

REPORT OF THE BIOLOGICAL SURVEY OF MUTSU BAY
36. OPHIUROIDEA OF THE MUTSU BAY AND VICINITIES¹⁾

By

HIKOSHICHRÔ MATSUMOTO

(With Plates XXI-XXIII and 10 text-figures)

INTRODUCTION

The present material was collected by Professor HATAI, Professor HÔZAWA and their coöperators and assistants. It has been submitted by Professor HÔZAWA for study to the present writer, who distinguished the following forms in it.

Order Gnathophiurida

Family Amphiuridae

1. *Ophiopholis mirabilis*
2. *Ophiophragmus japonicus*
3. *Ophiophragmus japonicus* var. *parvus*, n. var.
4. *Amphipholis tetracantha*, n. sp.
5. *Amphipholis kochii*
6. *Amphiura sinicola*, n. sp.

Family Ophiotrichidae

7. *Ophiothrix marenzelleri*

Order Chilophiurida

Family Ophiolepididae

8. *Ophiura kinbergi*
9. *Ophiura sarsii*

Among them, the eighth species is Indo-Pacific in distribution, the ninth is circumpolar and the rest are Honshû species. One species, which is not represented in this collection, can be brought here into consideration: it is *Amphipholis pugetana*, which is known in Japan to range from the Okhotsk Sea to the vicinity of Kinkwasan, though ranges from Alaska as far southward as to Peru along the western coast of the New World. By far the most abundant of this collection is the first species, which ranges from the Okhotsk Sea to around Honshû, and the next abundant

¹⁾ Contribution from the Marine Biological Station, Asamushi, Aomori-Ken. No. 173

is the ninth, which is distributed widely over the North Pacific, the Arctic Ocean and the North Atlantic.

DESCRIPTION OF SPECIES

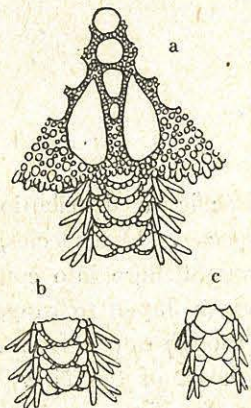
Ophiopholis mirabilis (DUCAN)

(Pls. XXI-XXIII, text-fig. 1)

CLARK, Mem. Mus. Comp. Zool., XXV, No. 1, 1915, p. 268;
MATSUMOTO, Journ. Sci. Coll., Tokyo, XXXVIII, Art. 2, 1917, p. 160;
MATSUMOTO, Annot. Zool. Jap., IX, Pt. 4, 1918, p. 478.

Station 1; off Yunoshima; numerous specimens. Station 21; off Hanakuri; abundant specimens. Station 24; off Moura; numerous specimens. Station 26; off Futagojima; abundant specimens. Station 27; off the Biological Station; numerous specimens. Station 28; off the Biological Station; numerous specimens. Station 30; off Itazaki; abundant specimens. Station 41; off Okunai-mura; abundant specimens. Station 42; off Yomogida-mura; abundant specimens. Station 44; off Futatsuya-mura; abundant specimens. Station 61; off Bentenjima and Ōshima; numerous specimens. Station 62; off Ozawa; numerous specimens. Station 63; off Shukunobe; seven specimens. Station 68; off Jōgasawa; one specimen. Station 72; off Asadokoro; one specimen. Station 73; off Shimizugawa; numerous specimens. Station 74; off Karibazawa; three specimens. Station 76; off Myōmae; abundant specimens. Station 77; off Arito; numerous specimens. Station 80; off Ushinosawa; numerous specimens. Station 81; off Yokohama; numerous specimens. Station 82; off Hinoki; numerous specimens. Off and west of Ōshima; abundant specimens. Ōse, off Yunoshima; three specimens.

This well-known species is characterised by the presence of a pair of especially large supplementary dorsal arm plates, besides series of smaller



Text-fig. 1. *Ophiopholis mirabilis*.
×6. a. From above. b. Dorsal view of three arm joints of middle part of arm. c. Ditto of distal part of arm.

supplementary ones, to each arm joint. As observed in young specimens or on distal arm joints of adults, the paired large supplementary plates are ontogenetically early to appear, appearing decidedly earlier than the smaller supplementary ones. In life, this species is one of the most charmingly coloured ophiurans, being variously variegated, annulated and spotted with various combinations of various shades of yellow, green, brown, orange, red, purple, gray, white, etc. Some of the life studies by late artist Mr. SAKUMA on this problem are shown on the accompanying plates. The elaborate coloration of this

kind is often to meet with in those ophiurans, which climb on or live among weeds and zoophytes.

Ophiophragmus japonicus MATSUMOTO

(Text-fig. 2)

CLARK, loc. cit., 1915, p. 239;

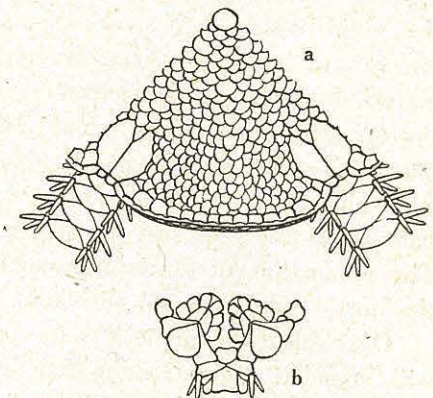
MATSUMOTO, loc. cit., 1917, p. 183;

MATSUMOTO, loc. cit., 1918, p. 478.

Amphioplus japonicus CLARK, Bull. Mus. Comp. Zool., LXII, No. 1918, p. 281.

Station 53; off Aburagawa; three specimens. Station 62; off Ozawa; one specimen. Off Gōzawa; five specimens.

Most of these specimens are young, only two from Station 53 being full-grown. All the specimens shows the characteristic frame-work of solid disk, having the special row of squarish marginal scales and a sort of fence of up-turned scales immediately outside them. In some specimens, the adoral shields meet with each other just inside the oral shield, while in others, they do not meet at all. The oral papillae are usually four on either side of the oral angle, but are sometimes five and sometimes three. When they are four or five in number, the outermost one arises from the oral plate and adoral shield or from the adoral shield and first ventral arm plate. When they are three, the oral structure is of course just the same as that of typical *Amphiodia*. There is no additional papilla just outside and above the infradental one, quite unlike in *Amphioplus*, the latter oral papilla being hence the highest of all the papillae in position. The adradial surfaces of



Text-fig. 2. *Ophiophragmus japonicus*.
×8. a. From above. b. Ventral view of two oral angles.

the oral angles are rather even and nearly vertical, instead of being hollowed out obliquely downwards:—a feature common with *Amphiopholis* but not with *Amphioplus*. In the writers opinion, the present species, as well as genus, belongs actually to the *Amphiodia*-group, but has nothing to do with the *Amphioplus*-group. As to the extent of the genus *Ophiophragmus*, the writer accepts LYMAN's original diagnosis, which

lays stress on the solid disk with the frame-work around it, though CLARK has tried to emend the genus, notwithstanding he was aware of a serious example of *Ophiophragmus chilensis* (MÜLLER & TROSCHEL) against his statement. No doubt, the present species is closely allied with *Ophiophragmus periercta* (CLARK) on the opposite coast of the North Pacific, though CLARK wants to refer the former to *Amphioplus* and the latter to *Amphiodia*. *Ophiophragmus*, as conceived by LYMAN, as well as by the writer, is valid and homogeneous, being intertropical in distribution, though a certain specific group of it might have arisen in, and be native to, the tropical and subtropical waters of the New World.

Ophiophragmus japonicus var. *parvus*, var. nov.

(Text-figs. 3 and 4)

Ōse, off Yunoshima; three specimens.

Diameter of disk 6 mm. Length of arms 25 mm. or more. Width of arms at base 1 mm.

Disk subpentagonal, covered with fine, imbricating scales of irregular size, solid, with a frame-work of a row of turned-up scales around, though any row of large and squarish marginal scales immediately inside it is quite indistinct:—a distinctive feature in contrast to the typical form of the species. The primary plates are indistinct at least in adult, though may be distinct in young individuals. Radial shields pear-seed shaped, one third as long as the disk radius, twice as long as wide, joined in pairs along the outer two thirds the length, rather acutely pointed within. The squamation of the interbrachial ventral surfaces is finer than that of the dorsal side. Genital slits long.

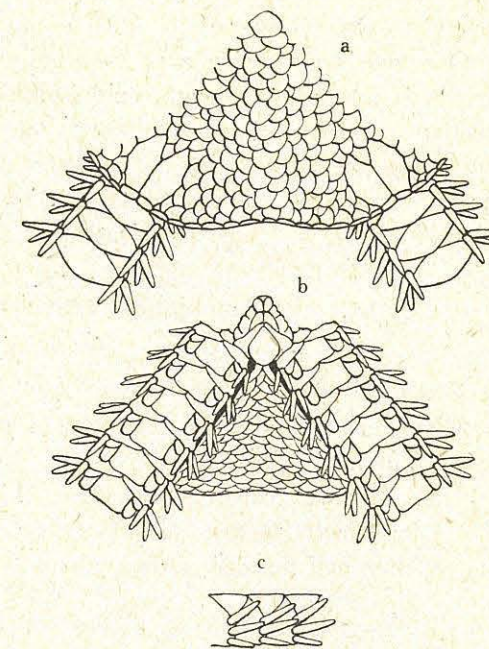
Oral shields rhomboidal, with the inner sides longer than the outer, with rounded angles, longer than wide. Adoral shields triangular, tapering inwards, meeting with each other just inside the oral shields. Four oral papillae on either side of the oral angle, close-set, forming a continuous row, blunt, none of them being operculiform, though the second outer one is the broadest; the infradental one is thick, while the other three are flattened and show a tendency of being imperfectly divided from one another.

Dorsal arm plates large, oval, very wide, with convex inner and outer borders, twice to two and a half times as wide as long, a little in contact with one another. Lateral arm plates low, inserted like as many wedges between both the successive dorsal and ventral arm plates above and

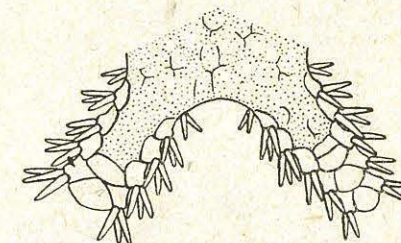
below, separated from each other above, more or less separated or just in contact below. First ventral arm plate very small, quadrangular, much wider than long. Those beyond pentagonal, with very large inner angle and linear or very slightly notched outer border, slightly wider than long, usually not in contact with one another. Three arm spines, conical, rather acute, subequal, though the upper two are more or less longer than the lowest, which is about as long as the corresponding arm joint. Two tentacle scales large, very flat, thin, the abradial one is the smaller of the two and overlaps the base of the adradial one, which is especially large and tongue-shaped.

Colour in alcohol, light yellow.

The present variety differs from the typical form of the species in the indistinctness of any row of large and squarish marginal scales, in the radial shields joined in pairs to a less extent and in the ventral arm plates being usually not in contact with one another. It appears probable, that the present variety, as well as species, is allied with the form imperfectly known under the name *Amphioplus megapomus* CLARK, though parts of its original description, which run as "upper arm plates tetragonal, broadly in contact," "apical ones of oral papillae widely separated from each other," "under arm



Text-fig. 3. *Ophiophragmus japonicus* var. *parvus*. ×10. a. From above. b. From below. c. Lateral view of three arm joints near disk.



Text-fig. 4. *Ophiophragmus japonicus* var. *parvus*. ×12. Specimen on way of regeneration of disk and some arms. Viewed from above.

plates much wider than long", &c., would not suit well for the present variety, as well as species.

One specimen, which must be eliminated from being the type of the variety, is interesting enough, exhibiting its being on the way of regeneration of disk and arms obviously after the loss of the original ones. The extent of the lost disk is indicated by the absence of the normal dorsal arm plates in a few basal arm joints. The disk covering acquired anew is a skin, in which calcification of plates and scales occurs.

Amphipholis tetracantha, sp. nov.

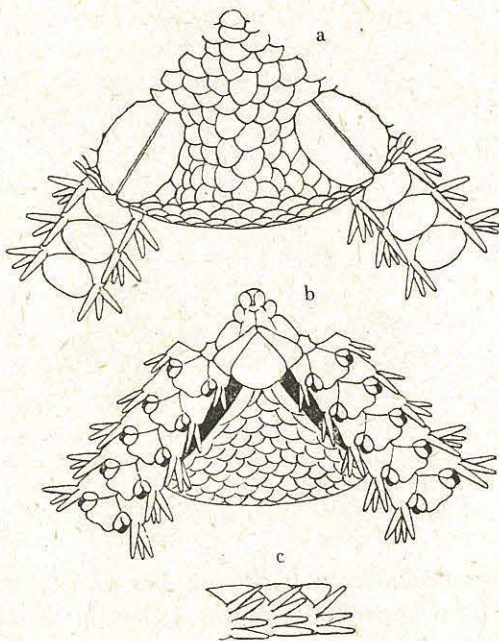
(Text-fig. 5)

Station 114; Ōma; one specimen.

Diameter of disk 3 mm. Length of arms 9 mm. Width of arms at base 0.5 mm.

Disk circular, covered with fine, thin, imbricating scales. Primary plates indistinct. Radial shields rather large, pear-seed shaped, slightly shorter than half the disk radius, about twice as long as wide, blunt both within and without, completely joined in pairs. Interbrachal ventral surfaces covered also with fine, thin, imbricating scales, which are finer than those of the dorsal side. Genital slits long.

Oral shields rhomboidal, with very acute inner and rounded lateral and outer angles, with inner sides longer than the outer, about as wide as long. Adoral shields triangular, long and narrow, wider outwards than inwards; meeting with each other within. Three oral papillae on either side of the oral angle; the inner two are rounded, while the outermost one is large, wide and



Text-fig. 5. *Amphipholis tetracantha*. ×20. a. From above. b. From below. c. Lateral view of three arm joints near disk.

operculiform. Teeth quadrangular and stout.

Dorsal arm plates rather large, oval, wider than long, as long as the corresponding arm joint, just a little in contact with, or just separated from, one another. Lateral arm plates rather low, flared outwards, those of the two sides meeting or not meeting above and meeting below. First ventral arm plate small, pentagonal, longer than wide, wider outwards than inwards, in contact with the next one. Those beyond pentagonal, with concave lateral borders, notched outer border and rounded outer lateral angles, where they are widest; longer than wide, not in contact with one another. Arm spines four in number on either side of the basal arm joints, but soon dropping to three outwards; short, conical, acute; the uppermost one is the longest and is hardly as long as the corresponding arm joint; the others are shorter. Two minute, oval, flat, leaf-like tentacle scales, of which the adradial one is slightly larger than the abradial.

Colour in alcohol: disk light yellow; arms, as well as the outer ends of radial shields, white.

This is a third Japanese species of those closely allied with *Amphipholis squamata* (DELLE CHIAJE), though the indistinctness of the primary plates, the inwardly blunt radial shields, the rather large dorsal arm plates, which are as long as the corresponding arm joint, the outwardly wider and outwardly notched ventral arm plates and the four arm spines would make the present species easy to be recognised.

These and the other Japanese species of *Amphipholis* can be distinguished as follows:

A — Radial shields perfectly jointed in pairs.

a — Arms three to four times as long as the disk diameter; dorsal arm plates without any streak along the median line.

b — Radial shields acute within; dorsal arm plates small, distinctly shorter than the corresponding arm joint; ventral arm plates with convex outer border, widest at the inner lateral angles.

c — Disk scales thin; rather indistinct from one another, so that the disk is very smooth; radial shields not very wide, about two and a half times as long as wide, the united width of each pair being nearly equal to the width of the corresponding arm base; three arm spines, of which the uppermost one is the longest, the lowest one the shortest, and the middle one the stoutest but not distinctly compressed *japonica*

cc — Disk scales thickened along the free-margins, concave, very distinct from one another, so that the surface of disk is not very smooth;

radial shields very wide, about twice as long as wide, the united width of each pair much exceeding the width of the corresponding arm base; three, sometimes four, arm spines, of which the uppermost one is the longest, and the middle one the shortest and stoutest and distinctly compressed. *sobrina*

bb — Radial shields blunt within; dorsal arm plates rather large, as long as the corresponding arm joint; ventral arm plates with notched outer border, widest at outer lateral corners; four arm spines at arm bases, the uppermost one being the longest. *tetracantha*

aa — Arms seven to eight times as long as the disk diameter; dorsal arm plates as long as the corresponding arm joint, with a distinct white streak along the median line; ventral arm plates with notched outer border; three arm spines, of which the uppermost one is the shortest.

. *pugetana*

AA — Radial shields divergent, being nearly or entirely separated from each other by a row of scales; three arm spines, of which the uppermost one is the shortest; tentacle scales large, the adradial one being especially the larger. *kochii*

Amphipholis pugetana (LYMAN)

CLARK, loc. cit., 1915, p. 242; MATSUMOTO, loc. cit., 1917, p. 191; MATSUMOTO, loc. cit., 1918, p. 478.

This species is not represented in the present collection, though it has been recorded by the writer from the Aomori Bay.

Amphipholis kochii LÜTKEN

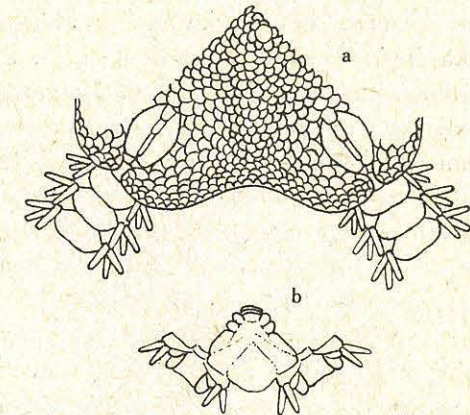
(Text-fig. 6)

CLARK, loc. cit., 1915, p. 241; MATSUMOTO, loc. cit., 1917, p. 192.

Station 17; Namiuchi. Heinai-mura; two specimens. Station 83; off Aburagawa; one specimen. Eastern shore of Yunoshima; five specimens. Off Futagojima, 18-19 fathoms; one specimen.

As already stated by the writer, this species is very variable, though is well-defined and valid. The largest one of these specimens, being that from Station 83, measures 9 mm. across the disk and some 55 mm. along the arms. In it, the armature of the oral angles and arm bases is covered over by a rather thick skin, so that the boundaries of the plates and shields are obscured, and the pair of infradental papillae are widely apart from each other, just as once illustrated by LYMAN:—Ill. Cat.

Mus. Comp. Zool., No. VIII, II, Ophiur. and Astrophyt., 1875, Pl. V, fig. 72. In another specimens, the primary plates are distinct and are located and arranged excentrically, as if the growth rate of the disk covering might have been heterogenous in different radii and interradii. The larger adradial one of the characteristically large tentacle scales is usually tongue-shaped, but is nearly round in some specimens.



Text-fig. 6. *Amphipholis kochii*. ×8. a. From above. b. Ventral view of one oral angle.

Amphiura sinicola, sp. nov.

(Text-fig. 7)

Station 23 A; coast of Moura; two specimens.

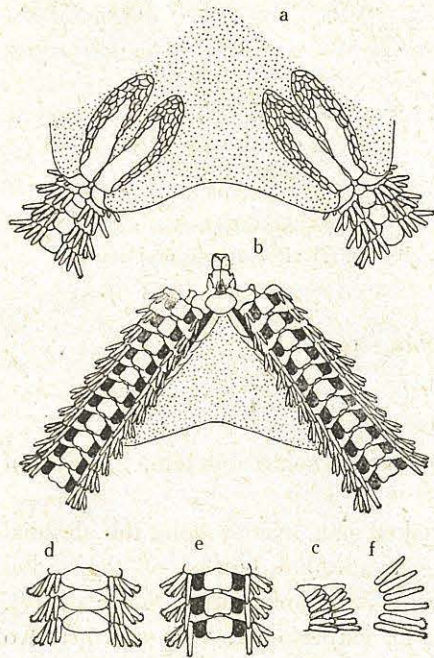
Diameter of disk 8 mm. Length of arms some 140 mm. Width of arms at base 1 mm.

Disk five-lobed, covered by a soft naked skin, except along the abradial border, inner border and inner half of adradial border of the radial shields, where a few to several rows of fine imbricating scales persist. Naked part of radial shields lance-shaped, rather long, very narrow, two fifths to one half as long as the disk radius, about four times as long as wide; their pair can be sometimes very closely set and sometimes divergent. Interbrachial ventral surfaces covered also by a soft naked skin. Genital slits long. Genital scales arranged in a row and overlapping one another.

Oral shields trapezoidal or hexagonal, with rounded corners, one and a half time as wide as long, wider within than without; madreporic shield much larger and nearly oval. Adoral shield three-lobed, with concave sides and rounded lobes, separated from each other interradially by a conspicuous depression, either meeting with each other over the first ventral arm plate or separated from each other by the same plate radially. The oral plates also embrace the just mentioned conspicuous depression, just as observed in *Amphiura vadicola* MATSUMOTO, as well as in *Ophio-*

thrix. Two oral papillae on either side of each oral angle; the infradental one is conical or peg-like and stout, while the distal one, arising almost from the inner end of the adoral shield, is weaker, abbreviatedly lanceolate, flattened and acute. Teeth quadrangular and stout.

Arms very long, about sixteen to eighteen times as long as the disk diameter. The dorsal arm plates at the base are narrow and almost circular, while those of the major part of the arm beyond are transversely oval, wider than long, about one and a half time to twice as wide as long, in contact with one another to a moderate extent. Lateral arm plates not very prominent, almost concealed by the arm spines, not meeting above or below, nor in contact on the sides but separated by a naked space. First ventral arm plate quadrangular or hour-glass shaped, being constricted by the adoral shield on both sides, longer than wide. The second ventral one is squarish, slightly longer than wide, in contact with the first plate. A few plates beyond are squarish and about as wide as long. A few still beyond are squarish and wider than long. Those further beyond are pentagonal, with large and obtuse inner angle, rounded outer angles and notched outer border, and are wider than long; the successive plates are separated by very narrow spaces, where the lateral arm plates are wedged in. Arm spines six or seven at the arm base, and five at the major middle part of the arm, peg-like, flattened, blunt, longer downwards, nearly equal to or slightly longer than the corresponding arm joint; they become more flattened outwards, the second spine from below becoming especially so and spur-shaped, with numerous minute thorns on the very much flattened end;



Text-fig. 7. *Amphiura sinicola*. a. From above, x8. b. From below, x8. c. Lateral view of two arm joints near disk, x8. d. Dorsal view of three arm joints of the widest part of arm, x8. e. Ventral view of ditto, x8. f. Arm spines of one side of arm joint near disk, x16.

spines, where the lateral arm plates are wedged in. Arm spines six or seven at the arm base, and five at the major middle part of the arm, peg-like, flattened, blunt, longer downwards, nearly equal to or slightly longer than the corresponding arm joint; they become more flattened outwards, the second spine from below becoming especially so and spur-shaped, with numerous minute thorns on the very much flattened end;

the lowest one and the third from below are also somewhat thorny at the tip. Tentacle pores large, unprotected.

Colour in alcohol, straw-yellow; distal parts of arms whitish.

It is quite interesting to meet with a number of species, including this new one, which are closely allied together, in Japanese waters, each having a limited range; they are *Amphiura vadicola* MATSUMOTO from the Kagoshima Gulf and Chintô, Korea, *A. ecnomiotata* CLARK from the Suruga Gulf and the Tokyô Gulf, *A. aestuarii* MATSUMOTO from Misaki and the present species from the Mutsu Bay. Two foreign species can be added here; viz. *A. phalerata* (LYMAN) from the Philippines and *A. octacantha* (CLARK) from Friday Island. Above all, the present species is most closely allied with *A. vadicola* than with any other species, the Japanese representatives being distinguished from each other as follows:

Amphiura with mostly naked disk, disk scales persisting only around the radial shields, and with large unprotected tentacle pores.

A — Five to seven arm spines, lower ones of which are thorny at the tip; dorsal arm plates in the major part of the arm very large and wide, distinctly much wider than long; oral shields wider than long.

a — Five arm spines near disk, but four more distally; those of the proximal arm joints are conical, though they become flattened outwards; dorsal arm plates very large and wide even at the arm base; arms twelve to thirteen times as long as the disk diameter. *aestuarii*

aa — Six or seven arm spines near disk, but five or six more distally, flattened; dorsal arm plates at the arm base small, narrow, round.

b — Radial shields small and very narrow, naked part being two fifth to one half as long as the disk radius and about four times as long as wide; distal oral papilla weak, abbreviatedly lanceolate, flattened, acute; dorsal arm plates at the arm base small, but not rudimentary, being in contact with one another and with the lateral arm plates; first ventral arm plate longer than wide; arms about sixteen to eighteen times as long as the disk diameter. *sinicola*

bb — Radial shields large, naked part being one half to two thirds as long as the disk radius and about three times as long as wide; distal oral papilla conical, stout, longer than the infradental one; dorsal arm plates at the arm base rudimentary, surrounded by spaces of soft naked skin; first ventral arm plate wider than long; arms exceedingly long, more than thirty times as long as the disk diameter. *vadicola*

AA — Ten arm spines with thorny tip; dorsal arm plates narrow, longer than wide; oral shields longer than wide; arms about fourteen

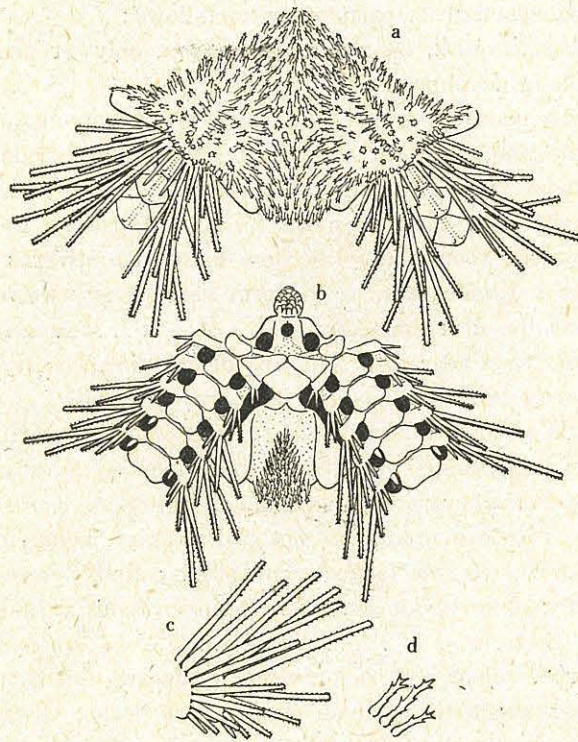
times as long as the disk diameter. *ecnomiotata*

Ophiothrix marenzelleri KOEHLER

(Text-fig. 8)

CLARK, loc. cit., 1915, p. 281; MATSUMOTO, loc. cit., 1917, p. 220;
MATSUMOTO, loc. cit., 1918, p. 478.
Ophiothrix hylodes, CLARK, loc. cit., 1915, p. 273.
Station 23; Moura; one specimen.

The specimen belongs to the littoral form of the species, as distinguished by the writer, approaching however considerably to the sublittoral. The arm spines are eight or nine on either side of the basal arm joints,



Text-fig. 8. *Ophiothrix marenzelleri*. a. From above, x6. b. From below, x6. c. Lateral view of two arm joints near disk, x6. d. Three disk spines or tubercles, x12.

only moderately widened, showing a tendency to be clavate at the tip; the third spine from above is usually the longest, being about three and a half times as long as the corresponding arm joint; the spines diminish in length both upwards and downwards. The first to third or fourth brachial tentacle pores are free of scales, while those beyond are provided with usually one, sometimes two, scales. In colour in alcohol, the disk is variegated with light brown and blue, having however a white spot at the outer end of the radial shields, and the arms are banded with dark brown and blue, the light-coloured streak along the dorsal median line being faintly indicated.

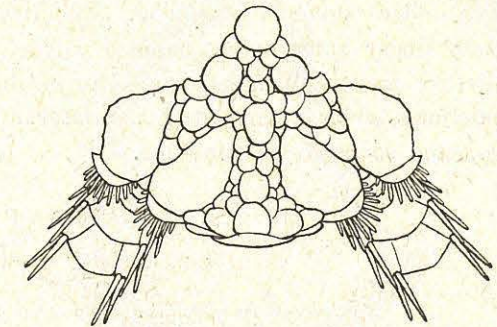
only moderately widened, showing a tendency to be clavate at the tip; the third spine from above is usually the longest, being about three and a half times as long as the corresponding arm joint; the spines diminish in length both upwards and downwards. The first to third or fourth brachial tentacle pores are free of scales, while those beyond are provided with usually one, sometimes two, scales. In colour in alcohol, the disk is variegated with light brown and blue, having however a white spot at the outer end of the radial shields, and the arms are banded with dark brown and blue, the light-coloured streak along the dorsal median line being faintly indicated.

Ophiura kinbergi (LJUNGMAN)

(Text-fig. 9)

CLARK, loc. cit., 1915, p. 321; MATSUMOTO, loc. cit., 1917, p. 271.
Station 19; off Tsuchiya; two specimens. Station 68; off Jōgasawa; seven specimens.
Station 107; mouth of Fukuura Bay; numerous specimens.

Within the limit of Japanese waters, the present species is well-defined and appears to be fairly uniform. It shows no tendency to vary toward *Ophiura sarsii* LÜTKEN, which shows a variation toward it. Only sometimes, especially in young, the radial shields are in contact in pairs to a short extent. The Mutsu Bay and vicinity are the known northern limit of this Indo-Pacific species.



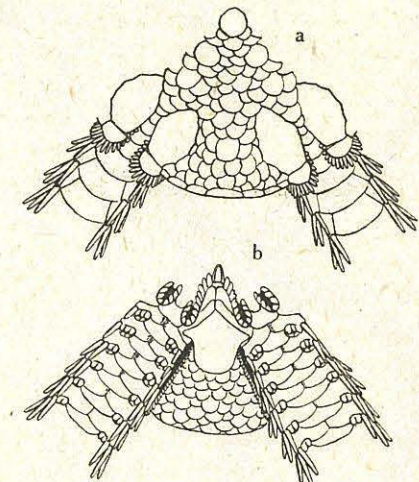
Text-fig. 9. *Ophiura kinbergi*. x8. From above.

Ophiura sarsii LÜTKEN

(Text-fig. 10)

CLARK, loc. cit., 1915, p. 323; MATSUMOTO, loc. cit., 1917, p. 272;
MATSUMOTO, loc. cit., 1918, p. 479.
Station 26; off Futagojima; one specimen.
Station 43; off Ishihama-mura; abundant specimens. Off Asadokoro; numerous specimens. Off Kusodomari; nine specimens. Off Yomogida-mura; numerous specimens.

The majority of the specimens are small, including none of very large ones and a few which are some 16 mm. across the disk. A considerable number of the specimens have rather long and slender papillae of the arm combs within the limit of the present species, tending more or less to approach to *Ophiura kinbergi*. The continuation of the series of the comb



Text-fig. 10. *Ophiura sarsii*. x4. a. From above. b. From below.

papillae is, as a rule, extended to the outer adradial border of the radial shield; and the papillae of this continuation, as well as a few immediately neighbouring ones, which arise from the comb plate, are very short and like mere granules. Besides, there occurs a series of granule-like papillae on the dorsal arm plate of the arm base inserted into the disk, arising from the opposite border of the distal continuation of the genital slit and lying under the comb papillae. The oral shields are pentagonal, with nearly linear inner sides, notched lateral sides and convex outer side; they are mostly about as long as or slightly longer than wide, but are sometimes wider than long; the lateral angles are sometimes strongly projected so as to be wing-like.

EXPLANATION OF PLATE

Plate XXI

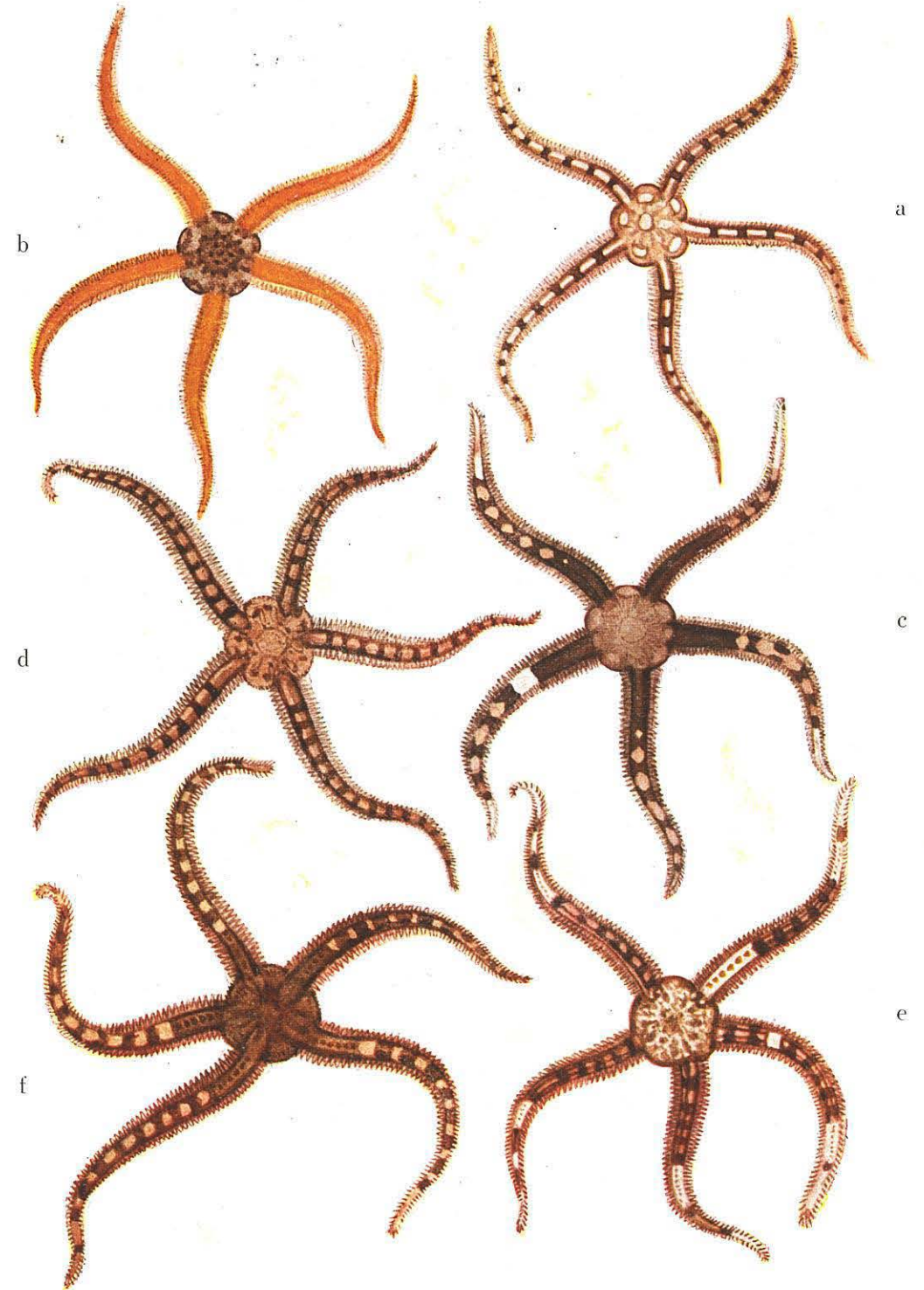
Ophiopholis mirabilis. Coloration in life in dorsal view.

Plate XXII

Ophiopholis mirabilis. Coloration in life in dorsal view.

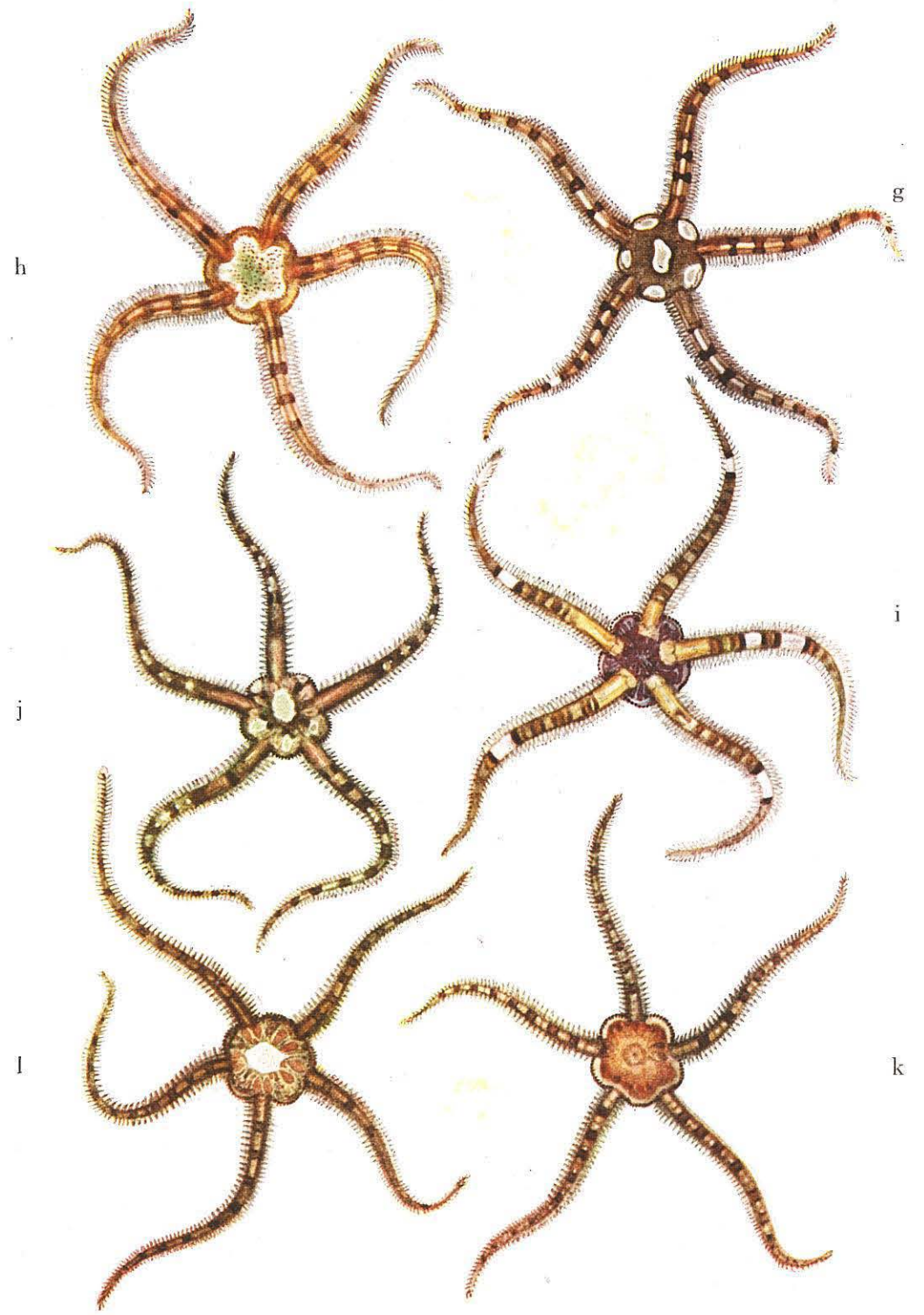
Plate XXIII

Ophiopholis mirabilis. Coloration in life in dorsal view.



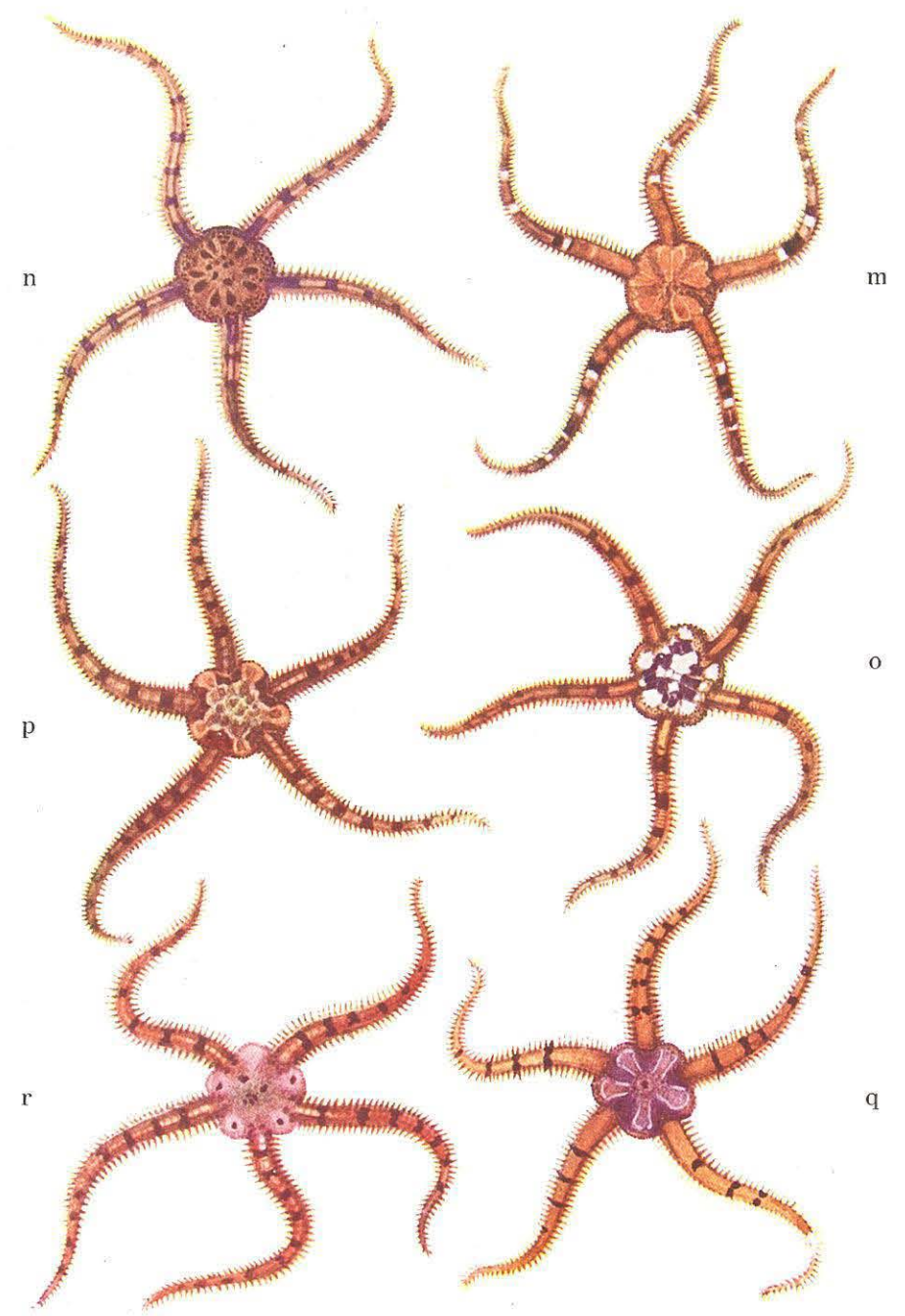
B. SAKUMA del.

H. MATSUMOTO: Ophiuroidea of Mutsu Bay.



B. SAKUMA del.

H. MATSUMOTO : Ophiuroidea of Mutsu Bay.



B. SAKUMA del.

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