mr. R. SAITÔ.
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2 f.	47—64 mm.	Ogasawara Is.	Z. I., Sc. D., Tokyo I. U.
1 m.	57	„	Z. I., Sc. D., Kyoto I. U.
2 m. 1 f.	45—55	„	Tokyo Imp. H. Mus.
1 m.	47	Palau, Caroline Is.	Mr. S. FUJITA.

Color: Even alcoholic specimens retain the characteristic color of the species. The ground color is olivaceous yellow, mottled here and there with a dark pigment. Conspicuous patches are found on the marginal parts of the sixth thoracic and first abdominal somites, and also on the area between the intermediate and marginal carinae.

Distribution: PARISI has recorded this species from Sagami Bay. This species has a very wide distribution and is known from various localities of the tropical and subtropical parts of the Indo-Pacific and Atlantic Oceans.

Pseudosquilla ornata MIERS

(*Pl. XIV, figs. 2—2b*)

Pseudosquilla ornata MIERS (1880), BIGELOW (1894), BORRADAILE (1907),
KEMP (1913, 1915).

Pseudosquilla oxyrhyncha BORRADAILE (1898, 1907).

Specimens examined:

2 f. 57—61 mm. Ogasawara Is. Mr. KUNIEDA.

This species resembles *P. ciliata*, but differs in the features pointed out by KEMP (1913). The whole animal looks more slender than *P. ciliata*. In one of the specimens (57 mm. Pl. XIV. fig. 2b), the rostrum ends in a delicate but acute median spine, while the other specimen has no such spine. The dorsal ridge of the carpus of the raptorial limb ends in an acute spine.

Color: In the specimens in alcohol the whole dorsal surface is brownish, and covered with a number of small ring-shaped purplish markings which give the surface a marmoreal appearance. Very conspicuous round patches of the same color surrounded by a pale ring, occur on

the lateral parts of the carapace. In the uropod the proximal segment of the exopodite, the endopodite and the basal prolongations have a transverse dark bar.

On the ventral surface, the parts just internal to the base of the leg of the sixth to eighth thoracic somites are marked each with a dark spot.

Distribution: ORTMANN (1894) has recorded this species from Kago-sima. Besides, it is known from Tahiti, Samoa, Philippines, Amboina, Chagos Arch., Seychelles and Mauritius (KEMP).

Pseudosquilla oxyrhyncha BORRADAILE, according to the original description, resembles very closely *P. ornata*, but differs from the latter mainly in that the rostrum has an apical spine and the dorsal edge of the carpus of the raptorial limb terminates in a spine. The specimens of *P. ornata* before me, as mentioned above, have the spine in the carpus of the raptorial limb and one of them has the apical spine in the rostrum. Thus, *P. oxyrhyncha* is probably to be merged in *P. ornata*.

BORRADAILE's specimen is from Rotuma, Fiji Is.

Pseudosquilla empusa (DE HAAN)

(Pl. XIII, fig. 1)

Pseudosquilla? *empusa*, MIERS (1880), BIGELOW (1894).

Pseudosquilla empusa KEMP (1913), KOMAI (1914).

Squilla empusa DE HAAN (1849).

Specimens examined:

1 f.	107 mm.	Nagasaki.	Mr. I. KANEKO.
1 m.	106 ,,	Rotiku, Formosa.	Mr. M. MAKI.

This species had been known for more than sixty years by a single example from Japan described by DE HAAN. I was able to secure the above two specimens through the kindness of friends.

The entire surface is rugose, covered all over with small pits. The carapace shows a well-defined cervical groove, in which the median part is distinct; the anterior margin is nearly straight, while the lateral and

posterior margins are strongly sinuate; the antero-lateral corners are nearly rectangular and the postero-lateral evenly rounded. The lateral margin is bordered with a carina which is especially marked in the part near the postero-lateral angle. The length of the carapace measures about $1/4$ the total length; the greatest breadth at the posterior margin is somewhat smaller than the length.

The rostrum is more than twice as broad as long, and strongly depressed along the median line in the anterior half; the anterior end is curved strongly downward and has a slightly-pointed tip; the posterior parts of the lateral margins are also curved downward. The eye-peduncle is oblique, the posterior half being covered by the rostrum; the cornea is elongated, constricted strongly in the middle and directed forward; the length of the cornea is about $1/7$ of the length of the carapace. The antennular peduncle and the antennal scale are about equal in length, being nearly $2/3$ the carapace.

The dorsal ridge of the carpus of the raptorial limb is provided with an acute spine at about the middle of the entire length, and in addition, a smaller spine near the distal end; the outer margin of the dactylus describes an arc and has a denticle at the base; the inner margin is divided into three spines, including the terminal one.

The fifth thoracic somite narrows gradually toward the lateral margin and ends in a flat process. The lateral parts of the sixth and seventh somites are produced into lobes which show rounded outlines.

The first five abdominal somites bear each a semilunar depression near the lateral margin, the part inside of which depression is raised slightly, defining a rudiment of the intermediate carina. The postero-lateral corner is gradually more acute in the posterior somites; in the fifth somite the corner bears a short spine.

The sixth somite bears three pairs of low carinae, of which the submedian and lateral carinae terminate in spines; the intermediate carinae are broad and irregular in shape. On the ventral side, the postero-lateral corner is provided with a short acute spine.

The telson is slightly broader than long, the length being nearly $1/6$

of the total length; the dorsal surface is provided with a strong median carina and four pairs of carinae, of which the submedians and intermediates are but faintly defined, while the laterals and marginals are fairly distinct. The lateral carinae are divergent posteriorly and end abruptly at the bases of the intermediate marginal spines. All the three pairs of marginal spines are well developed and provided each with a distinct carina. The intermediate spines are the longest of the three pairs, and the submedian spines have mobile tips. There is a denticle inserted between the submedian and intermediate spines. The posterior indentation of the telson is bordered with a series of minute spinules.

In the uropod the outer spine of the basal segment is more than twice as long as the inner; besides there is a spine, about half as long as the inner spine on the inner margin at about the middle of the margin, and also a series of denticles. The two segments of the exopodite are of nearly the same length; the second segment is provided with eight mobile marginal spines. The endopodite is nearly five times as long as broad.

Color: The fresh specimen shows a very conspicuous coloration. The ground color is greyish and has bright orange-red bands as shown in the figure. On the ventral surface, the maxillae and maxillipeds are orange and the pleopods are light orange. The setae of the appendages are red.

This is probably a deep-sea dweller. The intersegmental parts are very soft and easily broken, though the sclerites are rather hard and well calcified.

Pseudosquilla sp.

(Text-figure 2)

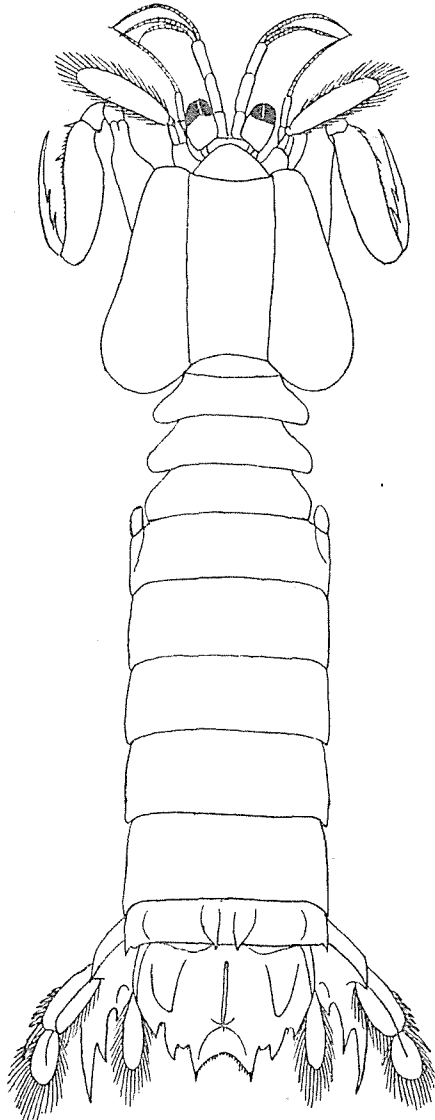
A small specimen of the post-larval stage (length 21 mm.) which was collected at Miyakezima in the group of the Seven Islands of Idu, resembles very closely *P. empusa*, but bears a marked difference in the form of the eyes.

The entire animal is still soft. The rostrum is twice as broad as long,

with the apex rounded and curved strongly downward. The diameter of the cornea is only $\frac{2}{3}$ that of the peduncle. In the carapace the anterior margin is straight, the posterior deeply sinuate; the antero-lateral corner is blunt and the postero-lateral broadly rounded. The gastric sutures are convergent posteriorly. In the carpus of the raptorial limb the dorsal ridge terminates in an acute spine, and the ventral ridge ends in a blunt process. The propodus has three mobile spines on the inner margin. The dactylus is provided with a small lobe at the base of the outer margin which is convex, and the spines are three, including the terminal one. The thoracic and first five abdominal somites are devoid of carinae. The lateral process of the sixth thoracic somite is rounded and that of the seventh is truncated.

The postero-lateral corners of the abdominal somites are angular and end in spines in the fifth somite. On the sixth somite, the submedian and lateral carinae end in spines, while the intermediate carina is faintly defined. On the ventral surface, the postero-lateral corner is provided with a short acute spine.

The telson is more than 1.5 times as broad as long. The



Text-figure 2.
Pseudosquilla sp. $\times 6$

median carina is distinct and ends in a short spine, the submedian rudimentary and the intermediate carinae are divergent posteriorly. The marginal spines are all of about the same length. The submedian spines are surmounted with a movable spine. The secondary spinules are 1-2-16-16-2-1 in number.

In the uropod the outer spine of the basal prolongation is about 2.5 times as long as the inner spine; the inner margin has an acute tooth at about the middle; the margin proximal to the tooth is nearly straight, while the part distal to it is strongly sinuate. The mobile spines on the outer margin of the proximal segment of the exopodite are eight in number.

I can not identify this specimen with any of the known *Pseudosquilla* species. Though it is certain that it shows a close resemblance in many respects to *P. empusa*; the shape of the eyes is distinctly different. The specimen perhaps represents a species yet undescribed.

***Pseudosquilla dofleini* BALSS**

Pseudosquilla dofleini BALSS (1910), FUKUDA (1913), KEMP (1913).

Specimens examined:

- | | | | |
|------|------------------------------|----------------------|------------------------|
| 1 m. | 32 mm. | Tateyama, Prov. Awa. | Tokyo High. Norm. Sch. |
| 1 m. | 54 ,, | Misaki. | Mr. R. SAITO. |
| 22 | (post-larval stage) 20—30 ,, | Seto, Prov. Kii. | Seto Mar. Biol. Lab. |
| 1 f. | 56 ,, | Tusima. | Mr. I. KANEKO. |

The adult specimens all agree with BALSS' description and figure very well. This species is characterized by the rostrum terminating in a flat median spine, the cornea being greatly elongated and the basal process of the uropod bearing a tooth and also a series of smaller teeth on the inner margin. The individuals at the post-larval stage of the length 20—30 mm. collected at Seto, retain larval features in that the carinae on the telson have not yet developed, and there is a wide space between the submedian spines bordered with a number of minute spinules. The eyes, the rostrum and the raptorial limbs are, however, exactly identical with the same in the adult. The inner margin of the basal prolongation of the

uropod bears no tooth in the smallest individual of 20 mm.; it bears a well-developed terminal tooth and a few rudimentary smaller teeth in most of the other individuals. Even in the largest individual 30 mm. in length, the penes are merely short and round processes.

Color: Except for the usual dark minute dots all over the surface which occur in some specimens, there is no conspicuous coloring.

Distribution: BALSS' type-specimen came from Sagami Bay. The species is not known outside of Japan.

Genus *Lysiosquilla*

Lysiosquilla maculata (FABRICIUS)

Lysiosquilla maculata, DANA (1852), MIERS (1880), BROOKS (1886),
BIGELOW (1894), BORRADAILE (1898), DE MAN (1902), FUKUDA (1909, 1910),
BALSS (1910), KEMP (1913, 1915), SUNIER (1918), EDMONDSON (1921).
Squilla maculata, MILNE-EDWARDS (1837), DE HAAN (1849).

Specimens examined:

1 m.	275 mm.	Nangô, Prov. Hiuga.	
1 m.	195 "	Sibusî, Prov. Satuma.	
1 f.	175 "	Ryûkyû Is. ?	Z. I., Sc. D., Tokyo I. U.
1 m.	295 "	Bôkô (Pescadores) Is., Formosa.	Mr. M. MAKI.
1 m.	200 "	Takao, Formosa.	"
1 m.	128 "	Palau, Caroline Is.	Mr. S. FUJITA.

Distribution: This species has a wide Indo-Pacific distribution extending from Japan and Oceania to South Africa. In the Atlantic this species has been recorded from Antigua, W. Indies (STEBBING) (KEMP, 1913).

Lysiosquilla maculata var. *sulcirostris* KEMP

Lysiosquilla maculata var. *sulcirostris* KEMP (1913), KOMAI (1914), PARISI (1922).

Specimens examined:

1 m.	88 mm.	Nagasaki.	Mr. I. KANEKO.
1 m.	162 "	Ogasawara Is. ?	Mr. R. SAITO.

The specimens before me have the features characteristic of the variety as given by KEMP. The rostrum is triangular and has a long apical spine, the margin of which is bordered with a well-defined groove. The spines of the raptorial dactylus are 8. Besides these, the abdomen is somewhat narrower as compared with that of *L. maculata*.

Color: In color the specimens show no difference whatever from the original species.

Distribution: Andaman Is. (KEMP), Amboina (PARISI).

***Lysiosquilla crassispinosa* FUKUDA**

Lysiosquilla crassispinosa FUKUDA (1909, 1910), KEMP (1913).

Specimen examined:

1 f. 275 mm. Sagami Sea. Z. I., Sc. D., Tokyo I. U. (Type).

Recently I was kindly shown in the British Museum by Doctor W. T. CALMAN a second specimen of this curious species. The specimen was a female 207 mm. in length and had come from a bottom of 150 fathoms off Natal. My specimen was also taken from a deep part of the Sagami Sea.

***Lysiosquilla acanthocarpus* MIERS**

(*Pl. XIV, figs. 4-4d*)

Lysiosquilla acanthocarpus, MIERS (1880), BIGELOW (1894),

JURIGH (1904), BALSS (1910).

Lysiosquilla sarasinorum, BIGELOW, (1894).

Specimens examined:

1 f. 61.5 mm. Prov. Sima. Dr. K. NIINOMI.

1 f. 53 ,, Giran, Formosa. Mr. M. MAKI.

The smaller specimen from Formosa agrees very well with KEMP's description of this species. The larger one from Prov. Sima on the Pacific coast of Honsyû, differs from that specimen, as well as from the

description, in the following respects:

<i>Specimen from Sima.</i>	<i>Specimen from Formosa.</i>
1. Rostrum broader than long (3.7 mm. : 3.2 mm.).	longer than broad (3.0 mm. : 3.5 mm.).
2. Raptorial spines 9 including the terminal.	7 (according to KEMP, generally 6).
3. Prominence at the base of raptorial dactylus obsolete.	distinct.
4. Marginal spines of telson 4 on left side, 3 on right side.	3 on each side.
5. Dark pigmentary bands rather indistinct.	distinct.

The specimen from Sima shows thus an asymmetry in the armature of the telson, which makes the identification somewhat doubtful. But, this is probably an individual abnormality. The other differences also are, in my opinion, not sufficient to warrant separating the specimen from *L. acanthocarpus*. It may be added that the specimen approaches MIER's *var. septemspinosa* in having a broader rostrum and in the spines of the raptorial dactylus being more numerous than in the type.

Distribution: BALSS has described this species from Takao, Formosa. The other localities known are, according to KEMP, Penang, N. Australia, the Andaman Is., Madras and Trincomali. *L. acanthocarpus var. septemspinosa* has been recorded from Senegambia.

Lysiosquilla multifasciata WOOD-MASON

Lysiosquilla multifasciata WOOD-MASON (1895), NOBILI (1903, 1906),

BALSS (1910), KEMP (1913, 1915).

Lysiosquilla acanthocarpus FUKUDA (1919, 1910).

Specimens examined:

3 m.	1 f.	27-40 mm.	Tateyama, Prov. Awa.	Tokyo High. Norm. Sch.
1 f.	39	„	Seto, Prov. Kii.	Seto Mar. Biol. Lab.
1 f.	45	„	Nagasaki.	Mr. I. KANEKO.

Distribution: BLASS has recorded the species from Takao, Formosa. The other localities are: Bombay (WOOD-MASON, KEMP), Borneo and the Red Sea (NOBLI) and Mindoro, Philippine Is. (KEMP).

Lysiosquilla latifrons (DE HAAN)

(*Pl. XIV, 3-3b*)

Lysiosquilla latifrons, MIERS (1880), BIGELOW (1894), RATHBUN (1903), KEMP (1913).

Squilla latifrons DE HAAN (1849).

Lysiosquilla brazieri MIERS (1880), BIGELOW (1894), CHILTON (1910).

Specimen examined:

1 f. 70 mm. Nagasaki. Mr. I. KANEKO.

Apart from DE HAAN'S original one, no full description of this species exists, so that it will perhaps not be superfluous to describe the above specimen at some length.

The rostrum is much broader than long, the ratio of the greatest breadth at base to the length being about 4 : 3; the tip is produced into a flat acute spine and the antero-lateral angles are broadly rounded. The carapace is about 1/5 as long as the body, the breadth at the posterior end being nearly the same as the length; the corners are all broadly rounded. The eyes are almost as long as wide, being about 1/5 of the carapace; the cornea is set nearly vertical to the peduncle. The peduncle of the antennule is slightly longer than half of the length of the carapace; the basal spine of the antennular segment is long and acute. The antennal scale is about 1/3 as long as the carapace.

In the raptorial limb, the ventral ridge of the carpus is provided with a spine; the dactylus has an obtuse denticle at the base of the outer margin which is slightly sinuate at base; the inner margin is divided into six spines including the terminal one, of which the penultimate spine is a little shorter than either adjoining spine, and the tip does not reach the level of the tips of the other spines.

The lateral margins of the sixth and seventh thoracic somites are truncated, that of the eighth rounded. The exopodite of the ambulatory

legs is broadened into the shape of a disc in the first two pairs, in the last being linear; a spur-like process occurs on the basal segment of all three pairs.

The sixth abdominal somite is obliquely sulcated on either side, and produced into a sharp spine at the postero-lateral angle.

The telson is nearly as long as broad; the dorsal surface is set with a row of seven acute spines situated at equal intervals near the posterior margin; of these spines the median somewhat surpasses the rest in thickness; the other three pairs are gradually longer outwards; the submedian and the intermediate spines, as well as the latter and the lateral spine, are interposed each with a shallow longitudinal furrow, while such a furrow does not exist between the submedian spines and the median spine, so that the median three spines make one group, and the lateral four are separated one from the other. The margin is beset with three pairs of acute spines besides the minute spinules (1-4-11-12-4-1) inserted in the space between them. The submedian spines are mobile. The post-anal spine is acute and almost as long as the intermediate marginal spine.

In the uropod, the outer spine of the basal prolongation is about $\frac{3}{5}$ as long as the inner spine; on the ventral side an acute spine is present in the basal segment near the base of the endopodite; the movable spines of the basal segment of the exopodite are 7 in number; the distal segment is slightly longer than the endopodite.

Color: In formalin the carapace is marked with three dark bands rather obscurely defined. The thoracic somites are marked each with one broad transverse band and the first five abdominal somites with two similar bands, a narrower one on the posterior margin and a broader one in front of it. In the fifth abdominal somite the postero-lateral corners are conspicuously dark.

On the telson there are two conspicuous pairs of dark patches, one including the area between the bases of the median and submedian dorsal spines and the other occurring on the area between the bases of the intermediate and lateral dorsal spines. The basal part of the distal segment of the exopodite of the uropoda is also dark.

Distribution: RATHBUN has recorded a female from Nagasaki. This species is also known from Port Jackson, Australia (MIERS) and Otaki, New Zealand (CHILTON).

Genus *Odontodactylus*

Odontodactylus scyllarus (LINNAEUS)

(*Pl. XIII, fig. 2*)

Odontodactylus scyllarus, BIGELOW (1894), BORRADAILE (1898), RATHBUN (1903),
FUKUDA (1910—1911), KEMP (1913), KEMP & CHOPRA (1921).

Cancer scyllarus LINNAEUS (1758).

Gonodactylus scyllarus, MILNE EDWARDS (1837, 1836—1849), MIERS (1880,
1880a), DE MAN (1887).

Specimens examined:

1 f.	100 m.	Ogasawara Is.	Tokyo Imp. H. Mus.
1. m.	164 ,,	Bônotu, Prov. Satuma.	
1. m.	75 ,,	Seto, Prov. Kii.	Seto Mar. Biol. Lab.

The cornea measures about $1/6$ as long as the carapace excluding the rostrum in the larger male, about $1/5$ in the female and about $1/4$ in the smaller male. The antennal scale is 0.77 times the length of the carapace excluding the rostrum in the larger male, 0.8 times in the female and 0.9 times in the smaller male. The ophthalmic somite is entirely covered by the rostrum in the two larger specimens, while it is entirely exposed in front of the tip of the rostrum in the smaller male.

Color: The color in the smaller male specimen preserved for a short while in alcohol, and presumably not very different from the original color, is as shown in the figure. Bluish-purple is the predominant color on a yellowish grey background. The lateral parts of the carapace are marked with several rings, regular and irregular, which give the parts a marmoreal appearance. The raptorial dactylus, the flagella of the antennules and antennae, and the tip of the spines of the uropods and telson are pinkish.

Distribution: RATHBUN has recorded a male from Wakanoura,

Prov. Kii. This species has been obtained at various spots of the Indo-Pacific Region (See KEMP, 1913).

Odontodactylus japonicus (DE HAAN)

(Pl. XIII, figs. 3-4)

Odontodactylus japonicus, BIGELOW (1894), FUKUDA (1909, 1910), KEMP (1913),
KOMAI (1922).

Gonodactylus japonicus DE HAAN (1849), MIERS (1880).

Gonodactylus edwardsii, BALSS (1910).

Specimens examined:

1 m.	160.5 mm.	Tateyama, Provc. Awa.	Z. I., Sc. D., Tokyo I. U.
1 m.	153.	„	Tokyo Bay. „
3 m.	1 f. 106—151 mm.	Misaki.	„
3 m.	3 f. 113—145 „	Akiya, Prov. Sagami.	Mr. K. HOSOYA.
1 m.	283 „	Seto, Prov. Kii.	Seto Mar. Biol. Lab.
2 m.	1 f. 126.5—156 „	Nagasaki.	Mr. I. KANEKO.
1 —	—	Korea.	Mr. R. SAITO.
1 f.	59 „	Ogasawara Is.	Z. I., Agr. D., Tokyo I. U.
1 m.	147.5 „	Yaeyama Is.	Tokyo Imp.-H. Mus.
7 individuals of post-larval and larval stages.			
	30—36 mm.	?	(from the stomach of <i>Thynnus</i> .)

This species is not uncommon in the warmer seas around Japan. In the neighbourhood of Misaki it is known among fishermen as “Oki-syako” (offing mantis-shrimp) or “Hana-syako” (flower mantis-shrimp) with reference to its habitat and coloration respectively.

Color: As I have stated in one of my previous papers, the sexual difference in coloration is remarkable (Pl. XIII, figs. 3, male; 4, female). “In the male; the entire dorsal surface of the body is of a bright salmon-red color. The color is shaded into a vivid purple in the antennal scales as well as in both the exo- and endopodite of the uropods. The marginal hairs of these appendages are of a very bright scarlet-red. The mobile spines of the exopodite are orange. In the female, on the other hand,

the posterior half of the body is bluish green; the color is shaded into the salmon-red of the anterior half of the body at the first abdominal somite.* The salmon-red color of the anterior half of the body is not so bright as in the male. For the rest, the coloration of the sexes is practically identical. The difference in the coloration of the sexes is so remarkable that one can readily tell one from the other without examining structural differences, provided the specimens be fresh or for a short time in preserving fluid" (KOMAI, 1922, pp. 102—103).

I have also described in the same paper a male specimen having a coloration somewhat approaching that of the female, which showed at the same time some abnormalities in internal structure (for details l. c.).

The seven small specimens obtained from the stomach of the fish *Thynnus*, show the stages of the transitory change from the larval to the post-larval phase. In two of these, both 30 mm. long and 6 m. broad, the sex can not be distinguished, but otherwise, they have nearly perfect adult features. The raptorial dactylus bears a series of spines, and is slightly inflated at the base; the sixth abdominal somite and the telson is already provided with all the carinae of the adult, and the postero-lateral corners of the fourth and fifth abdominal somites are produced into spines. In the other two specimens, 29 and 30 mm. long respectively and 4.5 mm. broad, the entire shape is much more slender than in the adult or in the preceding two specimens. The raptorial dactylus has no spines on the inner margin. In the sixth abdominal somite the submedian and lateral carinae are differentiated; and in the telson the median, intermediate and marginal carinae are found. The telson is nearly as long as broad. In the remaining three specimens which measure 30, 32 and 36 mm. respectively from the tip of the long rostrum to the posterior end of the telson, the carapace is still in the larval state, with all the antero-median (rostral), antero-lateral, postero-lateral and postero-median spines.

Distribution: BALSS, KEMP and PARISI have all recorded this species from Misaki. Outside of the Japanese coast, it has been described

* The level of transition of the two colors seems to be somewhat variable but exists in the first three abdominal somites.

from Hongkong(KEMP), Chinese Seas(MIERS) and off the Seychelles (BORRADAILE).

Genus *Gonodactylus*

Gonodactylus chiragra(FABRICIUS)

Gonodactylus chiragra, H. MILNE-EDWARDS (1837), MIERS (1880), BROOKS (1886), DE MAN (1888, 1902), BIGELOW (1894), BORRADAILE (1898, 1899, 1907), LENZ (1901), LANCHESTER (1903), JURICH (1904), TATTERSALL (1906), NOBILI (1906), FUKUDA (1908, 1910), KEMP (1913, 1915), EDMONDSON (1921, 1923).

Gonodactylus smithi Pocock (1893).

Specimens examined:

1 f.	40	mm.	Misaki.	Mr. R. SAITÔ.
1 m.	47	"	Akiya, Prov. Sagami.	Mr. K. HOSOYA.
1 m. 2 f.	32—44	"	Misaki?	"
1 m. 1 f.	56—80	"	Seven Is., Idu.	Z. I., Sc. D., Tokyo I. U.
2 f.	—		Ogasawara Is.	"
1 m.	71	mm.	Yakusima, Prov. Osumi.	Mr. T. KUROIWA.
1 m. 1 f.	—		Tanegasima "	Mr. I. KANEKO,
3 f.	—		" "	Mr. Y. NAKANO.
19 m. 7 f.	-77	mm.	Ryûkyû Is.	Z. I., Sc. D., Tokyo I. U.
1 m.	73	"	" "	Tokyo Imp. H. Mus.
1 f.	65	"	Yaeyama, Ryûkyû group.	"
1 f.	71.5	"	Northern Part of Formosa.	Mr. M. MAKI.
5 m. 5 f.	44—68	"	Syôryûkyû Id., Formosa.	Mr. M. MAKI.
1 f.	49	"	Palau, Caroline Is.	Prof. S. GOTÔ and Mr. Y. OKADA.
1 f.	40	"	Caroline Is.	Prof. S. TAKAHASI.
1 f.	55	"	Angaur, Caroline Is.	Mr. S. FUJITA.

Color: As noted by KEMP, this species is variable not only in structure, especially of the telson, but also in coloration. While the prevalent color of the body in alcohol is yellowish brown or olivaceous brown, with the raptorial dactylus pinkish or bluish and the distal part of the propodus

bluish or dull purple, some are pale yellow with black spots on either side of the last two thoracic and first four abdominal somites. In the female from Formosa preserved in formalin, the entire dorsal surface is pinkish, and the raptorial limbs are very brightly pinkish.

Distribution. This species is almost the commonest species of all stomatopods throughout the tropical and subtropical Indo-Pacific area.

Gonodactylus chiragra var. platysoma (WOOD-MASON)

Gonodactylus chiragra var. platysoma, KEMP (1913, 1915).

Gonodactylus platysoma WOOD-MASON (1895).

? *Gonodactylus chiragra var. acutus* LANCHESTER (1895), BORRADA LE (1907),
LENZ (1910).

Specimens examined:

1 m.	1.55 mm.	×	13 mm.	Jaluit, Marshall Is.	Mr. S. FUJITA.
1 m.	50 "	×	11 "	" "	Mr. E. HORII.

Both the specimens have all the features which distinguish the variety from *G. chiragra* s. str., namely, the shorter and more depressed body, the shorter and straight raptorial dactylus and the absence of the antero-lateral marginal tooth of the telson; besides, both of them have conspicuous dark patches on the median line, one specimen on the sixth thoracic and first abdominal somites and the other on the fifth and eighth thoracic somites.

Perhaps this variety deserves to be raised to the status of a separate species.

Distribution. PARISI has recorded a female of this variety from Yae-yama, Ryūkyū group. This variety is known from the Andamans, Society Is., Mauritius and the Philippines, besides the specimens recorded as *var. acutus* which were taken from Minikoi (LANCHESTER), Zanzibar, Madagascar (LENZ), Guam and Marquesas (EDMONDSON).

Gonodactylus glabrous BROOKS

Gonodactylus glabrous BROOKS (1886), BIGELOW (1894), DE MAN (1902),
 JURICH (1904), FUKUDA (1908, 1910), KEMP (1913, 1915), PARISI (1922).
Gonodactylus graphurus DE MAN (1887).
Gonodactylus glaber HENDERSON (1893), NOBILI (1906), BORRADAILE (1907).

Specimens examined:

5 m. 6 f.	22—35	mm.	Misaki.	Mr. R. SAITÔ.
2 m. 2 f.	28—36.5	mm.	Misaki?	„
1 f.	28	„	Tusima.	Mr. I. KANEKO.
1 f.	36.5	„	Ryûkyû.	Tokyo Imp. H. Mus.
5 f.	33—41	„	„	Z. I., Sc. D., Tokyo I. U.
1 m. 3 f.	29—36	„	Ogasawara Is.	„
1 f.	32	„	„	Z. I., Agr. D., Tokyo I. U.
2 f.	—		Truk, Caroline Is.	Prof. N. YAMASAKI.

Distribution: *G. glabrous* has been recorded from various localities of the Indo-Pacific as well as from the Mediterranean.

Gonodactylus graphurus MIERS

Gonodactylus graphurus MIERS (1875, 1880), BROOKS (1886), BIGELOW (1894),
 LENZ (1901, 1910), NOBILI (1906), KEMP (1913), BALSS (1921).

I have seen no specimen referable to this species; but BALSS (1921) has recorded this from Satuma.

Distribution: According to KEMP and BALSS, this species is known from Samoa, Thursday I. and other localities of Australia, Arafura Sea, China Seas, Amboina, Marianne Arch. and Zanzibar.

Gonodactylus spinoso-carinatus FUKUDA

Gonodactylus spinosocarinatus FUKUDA (1909, 1910), KEMP (1913).

Specimens examined:

- 2 f. 15—28.5 mm. Sagami Bay. Z. I., Sc. D., Tokyo I. U. (Types).
1 m. 22.5 ,, Katuura, Prov. Kadusa. Tokyo Imp. H. Mus.

The third specimen of this rare species which came from a locality very near that of the types, shows much the same characteristics as those. Like the types, this specimen is very small in size, measuring only 22.5 mm. in length and 3.5 mm. in the greatest breadth of the body but is an adult in every feature.

In the telson a low carina is present on the submedian marginal spine. A prominent lobe-like process exists at the base of the proximal segment of the exopodite of the uropod. The marginal spines are six on either side, of which the proximal three are slender and straight, while the distal three are stout and claw-like, with tips strongly recurved, the fourth spine being the largest and the fifth and sixth gradually smaller. The setae of the exo- and endopodite of the uropod, as well as those of the antennal scale, are restricted to the outer margin especially in the distal portions.

Gonodactylus tanensis (FUKUDA)

Gonodactylus tanensis, KEMP (1913).

Protosquilla tanensis FUKUDA (1911, 1911a).

Specimen examined:

- 1 m. Tanegasima. 30.5 mm. (Type).

No other specimen has ever since been described.

Gonodactylus glyptocercus WOOD-MASON

Gonodactylus glyptocercus WOOD-MASON (1876), MIERS (1880),

BROOKS (1886), KEMP (1913).

Protosquilla cerebralis BROOKS (1886), DE MAN (1887, 1902),

BORRADAILE (1898, 1899), FUKUDA (1908, 1910).

Specimens examined:

1 m. 3 f. 25—37 mm. Ryūkyū. Z. I., Sc. D., Tokyo I. U.

Distribution: Fiji Is., New Britain, Loyalty Is., Pulo Edam, Ternate, Nicobars, Andamans and Mergui Archipelago.

Gonodactylus spinosissimus PFEFFER

Gonodactylus spinosissimus, BIGELOW (1894), NOBILI (1906), KEMP (1913).

Protosquilla brooksi FUKUDA (1908, 1910).

Protosquilla spinosissimus, TATTERSALL (1906).

Specimens examined:

3 f. 22.5—39.5 mm. Prov. Awa in Honsyū.

2 m. 6 f. 42—59 ,, Misaki. Mr. K. AOKI.

1 m. 2 f. 41—50 ,, Akiya, Prov. Sagami. Mr. K. HOSOYA.

In my previous paper I identified, with some doubts, my specimen from Awa with *Protosquilla brooksi* DE MAN, since at that time I was able to see neither PFEFFER's paper nor any detailed description of *G. spinosissimus*. Judging from the descriptions of TATTERSALL and KEMP, the Japanese specimens seem to have shorter spinules on the last two somites than the specimens from other sources, and, moreover, they have distinct longitudinal furrows on the central parts of the fifth abdominal somite which the specimens from other localities seem to be lacking (c. f. FUKUDA, 1910, figs. 1, 1a).

It is not improbable that *G. brooksi* is identical with *G. spinosissimus*, since the only difference seems to be in the number of the spinules of the last two somites which varies within each species.

Color: The color is variable. The ground color in fresh examples may be olivaceous, yellowish brown or reddish brown, and mottled with dark pigment. The flagella of the antennules and antennae are pinkish.

Distribution: Ceylon, Andamans, Red Sea and Zanzibar.

DISTRIBUTION OF STOMATOPODA IN THE SEAS
AROUND JAPAN AND ADJACENT LOCALITIES.

First, attention may be called to the richness in species of the stomatopods found in this region. Apart from all the forms occurring in the more remote islands, such as the Micronesia, Ogasawara Is., as well as Formosa and the Ryûkyû Is., we have altogether 30 species and 1 variety of stomatopods inhabiting the seas north of Kyûsyû. This number, as compared with 22 species and 2 varieties known from the Philippines (KEMP, 1915), or with 22 species and 2 varieties from the East Indies (KEMP, 1913, SUNIER 1918), is fairly remarkable. This may be due in part to the fact that the Japanese stomatopod fauna has been rather thoroughly explored, more so than in any of the above localities. But when we consider the fact that stomatopods are chiefly the inhabitants of tropical and subtropical seas, the richness in species near Japan becomes more apparent.

The larger part of these species, as might naturally be expected, are those which are known from the southern part of Japan only, and consist, for the most part, of the forms which are distributed widely in the whole Indo-Pacific region. Thus, Kyûsyû, whence a rich collection has come under my examination, thanks to Mr. I. KANEKO'S effort, has yielded altogether 23 species and 1 variety. The number diminishes as we proceed northward, most of the species with a wide distribution being dropped from the list. On the Pacific coast, however, several of these species still remain in existence as far as the Bay of Sagami, for instance, *S. scorpio*, *S. raphidea*, *P. ciliata*, *L. multifasciata*, *G. chiragra*, *G. glabrous* and *G. spinosissimus*.

The fact that the fauna of Sagami Bay has much tropical facies is readily noticed by anybody who takes a glance at the littoral fauna around the Misaki Marine Laboratory, and is endorsed by all who have made a faunistic study of this region (e. g. DOFLEIN, 1906, 1906a, THIELEMANN, 1910, BALSS, 1924), so that it is very natural that comparatively many

tropical stomatopods are found in this region.

Besides those essentially tropical forms of stomatopods, there are certain number of species which have apparently been developed in the waters around Japan, such as, *S. fasciata*, *S. mikado*, *S. costata*, *P. empusa*, *P. dofleini*, *L. latifrons*, *O. japonicus* and *G. spinoso-carinatus*. These endemic species all have a rather limited distribution, a few being dispersed southward, but only to a limited extent. The richness in species of stomatopods around Japan, as compared with the Philippines or with the East Indies, is due in a large measure to the existence of these endemic species.

Kyûsyû and the Pacific coast of Sikoku and Honsyû south of Sagami Bay, have both the endemic and the tropical species mingled. The Inland Sea and the Japan Sea, on the contrary, have practically the former only. Thus, the stomatopod fauna seems to change abruptly when one passes the Strait of Tusima or the Strait of Simonoseki.

Little has been studied on the stomatopods of the Pacific coast north of Sagami Bay. But, evidently there are but a few species inhabiting this area: so far I know only one species, *S. oratoria*, from this region. This species extends farther north to the coast of Hokkaido, where we find probably the northern limit of the distribution of the stomatopod in the whole Indo-Pacific.

The stomatopod fauna of Formosa, as compared with that of Kyûsyû, shows more tropical facies, in having such forms as, *S. nepa*, *S. oratoria* var. *perpensa*, *S. interrupta* and *S. wood-masoni*.

No stomatopod inhabiting the region near Japan is common to the species known from the west coast of America. This is a rather striking fact, if we are reminded that there are 9 species, namely, *S. raphidea*, *P. ornata*, *L. crassispinosa*, *O. scyllarus*, *O. japonicus*, *G. chiragra*, *G. graphurus*, and *G. spinosissimus*, common to Japan and the east coast of Africa. This is probably due to the fact that there are few shores intervening between Japan and America where such essentially tropical animals as stomatopods might thrive.

In short, the stomatopod fauna around the coast of Japan is charac-

terized by the coexistence of the tropical and endemic elements. Such a condition may be noticed in the stomatopod fauna of the east coast of Australia, as well as in that of the east coast of Africa also, and stands in a rather sharp contrast, on the one hand, with the stomatopod fauna of the locality like the Philippines which comprises no endemic elements, and, on the other hand, with the same of the locality like the Mediterranean which contains few elements common with that of other localities.

In the appended table the distribution of all the species described in this paper in the localities within and without Japan is shown.



TABLE

	Honsyū, Pacific Coast	Honsyū, Japan Sea Coast	Inland Sea	Kyūshū	Ryūkyū	Formosa	Ogasawara Is.	China	Philippines	Micronesia	East Indies	Polynesia	Hawaii	Australia & N. Zealand	Indo-China, Siam, Malay Pen. (e. coast)	Bay of Bengal	Arabian Sea	Red Sea	E. coast of Africa	Atlantic & Mediterranean
<i>Squilla</i>																				
<i>latreillei</i>	..	..	..	X	..	..	..	..	..	..	..	..	..	..	X	..	X	..	..	..
<i>rotundicauda</i>	..	..	..	X	..	..	..	..	..	..	..	..	..	..	..	..	X	..	..	..
<i>fasciata</i>	X	X	X	X	..	..	..	X	..	..	..	..	..	..	..	X	..	..	..	..
<i>lata</i>	..	..	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>scorpio</i>	X	..	X	..	..	..	..	..	X	..	X	..	..	X	X	X	X	..	..	..
<i>leptosquilla</i>	..	..	..	X	..	..	..	..	X	..	X	..	..	..	..	X	..	..	..	..
<i>hieroglyphica</i>	..	..	..	X	..	..	..	..	X	..	..	..	..	..	..	..	..	..	..	..
<i>boops</i>	X	..	..	..	..	..	..	..	X	..	..	..	..	..	..	..	..	..	..	..
<i>nepa</i>	..	..	..	..	..	X	..	X	X	..	X	..	X	..	X	X	X	..	X	..
<i>oratoria</i>	X	X	X	X	X	X	X	X	X	X	..	..	X	..	X	X	..	..	..	..
<i>var. perpensa</i>	..	..	..	..	X	X	..	X	X	X	X	..	..	X	X	X	X	..	..	..
<i>interrupta</i>	..	..	..	..	..	X	..	X	X	..	X	..	..	X	X	X	X	..	..	..
<i>wood-masoni</i>	..	..	..	..	..	X	..	X	X	..	X	..	..	X	X	X	X	..	X	..
<i>mikado</i>	X	..	..	X	..	..	..	..	..	..	..	..	..	..	..	X	..	..	..	..
<i>costata</i>	X	X	..	X	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>multicarinata</i>	..	..	..	X	..	..	..	X	X	..	..	..	..	..	..	..	..	..	..	..
<i>raphidea</i>	X	..	..	X	..	X	..	X	X	..	X	..	..	..	X	X	X	..	X	..
<i>Pseudosquilla</i>																				
<i>ciliata</i>	X	..	..	..	..	..	X	..	X	X	X	X	X	X	X	X	X	X	X	X
<i>ornata</i>	..	..	..	X	..	..	X	..	X	..	X	..	..	..	..	..	X	..	..	..
<i>empusa</i>	..	..	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>dofleini</i>	X	..	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>Lysiosquilla</i>																				
<i>maculata</i>	..	..	..	X	X	X	..	..	X	X	X	X	X	..	..	X	..	..	..	X
<i>var. sulcirostris</i>	..	..	..	X	..	..	X	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>crassispinosa</i>	X	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
<i>acanthocarpus</i>	X	..	..	..	..	X	..	..	X	..	..	..	..	X	..	X	..	..	..	..
<i>multifasciata</i>	X	..	..	X	..	X	..	..	X	..	X	..	..	..	..	..	X	..	..	..
<i>latifrons</i>	..	..	..	X	..	..	..	..	..	..	..	..	..	X	..	..	..	..	..	..
<i>Odontodactylus</i>																				
<i>scyllarus</i>	X	..	..	X	..	..	X	..	..	..	X	X	..	..	..	X	..	..	..	..
<i>japonicus</i>	X	..	..	X	X	..	X	X	..	..	X	..	..	..	..	..	..	..	X	..
<i>Gonodactylus</i>																				
<i>chiragra</i>	X	..	..	X	X	X	X	..	X	X	X	..	..	X	X	X	X	X	X	..
<i>var. platysona</i>	..	..	..	X	..	..	..	..	X	X	X	..	..	..	..	..	..	..	..	..
<i>glabrous</i>	X	..	..	X	X	..	X	..	X	X	X	..	..	X	X	X	X	X	X	X
<i>graphurus</i>	X	X	..	X	X	X	..
<i>spinoso-carinatus</i>	X
<i>tanensis</i>	X
<i>glyptocercus</i>	X	X	X	X
<i>spinosissimus</i>	X	X	X	..	X

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EXPLANATION OF PLATES

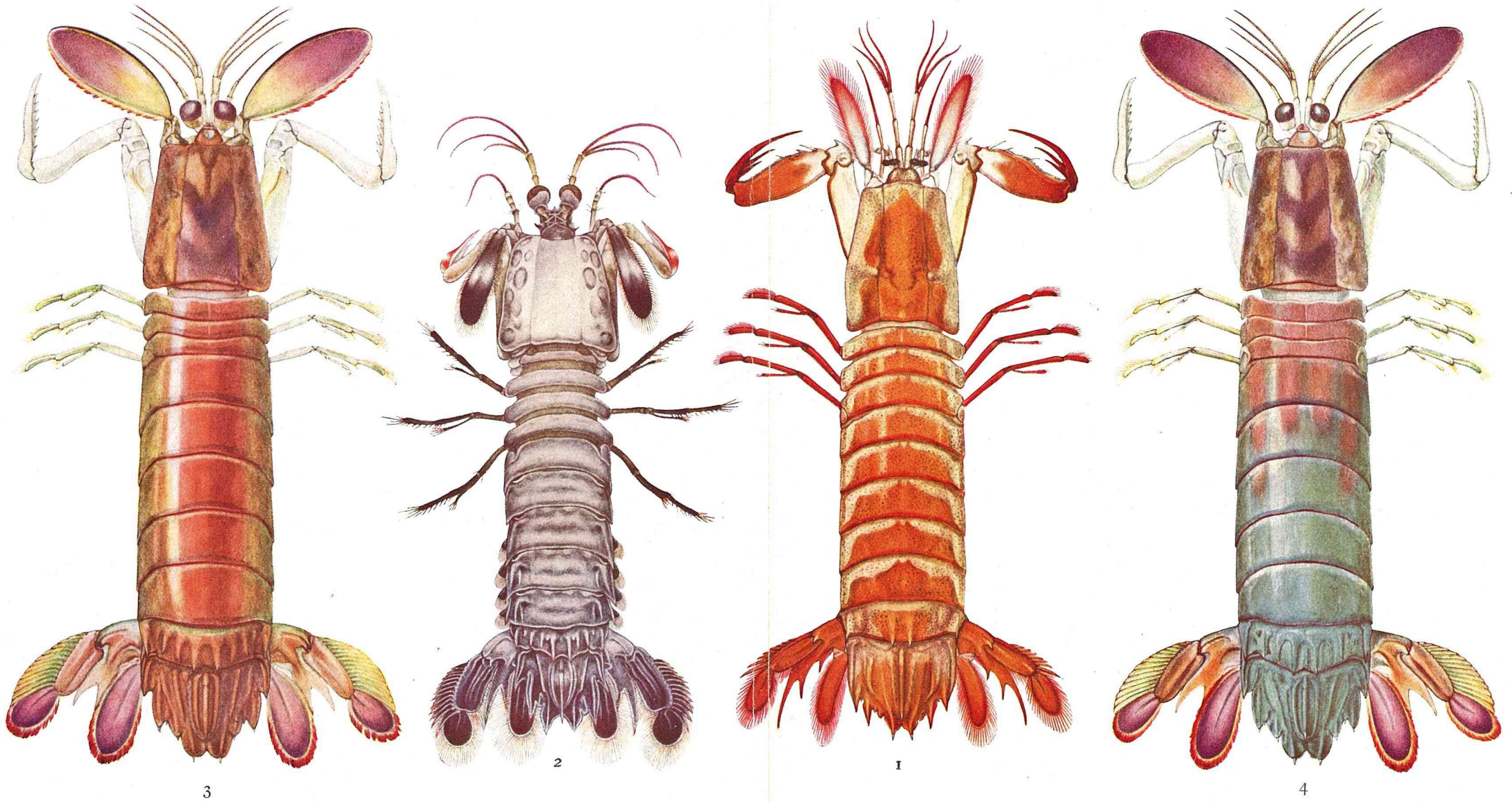
Plate XIII

(Color in preserving fluid for a short while and presumably almost the same as the original)

- Fig. 1. *Pseudosquilla empusa* (DE HAAN). Specimen from Nagasaki. $\times 1$.
 Fig. 2. *Odontodactylus scyllarus* (LINN EUS) Specimen from Seto. $\times 1.2$
 Fig. 3. *Odontodactylus japonicus* (DE HAAN). A male from Sagami Bay. $\times 0.8$.
 Fig. 4. the same. A female from Sagami Bay. $\times 0.8$.

Plate XIV

- Figs. 1—1b. *Squilla lata* BROOKS. Specimen from Nagasaki. $\times 4$.
 1. Anterior part of body.
 1a. Left raptorial limb.
 1b. Posterior part of body.
 Fig. 2—2b. *Pseudosquilla ornata* MIERS. $\times 2$.
 2. Anterior part of body of a specimen from Ogasawara Is.
 2a. Rostrum of another specimen from the same locality.
 2b. Right raptorial limb.
 Figs. 3—3b. *Lysiosquilla latifrons* (DE HAAN), from Nagasaki. $\times 2$.
 3. Anterior part of body.
 3a. Right raptorial limb.
 3b. Posterior part of body.
 Figs. 4—4a. *Lysiosquilla acanthocarpus* MIERS. Specimen from Formosa. $\times 4$.
 4. Right raptorial limb.
 4a. Rostrum.
 Figs. 4b—d. *Lysiosquilla acanthocarpus* MIERS. Specimen from Sima. $\times 4$.
 4b. Right raptorial limb.
 4c. Rostrum.
 4d. Telson.
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S. KIKKAWA & M. ABE Del.

T. KOMAI: Stomatopoda of Japan and Adjacent Localities.

