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KEYS FOR THE IDENTIFICATION OF ECHINODERMATA OF THE BRITISH ISLES

by

Eve C. Southward

Marine Biological Association - Echinoderm Survey

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Very largely derived from TH. MORTENSEN "Handbook of the Echinoderms
of the British Isles", Oxford University Press

(1927)

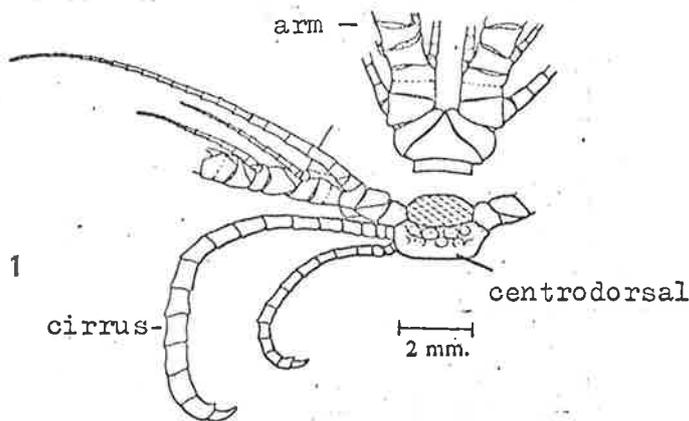
CRINOIDEA

Crinoids have five, ten or more feather-like arms attached to a small cup-shaped body. The mouth and anus are both on the upper side of the body. The lower side is, in the sea-lilies, attached to a jointed stalk. The feather-stars, on the other hand, spend a brief juvenile period attached to a stalk and then become free-living. The lower side of the body then consists of a large calcareous plate, the centrodorsal, and this bears a number of slender, jointed appendages, called cirri, with which the feather star holds on to convenient objects. In British seas there are two species of feather-star but no sea-lilies.

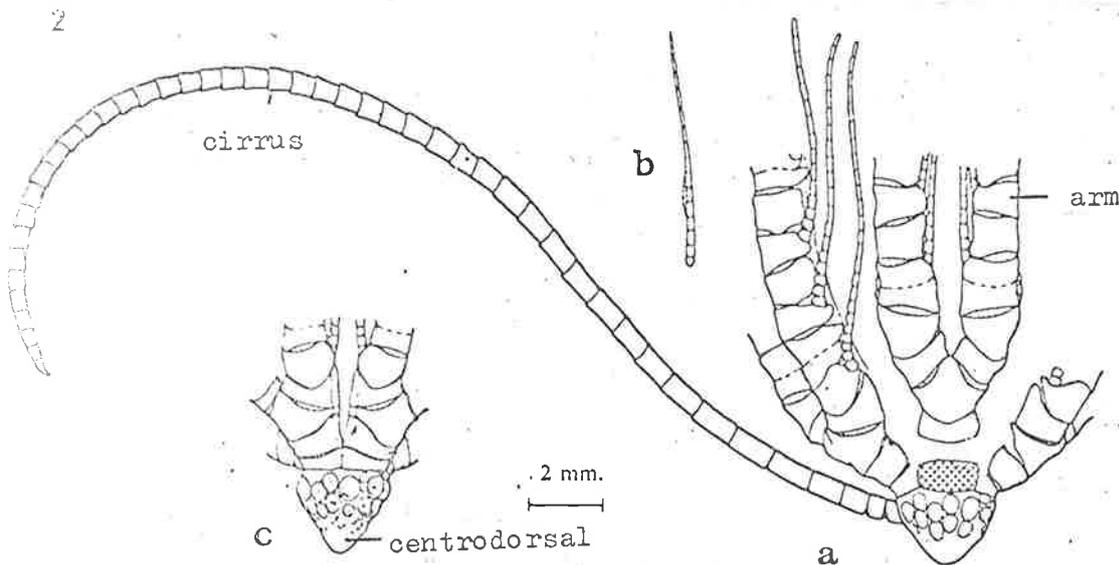
KEY

1. Cirri short, the longest having 14-17 joints;
centrodorsal flattened (fig. 1) . . . Antedon bifida
10 arms; colour red, purple, orange or yellow.
Subtidal down to 200 m; southwest, west and
northeast coasts.

Cirri long, having 40-50 joints; centrodorsal conical or
broadly truncated (fig. 2) . . . Leptometra celtica
10 arms. Depths of 70 to more than 200 m;
west coasts of Scotland and Ireland.



Antedon bifida (Pennaht)



Leptometra celtica

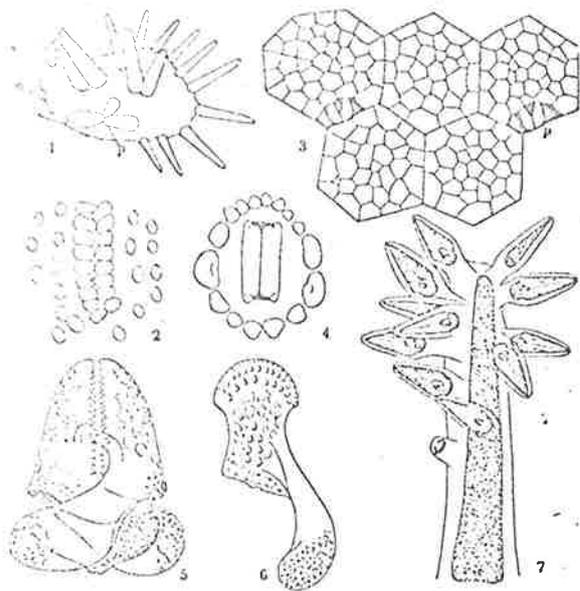
ASTEROIDEA

Asteroids, or starfish, have a starshaped body, with either a spiny or a smooth surface. There are five or more arms of variable length, extending from a central disc, usually without a distinct limit between disc and arm. The mouth is on the underside of the disc and the anus, if present, is on the upper side. On the underside of each arm is a furrow, the ambulacral furrow, containing the soft, fingerlike tube feet. Along the edges of the ambulacral furrow are rows of adambulacral spines, which are generally larger than the other spines of the under surface. Along the edge of the disc and arms of some species there is a series of large distinct plates, the marginal plates. The skin of the upper side is supported by a network of calcareous plates, to which spines are usually attached. The spines may be single or in groups. In some cases they are arranged in regular bundles attached to a central column; these bundles are called paxillae. Other small spines may be arranged in pairs to form pincers of various types, named pedicellariae (fig. 3). The skin between the spines of the upper side may bear delicate, extensible tubes, termed papulae, which act as gills.

KEY

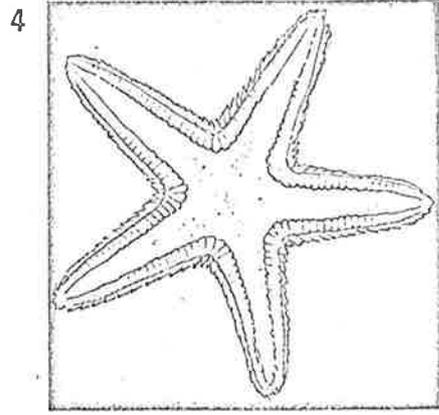
1. Marginal plates large, usually distinct, sometimes covered by skin; tube feet in 2 series 3
Marginal plates inconspicuous; tube feet in 2 or 4 series . 2
2. Crossed pedicellariae present (fig. 3); spines of upper side usually single; tube feet in 4 series 13
Pedicellariae rare, never of crossed type; spines of upper side usually in groups; tube feet in 2 series . 7
3. Tube feet pointed, no sucking disc 4
Tube feet with sucking disc 6
4. Both rows of large marginal plates obvious; those of the lower row each have 4 or 5 large spines which form fringe around whole body (fig. 4) Astropecten irregularis
5 fairly short arms; colour pinkish or yellowish.
Max. diam. 20 cm. Shallow water to more than 200 m depth, in sand. All round British Isles.
Only lower row of marginal plates obvious, all with spines; upper row of plates paxilliform (see above) 5
5. 5 arms; lower marginal plates bear 3 (rarely 4) spines each Luidia sarsi
Colour reddish brown. Max. diam. 34 cm.
Shallow water to more than 200 m; all round British Isles.
7 arms; lower marginal plates have 4 or 5 spines each (fig. 5) Luidia ciliaris
Colour red. Max. diam. 60 cm. Shallow water to more than 200 m; south, west and northeast coasts.

6. Marginal plates large and distinct; edge of disc vertical; upper side and marginal plates bear thick spines
 Hippasteria phrygiana
 Disc large, arms short; colour red. Max. diam. 40 cm. Depths of 20 to more than 200 m; west north and northeast coasts, rare.
- Marginal plates less distinct. partly overlapping; disc sharp-edged, with fringe of fine spines; upper surface with thick smooth skin and no spines . Porania pulvillus
 Disc large, arms short; colour red or yellowish, spotted or mottled. Max. diam. 12 cm. Shallow water to more than 200 m, on sand; south, west and northeast coasts.
7. Body flattened to give sharp edge between upper and lower sides 8
 No sharp limit between upper and lower sides 9
8. Body very thin with a crestlike thickening along each ray (fig. 6) Anseropoda placenta
 Shape pentagonal, colour red on upper side, yellow on lower. Max. diam. 20 cm. Shallow water to 200 m; south, west and northeast coasts.
- Body not very thin; no crest along rays . Asterina gibbosa
 Body starshaped, with very short arms; upper side slightly swollen; colour greenish, yellowish or brownish. Max. diam. 6 cm. On or under stones, shore and shallow water; all round British Isles.
9. Small disc, 5 long arms (rarely 6 or 7) 10
 Large disc, at least 7 arms, usually 9 or more 12
10. Spines rather coarse, single . Echinaster sepositus
 Usually 5 arms, occasionally 6 or 7; colour scarlet; soft kin covers body and most spines. Max. diam. 14 cm. Shallow water to more than 200 m; Brittany.
- Spines very fine, in small groups 11
11. Spines end in crown of long thorns, not covered by skin (fig. 9) Henricia sanguinolenta
 5 arms, colour red, tips of arms usually white. Max. diam. 20 cm. Shallow water to more than 200 m; northwest, north and northeast coasts.
- Spines have rather blunt ends with irregular points (fig. 8) and are covered with thick skin . Henricia oculata
 5 arms, colour red, orange or yellow. Low water to about 100 m, on coarse sand and gravel; south and west coasts, Irish Sea.

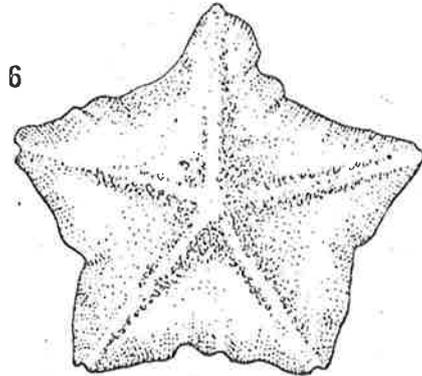


—Various sorts of pedicellariae of Asteroidea.
(From *Danmark's Fauna*.)

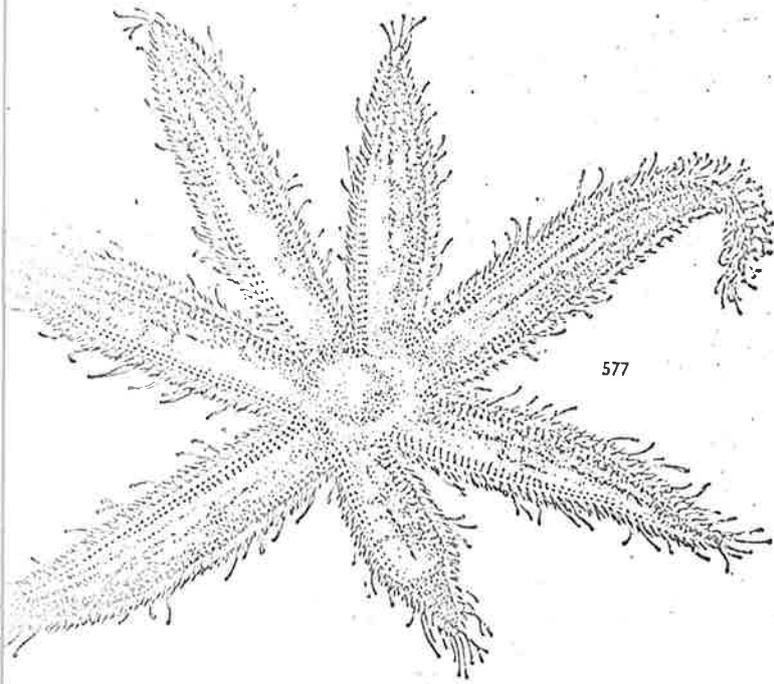
1. Type (*Panister tenuispinus*). $\times 13$. 2. Pectinate pedicellaria (*Pseud-
Panister*). $\times 13$. 3. Panilla-like groups of grains from the dorsal side of *Ceramaster*
with two valvate pedicellariae. $\times 13$. 4. Bivalve pedicellaria of *Hippasteria*
with two valves. $\times 120$. 5. Crossed pedicellaria of *Asterias rubens*. $\times 120$. 6. Valve of the
pedicellaria from the inside. $\times 120$. 7. Group of straight pedicellariae on an adambul-
acrum of *Asterias rubens*; the small, lowermost one just beginning to form. $\times 10$.



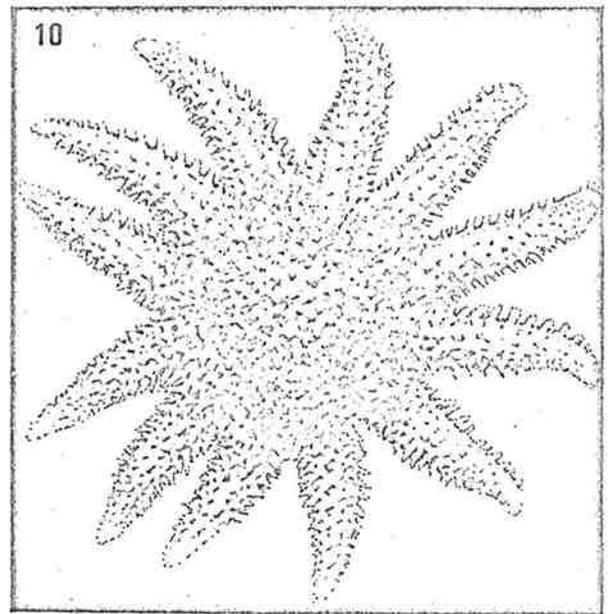
—*Astropecten irregularis*. Dorsal side.



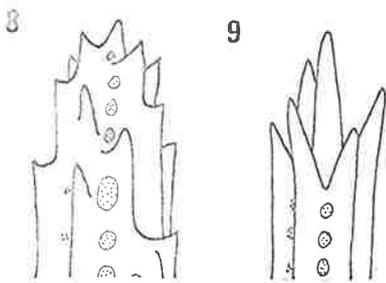
Anseropoda placenta



Luidia ciliaris



—*Solaster (Crossaster) papposus*, dorsal side.



Spine tips of
Henricia oculata Henricia sanguinolenta

12. Marginal paxillae (see p. 2) are long, obvious and in a single row round the edge of the body . Crossaster papposus
 8 to 13 arms, colour variable, disc usually purplish red, arms whitish with broad red transverse band, underside whitish. Max. diam. 38 cm. Shallow water to 100 m, on coarse sand and gravel; all round British Isles.

Marginal paxillae are small, inconspicuous and in two rows, the upper much smaller than the lower
 Solaster endeca
 7 to 13 arms, colour yellowish red or violet. Max. diam. 40 cm. Shallow water to more than 200 m; west, north and northeast coasts. Not in Channel.

13. Upper side has groups of granules or small spines
 Stichasterella rosea
 5 long tapering arms, colour orange, reddish or yellowish. Max. diam. 30 cm. Shallow water to more than 200 m; west, north and east coasts.

Upper side has single spines 14

14. Spines along edge of ambulacral grooves in very regular single series Marthasterias glacialis
 Small disc, long tapering arms; three conspicuous series of large spines on upper side of arms, colour greenish, yellowish, orange or reddish. Max. diam. 70 cm. Shore to 200 m; southwest and west coasts.

Spines in two series along edge of ambulacral grooves, at least on outer parts of arms 15

15. Upper side rather soft, with fairly large naked spaces between the spines; these spaces are occupied by several small, delicate papulae; the spines are irregularly arranged except for a fairly regular row along the midline of each arm Asterias rubens

Usually 5 arms, sometimes more; arms broad at base, tapering to tip. Colour reddish brown, orange or violet, with paler spines. Max. diam. 54 cm. Shore to more than 200 m; very common all round British Isles.

Upper side firm, with only small naked spaces and one or two papulae between the spines; spines irregularly arranged

. Leptasterias muelleri
 5 arms, broad at base and tapering to tip; colour reddish or violet, arm tips whitish. Shore to more than 200 m; western Ireland, Irish Sea, west and north Scotland. Max. diam. 20 cm.

OPHIUROIDEA

Ophiuroids, or brittle stars, have a body clearly divided into a central disc and five (rarely more) thin, jointed arms. The mouth is on the underside of the disc and there is no anus. On the underside of each arm there are two rows of tentacle pores, through which the soft tube feet emerge. The surface of disc and arms are usually covered with calcareous plates, the shape and arrangement of which are important for identification. On the upper side of the disc there is often a pair of large plates close to the base of each arm, termed radial shields (fig. 12, 14). In the middle part of the disc there may be large, well marked primary plates surrounded by smaller plates (fig. 18). Some species have the upper part of the disc covered with granules or spines or by thick naked skin. The arm joints usually have four plates, one upper (dorsal), one lower (ventral), and two lateral. Arm spines are attached to the lateral plates. At the sides of the tentacle pores there are very often some tiny plates, called tentacle scales (fig. 11, 13). The mouth area has a variety of special plates. Five jaws project into the mouth opening and along their edges are some small plates, called mouth papillae (fig. 11). On the apex of each jaw is either a single vertical series of teeth (fig. 11, 18) or several series of tooth papillae.

KEY

- | | | |
|----|---|----|
| 1. | The arms are moved vertically; disc and arms are covered with thick skin; arm spines point downwards | 2 |
| | The arms are usually moved horizontally; disc and arms are covered with scales; arm spines are not directed downwards | 3 |
| 2. | Arms branched several times <u>Gorgonocephalus caputmedusae</u>
Arms curl together to form dense network, colour yellowish or white. Max. diam. disc 9 cm. Depths of more than 150 m; edge of continental shelf and northern North Sea. | |
| | Arms unbranched <u>Asteronyx loveni</u>
Disc covered by smooth skin; long narrow arms; colour faint reddish. Max. diam. disc 35 mm, arm length 350 mm. Depths of more than 100 m; edge of continental shelf and some Scottish sea lochs. | |
| 3. | Arm spines pressed close to arm | 16 |
| | Arm spines stick out | 4 |
| 4. | Tooth papillae present (fig. 13, 14, 16) | 5 |
| | Only a single vertical series of teeth (fig. 11) | 9 |
| 5. | Mouth papillae present (fig. 13) | 6 |
| | No mouth papillae (fig. 14) | 8 |

6. Upper side of disc covered with small granules; two small tentacle scales beside each tentacle pore (fig. 13) .

Ophiocomina nigra

Arm spines smooth and slender. Max. diam. disc 25 mm, arm length 120 mm. Colour black, brown, grey or pink. Shallow water to 100 m, on stones gravel or coarse sand; south, west and northeast coasts.

Upper side of disc smooth, with very small scales; two tentacle scales, the inner one very long (fig. 16); arm spines short and flattened 7

7. 7 arm spines each side of each joint; radial shields distinct (fig. 16)

Ophiopsila aranea

Colour reddish brown with white spots, arms sometimes banded. Max. diam. disc 12 mm, arm length 80 mm. Depth 25 to 200 m, rock crevices; southwest England.

12 arm spines each side of each joint; radial shields completely hidden by scales

Ophiopsila annulosa

Colour reddish brown with white spots, arms distinctly banded. Max. diam. disc 12 mm, arm length 80 mm. Depths 30 to 100 m; western Ireland, southwest England.

8. Upper arm plates each raised at outer end, giving arm a keeled appearance; no spines on these plates (fig. 14) .

Ophiothrix fragilis

Upper surface of disc spiny, radial shields obvious; 7 arm spines each side of each joint; colour reddish, violet, white or spotted. Max. diam. disc 20 mm, arm length 100 mm. Shore to more than 200 m; all round British Isles.

Upper arm plates have flat outer edge and bear small spines (fig. 15)

Ophiothrix luetkeni

Upper surface of disc spiny, radial shields obvious; max. of 8 arm spines each side of each joint; colour pinkish, arms banded pink and white. Depths of 50 to more than 200 m; west of Ireland and north Minch.

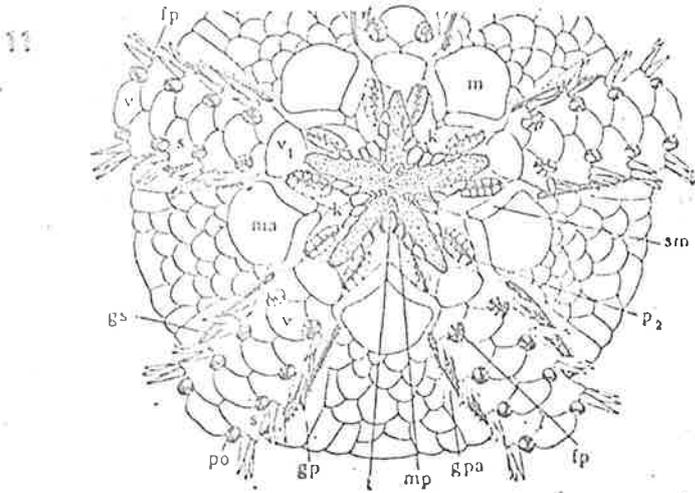
9. Two papillae on apex of jaw (fig. 19) 11

One papilla on apex of jaw (fig. 18) 10

10. Upper arm plates each surrounded by a circle of small plates (fig. 18)

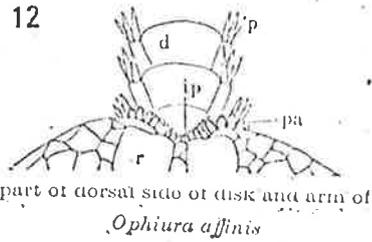
Ophiopholis aculeata

Disc covered with granules but naked areas over primary plates; radial shields not visible. Max. diam. disc 20 mm, arm length 80 mm. Shore to more than 200 m, in crevices; west and northeast coasts.



11.—A Brittle-star (*Ophiura robusta*) from the oral side

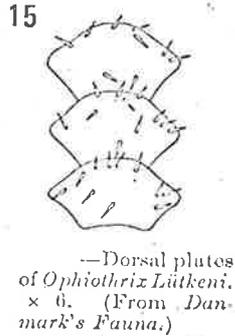
d, Dorsal plate; fp, Foot papillae or tentacle scales; gp, Genital plate; gpa, Genital papillae; gs, Genital or bursal slit; ip, Inner comb of papillae; k, Jaw; m, Mouth shield; ma, Madreporite; mp, Mouth papillae; p, Arm spines; pa, Outer comb of papillae; po, Pore of tube-foot; p₂, Second foot pore; r, Radial shield; s, Side or lateral plate; sm, Adoral shield; t, Teeth; v, Ventral plate; v₁, First ventral plate.



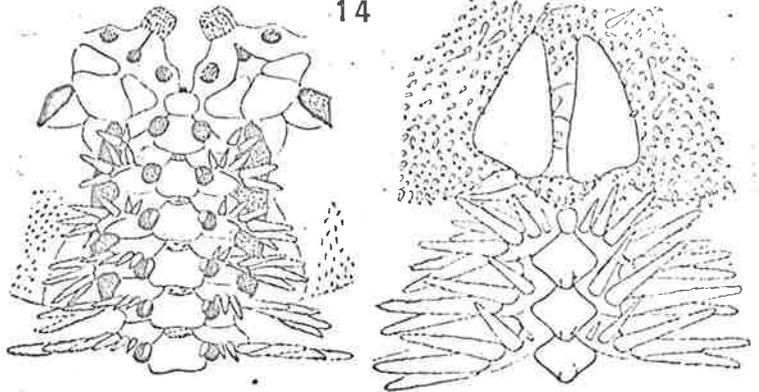
12.—part of dorsal side of disk and arm of *Ophiura affinis*



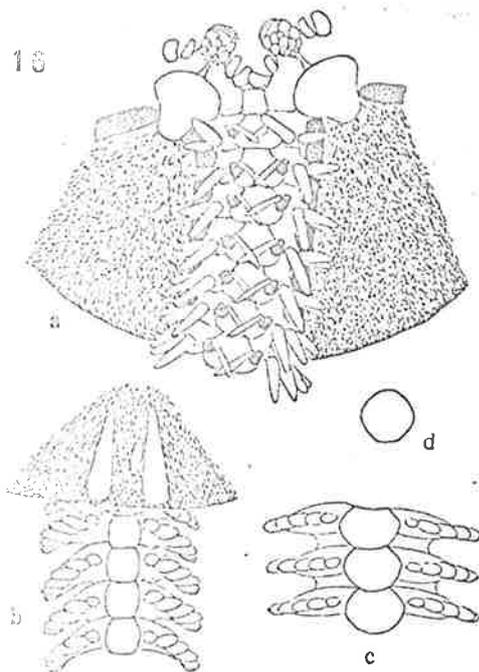
13.—*Ophiocomina nigra*; part of oral side.



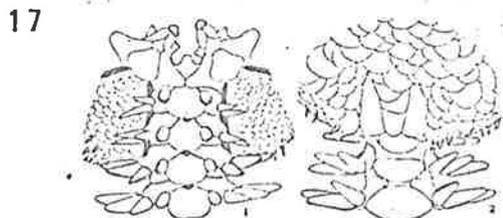
15.—Dorsal plates of *Ophiothrix Lütkeni*. × 6. (From *Danmark's Fauna*.)



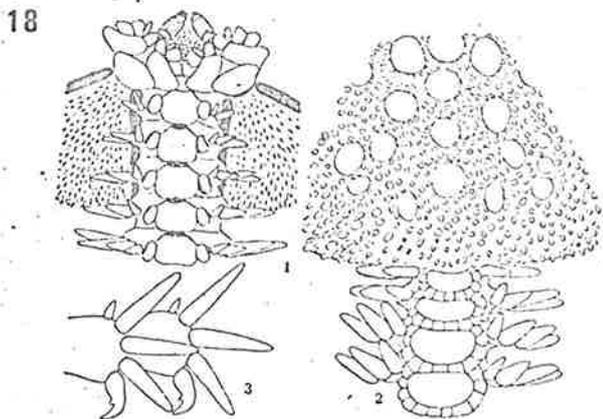
14.—*Ophiothrix fragilis*; part of oral and dorsal side. × 8.



16.—*Ophiopsyllia aranea*; part of oral side (a), of dorsal side, with distal part of arm (b), and of dorsal side of arm, from the middle (c); detail of younger specimen (d). × 8.



17.—*Ophiactis Balli*. 1. Oral side. 2. Dorsal side. × 8. (From *Danmark's Fauna*.)



18.—*Ophiopholis aculeata*. (From *Danmark's Fauna*.)

1. Part of oral side. 2. Of dorsal side. 3. Two arm joints from distal part of arm, in lateral view, showing the lower arm spine transformed into a hook. 1 and 2. × 4. 3. × 8.

- (10) Upper arm plates not surrounded by small plates (fig. 17)
 Ophiactis balli
 Disc covered with small scales, a few spines near edge; radial shields visible. Colour reddish with white bands on arms. Max diam disc 5 mm, arms 30 mm. Depths of 30 to more than 200 m, in crevices; south, west and northeast coasts.

11. Two outer mouth papillae on either side of jaw (fig. 19), the outermost very broad Amphipholis squamata
 Disc covered with scales, small radial shields visible (fig. 19); colour greyish. Max. diam. disc 5 mm, arm length 20 mm. Very common on shore, in crevices and algae, extends down to more than 200 m. All round British Isles.

One outer mouth papilla either side (fig. 20) 12

12. Scales of lower side and margin of disc end in small tubercles; radial shields transversely furrowed (fig. 20)
 Acrocnida brachiata
 Disc covered with small scales, radial shields small; colour greyish. Max. diam. disc 13 mm; arm length 200 mm. Shore to 40 m, in sand; south, west and northeast coasts.

Scales smooth, radial shields without transverse furrow . 13

13. Outer mouth papilla is a large rounded scale which obscures the jaw (fig. 21) Paramphiura punctata
 Disc covered with small scales; radial shields narrow (fig. 21); 5 slender arm spines on each side of each joint. Max. diam. disc 3 mm. North Sea and Channel, very rare.

Jaws not obscured (fig. 22, 23) 14

14. Tentacle scales present (fig. 23) . Amphiura chiajei
 Disc covered with scales, small radial shields visible; colour brownish. Max. diam. disc 11 mm, arm length 90 mm. Shallow water to more than 200 m, in muddy sand; south and west coasts, southern North Sea.

No tentacle scales (fig. 22, 24) 15

15. Upper side of disc naked except for narrow radial shields (fig. 24) Amphiura securigera
 Colour greenish, pale radial shields. Max. diam. disc 5 mm, arm length 60 mm. Depths of 25 to more than 200 m, on gravel; west coasts and Irish Sea.

Upper side of disc covered with coarse scales
 Amphiura filiformis
 Very delicate. Colour brownish. Max. diam. disc 10 mm, arm length 100 mm. Shallow water to more than 200 m, muddy sand and mud; all round British Isles, except perhaps the southeast.

16. A straight row of fine papillae across upper base of arm at edge of disc Ophiocten scutatum
 Disc covered by very small scales and several large primary plates; tentacle scales very large (fig. 25).
 Max. diam. disc 8 mm, arm length 24 mm. Depths of more than 150 m; near edge of continental shelf.

A pair of crescent-shaped rows of fine papillae (arm combs) at upper base of arm (fig. 11, 26) 17

17. Lower arm plates separated by pairs of pores (fig. 27); arm combs contain about 30 visible papillae each
 Ophiura texturata
 Disc covered by rather coarse scales, radial shields small; colour reddish brown. Max. diam. disc 36 mm, arm length 120 mm. Shallow water to 200 m, sand and muddy sand; all round British Isles.

No pores between lower arm plates (fig. 28) 18

18. Arm combs feebly developed (fig. 29) . Ophiura robusta
 Radial shields small; colour gray or brown with white spots. Max. diam. disc 10 mm, arm length 30 mm. Depths from 40 to more than 200 m; northern North Sea.

Arm combs well developed (fig. 26) 19

19. Second tentacle pore opens outside mouth (fig. 30); single tentacle scales Ophiura affinis
 Disc covered with fine scales and conspicuous circular primary plates; radial shields small; 3 small arm spines either side of each joint; colour reddish brown or gray. Max. diam. disc 8 mm, arm length 25 mm. Shallow water to more than 200 m, muddy sand; all round British Isles.

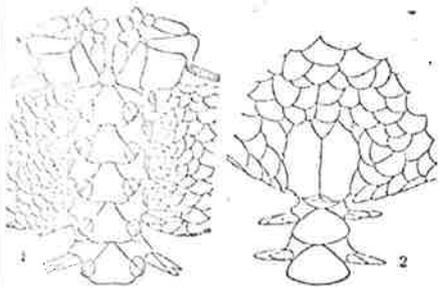
Second tentacle pore opens inside mouth slit (fig. 28); other tentacle pores near mouth have several tentacle scales 20

20. Innermost upper arm plate is heart-shaped (fig. 28); arm spines short, the longest being about half the length of the arm joint Ophiura albida
 Disc has rather coarse scales, radial shields touch; colour reddish brown with pale radial shields. Max. diam. disc 15 mm, arm length 60 mm. Shallow water to more than 200 m, coarse sand and gravel; all round British Isles.

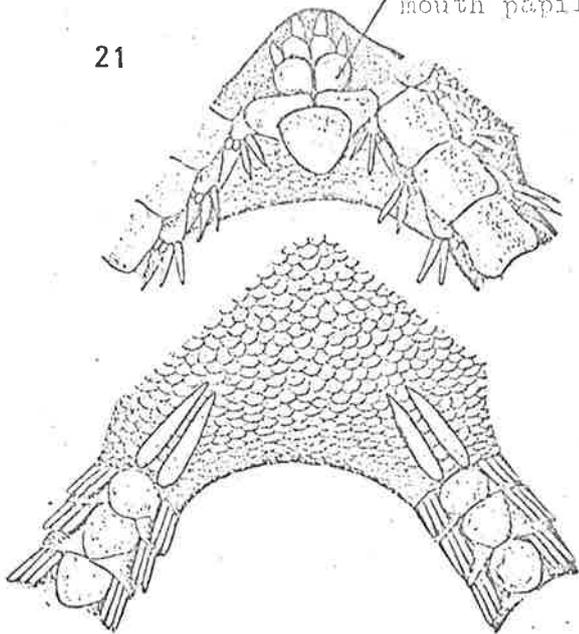
Innermost upper arm plate not heart shaped (fig. 26); longest arm spines are longer than arm joints

- Ophiura sarsi
 Disc has rather coarse scales: radial shields may touch; colour reddish, often mottled, radial shields may be paler. Shallow water to more than 200 m; northern North Sea, rare.

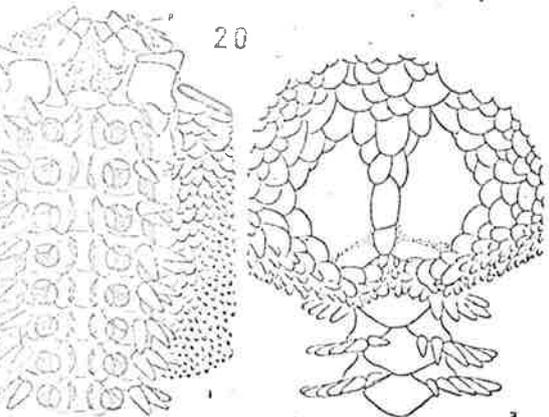
outer
mouth papilla



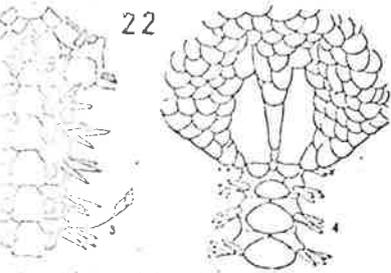
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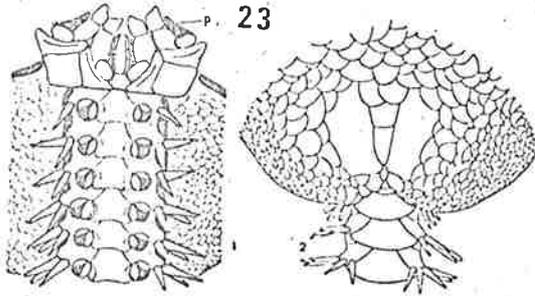
—*Paramphiura punctata*; part of oral and dorsal side.
(After Koehler, *Notes échinologiques*.)



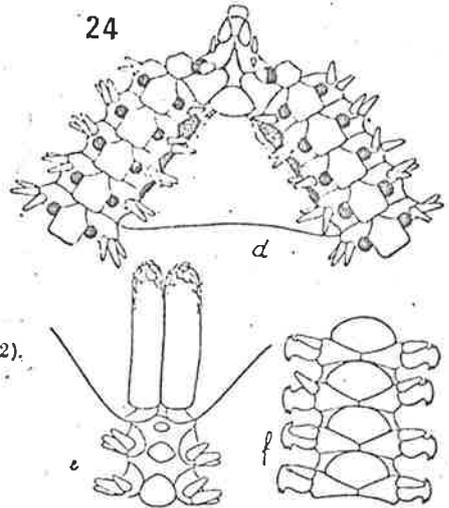
Croceuella brachiata; part of oral side (1) and of dorsal side (2).



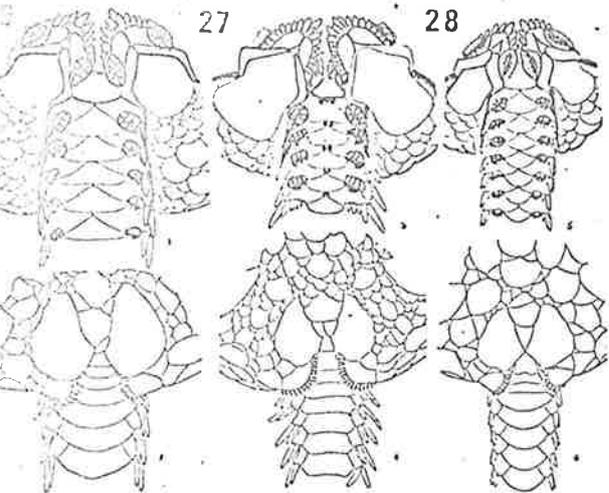
Amphiuva filiformis;
part of oral side (3) and dorsal side (4);



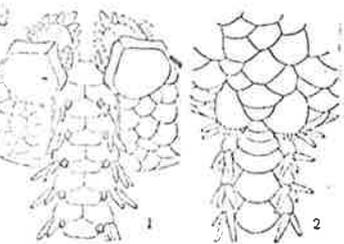
Amphiuva Chiajci; part of oral side (1) and dorsal side (2).



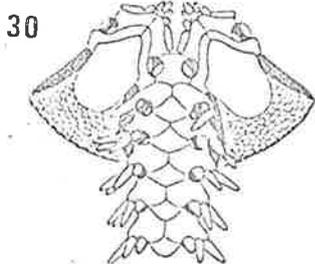
Amphiuva securigera
part of oral side, d;
part of dorsal side, e;
dorsal side of part of
arm, f.



—1-2. *Ophiura Sarsi*. 3-4. *O. texturata*. 5-6. *O. albida*. The
upper figures represent part of the oral side, the lower figures of the
dorsal side. × 4. (From *Danmark's Fauna*.)

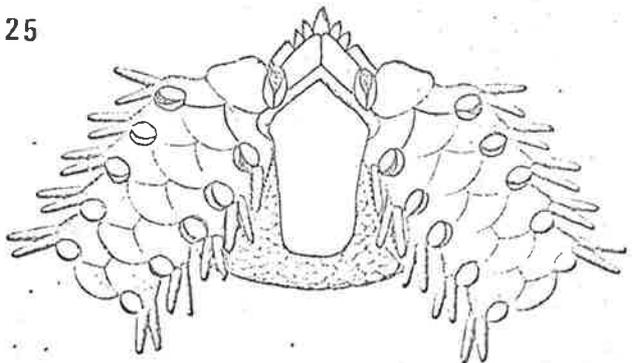


—1-2. *Ophiura robusta*.



—*Ophiura affinis*;
part of oral side. × 8.

25



—*Ophiocten scutatum*; part of oral side. × 10.
(From Koehler, *Monaco*, xiii.)

ECHINOIDEA

Echinoids, or sea urchins, have a body without arms. It may be globular, egg shaped, or flattened. The skeleton, or test, forms a complete covering and is composed of flat calcareous plates with knobs or tubercles, to which spines are attached. The mouth is on the underside while the anus is either on the upper side (in regular urchins) or near one end of the egg shaped, irregular urchins. The plates of the test are arranged in ten double series (fig. 31). Those of five double series are perforated by small pores, through which the soft tube feet emerge. The perforated plates are termed the ambulacral plates and the intermediate plates are termed interambulacral. On both sets of plates there are large primary tubercles which carry primary spines and smaller secondary tubercles bearing secondary spines (fig. 37). In regular urchins there is a circular soft-skinned area around the mouth, called the peristome, which bears a variable number of small calcareous plates. The test at the edge of the peristome is notched by gill clefts. In heart urchins the peristome is not obvious because it is covered with closely fitting plates. The spines are typically conical but in heart urchins they are variously flattened and ornamented. In addition, heart urchins often have small club-shaped dark spines arranged in narrow bands called fascioles (Fig. 47). Among the spines are delicate pincer-like organs or pedicellariae. These have heads composed of three valves, mounted on flexible stalks, and are of various shapes and sizes. Those with large globular heads, the globiferous pedicellariae, are the most valuable in the identification of regular urchins.

KEY

1. Body round (fig. 31), anal opening near centre of upper side 2
 Body oval, anal opening not central 9
2. Edge of test around mouth area is incised by deep gill clefts Sphaerechinus granularis
 Test somewhat flattened, closely covered with short spines. The valves of the globiferous pedicellariae have no side teeth (fig. 32). Ambulacral plates have 4 pairs of pores (fig. 41). Colour violet with white-tipped spines. Max. diam. 13 cm. Shallow water; Channel Islands and France.
 Edge of test around mouth area is not deeply incised, gill clefts scarcely noticeable 3
3. Valves of globiferous pedicellariae have no side teeth (fig. 35); spicules in tube feet have branched ends (fig. 42) Strongylocentrotus droebachiensis
 Test somewhat flattened, closely set with spines; ambulacral plates have 5 or 6 pairs of pores (fig. 37); colour greenish brown, spines green, red or violet with paler tips. Max. diam. 8 cm. Shore and shallow water; north and northeast coasts.
 Valves of globiferous pedicellariae have side teeth (fig. 34, 36); spicules in tube feet are simply c-shaped 4

4. Ambulacral plates each have 5 or 6 pairs of pores
 Paracentrotus lividus
 Test somewhat flattened, densely covered with strong spines; colour dark violet or olive green. Max. diam. 7 cm. Shore to 30 m, rock pools and crevices; common in western Ireland; very rare in southwest Scotland.
- Ambulacral plates each have 3 pairs of pores (fig. 38, 40) . 5
5. Skin of peristome is packed with thick plates; valves of globiferous pedicellariae have several lateral teeth (fig. 34) Psammochinus miliaris
 Test somewhat flattened, closely set with short, strong spines. Colour greenish with purple-tipped spines. Max diam. 5 cm. Shore to 100 m depth, under stones and in crevices; all round British Isles.
- Peristome is membranous, with only a few thin plates; valves of the globiferous pedicellariae have one or two teeth each side (fig. 36) 6
6. Every ambulacral plate bears a primary tubercle (fig. 38)
 Echinus elegans
 Test somewhat flattened, rather large primary spines; colour white, pink or violet, spines pink with white tip. Max. diam. 8 cm. Depths of more than 100 m; off west and north coasts.
- Approximately every second ambulacral plate has a large primary tubercle (fig. 39) 7
7. Test white, globular Echinus tenuispinus
 Spines short and slender, rather scarce; peristome plates bear small spines. Max. diam. 6 cm. Depths of more than 100 m, near edge of continental shelf.
- Test red, purple or greenish 8
8. Test globular, uniformly red to purple with white tubercles; plates on peristome bear small spines Echinus esculentus
 Spines short, reddish; primaries and secondaries about the same size.
- Test slightly conical, red colour broken by vertical white bands, or restricted to small patch on top; no spines on peristome plates Echinus acutus
 Primary spines longer and thicker than secondaries, red or green at base and white at tip. Max. diam. 15 cm. In depths of more than 50 m; outer continental shelf and northern North Sea.

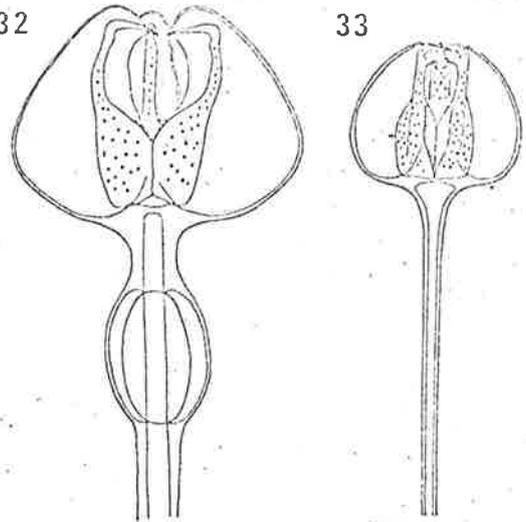
Globiferous pedicellariae of

Sphaerechinus granularis

Paracentrotus lividus

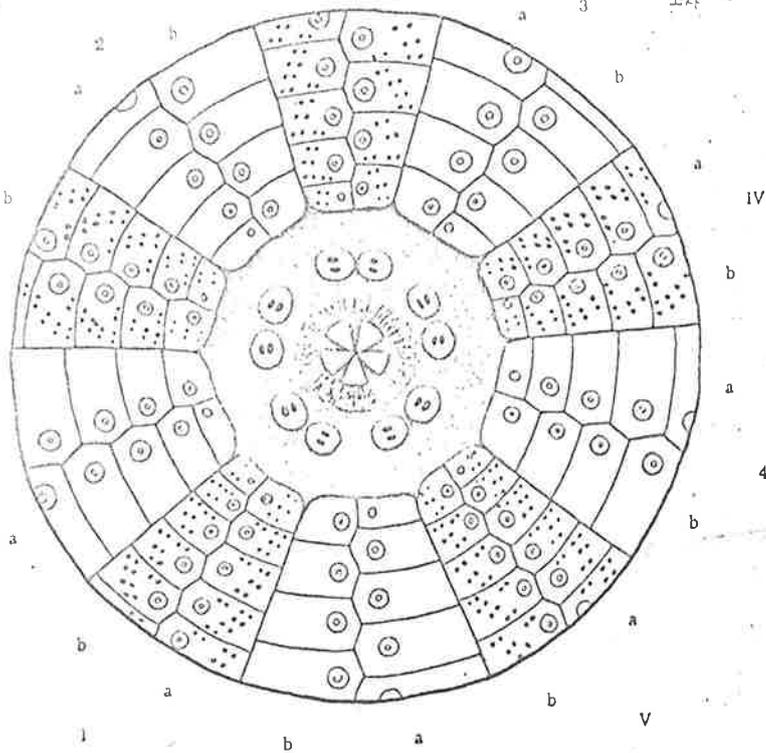
32

33



Spicule from tube foot of S. droebachiensis

42

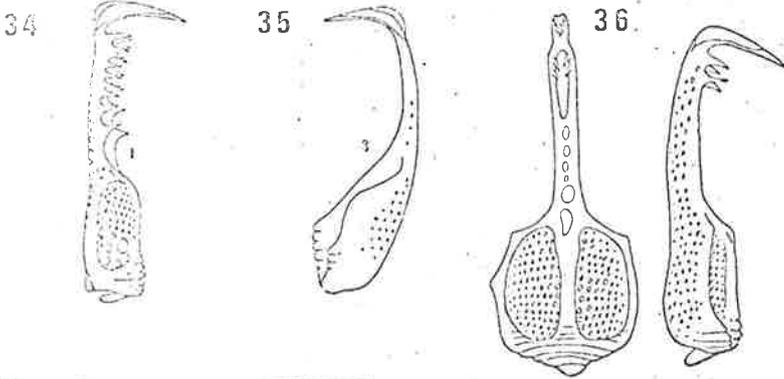


5

Structural pattern of the test of a regular sea urchin seen from the ventral [oral] side: I-V - ambulacra rows; 1-5 - interambulacra rows. In the center is the mouth, surrounded by five triangular teeth; around these is the perignathic girdle (crosshatched) of the thickened oral membrane (peristome) is shaded, and on it are five pairs of pore-bearing oral or buccal plates, each plate corresponding to one oral podium; at the margins of the peristome are 10 small notches projecting into the test: these are the gill cuts

Isolated valves of globiferous pedicellariae

P. miliaris S. droebachiensis E. elegans

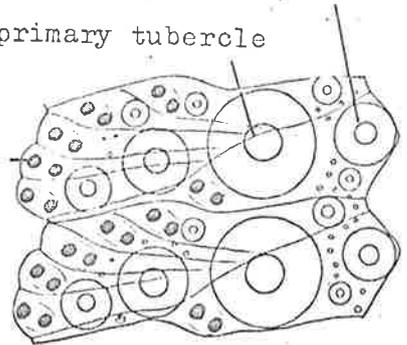


secondary tubercle

primary tubercle

37

pore

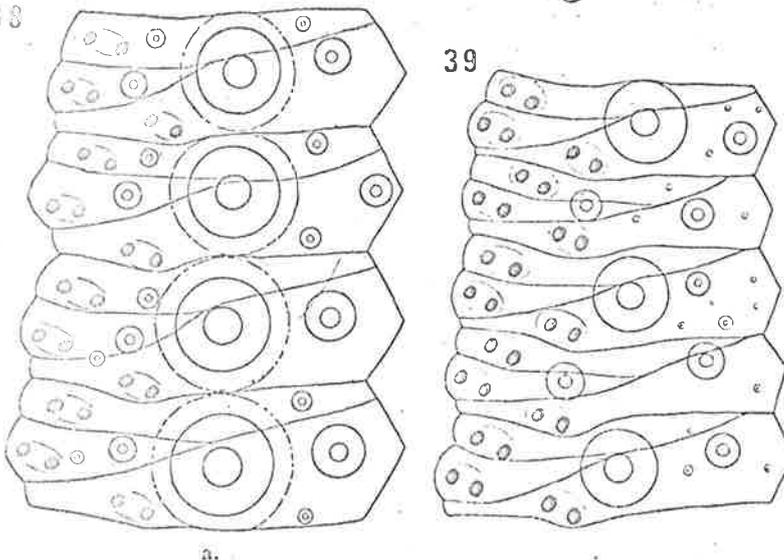


a.

Part of ambulacrum of *Strongylocentrotus droebachiensis*

38

39

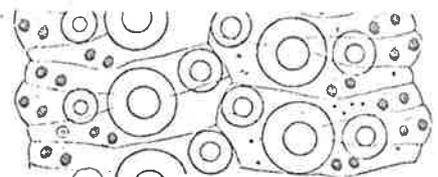


a.

Ambulacra of *Echinus elegans*.

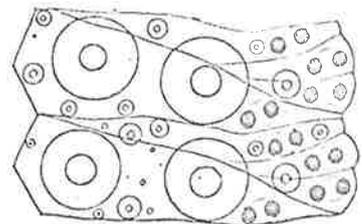
Echinus esculentus

40



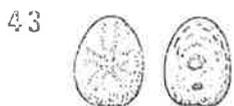
Psammechinus miliaris;

41

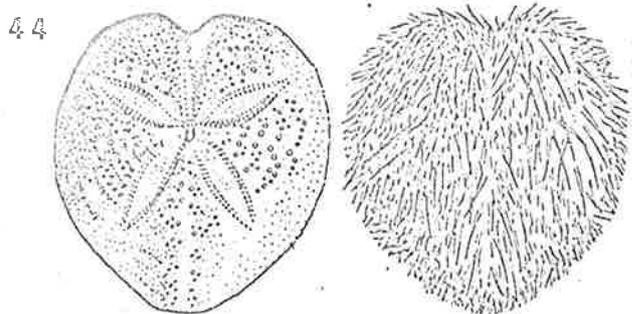


Sphaerechinus granularis,

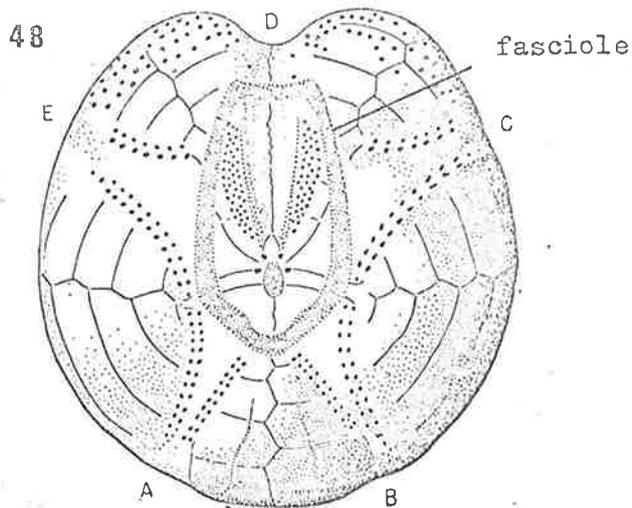
9. Mouth in centre of underside, anus on underside between mouth and posterior margin; test flattened, very small (fig. 43)
Echinocyamus pusillus
 Fine short spines; colour green or gray. Max. length 15 mm. Shallow water, common in gravel; all round British Isles.
- Test more or less egg-shaped, mouth near anterior end of underside, anus usually on posterior margin (fig. 49) 10
10. Narrow band of dark spines, termed a fasciole, forms a ring or oblong below the anal region 11
- In addition to a subanal fasciole there is a second fasciole on the upper surface of the test (fig. 48) 12
11. Subanal fasciole about three times as broad as long (fig. 46); test somewhat flattened . Spatangus purpureus
 Test heart-shaped (fig. 44); colour violet, spines of upper side paler. Max. length 12 cm. Shallow water to more than 200 m; all round British Isles.
- Subanal fasciole less than twice as broad as long (fig. 45); test high Spatangus raschi
 Colour deep violet. Max. length 12 cm. Depths more than 150 m; off western coasts.
12. Upper fasciole runs around tips of petal-like ambulacra (fig. 47) Brissopsis lyrifera
 Colour brown. Max. length 7 cm. Shallow water to more than 200 m, in soft mud; west, north and east coasts.
- Upper fasciole surrounds only the anterior ambulacral petal (fig. 48, 49) 13
13. Anterior ambulacrum is a deep furrow (fig. 48) Echinocardium cordatum
 Colour yellowish. Max. length 9 cm. Common on sandy shores and shallow water, also occurs down to 200 m; all round British Isles.
- Anterior ambulacrum is flush with test (fig. 49) 14
14. Some large tubercles, carrying long spines, between the ambulacra of the upper side; large labrum (plate behind the mouth, fig. 51) Echinocardium flavescens
 Colour yellow or pink. Max length 9 cm. Shallow water to more than 200 m, in muddy sand; all round British Isles.
- No large tubercles on upper side; small labrum (fig. 50)
Echinocardium pennatifidum
 Colour yellowish. Max. length 7 cm. Shore to more than 200 m, in sand; south, west and northeast coasts.



Echinocyamus pusillus



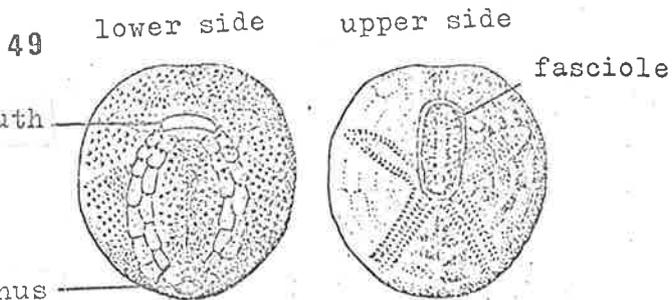
Spatangus purpureus



Echinocardium cordatum

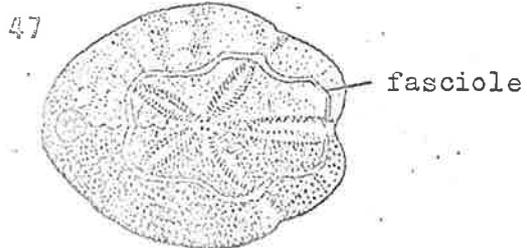


—Subanal fasciole of *Spatangus Raschi* (upper figure) and *Sp. purpureus* (lower figure). Slightly enlarged.



Echinocardium pennatifidum

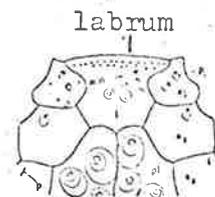
50



Brissopsis lyrifera

51

Echinocardium flavescens



HOLOPHUROIDEA

Holothurians or sea cucumbers are rather soft, sausage-shaped animals, without arms. The mouth is at one end of the body, surrounded by retractable tentacles and the anus is at the other end. In some species the body is flattened and the lower side on which the animal walks, is called ventral and the upper side is called dorsal. There are basically five longitudinal rows of tube feet, but various modifications of this pattern exist and a few species have no tube feet. After collection, the tentacles are usually retracted but if living specimens are left for a while in cool water they may extend them. Preserved specimens usually have to be partly dissected to discover the number of tentacles and their shape. In one group of holothurians the part of the body immediately behind the tentacles is more flexible than the rest (the introvert) and can be pulled back into the body by retractor muscles, carrying the tentacles well out of sight. In other holothurians the tentacles are drawn back into a fold around the mouth but there are no specialised retractor muscles. The body is covered with skin which contains, in most species, small calcareous deposits. The shape of these deposits is very important in classification. To investigate them, mount a small piece of skin on a slide in a drop of glycerine, and examine with a low power objective (e.g. x 10). Gentle pressure on the cover slip may help to make the deposits more visible. If it does not, a second preparation may be made, using a drop of a commercial 'bleach' instead of glycerine and leaving 30 min to clear. Very thick or opaque skin may have to be heated with a drop of 20 % potassium hydroxide solution, but this requires care. Potassium hydroxide is caustic. After treatment the residue must be washed well before mounting on a slide.

KEY

1. Tube feet well developed; tentacles shield or bush shaped . . . 2
 No tube feet; tentacles feather or finger shaped 20
2. Tentacles shield-shaped; no introvert (Aspidochirota) . . . 3
 Tentacles bush-shaped; introvert and associated
 retractor muscles present (Dendrochirota) 5
3. Calcareous deposits abundant, including well developed
 tables (fig. 54, 55) 4
 Calcareous deposits scarce, usually very reduced tables,
 consisting of disc without spire (fig. 53)
 Holothuria forskali
 Body slightly flattened, numerous tube feet in
 3 or 4 longitudinal series; colour black or
 brownish on upper side, paler below. Max. length
 30 cm. Low water to about 50 m depth; west and
 southwest coasts.

4. Deposits tables only (fig. 54) . Mesothuria intestinalis
 Body cylindrical, tube feet mainly ventro-
 lateral; colour grey, pink or violet. Max.
 length 30 cm. Depths of more than 50 m; off
 western Scotland.
- Three types of deposit: tables (fig. 55), flat rods and
 starshaped bodies . . . Stichopus regalis
 Body flattened, with tube feet in three rows on
 underside, many papillae around edge and on
 upper side; colour brown, often with white spots.
 Max. length 30 cm. Edge of continental shelf,
 upper depth limit not known.
5. Body cylindrical 6
 Body with flat lower sole, upper side with scales . . . 19
6. 10 tentacles 7
 15 to 30 tentacles, usually in two rings . . . 17
7. Tube feet in five fairly distinct rows 8
 Tube feet scattered all over body 14
8. Body thick, cylindrical; skin leathery and almost without
 deposits. Young specimens have plates with holes (fig. 56)
 Cucumaria frondosa
 Colour usually brown, tentacles almost black,
 may be paler. Max. length 50 cm. Shallow water
 to 200 m; Scotland.
- Body not large and thick 9
9. Body elongated, with thin posterior end; deposits cup-shaped
 spicules (baskets) and smooth plates with holes (fig. 57)
 Cucumaria elongata
 Smooth skin, colour brown. Max. length 15 cm.
 In muddy sand, shallow water to 70 m; west,
 north and north-east coasts.
- Body small, not elongated; deposits smooth or tuberculate
 plates, with or without baskets or stellate spicules . . . 10
10. Deposits smooth plates, with or without star-shaped
 spicules (fig. 58) 11
 Deposits tuberculate, with baskets or star-shaped
 spicules (fig. 60) 12

52

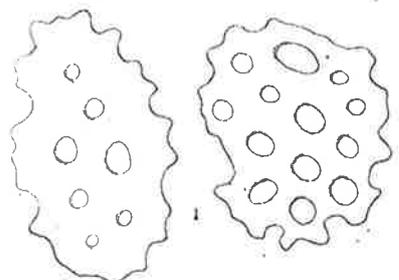
sty-
tacles

introvert

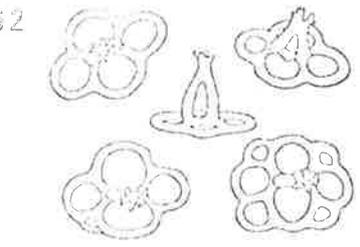
tube feet

anus

Anatomy of Cucumaria



- Calcareous deposits of *Thyone raphanus* (1)



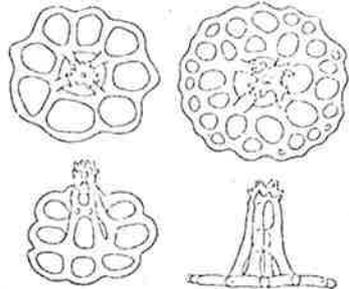
- Calcareous deposits of *Thyone fusus*. x 200.

53



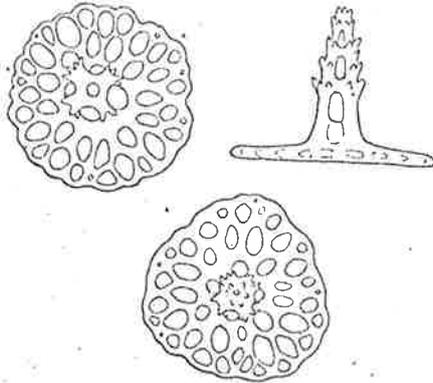
- Deposits of *Holothuria Forskali*. x 450. (After Bell, *Catalogue Brit. Echinod.*)

54



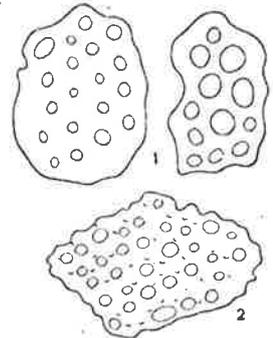
- Calcareous deposits (tables) of *Mesothuria intestinalis*, seen from above and in side view. x 145. (From *Danmark's Fauna*.)

55



- Tables of *Stichopus regalis*, from above and inside view.

56



- Calcareous deposits of *Cucumaria Hymnami* (1) and *Cuc. frondosa*, young (2). 1, x 50; 2, x 80. (From *Danmark's Fauna*.)

57

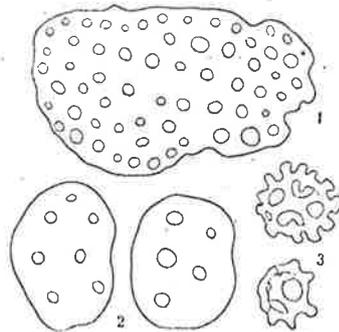
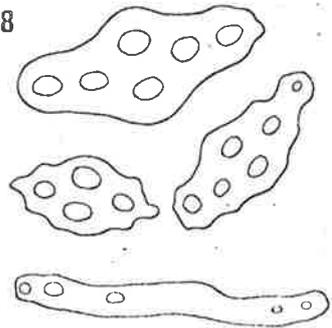


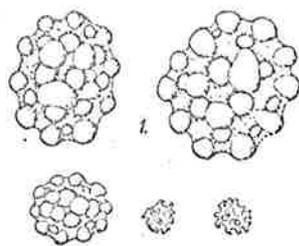
FIG. 238. - Calcareous deposits of *Cucumaria elongata*. 1, x 50; 2, 3, x 145. (From *Danmark's Fauna*.)

58



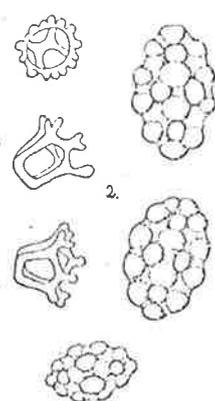
- Deposits of *Cucumaria saxicola* from the skin and the tube-feet (the lowermost figure). x 180.

60



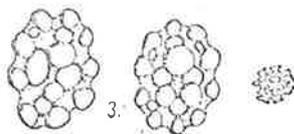
- Deposits of *Cucumaria Planci* (1),

61



C. lefevrei (2)

63



Cuc. lactea (3). x 190.

11. Deposits large plates with holes (fig. 56) Cucumaria hyndmanni
 Body stout, slightly tapering posteriorly; skin smooth and thick; colour whitish or faint red. Max. length 5 cm. In gravel or muddy sand; shallow water to more than 200 m; south, west and northeast coasts.

Deposits small plates with four main holes (fig. 56), also small star-shaped bodies in outer layer of skin

. Cucumaria saxicola
 Body cylindrical; skin delicate, colour white, tentacles dark. Max. length 15 cm. Under stones on shore and in crevices down to 50 m. Southwest England and southwest Ireland.

12. Deposits in surface layer of skin are baskets, inner layer of plates with 4 holes and prominent nodules (fig. 61)

. Cucumaria lefevrei
 Body cylindrical, skin tough; colour brownish or black. Max. length 15 cm. Under stones, shore to 20 m depth; southwest England and western Ireland.

Deposits in surface layer are irregular starshaped 13

13. Tube feet scarce, in zig-zag rows Cucumaria lactea

Body cylindrical, skin thick and smooth; inner layer of deposits with large nodules and more than 4 holes (fig. 63); colour white or brown. Max. length 4 cm. In crevices and on algae, shore to 100 m; south, west and northeast coasts.

Tube feet in five distinct double rows Cucumaria planci
 Body cylindrical, skin thick, smooth; inner layer of deposits with large nodules and more than four holes (fig. 60). Colour brownish. Max. length 15 cm. Shallow water to more than 100 m; distribution not well known, but found on west coasts, Irish Sea and Dogger Bank.

14. Deposits present all over body 15

At least part of body lacks deposits 16

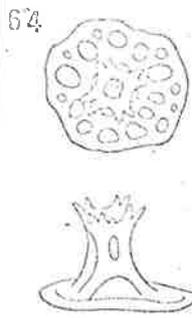
15. Deposits are tables with spires (fig. 62) Thyone fusus

Body attenuated at both ends; colour white or pink. Max. length 20 cm. In shell gravel, shallow water to more than 200 m; all round British Isles.

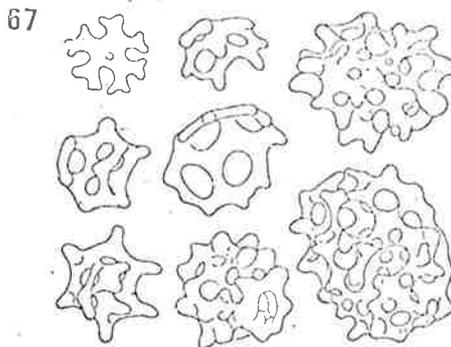
Deposits flat plates with smooth holes (fig. 59)

. Thyone raphanus
 Body with long thin "tail"; colour yellowish or brownish. Max. length 6 cm. Muddy sand or muddy gravel, shallow water to more than 200 m; southwest, west and northeast coasts.

16. No deposits, except in tube feet . Thyone roscovita
Skin thick, rosy grey, not transparent.
Shore to 40 m; Brittany and Atlantic coast
of France.
- Deposits at posterior end of body only . Thyone inermis
Body attenuated at both ends, skin thin and
transparent; deposits discs with spires; colour
pink. Max. length 15 cm. Depths of 30 to 180 m;
south and west coasts.
17. Tube feet in five fairly distinct rows . Neopentadactyla mixta
Body elongated, attenuated at both ends; deposits
are tables (fig. 64); colour yellowish violet.
Max. length 20 cm. Found in gravel, 20 to 200 m
depth; west of England, west of Ireland and Irish Sea.
- Tube feet scattered all over body 18
18. Tentacles of inner ring in close pairs, almost fused
together Thyonidium pellucidum
Body short, skin thin and transparent, tube feet
large and few. Deposits tables (fig. 65), but
scarce in larger specimens; colour reddish. Max.
length 12 cm. 10 to more than 200 m depth; west
and northeast coasts.
- Tentacles of inner ring in more widely spaced pairs
. Thyonidium commune
Body elongated, tapering at ends, skin thick and
not transparent; deposits absent except around
bases of tentacles, they are small tables (fig. 66);
tube feet very fine and numerous; colour whitish,
tentacles darker. Max. length 20 cm. Shallow water
to more than 200 m.; west coasts.
19. Body flattened, head oval shape; centre of sole without
tube feet, scales of upper side large; mouth opening
surrounded by many small plates . Psolus squamatus
Colour white, yellowish or pinkish. Max. length
7 cm. 50 to more than 200 m depth; western
Scotland.
(N.B. Young P. phantapus are the same shape as
P. squamatus. They can be distinguished by the
shape of the deposits in the skin of the sole,)
fig. 67, 68.)
- Body not flattened, sole rather small, anterior and
posterior ends stick upward; posterior end tapers to a tail;
tube feet all along centre line of sole; scales rather small
. Psolus phantapus
Colour varies from yellowish brown to almost
black; Max. length 15 cm. 50 to more than 200 m
depth; northwest and northeast coasts.



Deposits from body wall of *Thyonidium pellucidum*.
× 145. (From *Danmark's Fauna*.)
1. From above. 2. Half side view. 3. Side view.



Calcareous deposits from the ventral sole of *Psolus plantapus*.
× 145. (From *Danmark's Fauna*.)

Deposits of
Naopentadactyla
mixta

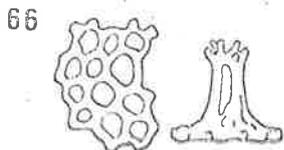
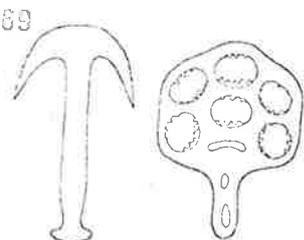
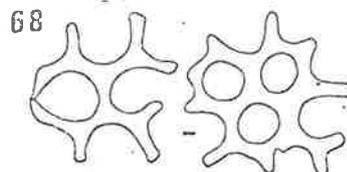


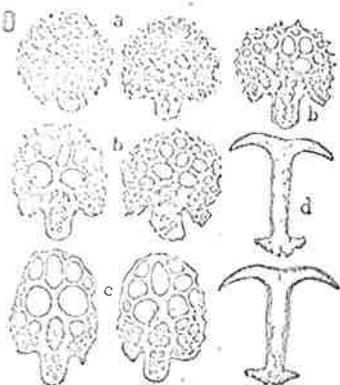
FIG. 250.—Deposits from
introvert of *Thyonidium*
commune. × 250.



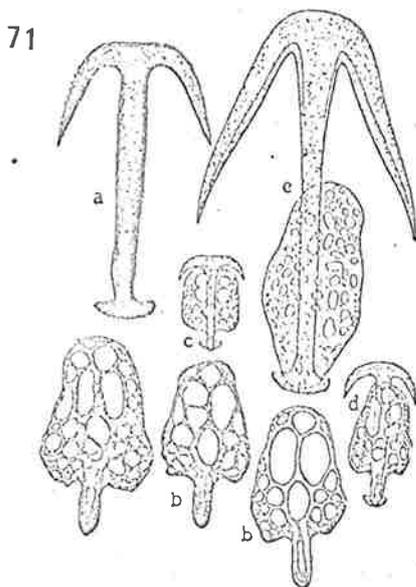
—Anchor and anchor
plate of *Labidoplax Buski*.
× 200. (From *Danmark's*
Fauna.)



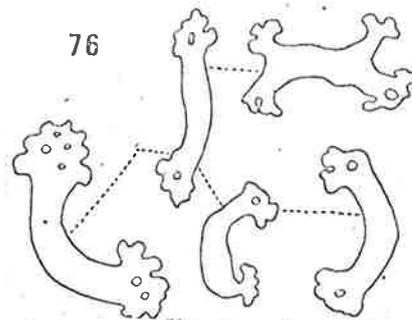
—Deposits from the ventral sole
of *Psolus squamatus*



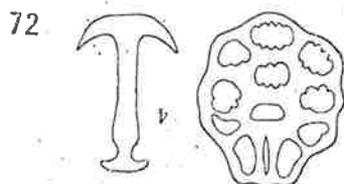
Anchor plates (a-c) and anchors (d)
of *Labidoplax Thomsoni*.



—Deposits of *Labidoplax digitata*. × 70. (After Koehler,
Echinodermes, Faune de France.)



Spicules from
tentacles of
Leptosynapta
cruenta



Leptosynapta minuta

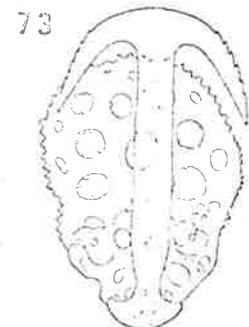
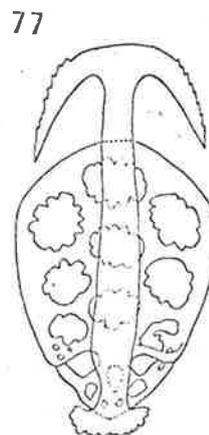
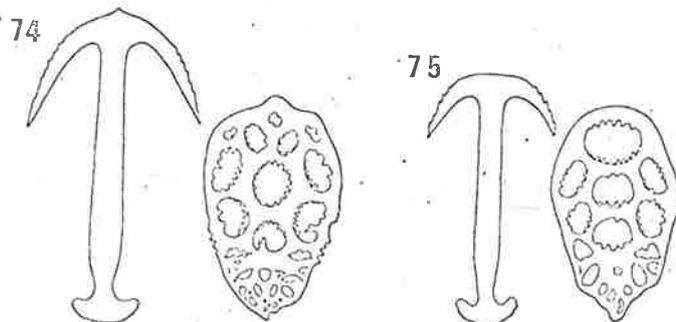


FIG. 263.—Anchor and
anchor plate of *Lepto-*
synapta Galliennii.
× 155.



Anchor and anchor plate
of *Leptosynapta cruenta*



Leptosynapta bergensis * *Leptosynapta inhaerens*

20. No deposits in skin Rhabdomolus ruber
 Body cylindrical, colour red. Max length 1cm.
 Shallow water; Heligoland and Brittany.
- Deposits are anchor shaped, with attached flat 'anchor plates'
 (fig. 71) 21
21. Anchor plate has a distinct 'handle' at end attached to
 anchor (fig. 71) 22
- Anchor plate does not have such a handle 24
22. Tentacles 11, each with a long terminal digit and one
 pair of smaller lateral digits Labidoplax buski
 Body cylindrical, colourless; anchor plates have
 4 main holes (fig. 69). Max length 3 cm. In
 muddy gravel from 10 to more than 200 m depth;
 west coasts.
- Tentacles 12, each with two pairs of lateral digits 23
23. Anchor plates are thin, elongate, with smooth edge and
 many holes (fig. 71) Labidoplax digitata
 Body cylindrical, colour red or brown. Max. length
 30 cm. In muddy sand, shore to about 70 m depth;
 south and west coasts.
- Anchor plates are thick, fanshaped, with serrate edge and
 many holes (fig. 70) Labidoplax thomsoni
 Body cylindrical. Shore of Belfast Lough.
24. Tentacles 10, simple, no digits Leptosynapta minuta
 Body cylindrical, transparent, colourless;
 deposits anchors, large and small plates (fig. 72).
 Max. length 1 cm. Shallow water; Heligoland,
 Brittany and Irish Sea.
- Tentacles usually 12, with lateral digits 25
25. Tentacles have 8 to 11 short digits Leptosynapta bergensis
 Body cylindrical, colour dark pink; anchor plates
 of anterior end of body usually smooth (fig. 74).
 Max. length 30 cm. In muddy sand; shallow water;
 North Sea and Channel.
- Tentacles have 5 to 7 pairs of digits, increasing in length
 towards the tip 26
26. Anchor plates of anterior end of body have serrated edge
 (fig. 73) Leptosynapta gallienci
 Body cylindrical, skin rough, deep pink. Max.
 length 30 cm. Shore and shallow water; Brittany.
- Anchor plates of anterior end of body have smooth edge 27

