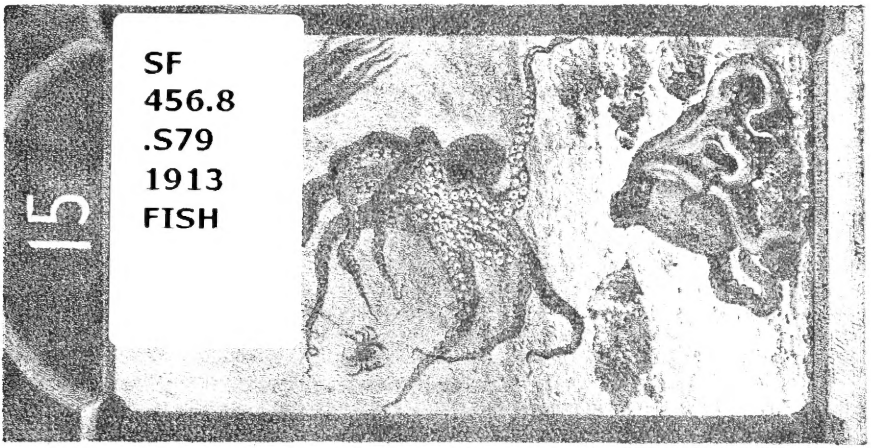
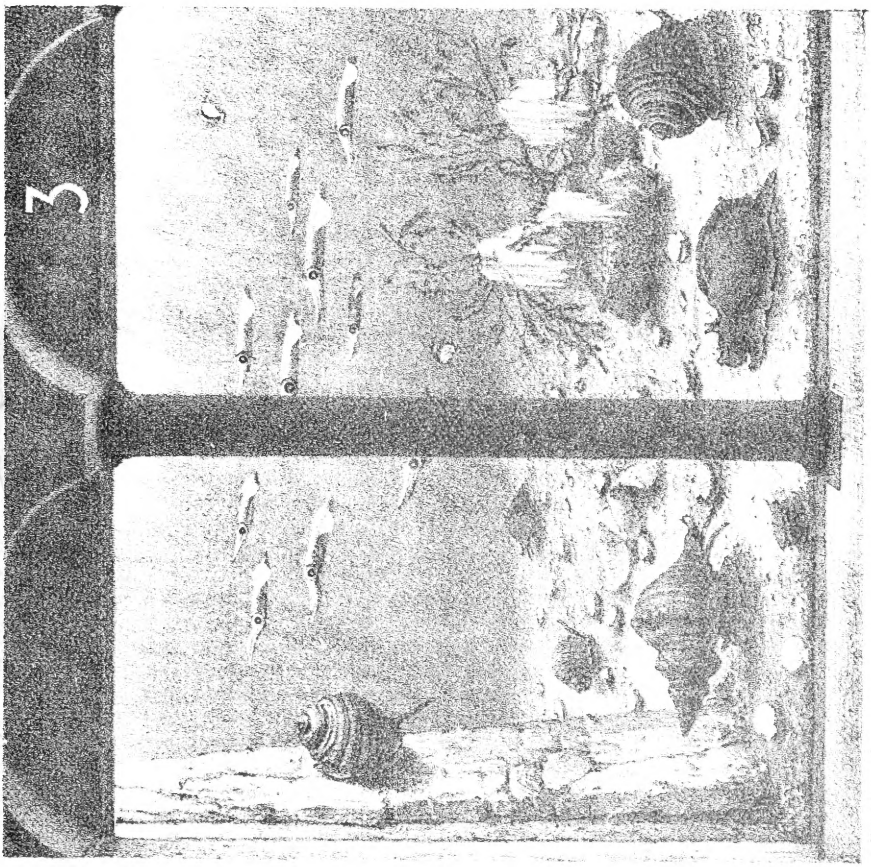
AQUARIUM NEAPOLITANUM.





Dr. Alvin Seale
Compliments of Professor Wallis

GUIDE

TO THE

AQUARIUM

OF THE

ZOOLOGICAL STATION AT NAPLES

Naples 6 Feb. 1925

EIGHTH EDITION

WITH 168 ILLUSTRATIONS

PRINTED BY
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1913

Part first.

List of the contents of each tank.

**The Aquarium contains only marine animals and plants.
All have been found in the bay of Naples.**

In the ensuing list only the most remarkable of the animals and plants are mentioned; the description given is purposely couched in colloquial language, being designed to convey, if possible, in a few words a sufficient impression of the animal to lead to its identification. The asterisk (*) before a name signifies that the animal does not occur at all seasons of the year. With the descriptions of the figures are given the references to the pages in the second part of the guide, where they are dealt with more fully.

The ascending streams of silvery bubbles in the tanks are the air drawn in by the sea-water, which is always being pumped in from dark tanks under the aquarium. Those animals and plants which are found near the upper part of a tank will be seen double, owing to the reflection against the surface of the water. All the tanks, especially, perhaps, Nos. 1, 3, 9, and 20, gain enormously by being seen in the sunlight between 12 and 2 o'clock.

On the walls of most tanks will be seen the white tubes of *Ciona* (compare tank 4), the colonies of *Botryllus* (p. 99) and other Compound Ascidians, and a little white Sponge (p. 63, These grow and breed in the water of the aquarium, attaching themselves to all suitable surfaces. In most tanks are swarms of tiny, reddish-brown Opossum-shrimps (p. 87). — In comparing the Fishes with the figures in the Guide, it must be remembered that in many species the dorsal fin nearest the head is not visible except when erected (often for defence); notice, as an example, *Labrax* (fig. 54) in tank 10. — The visitor must not rashly ascribe the power of walking about to Sponges, Tunicates, Anemones, etc., which he may find moving among the rocks in various tanks. After seeing tank 23 he will be prepared to trace such vagaries to the little crab which is their cause.

The numbers are written in red charactres above the tanks.

Tank No. 1.

Containing exclusively **Echinoderms** (p. 72).

1. **Starfishes** or "five-fingers", with five (rarely more) creeping arms: *Echinaster* (fig. 2), red and slender armed; *Luidia* (fig. 5) orange, and much larger; generally with seven arms; *Asterias* (fig. 3), large and greenish or brownish, with pointed knobs; *Astropecten* (fig. 1), with points like little tusks fringing the arms; *Palmipes*, arms webbed, like a pentagonal piece of red paper.
2. **Brittle-stars,** with five (or rarely six) arms, thinner and more snake-like than those of the Starfishes; round body like a thick halfpenny (*Ophioderma*, fig. 4).
3. **Feather-stars,** (*Antedon*, fig. 6) mostly holding by their backs to dead coral-stems (see tank 21) in the centre of the tank. They are yellow or red and have ten plumed arms with which they can swim.
4. **Sea-urchins,** globular or base-shaped and covered with spines. *Sphaerechinus* (fig. 8), generally purplish, the spines being tipped with white; *Strongylocentrotus*, smaller and more depressed, of a very dark purple colour, largely eaten in Naples; *Dorocidaris* (fig. 7), pink with knobs, bearing a few long and sticklike spines. Several other kinds.
5. **Sea-cucumbers,** sack-shaped bodies covered with suckers. The delicate brown feathery undergrowth will be seen to be the tentacles of numerous sea-cucumbers (*Cucumaria*, fig. 9), adhering to the rocks; each has ten tentacles round its mouth, in crawling they are retracted; in the larger species (*Holothuria*, fig. 11) which is black, they are not obvious; *Stichopus* (fig. 10) is reddish. a foot long, and flat.

The starfishes, sea-urchins and sea-cucumbers adhere to the glass or rock by numerous suckers, with which they crawl (for details v. p. 72); the brittle-stars move by wriggling, the feather-stars can swim by movements of their arms.

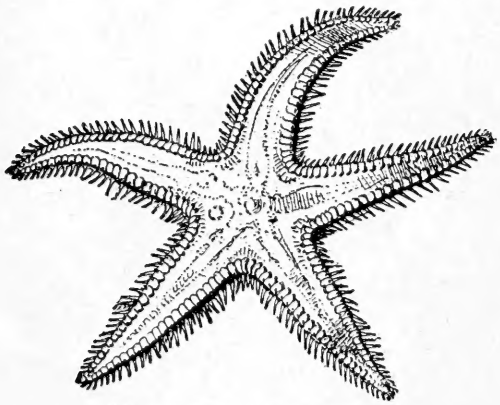


Fig. 1. *Astropecten aurantiacus*, 1/4 nat. size. p. 75.

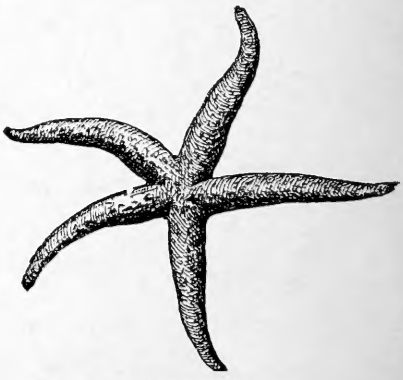


Fig. 2. *Echinaster sepositus*, 1/3 nat. size. p. 75.

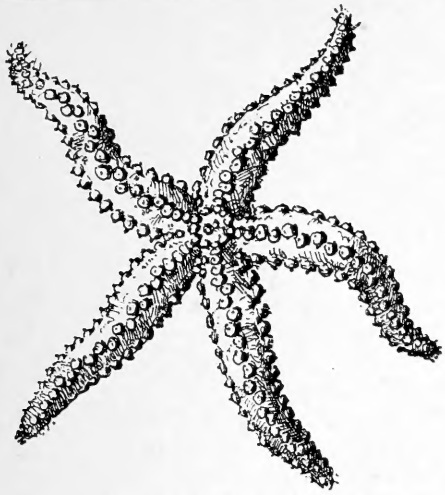


Fig. 3. *Asterias glacialis*,
1/3 nat. size. p. 75.

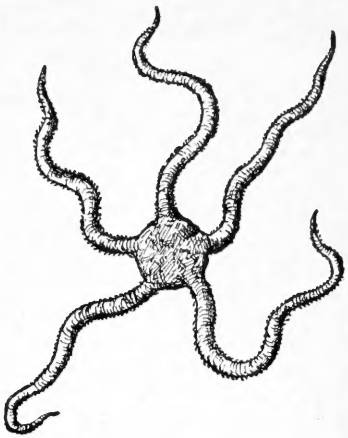


Fig. 4. *Ophioderma longicauda*,
1/2 nat. size. p. 75.

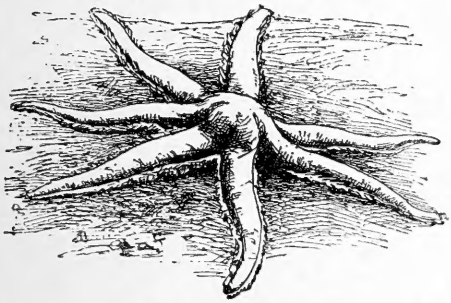


Fig. 5. *Luidia ciliaris*,
1/4 nat. size. p. 75.

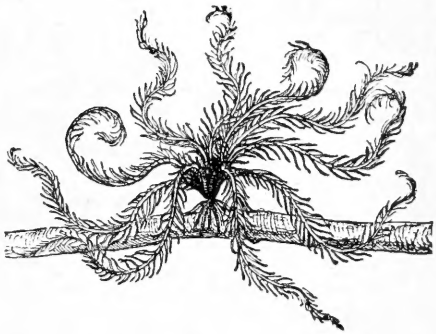


Fig. 6. *Antedon rosacea*,
attached to a branch of *Antipathes*,
1/2 nat. size. p. 75.

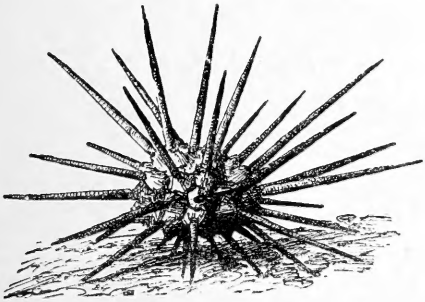


Fig. 7. *Dorocidaris papillata*,
1/2 nat. size.
The sucker-feet are not visible p. 75.

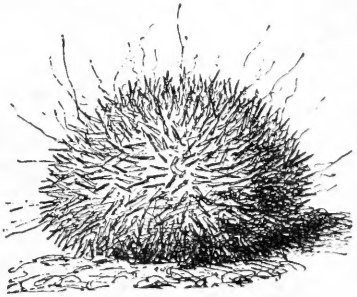


Fig. 8. *Sphaerechinus granularis*,
1/2 nat. size.
with projecting sucker-feet, p. 75.

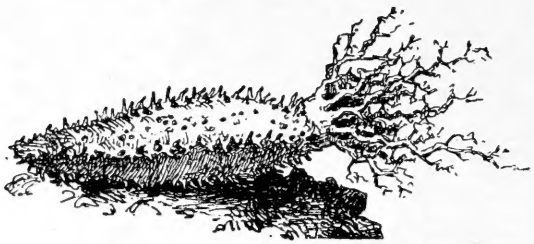


Fig. 9. *Cucumaria Planci.* on a stone, with outstretched tentacles, 1/2 nat. size. p. 75.

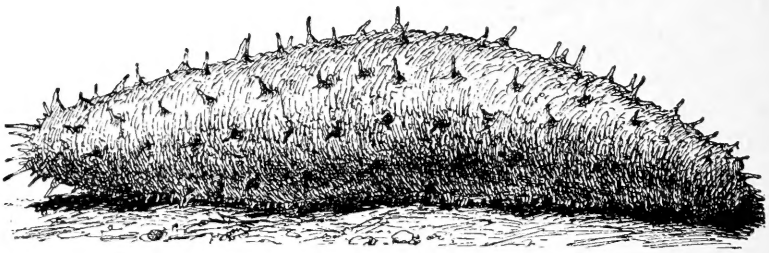


Fig. 10. *Holothuria tubulosa,* 1/3 nat. size. p. 75.

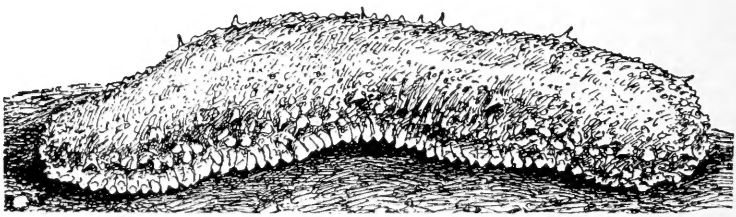


Fig. 11. *Stichopus regalis,* 1/2 nat. size. p. 75.

Tank No. 2.

Fishes only. *Oblata* (fig. 14), silver, with a black root to its tail; *Box* (figs. 12 and 13).

Plants. The green sea-lettuce (*Ulva lactuca*) serves as food for the fish *Box salpa*.

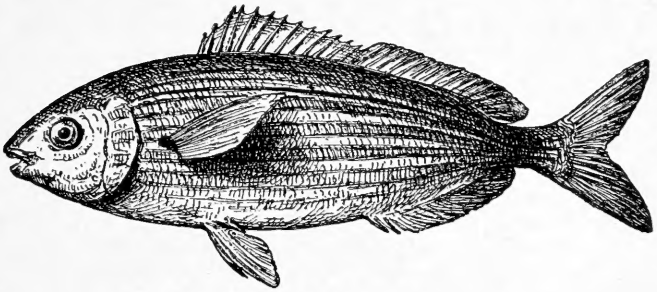


Fig. 12. *Box salpa*, 1/2 nat. size. p. 115.

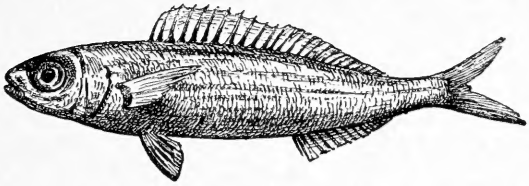


Fig. 13. *Box boops*, 1/2 nat. size. p. 115.

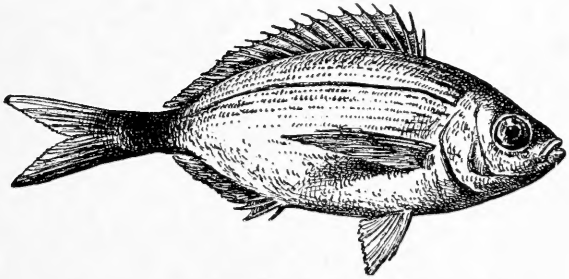


Fig. 14. *Oblata melanura*. 1/2 nat. size. p. 115.

Tank No. 3.

Containing mainly **Molluscs.**

1. **Cephalopods** (p. 89). *Squid or Calmar (*Loligo*, fig. 15), delicate, transparent and fish-like with large eyes, swimming with equal ease backwards or forwards.
2. **Snails** (p. 93). Sea-hare (*Aplysia*, fig. 18), soft black or brown lumps as large as a man's fist. **Pleurobranchus* (fig. 21). **Umbrella* (fig. 19), with a flat shell on its back. Triton's horn (*Tritonium*, fig. 17) with red body and yellow horns banded with black; shell pointed and shaped like a whelk; *Tun (*Dolium*, fig. 16), black and white body, rounded shell; *Murex* (fig. 23), much smaller, with spines; Helmet shell (*Cassis*, fig. 20); *Natica* (fig. 22).
3. **Bivalves** (p. 95). Scallop (*Pecten*, fig. 25) with flat fluted shell; sometimes to be seen swimming by flapping the valves of the shell. Edible mussel (*Mytilus*, fig. 24), a group attached to a cable. Piddock (*Pholas*, fig. 27) and *Lithodomus* (fig. 26) both in holes which they have bored in rocks or coral.

***Eggs of Molluscs.** The squids and snails can often be seen laying their eggs in bands or clumps. Those of the Squids are long white backs hanging from the dead coral; of the Sea-hare, fine yellow strings; of the Tun ribbons a finger-length broad, and of *Murex* large honeycomb-like masses.

4. **Crustaceans.** **Homola* (p. 85), standing as if on stilts, with the hind legs held up.

Plants. The lettuce sea-weed serves as food for the sea-hares.

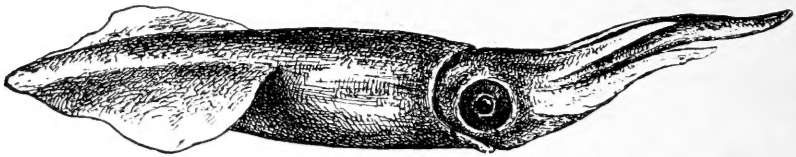


Fig. 15. *Loligo vulgaris* (Squid), 1/2 nat. size. p. 91.

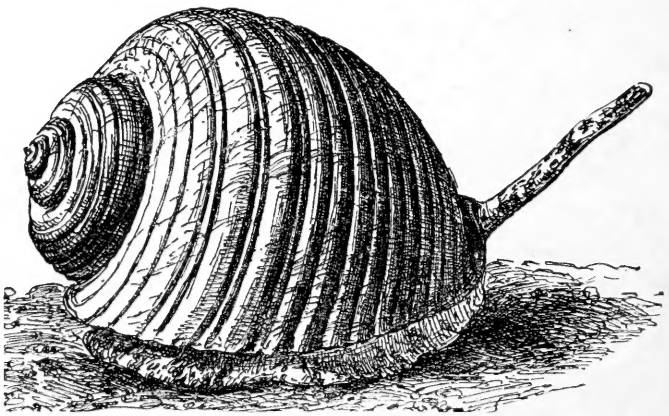


Fig. 16. *Dolium galea* (Tun). 1/3 nat. size. p. 93.

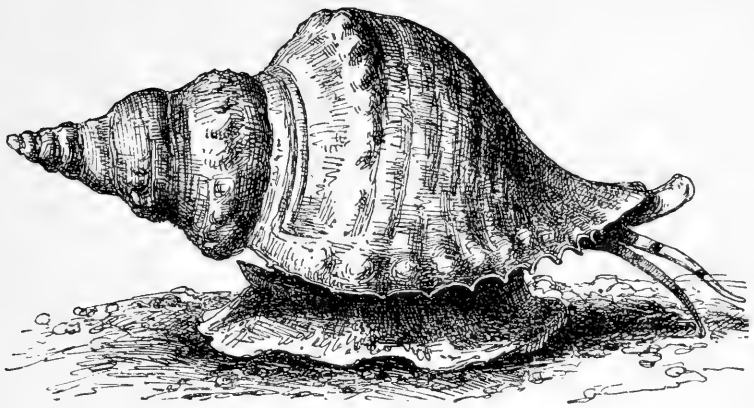


Fig. 17. *Tritonium nodiferum* (Triton's horn), 1/3 nat. size. p. 93.

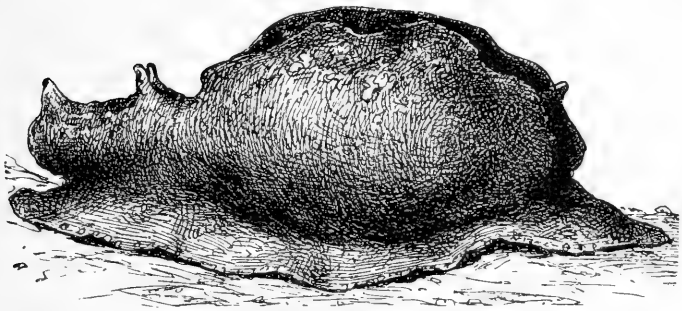


Fig. 18. *Aplysia limacina* (Sea-hare), 1/2 nat. size. p. 94.

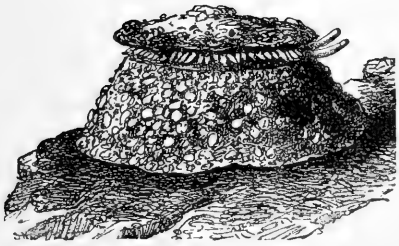


Fig. 19. *Umbrella mediterranea*, 1/2 nat. size. p. 94.

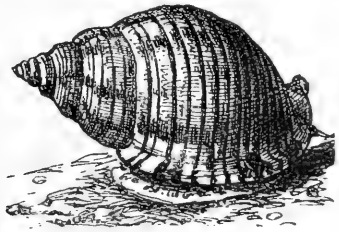


Fig. 20. *Cassis sulcosa* (Helmet-shell), 1/2 nat. size. p. 92.

Fig. 21. *Pleurobranchus testudinarius*, 1/2 nat. size. p. 94.

Fig. 22. *Natica millepunctata*, 1/2 nat. size. p. 93.

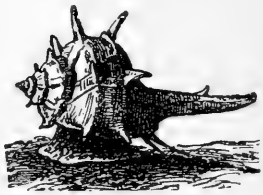


Fig. 23. *Murex brandaris*, 1/2 nat. size. p. 93.

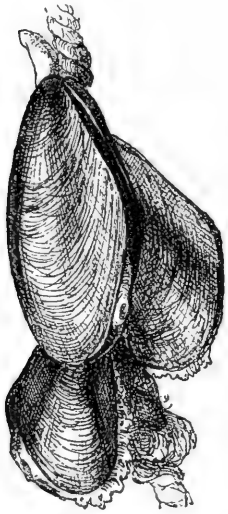


Fig. 24. Three specimens of *Mytilus galloprovincialis* (Edible Mussel), attached to a pice of rope, 1/2 nat. size. p. 97.

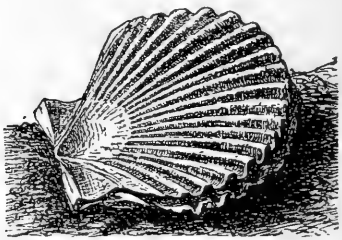


Fig. 25. *Pecten jacobaeus* (Scallop), 1/2 nat. size. p. 98.

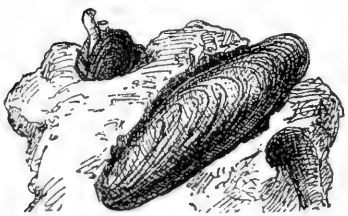


Fig. 26. Two specimens of *Lithodomus dactylus*, within a pice of tufa, 1/2 nat. size. p. 97.

Fig. 27. *Pholas dactylus* (Piddock), in a stone, 1/2 nat. size. p. 97.

Tank No. 4.

In the centre a group of **Tubicolous Worms** (sea tank 22), a foot high resembling palms. Over the whole floor are scattered *Ascidians* (Sea-squirts, p. 99), *Cynthia* (fig. 28) crimson-scarlet, sausage-shaped; the mouths of the two tubes can be seen projecting. *Phallusia* (fig. 29), knobbed white mass. *Ciona* (fig. 30), white half-transparent double tubes. Colonies of *Diazona* (fig. 31) composed of a number of separate animals.

Fishes. *Heliases* (fig. 32), small and black with deeply forked tail. **Apogon* (fig. 33), red, only in summer. *Lichia* (fig. 42), silvery.

Sea-weeds. Red algae (*Sebdenia* and *Vidalia*) like withered beech-leaves. Green alga (*Codium bursa*), dark green balls from the size of a marble to that of a melon.

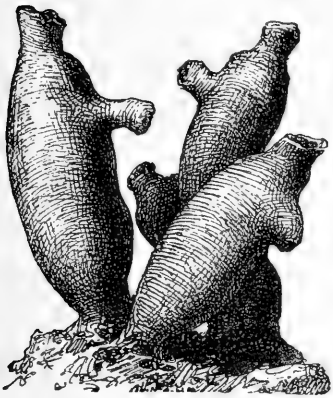


Fig. 28. Four specimens of *Cynthia papillosa*, 1/2 nat size. p. 99.

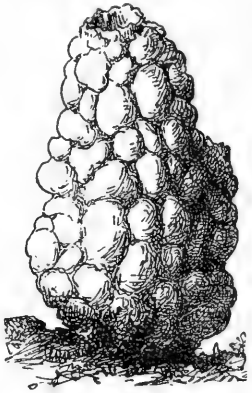


Fig. 29. *Phallusia mamillata*, 1/2 nat. size. p. 99.

Fig. 30. Four specimens of *Ciona intestinalis*, 1/2 nat. size. p. 99.

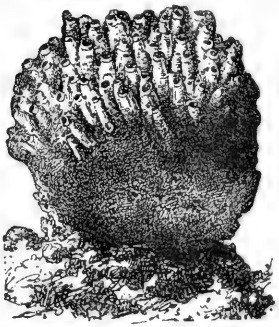


Fig. 31. A colony of *Diazona violacea*, 1/3 nat. size. p. 100.

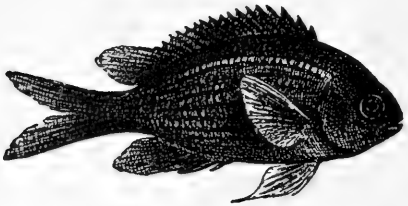


Fig. 32. *Heliases chromis*, 1/2 nat. size, p. 113.

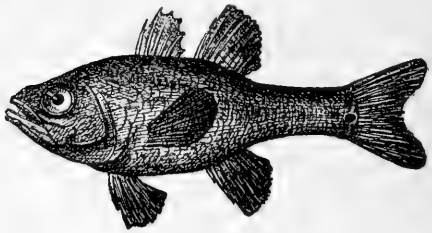


Fig. 33. *Apogon rex mullorum*, 1/2 nat. size. p. 114.

Tank No. 5.

About ten kinds of **Fishes** continuously swimming. Among these prominent by colour or size. Gilt-head (*Chrysophrys*, fig. 34), silvery, with a black smudge on each side of its head; seen from in front, a light stripe between the eyes. (Large specimens in Tank 10.) Sea-bream (Snapper, *Pagellus*, fig. 35), pale red above, bluish below. Toothed bream (*Dentex*, fig. 36), light with three or four light-brown cross stripes, heavy nose, eyes high, straight mouth with corners down, noticeably sullen and aggressive expression. Wrasse (*Labrus*, figs. 37, 39) with swollen lips. Peacock-wrasse (*Crenilabrus pavo*, fig. 38), with blue fins and tail. Black Bream (*Cantharus*, fig. 40), bluish with short mouth. Sar (*Sargus*, fig. 41), fins with dark edges.

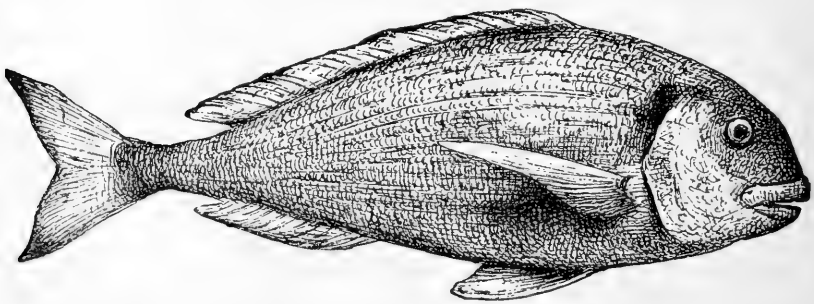


Fig. 34. *Chrysophrys aurata* (Gilt-head), 1/3 nat. size. p. 115.

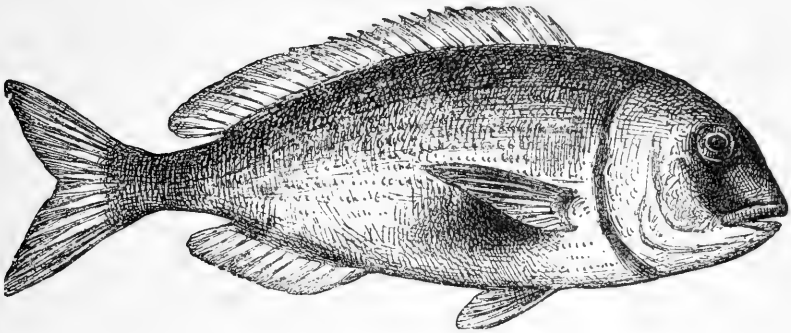


Fig. 35. *Pagellus erythrinus* (Sea-bream), 1/2 nat. size. p. 115.

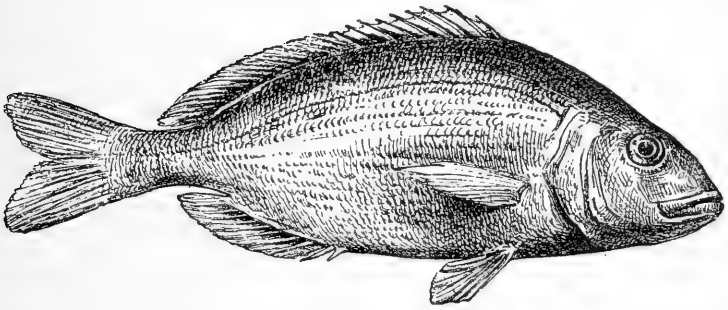


Fig. 36. *Dentex vulgaris* (Toothed Bream), 1/3 nat. size p. 115.

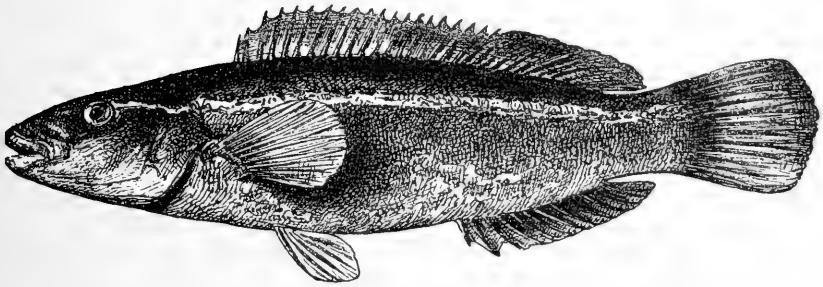


Fig. 37. *Labrus festivus* (Wrasse), 1/2 nat. size. p. 113.

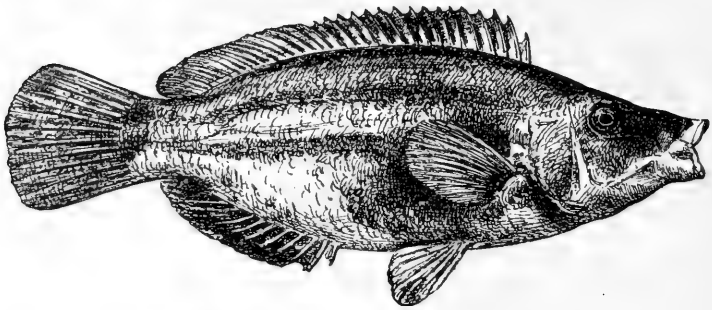


Fig. 38. *Crenilabrus pavo* (Peacock-wrasse), 1/2 nat. size. p. 113.

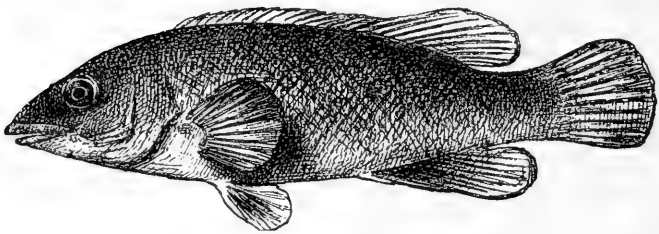


Fig. 39. *Labrus merula* (Wrasse), 1/2 nat. size. p. 113.

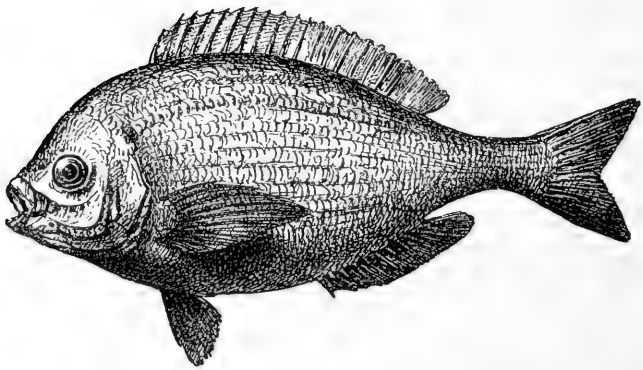


Fig. 40. *Cantharus vulgaris* (Black Bream), 1/2 nat. size. p. 115.

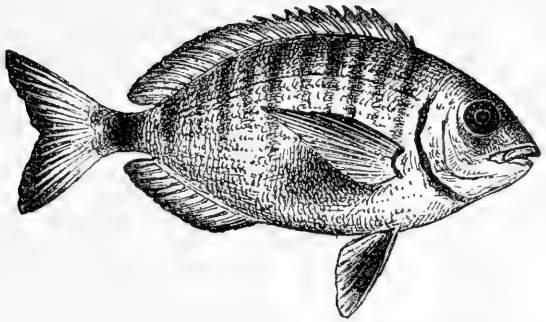


Fig. 41. *Sargus Rondeletii* (Sar), 1/3 nat. size. p. 115.

Tank No. 6.

Fishes. Sea-scorpions *(Scorpaena)*, a larger (fig. 43) and a smaller species, almost always lying still. Colouration resembling that of the stones.

Crustaceans. Lobster (*Homarus*, fig. 44).

Sea-weeds. On the stones the green alga *Codium elongatum*. The pink stone-like balls are calcareous sea-weeds (Corallinae, cp. Tank 21). The large bush-like plants are *Cystoseiren*.

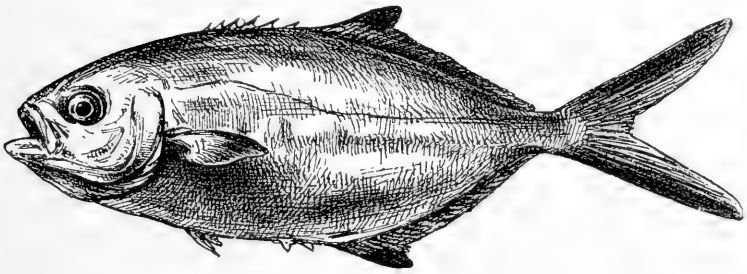


Fig. 42. *Lichia glauca*. 1/3 nat. size. p. 117.

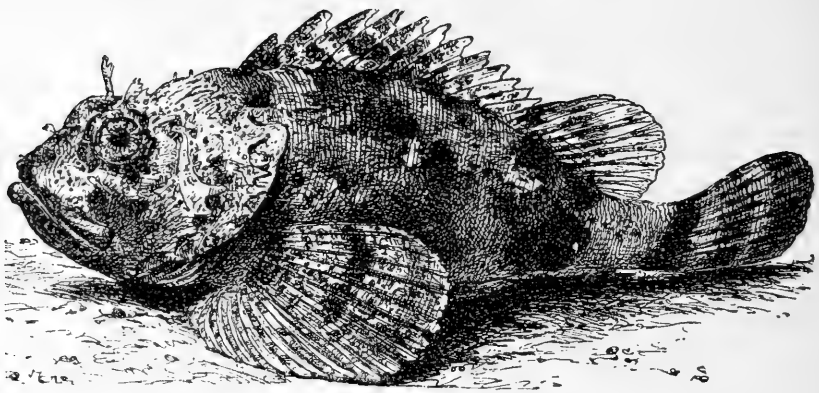


Fig. 43. *Scorpaena porcus*, 1/2 nat. size. p. 108.

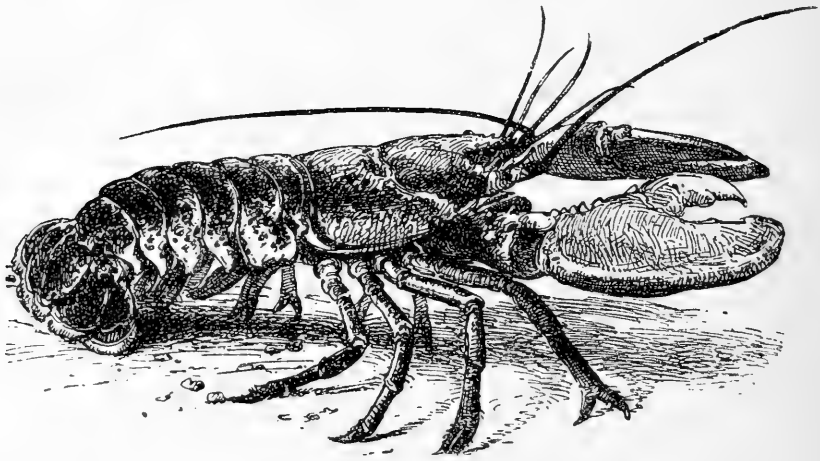


Fig. 44. *Homarus vulgaris*, (Lobster), 1/3 nat. size. p. 78.

Tank No. 7.

Fishes. Grey Mullet (*Mugil*, fig. 45), slender and silvery, the underlip shaped like a W. *Umbrina* (fig. 48), dark with light undulating stripes.

Crustaceans (p. 78). Crawfish or Spiny-lobster (*Palinurus*, fig. 47), like a lobster without large pinching claws. Note the constant movements of feelers and mouth-parts. The eyes are placed on moveable stalks and can be retracted into recesses on the head. Flat-lobster (*Scyllarus*, fig. 46), lobster-like, with short flat legs and claws.

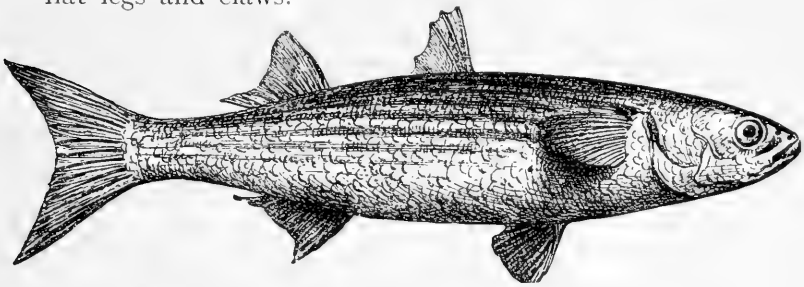


Fig. 45. *Mugil cephalus* (Grey Mullet), 1/2 nat. size. p. 114.

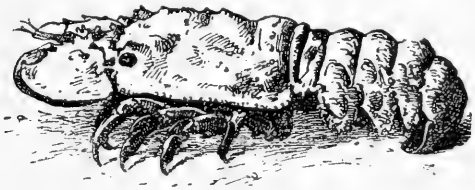


Fig. 46. *Scyllarus latus* (Flat-lobster), 1/2 nat. size. p. 81.

Fig. 47. *Palinurus vulgaris* (Crawfish), 1/3 nat. size. p. 80.

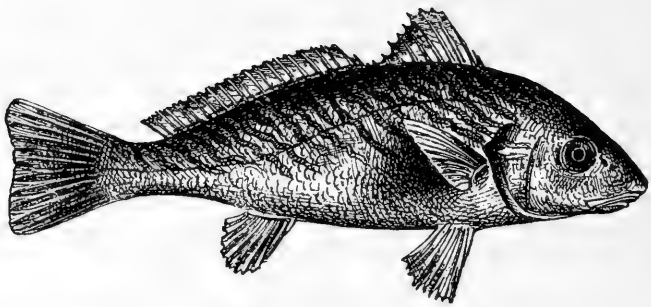


Fig. 48. *Umbrina cirrossa*, 1/3 nat. size. p. 115.

Tank No. 8.

Sea-anemones (p. 63). The larger ones are the Opelet (*Anemonia*, fig. 49).

Fig. 49. *Anemonia sulcata*, 1/2 nat. size. On the right is the rock to which it is attached. p. 64.

Tank No. 9.

Sea-anemones. In the foreground (isolated) the crimson-purple *Cereactis* (fig. 53), and other kinds.

Corals. In the background the orange-coloured colonies of *Astroides* (fig. 52).

Fishes. *Cuckoo (*Capros*, fig. 50), oval, red little fish. *Trumpeter (*Centriscus*, fig. 51), with long snout and back-thorn. *Anthias*, delicate pink, tail crescent-shaped, fins very large, almost transparent.

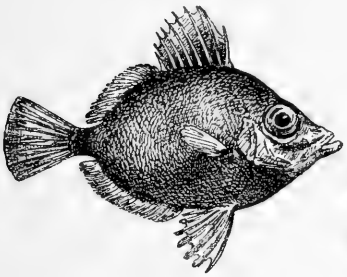


Fig. 50. *Capros aper* (Cuckoo), 1/2 nat. size. p. 116.

Fig. 51. *Centriscus scolopax* (Trumpeter), 1/2 nat. size. p. 116.

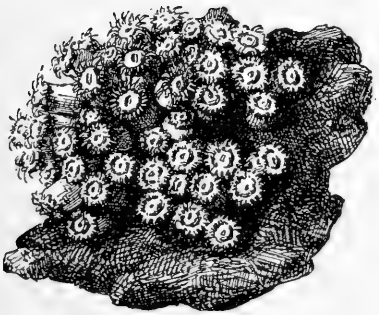


Fig. 52. Colony of *Astroides calycularis*, 1/2 nat. size. On the right is the rock to which it is attached. p. 65.

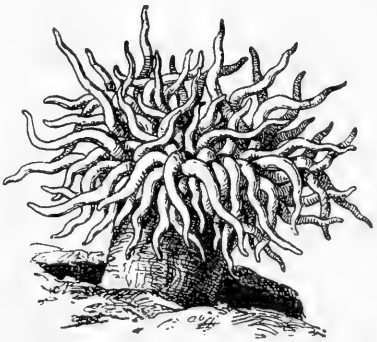


Fig. 53. *Cereactis aurantiaca*, projecting out of the sand, 1/2 nat. size. p. 64.

Tank No. 10.

It contains the large kinds of **Fishes.** The following are conspicuous. The Sea-Perch (*Serranus*, fig. 56) heavy, often motionless for a long time in mid-water or in the stream of entering water and air-bubbles, and frequently in characteristic sloping position; reddish-brown, mottled white, no silver. Bass (*Labrax*, fig. 54), salmon-shaped, with silver scales. Sea-Crow (*Corvina*, fig. 55), dark, with dark lower fins. Gilthead (*Chrysophrys*, fig. 34), oval and blunt-headed, with white marks over the eyes (effect of light in this tank) and black splotches on the sides of the neck (see Tank 5). The Angler-Fish (*Lophius*, fig. 57), lying always on the ground; brown and ragged with tufts like sea-weed and with enormous jaws. Conger-eel (*Conger*, fig. 58), four or five feet long and eel-shaped. Dog-fishes and Sharks, with the mouth under the head and five gill-slits on each side of the neck; moving with a lithe motion. Smooth-hound (*Mustelus*, fig. 59), a small grey shark. Spotted Dog-fish (*Scyllium*, fig. 60), generally heaped on the bottom against the glass. Sting-ray (*Trygon*, fig. 62), with black wings and long black tail. Angel-fish (*Squatina*, fig. 61), big and grey.

Reptiles. Turtle (*Thalassochelys*, fig. 63).

On a dead coral-branch near the right wall of the tank hang one or more Dog-fish eggs.

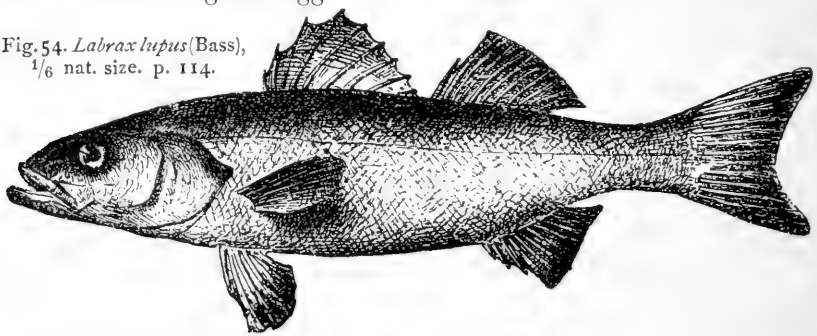


Fig. 54. *Labrax lupus* (Bass), 1/6 nat. size. p. 114.

Fig. 55. *Corvina nigra* (Sea-crow), 1/3 nat. size. p. 115.

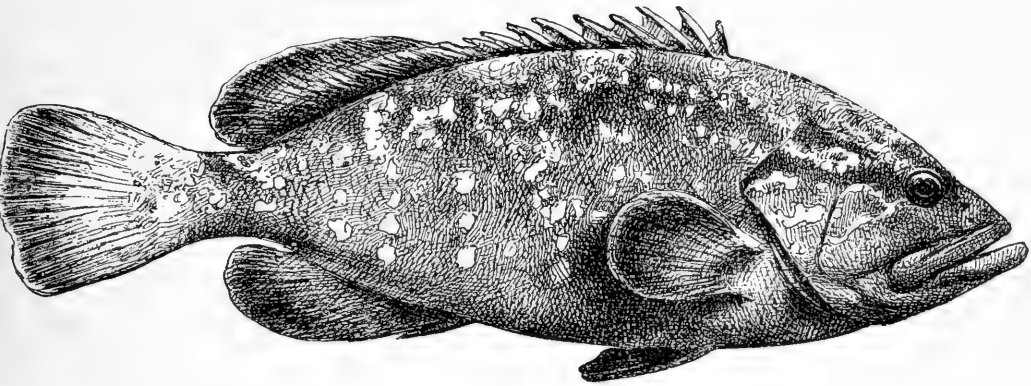


Fig. 56. *Serranus gigas* 1/4 nat. size. p. 113.

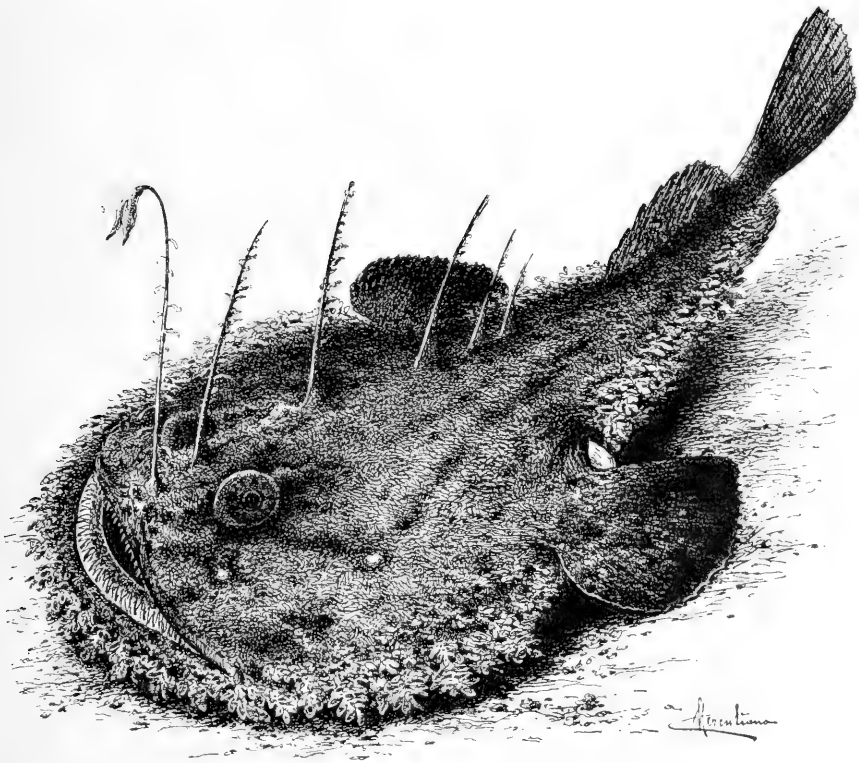


Fig. 57. *Lophius piscatorius* (Angler-fish), 1/3 nat. size. p. 107.

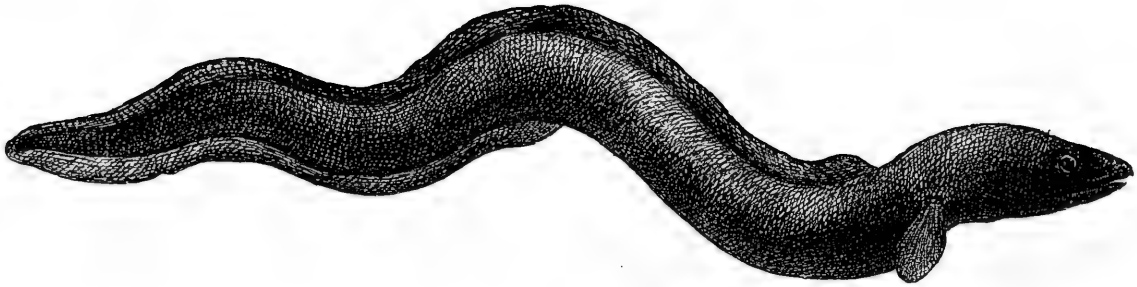


Fig. 58. *Conger vulgaris* (Conger), 1/5 nat. size. p. 110

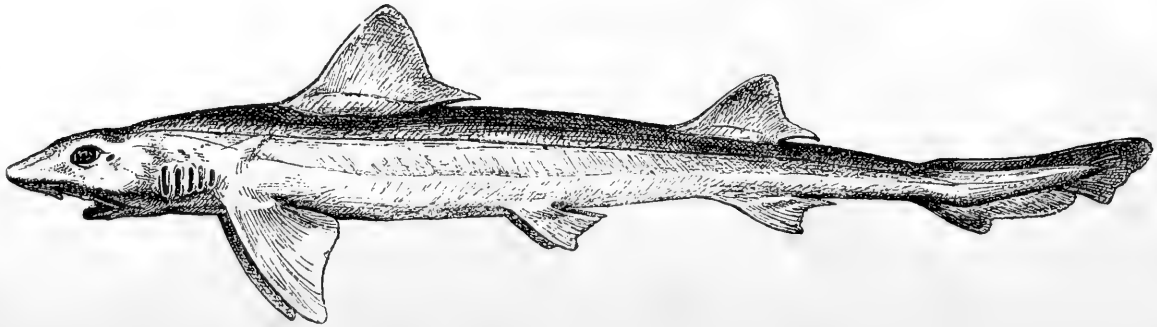


Fig. 59. *Mustelus vulgaris* (Smooth-hound), 1/6 nat. size. p. 105

Fig. 60. *Scyllium catulus* (Spotted Dog-fish), 1/6 nat. size. p. 104.

Fig. 61. *Squatina angelus* (Angel-fish), 1/10 nat. size. p. 105.

Fig. 62. *Trygon violaceus* (Sting-ray, 1/5 nat. size. p. 106.

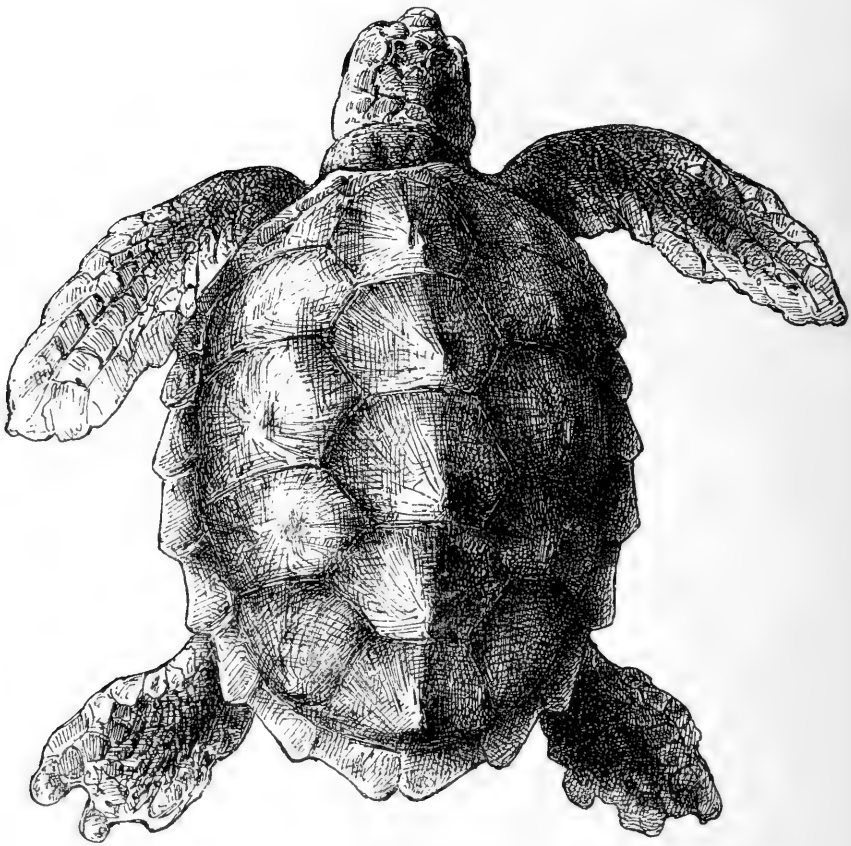


Fig. 63. *Thalassochelys corticata* (Caouana), 1/6 nat. size. p. 117.

In the small open

Tank No. 10a.

in front of Tank 10, lying on or half buried in the shingle, is an **Electric Ray** (*Torpedo*, fig. 64) from which shocks may be taken. The fingers should be placed under the broad part of the body, the thumb above, and the animal squeezed and lifted up. Frequently among the shingle are small white pointed objects, about two inches long, looking not unlike split sardines. These are **Lancelets** (*Amphioxus*, fig. 65), the lowest of Vertebrates.

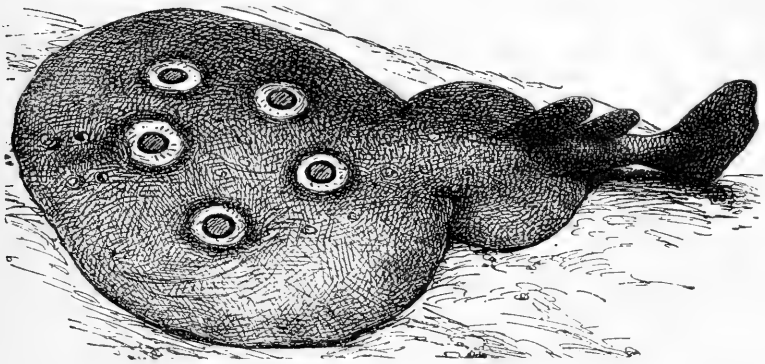


Fig. 64. *Torpedo ocellata* (Electric Ray), 1/3 nat. size. p. 105.

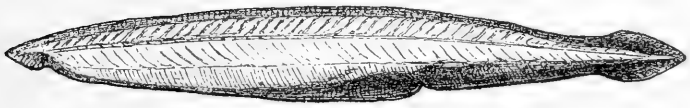


Fig. 65. *Amphioxus lanceolatus* (Lancelet), twice nat. size. p. 101.

Tank No. 11.

Fishes. Coiling among old pottery both the Roman Eel (*Muraena*, fig. 66), with fine markings, and the Conger (*Conger*, fig. 58), dark-coloured.

Fig. 66. *Murena helena* (Roman Eel), 1/4 nat. size. p. 110.

Tank No. 12.

Fishes. Several species of Skates (*Raja*, fig. 67) and Electric Rays (*Torpedo*, fig. 64). Both of these are flat and nearly hidden in the sand; the skate grey with pointed snout, the electric ray brown, one species (*ocelata*) with five large spots and semi-circular head. Also young Dog-fish (*Scyllium*, fig. 60). On the sand are small Gobies (fig. 68) in constant movement, which serve as food for the skates and rays.

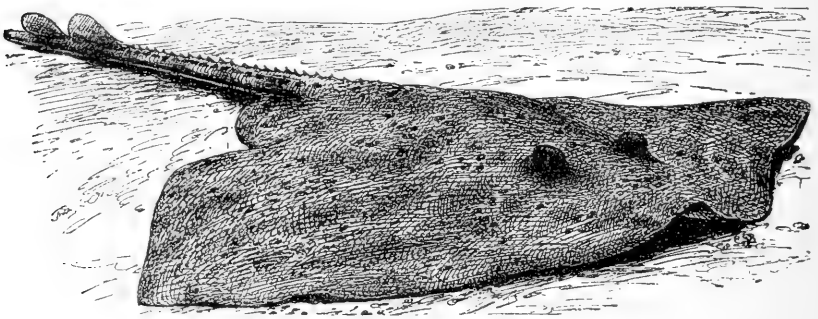


Fig. 67. *Raja punctata* (Skate), 1/3 nat. size. p. 106.

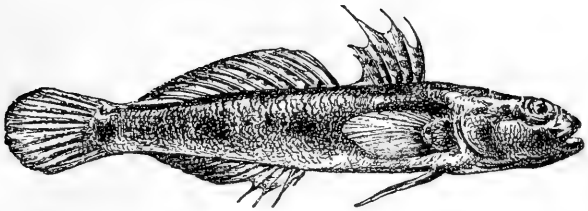


Fig. 68. *Gobius paganellus* (Goby), 1/2 nat. size. p. 109.

Tank No. 13.

Fishes. *File-fish (*Balistes*, fig. 69), oval and laterally compressed.

Crustaceans. Spider-crabs, the large *Maja* (fig. 70) and a small kind disguised with sea-weeds etc.

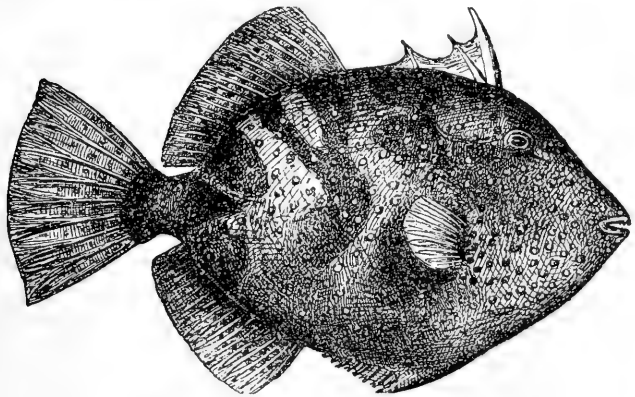


Fig. 69. *Balistes capriscus* (File-fish), 1/2 nat. size. p. 116.

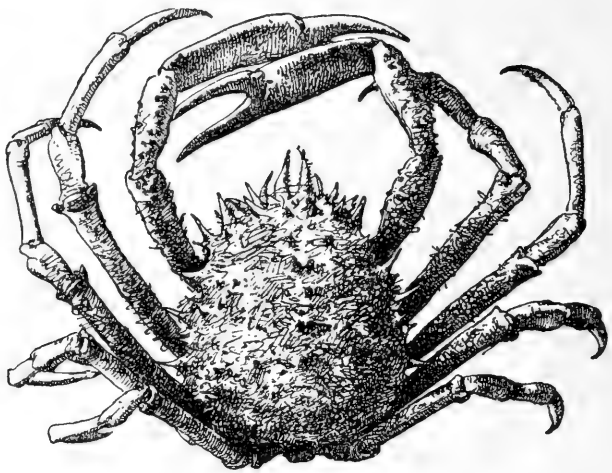


Fig. 70. *Maja squinado* (Spider-crab), 1/2 nat. size. p. 84.

Tank No. 14.

Fishes. Small kind of *Serranus*, e. g. Lettered-perch (fig. 71), with cross-bands of brown and silver.

The plants (*Posidonia Caulini*) are not true sea-weeds (Algæ) but a kind of flowering plant.

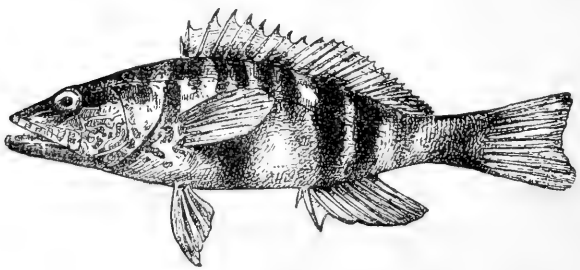
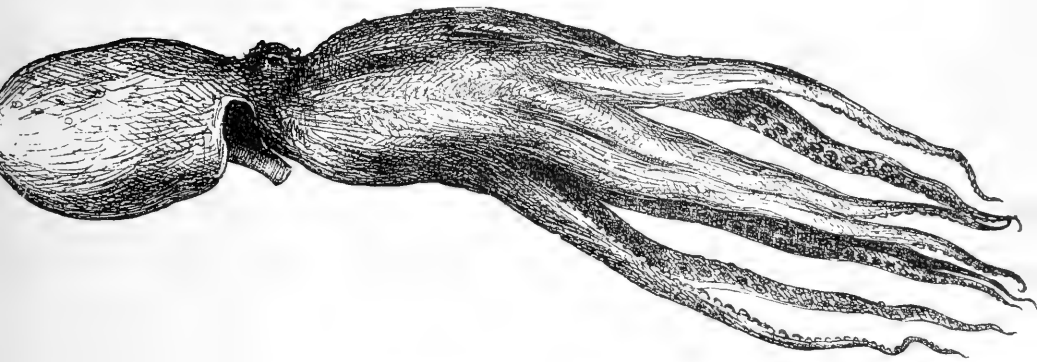
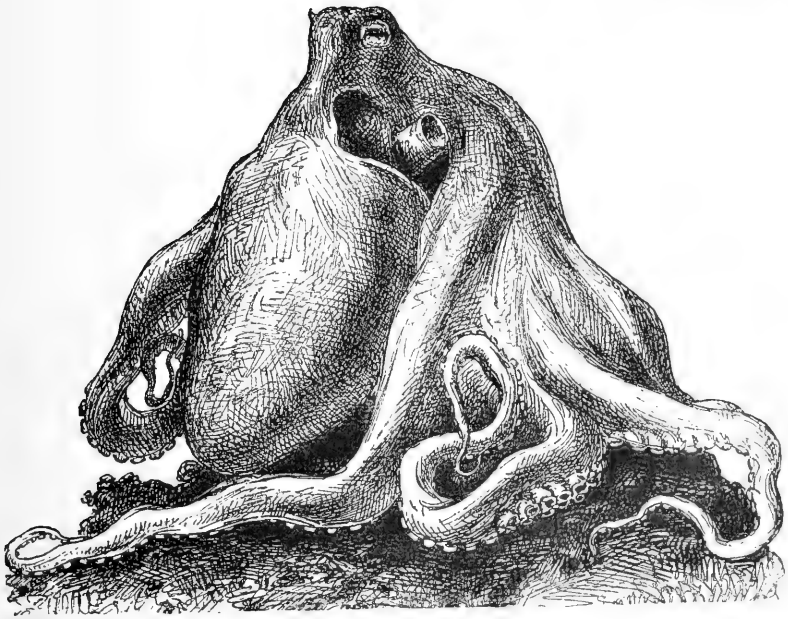


Fig. 71. *Serranus scriba* (Lettered-perch), 1/2 nat. size. p. 114.

Tank No. 15.

Octopus, with eight suckered arms (figs. 72 and 73). The mouth is concealed under the arms. On request the attendant will feed the animals with crabs.





Figs. 72. and 73. *Octopus vulgaris*, swimming and on a stone, 1/3 nat. size. p. 89.

Tank No. 16.

Fishes. Red mullet (*Mullus*, fig. 74), usually groping around on the sand with the two feelers. Swimming freely is *Smaris* (fig. 75), light brown, with a black spot on either side behind the breast-fin.

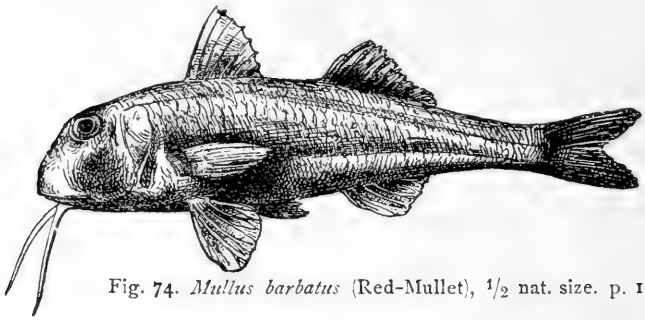


Fig. 74. *Mullus barbatus* (Red-Mullet), 1/2 nat. size. p. 110.

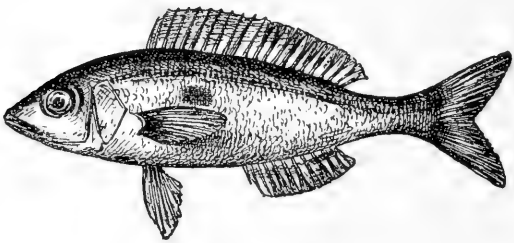


Fig. 75. *Smaris alcedo*, 1/2 nat. size. p. 115.

Tank No. 17, 18.

Fishes. On the sand the Gurnard (*Trigla*, fig. 76), walking on six finger-like processes, which are detached rays of the fin. *Flying Gurnard (*Dactylopterus*, fig. 77), reddish with large wing-like fins.

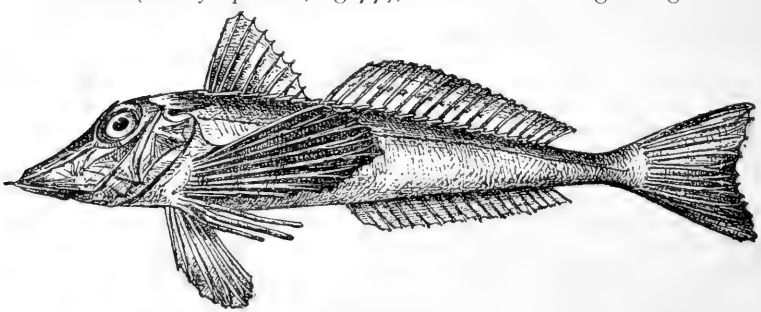


Fig. 76. *Trigla lyra* (Gurnard), 1/2 nat. size. p. 109.

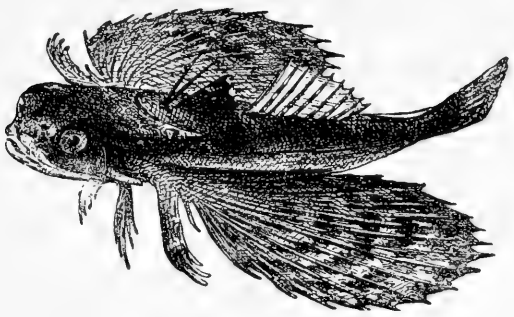


Fig. 77. *Dactylopterus volitans* (Flying-gurnard), 1/2 nat. size. p. 110.

Tank No. 19.

Cuttlefish (*Sepia*, p. 90, fig. 78). Like the Octopus and Squid these are molluscs. Four to ten inches long and half as broad, in shape like a small, big-headed, heavily-made fish. They may be floating, but generally lie in corners on the sand which they resemble in colour. The dirty colour of the water is due to the ink they squirt out when disturbed.

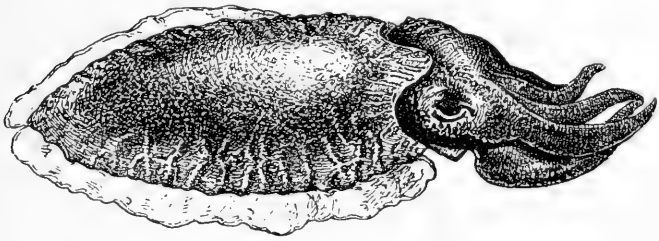


Fig. 78. *Sepia officinalis* (Cuttlefish), 1/2 nat. size. p. 90.

Tank No. 20.

Pelagic Animals (see Note on p. 57). These show best in bright sunshine (from noon to two); many do not live long, and the tank is richest after a calm dull day. The more delicate are in wide glass cylinders, to prevent injury from the stream of water. There may be present:

Jelly fish. A. Medusae (p. 68). *Carmarina* (fig. 79), two or three inches long, umbrella-shaped, perfectly transparent. *Pelagia* (fig. 80), white with numerous spots. *Olindias* (fig. 81). *Tima* (fig. 82). *Rhizostoma* (fig. 83), a white globe with a violet border and a swelling violet and white stalk. *Cotylorhiza* (fig. 84), from September to January; nearly a foot across.

B. Ctenophora (p. 71), have each eight ribs of moving paddles, which give the effect of running beads of light with rainbow colours. Beroë (fig. 85), one to three inches long, shaped like a bishop's mitre; a most delicate pink. *Eucharis* (fig. 86), much broader base with rounded projections, quite transparent. *Callianira* (fig. 87), small with long tentacles. Venus' Girdle (*Cestus*, fig. 88), a transparent ribbon about an inch broad.

C. Siphonophora (p. 70), generally like transparent filmy flowers on a central stalk: *Physophora* (fig. 89), *Forskalia* (fig. 92), *Velella* (fig. 91), *Hippopodius* (fig. 90), etc.

Tunicates (p. 99). Salps, partly smaller animals united together in a chain (figs. 93 and 94), and partly single larger individuals (fig. 95). Each animal is a transparent swimming barrel, the globular brown kernel at one end being the intestines etc. **Pyrosoma* (fig. 96), a transparent frothy cylinder up to eight inches by three.

Molluscs. A. Heteropods (p. 95). *Pterotrachea* (fig. 97), has a long proboscis and sculls itself rapidly on its back. Somewhat similar is the allied *Carinaria* (fig. 98), less transparent and with a small shell. B. Pteropods (Sea-butterflies, p. 95), flap a pair of transparent wings (*Hyalea*, fig. 99).

Besides these pelagic animals there are outside the cylinders various small *Octopods* (p. 89) and crawling Molluscs, such as **Doris* (fig. 100), as large as a thumb, a tuft at one end, **Aeolis* (fig. 101), **Tethys* (fig. 102), as large as a hand, spotted with red and brown.

Of **Crustaceans** various kinds of shrimps (see Tank 23).

Fig. 79. *Carmarina hastata*, 1/2 nat. size. p. 68.

Fig. 80. *Pelagia noctiluca*, 1/3 nat. size. p. 68.

Fig. 81. *Olindias Müllerii*, 1/2 nat. size. p. 68.

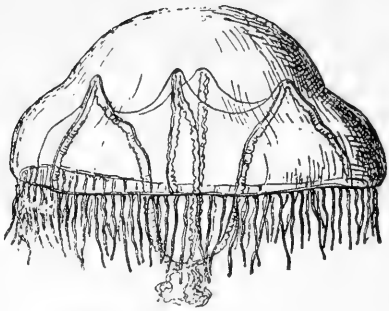


Fig. 82. *Tima flavilabris*, 1/2 nat. size. p. 68.

Fig. 83. *Rhizostoma pulmo*, small specimen. p. 68.

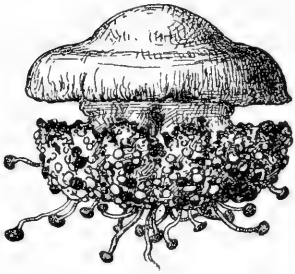


Fig. 84. *Cotylorhiza borbonica*, 1/3 nat. size. p. 68.

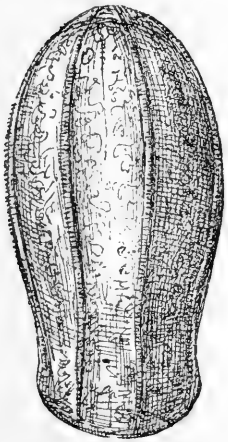


Fig. 85. *Beroë ovata*, 1/2 nat. size. p. 71.

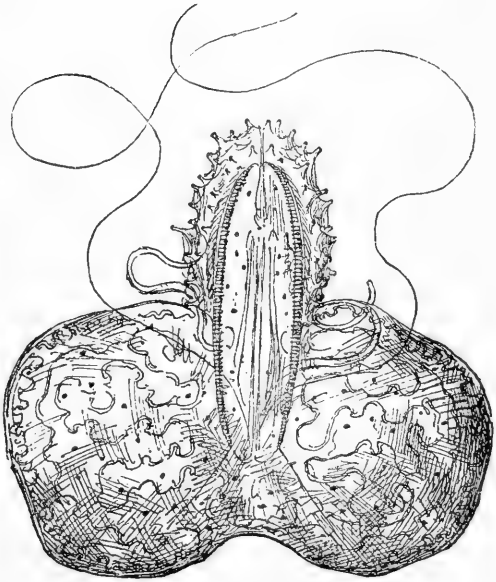


Fig. 86. *Eucharis multicornis*, 1/2 nat. size. p. 71.

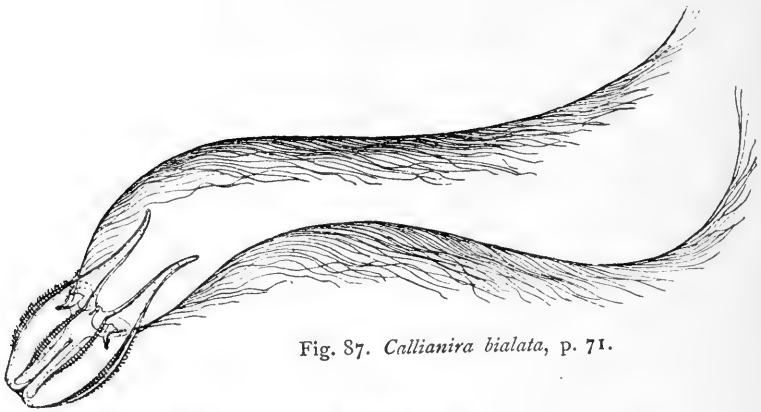


Fig. 87. *Callianira bialata*, p. 71.

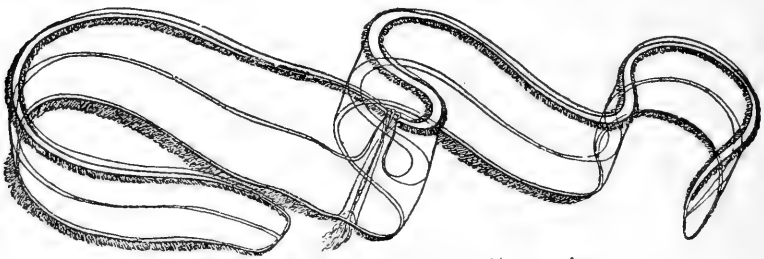


Fig. 88. *Cestus veneris* (Venus' Girdle), 1/2 nat. size. p. 71.

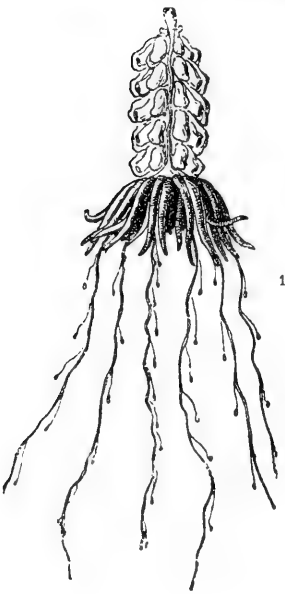


Fig. 89. *Physophora hydrostatica*, 1/2 nat. size, p. 70.

Fig. 90. *Hippopodius neapolitanus* p. 70.

Fig. 91. *Velella spirans*. p. 70.

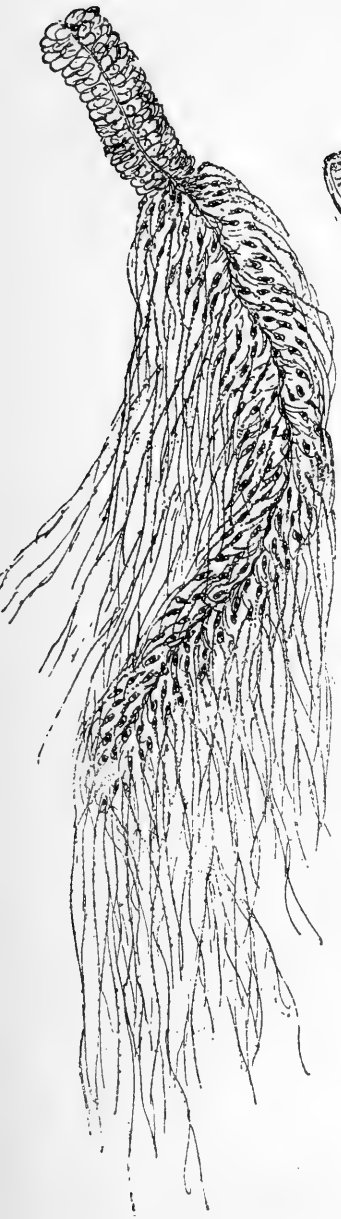


Fig. 92.
Forkalia contorta. p. 70.

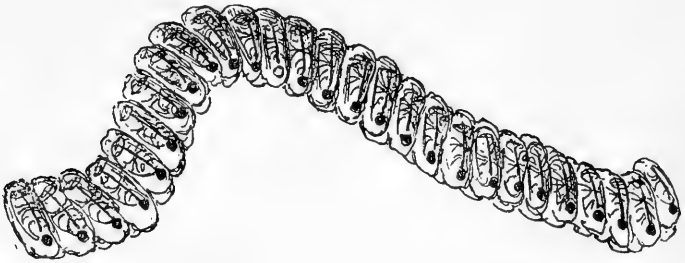


Fig. 93. Chain of *Salpa maxima-africana*,
1/2 nat. size. p. 101.

Fig. 94. Chain of *Salpa pinnata*,
1/2 nat. size. p. 100.

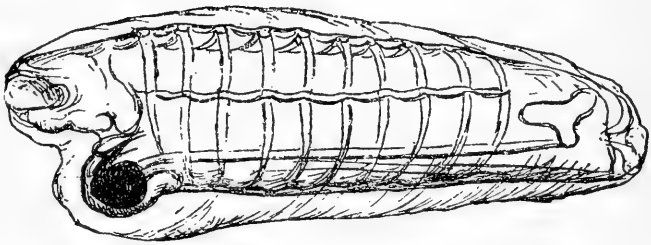


Fig. 95. Single individual of *Salpa maxima-africana*,
1/2 nat. size. p. 101.

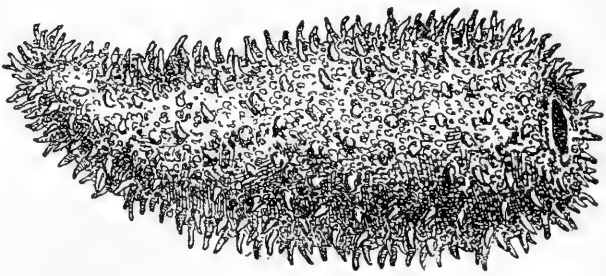


Fig. 96. *Pyrosoma elegans*,
1/2 nat. size. p. 100.

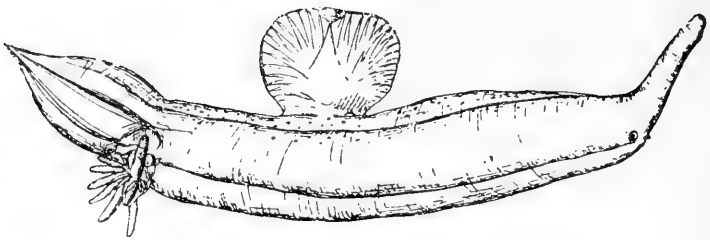


Fig. 97. *Pterotrachea coronata*, 1/2 nat. size. p. 95.

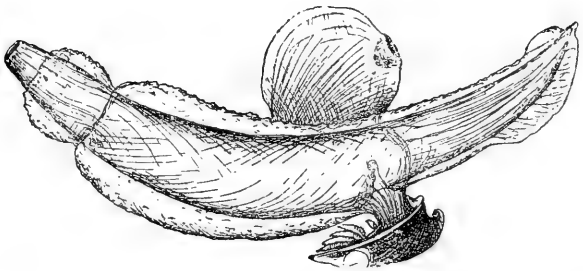


Fig. 98. *Carinaria mediterranea*, 1/2 nat. size. p. 95.

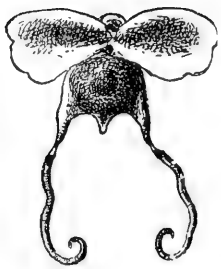


Fig. 99. *Hyalea tridentata*. p. 99.

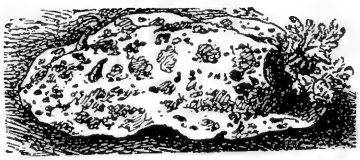


Fig. 100. *Doris tuberculata*, 1/2 nat. size. p. 95.

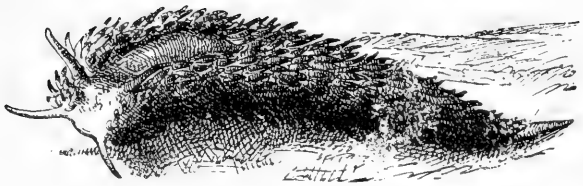


Fig. 101. *Aeolis papillosa*, p. 95.

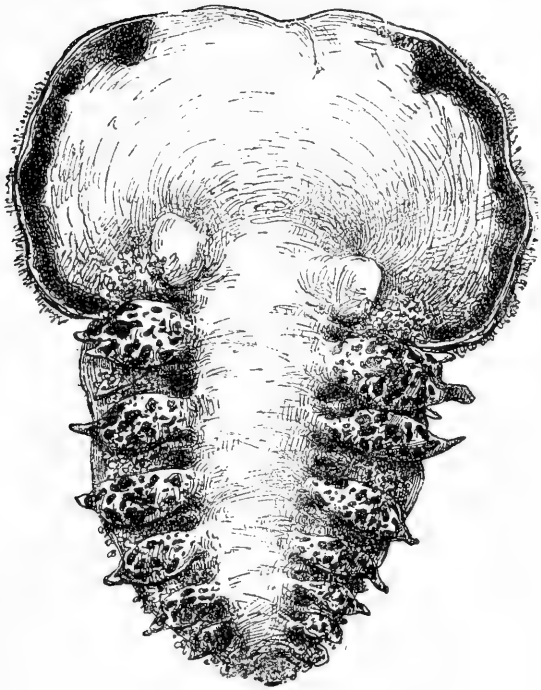


Fig. 102. *Tethys leporina*, 1/2 nat. size. p. 94.

Tank No. 21.

Fishes. On a dead *Gorgonia*-stem, a Dog-fish egg, with the embryo moving inside.

Fleshy Corals (p. 66). On the bottom, thick pink and white branches of "Dead-mens' fingers" (*Alcyonium*, fig. 104); Seapen (*Pennatula*, fig. 103), pink, like a swollen ostrich plume. Both of these can absorb water, thereby swelling up and extending.

Hard Corals (p. 65). White Coral (*Isis*, fig. 105). In the background, above, Black Coral (*Antipathes*, fig. 106). *Dendrophyllia*, thickish grey branches with bright yellow tops (fig. 107). Red Coral (*Corallium*, fig. 108), stem red, polyps white; this is the coral used in jewellery. Sea-Fan (*Gorgonia*, fig. 109), fan-like, red branches, in the background.

Sea-anemones (p. 63). *Alicia* (fig. 110).

Hydroid-polypes (p. 69). Delicate soft feathery tufts: *Antennularia* (fig. 111); *Aglaophenia* (fig. 112); *Pennaria* (fig. 113); *Tubularia* (fig. 114).

Polyzoa (p. 78). *Retepora* (fig. 115); *Myriozoum* (fig. 116).

Sponges (p. 61). In the foreground the toilet-sponge (*Euspongia*, fig. 117), inconspicuous, grey or brown colour, velvety surface, a few large holes; *Tethya* (fig. 118) on the sand, like a rough Tangerine orange. *Axinella* (fig. 119), red branches, thicker and more irregular than the coral *Gorgonia*. Other kinds, white brown or pink, bowl-shaped, or finger-shaped, on the rocks.

Sea-weeds. Red algæ: *Vidalia*, brown fronds. Green algæ: *Valonia*, glistening green ball-like bubbles, and *Dasycladus*. Yellow or bright red corallines (*Lithophyllum*, etc.), hard and calcareous and therefore resembling incrustations and stones.

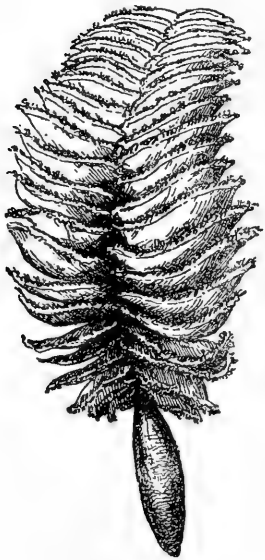


Fig. 103. *Pennatula phosphorea* (Sea-pen) in extended condition, 1/2 nat. size. p. 66.

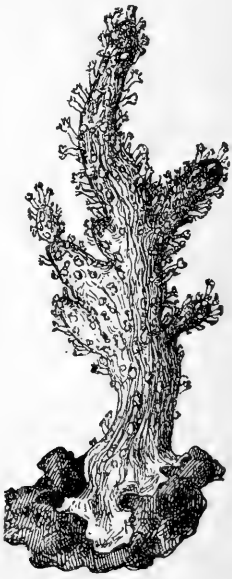


Fig. 104. *Alcyonium palmatum* (Deadmen's fingers) with expanded polypes, 1/2 nat. size. p. 66.

Fig. 105. *Isis neapolitana* (White Coral), on a stone, with expanded polypes. The bark has died off at the lower end and the skeleton is therefore visible. 1/2 nat. size. p. 66.

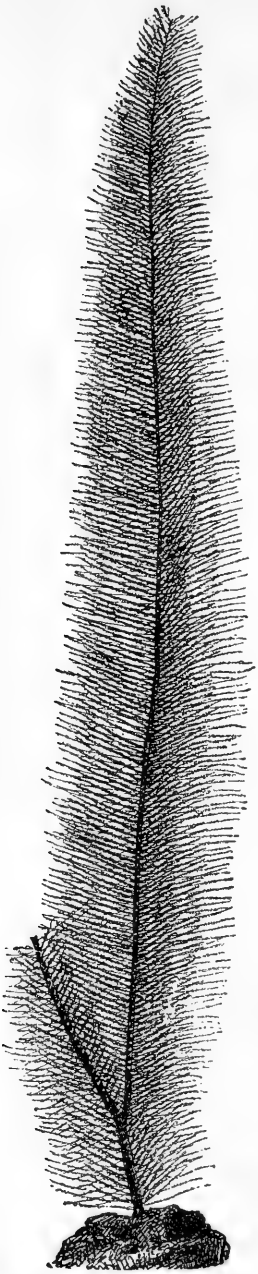


Fig. 106. *Antipathes larix* (Black Coral), attached to a stone, 1/2 nat. size.

Fig. 107. *Dendrophyllia ramea*.
1/2 nat. size.
The branch projects from a stone and bears two living and three dead individuals (polypes). p. 65.

Fig. 108. *Corallium rubrum* (Red Coral), on a stone, with expanded polypes,
1/2 nat. size. p. 66.

Fig. 109. *Gorgonia verrucosa* Sea-fan), on a stone,
1/2 nat. size.
Some of the polypes are expanded.

Fig. 110. *Alicia Costae*, attached to a stone,
1/2 nat. size. p. 64.

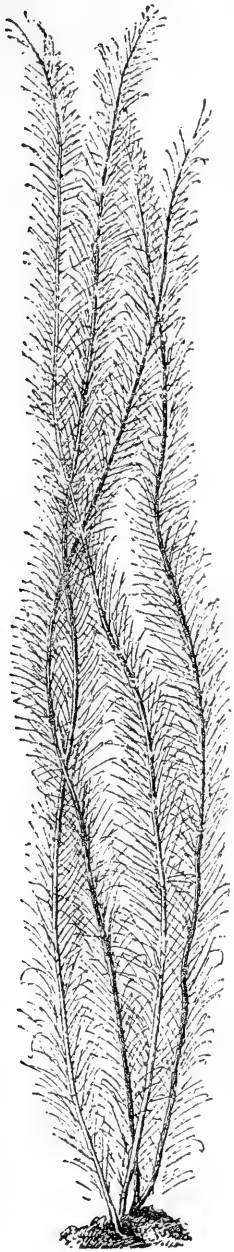


Fig. 111.
Antennularia antennina,
p. 69.

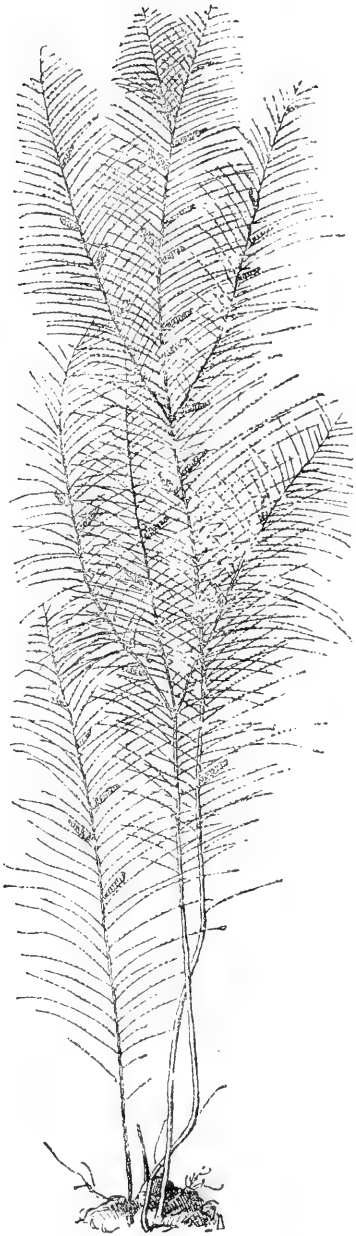


Fig. 112.
Aglaophenia myriophyllum
p. 69.

Fig. 113. *Pennaria Cavolinii.* p. 69.

Fig. 114. *Tubularia larynx.* p. 69.

Fig. 115. *Retepora cellulosa,* 1/2 nat. size. p. 78.

Fig. 116. *Myriozoum truncatum.* 1/2 nat. size. p. 78.

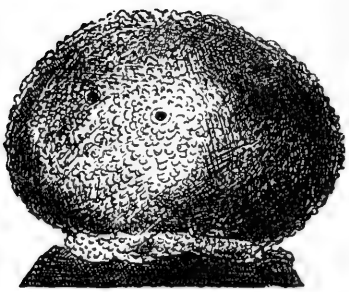


Fig. 117. *Euspongia officinalis* (Toilet sponge) attached to a stone. In its living state, 1/2 nat. size. p. 62.

Fig. 118. *Tethya lyncurium* on a stone. p. 62.

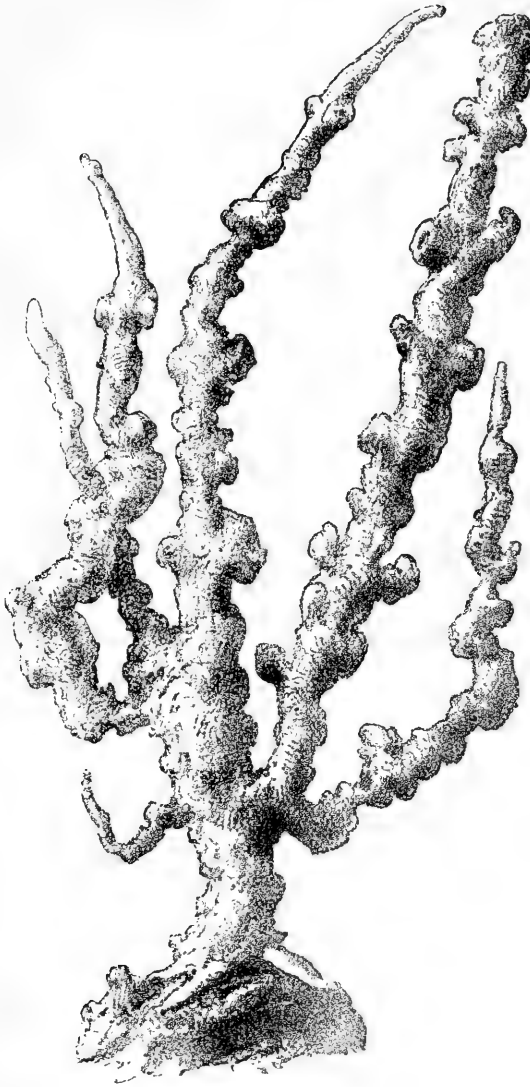


Fig. 119. *Axinella faveolaria* on a stone,
1/2 nat. size. p. 62.

Tank No. 22.

Ringed Worms (p. 76). *Spirographis* (fig. 120) in straight tubes composed of hardened slime, with palm-like crown of gills. The red feathers on coiling white tubes are *Protula* (fig. 121). *Hydroides*, smaller and always massed together (fig. 122). Sea-mouse (*Aphrodite*, fig. 130) crawling on the sand.

Molluscs. A. Snails (p. 92). Worm-shell (*Vermetus*, fig. 123) resembling the worm *Protula*, but easily distinguishable by its two feelers. Ear-shell (*Haliotis*, fig. 125) on the sand.

B. Bivalves (p. 95). Oysters (*Ostrea*, fig. 124); *Avicula* (fig. 126); *Pinna* (fig. 127), horny-looking, ragged; etc.

Sea-anemones (p. 63). *Cerianthus* (fig. 128) large, grass-green or brown. Also other kinds.

Crustaceans (p. 78). Sometimes hanging down from floating wood or pumice the * Goose-barnacle (*Lepas*, fig. 129). Crawling on the sand or half hidden in it **Penaeus* (fig. 132) and * *Stenopus* (fig. 131).

Plants as in Tank 21.

On request the attendant will drive the Tube-worms back into their tubes.

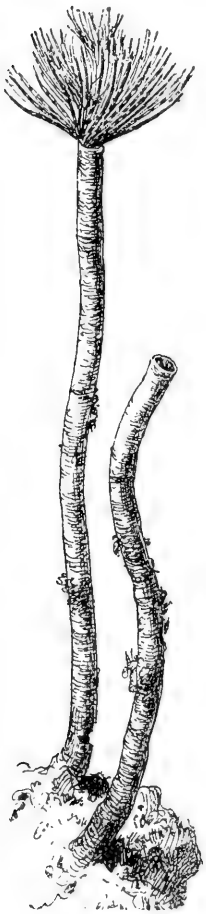


Fig. 120. *Spirographis Spallanzanii*, 1/2 nat. size. p. 76.

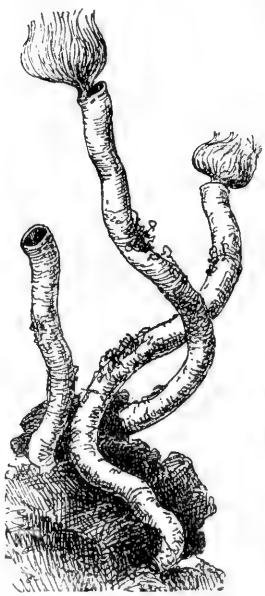


Fig. 121. *Protula intestinum*, 1/2 nat. size. p. 76.

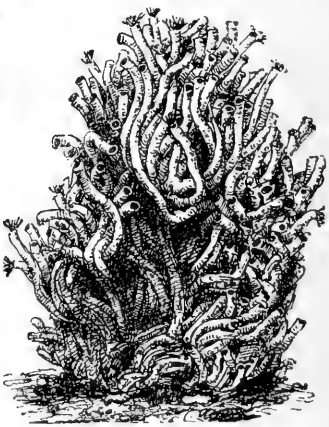


Fig. 122. *Hydroides uncinata*. p. 76.

Fig. 123. *Vermetus gigas* (Worm-shell), wo living specimens and one empty shell, 1/2 nat. size. p. 93.

Fig. 124. Two specimens of *Ostrea edulis* (Oyster) on a stone, 1/2 nat. size. p. 96.

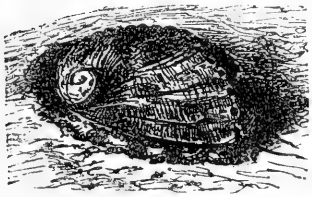


Fig. 125. *Haliotis tuberculata* (Ear-shell), 1/2 nat. size. p. 92.

Fig. 126. Four specimens of *Avicula hirundo* attached to a stone, 1/2 nat. size. p. 97.

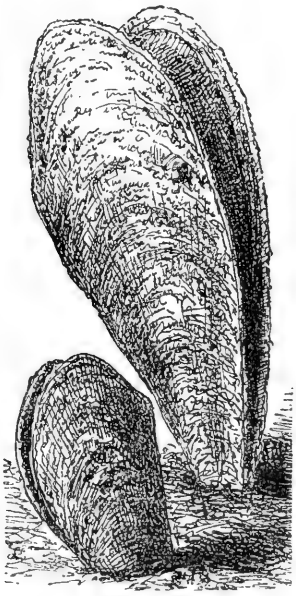


Fig. 127. Two specimens of *Pinna nobilis* partly buried in the sand, 1/4 nat. size. p. 97.

Fig. 128. *Cerianthus membranaceus*, 1/4 nat. size. p. 64.

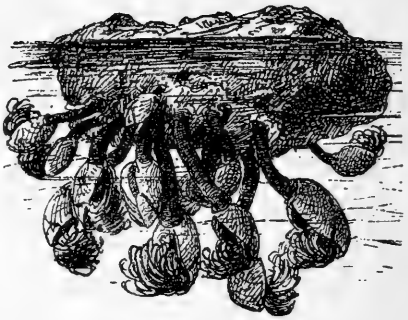


Fig. 129. *Lepas anatifera* (Goose-barnacle) hanging to a floating piece of pumice stone, 1/2 nat. size. p. 88.

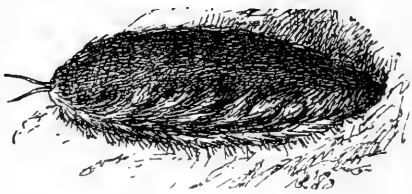


Fig. 130. *Aphrodite aculeata* (Sea-mouse), 1/2 nat. size. p. 77.

Fig. 131. *Stenopus spinosus*, 1/2 nat. size. p. 81.

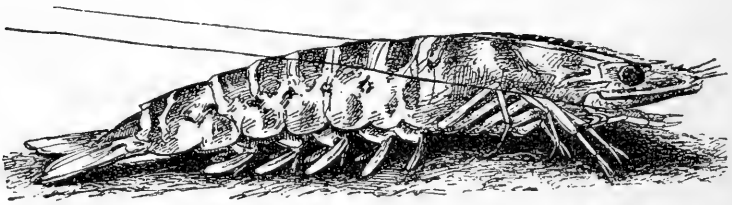


Fig. 132. *Penaeus caramote*, 1/2 nat. size. p. 81.

Tank No. 23.

Mostly small **Crustaceans.**

Short-tailed (p. 84). *Ilia* (fig. 133), small and round. The Bashful Crab (*Calappa*, fig. 134), half-globular, with reddish spots, legs yellow and very thin, often hidden in the sand. *Lupa* (fig. 135). The Common Green Crab (*Carcinus*, fig. 136), runs nimbly. *Eriphia* (fig. 137), large and powerful. Four-horned Spider Crab (*Lissa*, fig. 138). Scorpion Spider Crab (*Inachus*, fig. 139) with long slender legs which are frequently overgrown with sponges, weeds, etc. *Lambrus* (fig. 140), with long, sideways claws. *Dromia* (fig. 141), carrying about large orange or white sponges (*Suberites*). *Dorippe* (fig. 142), very flat. Several other speices as well.

Hermit-Crabs (p. 81), which walk around with their soft tail inside an old mollusc-shell for protection. *Pagurus* (fig. 143), mostly with big sea-anemones on the mollusc-shell; *Eupagurus* (fig. 144), much smaller, with one anemone. Also hermit-crabs whose shell is quite overgrown by a red sponge.

Long-tailed (p. 78). Prawn (*Palaemon*, fig. 145) light with brown stripes, very alert.

Mantis-Prawn (*Squilla*, fig. 146), with two purple eye-spots on the tail.

Fig. 133. *Ilia nucleus*, 1/2 nat. size. p. 85.

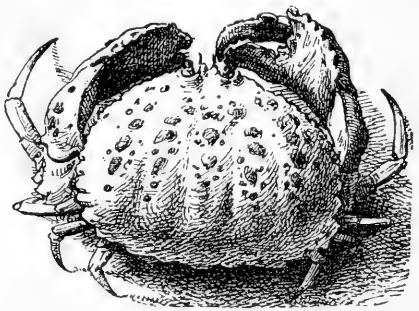


Fig. 134. *Calappa granulata* (Bashful-crab), 1/2 nat. size. p. 85.

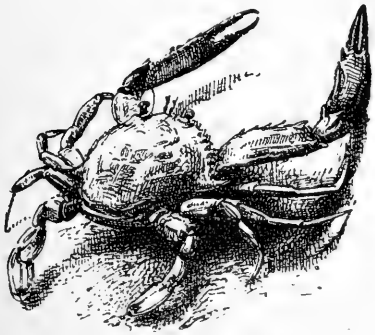


Fig. 135. *Lupa hastata*, 1/2 nat. size. p. 85.

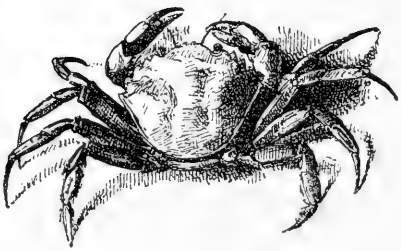


Fig. 136. *Carcinus maenas* (Green Crab), 1/2 nat. size. p. 85.

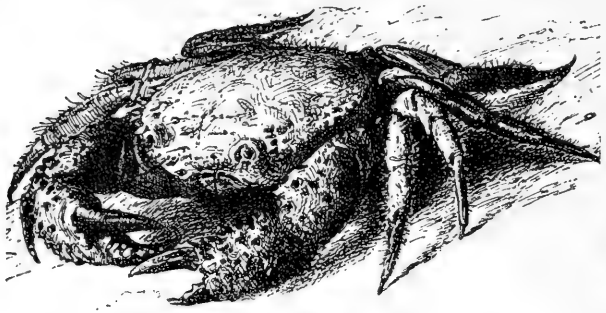


Fig. 137. *Eriphia spinifrons*, 1/2 nat. size. p. 85.

Fig. 138. *Lissa chiragra*, 1/2 nat. size. p. 84.

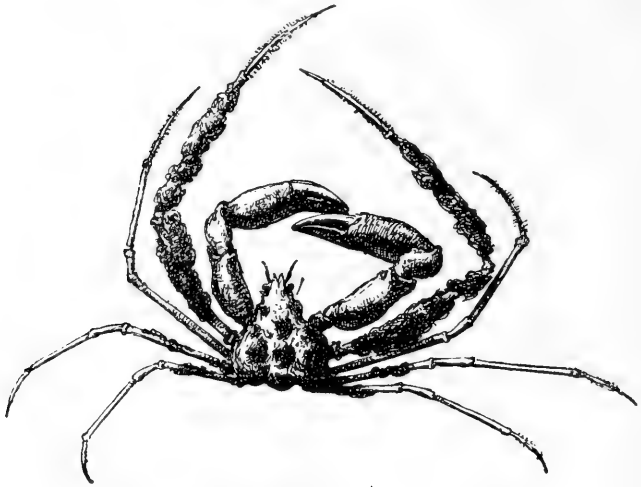


Fig. 139. *Inachus scorpio*, 1/2 nat. size. p. 84.

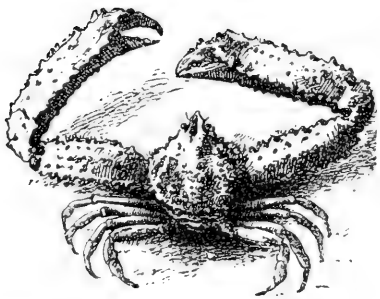


Fig. 140. *Lambrus angulifrons*, 1/2 nat. size. p. 84.

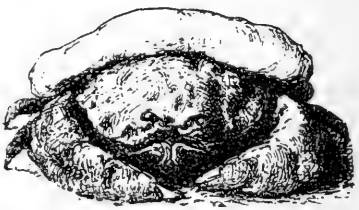


Fig. 141. *Dromia vulgaris* covered with a sponge, 1/2 nat. size. p. 85.

Fig. 142. *Dorippe lanata*, 1/2 nat. size. p. 85.

Fig. 143. *Pagurus striatus* (Hermit-crab) in a whelk-shell and bearing three Anemones, 1/2 nat. size. p. 81.

Fig. 144. *Eupagurus Prideauxii* (Hermit-crab) in a shell and bearing the Anemone *Adamsia palliata*, 1/2 nat. size. p. 83.

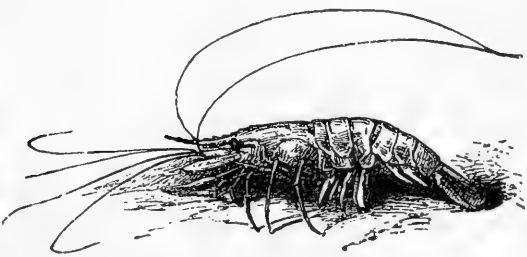


Fig. 145. *Palaemon xiphias* (Prawn), 1/2 nat. size. p. 81.

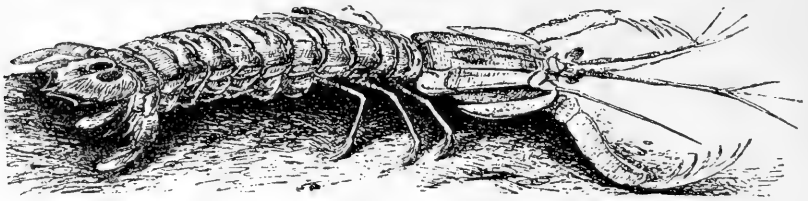


Fig. 146. *Squilla mantis* (Mantis prawn), 1/2 nat. size. p. 86.

Tank No. 24

illustrating concealment and mimicry of surroundings.

Hidden in or on the sand,

Fishes. Weever (*Trachinus*, fig. 147), long shaped body, head like a frog; Star-gazer (*Uranoscopus*, fig. 148) with big oval head and wide mouth. Both of these bury themselves all but their eyes. Rockling (*Motella*, fig. 149). Turbot (*Rhombus*, fig. 150) and Soles (*Solea*, fig. 151) the exact colour of the sand. *Young skate (*Raja*, fig. 67), and *young Angler Fish (*Lophius*, fig. 57).

Cephalopods. Musk-octopus (*Eledone*, p. 90) like the *Octopus* (fig. 72 and 73) but much smaller; white with black spots.

Bivalves. Cockle (*Cardium*, fig. 152); *Pectunculus*, much larger, shell without spines.

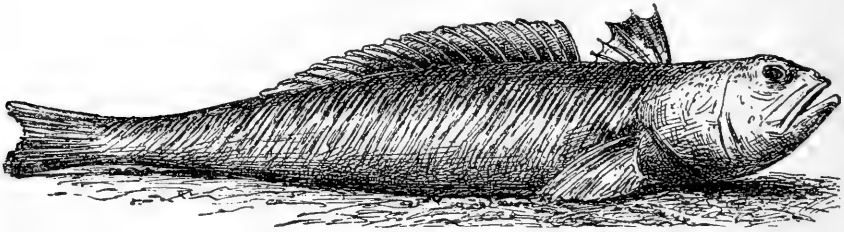


Fig. 147. *Trachinus draco* (Weever), 1/2 nat. size. p. 107.

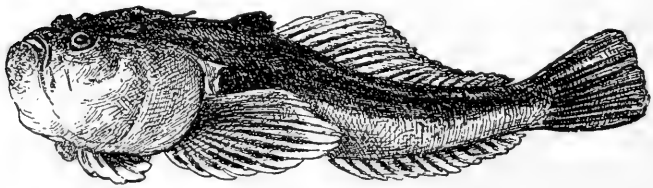


Fig. 148. *Uranoscopus scaber* (Star-gazer), 1/2 nat. size. p. 107.

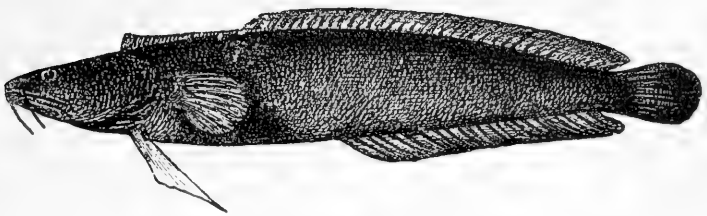


Fig. 149. *Motella vulgaris* (Rockling), 1/3 nat. size. p. 109.

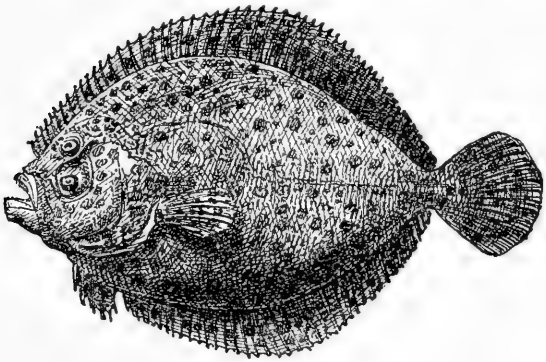


Fig. 150. *Rhombus laevis* (Turbot), 1/4 nat. size. p. 108.

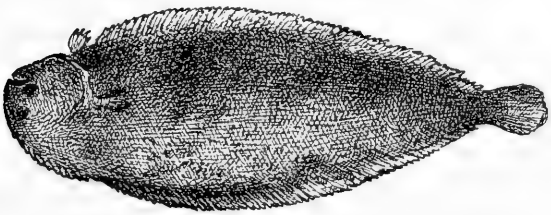


Fig. 151. *Solea vulgaris* (Sole), 1/3 nat. size. p. 108.

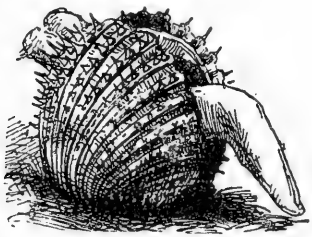


Fig. 152. *Cardium aculeatum* (Cockle), 1/2 nat. size. p. 98.

Tank No. 25.

Fishes. Sea horse (fig. 154) and Pipe-fish (fig. 153).

Plants. Sea-grass (*Posidonia* with broad fronds, and *Cymodocea* with narrow) and other algæ (*Sargassum*, *Cystoseira*).

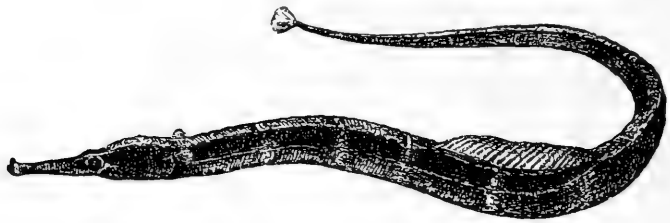


Fig. 153. *Syngnathus acus* (Pipe-fish), 1/2 nat. size. p. 112.

Fig. 154. *Hippocampus guttulatus* (Sea-horse), 1/2 nat. size. p. 112.

Tank No. 26.

Brightly coloured **Fishes.** *Xyrichthys* (fig. 155), of a pink colour. *Julis pavo* (fig. 156), with peacock-blue fins and *Coris vulgaris* (fig. 157). These are usually in continual movement, although they may be buried in the sand in winter. Butterfly-blenny (*Blennius*, fig. 158) with a back-fin like the wing of a butterfly, bearing an eyespot.

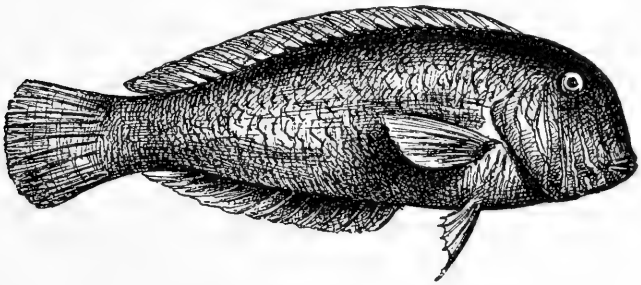


Fig. 155. *Xyrichthys novacula*, 1/2 nat. size. p. 113.

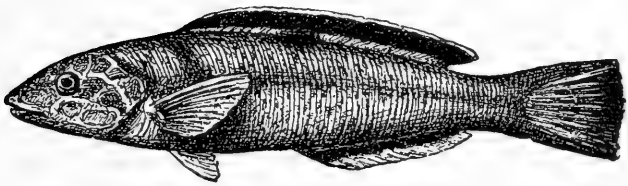


Fig. 156. *Julis pavo*, 1/2 nat. size. p. 113.

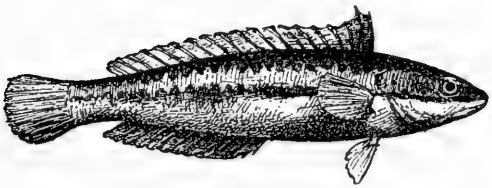


Fig. 157. *Coris vulgaris*, 1/2 nat. size. p. 113.

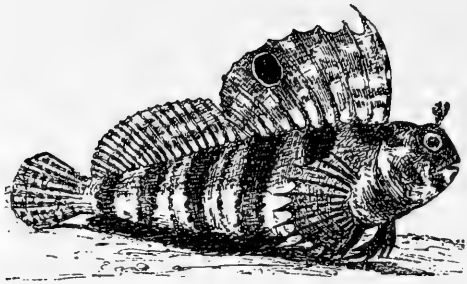


Fig. 158. *Blennius ocellaris*, (Butterfly-fish), 1/2 nat. size. p. 109.

Part second.

The first part presented the animals and plants to the visitor as they are found in the separate tanks of the Aquarium, mentioned their names and gave at the same time pictures so that the names could the more easily be applied to the right objects. But the name, shape and colour is only, so to speak, the 'outer shell' and however pleasing this may be to the eye, it does not alone satisfy. Rather it gives rise to the desire for a clear acquaintance with these often wierd-looking creatures, to learn more of their homes, the way they are caught, their life in captivity and further, to know a little of the results of the researches on their organization, development and functions which have been carried on for more than four decades by investigators from all nations in the other departments of the Zoological Station. It is hoped that the second part of the Guide will, to a certain extent, fulfill this wish, and this is undertaken with the more pleasure as the visitor to the Aquarium has himself a share in these investigations: his visit gives a contribution towards procuring the numerous and costly weapons with the aid of which the biologists in the Zoological Station attack the problems of their science.

The order followed here must be a different one from that in the first part, the order, namely, of the classification of animal life based on anatomical and genealogical considerations, rising from the simplest organisms to the highest, the Vertebrates. In museums no such double arrangement is necessary in description, as the stuffed or spirit specimens can be placed at will in the order of the zoological system. As long, however, as they still live one must remember that each beast has its little ways and according to these prejudices it must be treated. If it is to flourish it must be placed in suitable surroundings and company without any regard to genealogy. The only disadvantage is that the arrangement in the second part of the Guide makes it necessary for the visitor to wander in a zig-zag through the Aquarium to seek out the animals described.

Before we occupy ourselves, however, with the separate divisions of the animal kingdom, we will make a few general remarks.

As has already been mentioned, all animals and plants in the Aquarium come from the Gulf of Naples, and although there are several hundered species in the tanks, yet this is only a small proportion of the number present in the Gulf, which, in its flora and fauna is one of the richest of seas. Now as place could not have been found in the tanks for all the thousands of kinds which these waters harbour, a "selection of the fittest" had to be made, and this choice of the most suitable types was not easy, being conditioned not only by the nature of the animals, but also by the nature of the visitor to the Aquarium. Excluded was naturally the *genre ennuyeux*, for those not in some way distinguished by colour, form or movement were not worthy to be exhibited to an honourable public. Unsuitable too were all over-large animals such as dolfins, tunny-fish and sharks and, in the same way, the innumerable hosts of those too small. And besides these, such unbridled creatures as the flying-fish which leap over all confining boundaries, or mackerel, which at once run their heads against the wall, could not join the well-ordered social conditions of the aquarium tanks. And whether such beasts as jelly-fish, worms or the horrible Octopus should not have been barred in deference to the æsthetic sense, so well developed in these days, is left to the visitor himself to judge after seing them with his own eyes.

If, now, in looking at this selected company, one passes over form and colour and observes the movements, then one notices at once that two types are present here in the water which one will not remember having noticed among those animals living on land. These are, firstly the sessile animals, that is, those which are firmly attached to the ground, so that they are unable to move from their positions, and secondly there are those which have no such fixed attachment, but crawl or swim around, their whole life through. True, there are on dry land organisms which are fixed in their surroundings, but as these are well known to be plants, and as the essential distinction between plants and animals is usually held to consist in this, that the latter alone are able to move, the visitor to the aquarium is often inclined to take the sessile animals of the sea for plants. More especially is this the case if, added to that, they look like flowers or like trees, rooted below and branched above. But these sea-anemones, sponges, corals and many others, which are indeed distinguished as "plant-animals" (*Zoophytes*), are nevertheless all true animals, and the layman will no longer have doubts as to their animal nature when he learns that they swim gaily through the water in their youth, before they settle down to rest and vegetate like plants.

Between this type of *glebae adscripti* and those which have no firm foothold at all in life are all the crawling, sliding, walking, clambering, hopping, jumping water-beasts, most of which can, however, swim freely for a shorter or longer time.

Now, the class of swimming and floating animals which are quite free from the bottom consists of two divisions with regard to their capabilities of locomotion, and these two may be compared to the past and present types of airships. Like the older balloons many animals float freely in their medium, the specific weight of which approximates to their own. These passively follow the movements of the medium. The swimmers, however, are comparable to the Zeppelins, fitted with strong motors (muscles) and rudders, which overcome the sinking due to their own weight and the resistance of the medium, alter the direction of their movement at will and in point of speed compete successfully with the swiftest expresses. Between these two extremes there are all immaginable transitions and the more an animal approaches the condition of complete lack of active movement, and the less the importance of its own powers of swimming against the passive change of position by means of water currents, so much the more closely does it approach that group of marine animals (and plants) which are distinguished as *Plankton*. — The visitor will find typical sessile animals in tanks 4, 8, 9, 21, and 22 and tank 20 contains some of the larger floating animals, which are distinguished, like many Plankton organisms, by their great transparency.

According to the different means of locomotion just described, the animals choose out their habitats in the sea. The floating and permanently swimming animals live between the bottom and the surface of the water. They possess a number of different contrivances to overcome the tendency to sink, contrivances which consist either in an approximation of their specific weight to that of the water or of a slowing down of the sinking through an increase of the frictional resistance. The crawling, occasionally swimming and fixed animals populate, on the other hand, the coastal slopes and the rocky shallows (called "Secche") rising up from the mud. On these grounds they settle on the green meadows of *Posidonia* (sea-grass), between luxuriant bushes of sea-weed and on the red incrustations of calcareous algæ. Others live among the remains (detritus) of dead organisms, under stones, in the sand and on top of and in the mud which cover the floor of the Gulf.

These are the hunting grounds from which the Aquarium is replenished.

Two chief forms of net are used. Firstly ground-nets, which are dragged over the bottom and either tear away the animals which live between or on the stones by means of their heavy and sharp-edged frames or else graze lightly over the ground and stir up the more moveable forms, driving them into the sack of the net. Secondly floating nets made of silk gauze, which are drawn slowly through the water. To the ground-nets are attached untwined pieces of rope in which many animals become

entangled. Besides these, wicker-baskets and lines are used and, for shallower water, nets with stakes, which stir up the soft ground or scrape the rocks. But there are animals which cannot be fished for at all, not on account of their agility or strength, but because they are so delicate that they are destroyed and changed into a mass of slime by the least ungentle handling. This applies to many of the jelly-fish, which on this account must be carefully brought up from the water in buckets. Moreover, they cannot stand the movement of the waves and shun strong sunlight and both on rough and on cloudless days they retire down into the quiet twilight of the deeper waters. They are caught on calm days with a cloudy sky when they are often brought together in masses by the gentle currents. As such days are not frequent and these delicate animals survive but a short time in the Aquarium, where they are placed inside large glass-cylinders for protection, they can, unfortunately, only be exhibited irregularly to the visitors.

Having now brought up the animals from the "deep blue" of the Gulf and placed them into the tanks of the Aquarium we wish them to have the impression at once: "Quite like home!" It is naturally impossible to give them *all* their accostomed conditions of life, but all that is possible is done to make the guests comfortable. We give the largest tanks to the swimming animals, and rocky mounds are made for the inhabitants of stony grounds which can exercise their talents for climbing on the projecting ledges at the sides of the tanks. Opportunity is given too, to those who like it, to bury themselves in sand or mud. In one respect only the Aquarium does not copy natural conditions, and for a good reason. The enemies which sought for his life outside are here carefully kept away from the new arrival; for his destiny is not to be eaten, but to be admired. Rather, he himself must eat, and that with appetite. This is the first of the three chief conditions through which we try to comfort the prisoners for the loss of their homes. The second is to allow them to breathe in clean, constantly changing water and the third that they never have it too cold or too warm.

The feeding is by no means difficult. Sardines and shrimps are taken by many of the animals with as great pleasure as by men. Others show a more delicate taste, having a preference for oysters and other shell-fish. Others again are vegetarians and are pleased with a salad of sea-lettuce or even swallow sand or mud alone and many demand no feeding at all, being satisfied with the most minute organisms and organic particles which float about in the water. In this manner many sessile-animals take their nourishment, and, when one considers the matter, this mode of feeding is essentially the same as that of the whale. Both filter the food — be it microscopical organisms or herrings —

from the water, the fixed animals by driving the water through their bodies, the whales by driving their bodies through the water. Thus no inhabitant of the aquarium needs to undertake a tiring hunt for booty. Each gets his full share, and even if the hermit-crabs in tank 23 do scuffle for their mouthfuls, this is only a game without which the food has no taste for these odd little beasts.

Not only in the air and sunlight does respiration go on, but down below too, in the water, everything breathes. The only animal in the Aquarium which has to poke its nose above the surface to take in air is the turtle. All others, whether they have true gills like fish, molluscs and custaceans, or not, extract their air from the water, without which air they could not continue to live. For this reason a stream of clean oxygen-containing water is continuously driven into the tanks and the used-up water led off. The pumps must work steadily, with a short intermission during the night hours so that the water will stream into the tanks with enough force to take up the greatest possible quantity of air in the finest bubbles. This spray of air and water is best seen in tank 10 where the Sea-Perch delight in allowing their gills to be sprayed by the stream. The water is not pumped directly from the Gulf into the Aquarium tanks and the reason will be well-known to those who have been to Capri. The famous ultramarine blue of the Mediterranean is to be seen only at some distance from the harbour. Further in, the water is green or yellow in colour, a sign of impurity which would be very harmful to the inhabitants of the aquarium. For this reason the water is first allowed to stand in large cisterns in the cellars until it becomes clear, after which it is led into the tanks.

The greatest difficulties are encountered in avoiding extreme temperatures, the third of the three conditions mentioned above. For in this respect the inhabitants of the Bay are much less used to changes of temperature than their neighbours on land. When the land-temperature falls to 0^0 C and below and lizards creep into their holes and men under the bed-clothes in their unheated rooms, the sea-water is still at least at $12^1/_2{}^0$ C. And when in summer the Scirocco compels us for days on end to take an unwilling steam-bath, at 30^0 C or more in the shade, the lucky dwellers in the Bay, if they are not fixed to the cool ground, need only to dive a few yards down from the surface, which is never above 27^0 C, to reach the region of even temperature. For not only in the Bay of Naples, but throughout the whole Mediterranean, the water is never warmer than 27^0 C nor colder than 13^0 C. And further, these extremes are only met with in the surface layers. At depths lower than 500 metres all variations cease and from there down to the sea-bottom there is an even temperature of 13^0 C the whole year through.

The animals of the Mediterranean are so accustomed to such long-established narrow temperature limits that they suffer as soon as these are exceeded. Even an approach to the limits is often harmful and many animals protect themselves by burrowing in the sand, as for instance does the spider-crab, *Maja* (fig. 70) in summer and the fish *Coris* (fig. 157) in winter. The summer and winter extremes of temperature produce in many of the sessile animals (Hydroids, Corals, compound Ascidians, Bryozoa) extraordinary phenomena which are also caused by other conditions harmful to the organisms. These changes must also be looked upon as means of protection. The animal assumes the appearance of death, while some of the functions of life are set aside — are so to speak "latent" — in order the better to withstand the unfavourable conditions. The reader has doubtless, in this connection, already called to mind the winter sleep of the marmot, but in the case of the Hydroids and Corals life is much more latent. This state changes them into mere skeleton, nothing living being visible from the outside. The living substance is resting within, however, rolled up to a structureless mass at the base of the skeleton and this will fully regain its formative power on the return of favourable temperature conditions. But only few animals possess such contrivances for protecting themselves and if we restricted ourselves to them, the tanks of the Aquarium would be very deserted. In summer it is indeed possible to keep the temperature of the water in the Aquarium below the maximum of that in the Bay, by means of increased pumping and shortening of the nightly pauses, and seldom has it risen above 24° C. But even this is too much for many animals. Against the cold, however, continuous pumping does not help and we have at present no means of preventing the water from sinking below 13° C, or sometimes as far down as 8° C, for weeks on end in cold winters (experiments are at present being made with warm tubes). Such winters are injurious to the health of even old inhabitants of the Aquarium — thus in the winter of 1905 a dozen Sea-Perch which had been for ten years in tank 10 were sacrificed.

Sponges (Porifera).

Although in the earlier part of the 17th century it was debated whether sponges were plants or animals, close investigation soon rendered undoubted their animal nature. It was early remarked that "sponge" when burnt gave off a smell of burning hair or horn, and exact analysis showed it to be nearly allied to these substances. This in itself gave reason to suppose that the chemistry of their life was animal rather than vegetable. Though a living sponge is fixed and apparently motionless, it was found that the holes in its surafec are capable of opening and shutting, and that from the larger of them, when open, there is usually a strong stream of water issuing. This is compensated for by small entering streams through other holes far more numerous but generally invisible without magnification. Further it was found that the young sponge (varying from microscopic size to that of a pin's head) swims freely about by means of little waving hairs (flagella) over its surface. Finally it was shown that sponges live on solid food. While thus possessing all those characters that are more frequent among animals than plants they never contain any traces of the cottony and woody substances especially characteristic of the vegetable kingdom (cellulose).

The water entering by the small pores passes through a system of branching and fine canals, and is collected again by a similar system into the outflowing current from the large holes (oscula). At the junction between the two systems of tubes are the most vital organs of the sponge, little swollen cavities of microscopic size walled in with tiny living particles, each bearing a vibrating hair with which it lashes on the current and a transparent filmy skirt, with which it catches the microscopical organisms of the water which serve it as food.

All this labyrinth of canals and cavities is living, soft flesh. To prevent it falling a ready prey to the first hungry animal that passes, it is set through and through with little flinty needles or thorns, often of the most beautiful forms such as spears, anchors, stars, marbles, hooks, bows, etc. A smaller group of sponges has its spines of chalk, to serve the same end. A very large number of the flinty sponges cement their spines together with the horny substance already referred to; a few have lost the flinty spicules entirely and, to withstand better the shocks of the waves, have replaced them by the more elastic cement. The net-like skeletons of this last small group form the *sponges* — bath-sponges, toilet-sponges and the rest, with which we habitually associate the name. The animals in which they were contained are killed by exposure to the air, and then removed by repeated washing.

The **sponge of commerce** (*Euspongia*, fig. 117) is of the form we know in its domestic relations, but in life shows on its surface the largest only of its numerous holes; over all the rest the dark, slate-coloured flesh forms a continuous film. It is obtained by diving, dredging, or harpooning with a long trident; the principal marktes are at Trieste and Paris. Of the different kinds the finest and most costly is the Levantine sponge (*Euspongia officinalis*) which, in its varieties, extends on all the eastern Adriatic and Mediterranean shores. It is not found west of Naples and on the Italian coast no sponges occur in remunerative quantity, though quite recently some beds have been discovered near Sicily. The harder Zimocca sponge (*Euspongia zimocca*) from Asia Minor and Egypt fetches about one tenth of the price, as does the large coarse horse sponge (*Hippospongia equina*), found in all the Levant and extending along Africa to the Straits of Gibraltar; it is honeycombed with wide holes. Of the last genus (*Hippospongia*) are the American "glove sponge" and "sheeps-woll sponge"; their "hard-head" is related to the European Zimocca, while their "velvet sponge" and "grass sponge" are independent species. The Bahamas and Caribbean Sea form the American sponge-field. — After the removal of the soft parts of the sponge the fishermen usually fill the skeleton with sand, so as to increase its weight and thus to obtain a higher price for their goods. For this reason it is necessary to rinse newly bought sponges repeatedly so as to remove all foreign matter and it is well at first to add a little hydrochloric acid to the water. — The sponge of commerce is found rarely in the Bay of Naples. It chiefly frequents rocky coasts and coral reefs; it does not live in very deep waters.

Sponges have a great capacity for regeneration, which is in general more highly developed in lower than in higher animals. If a sponge be cut up in many pieces, each, under favourable circumstances, continues to live and after some time attains the full size again. It has been attempted to make use of this property for the commercial cultivation of sponges, but it did not prove remunerative and was given up.

Besides the Bath-sponge the Aquarium contains various flinty sponges conspicuous by shape or colour, as, for instance, the beautiful orange-red bushes of **Axinella** (fig. 119) looking like corals, the yellow balls of **Tethya** (fig. 118) and the dirty white lumps of **Geodia.** On the minute flint anchors which are scattered over the surface of the last mentioned form many animals and even fishes become attached. Thus caught they die and their decomposing bodies serve as food for the sponge. Other flinty sponges grow in the form of incrustations over stones and plants, and there are forms which settle on other animals and even serve them as houses. (**Suberites,** see p. 83.) The chalky sponges (*Calcarea*) are mostly small, and either grey or white. A fair

type is the **Sycon raphanus,** of which a variety peculiar to the Aquarium grows thickly on the walls of its tanks (fig. 159).

Although the sponges are, in the adult condition, firmly fixed to the substratum, yet in the youngest stages, as mentioned above, they swim freely around as so-called *Larvae* and chose their settling place from which they are later unable to move. In this manner the calcareous sponge just spoken of settles in the Aquarium and, as its wide distribution shows, flourishes. The other sponges exhibited are fished for in the Bay and remain alive for a long time and some even increase by a curious process. Thus after some months the tissues of *Axinella* degenerate for the most part, while those portions which have remained healthy fall to the ground and grow out to new bushes. Another sponge, **Chondrosia,** becomes blown out to a transparent bladder by gas which is formed within the body. Eventually it bursts and out of the pieces arise new colonies.

Fig. 159.
Some specimens of *Sycon raphanus*, attached to a piece of rock at the left hand.

Polypes (Anthozoa).

If it be difficult to the lay mind to apply the term Sponge to organisms, which in a living condition are not at all of a spongy nature, it will be found equally difficult to picture as Corals anything else than the beautiful red and white branches which are displayed as ornaments on writing-desks and chimney-pieces. And yet these branches are not really the animals themselves, but only the framework which they have built themselves and in which they live imbedded, in hundreds or thousands, side by side or one above the other. Of the *polypes*, the animals which build up the corals, the best conception may be gained by examining the

Sea-Anemones (Actiniæ).

These animals exhibit a cylindrical body, attached by an adhesive disk to some fixed object and bearing at its free end numerous very mobile tentacles. These encircle an aperture which serves both as mouth and as anus (fig. 49); it leads into a capacious stomach in which the food is digested. The soft and apparently unprotected polype is really very well armed. Many parts of the body, but especially the tentacles which serve to catch its prey, are provided with numerous microscopic vesicles, the so-called *stinging-cells*, each containing an acid liquid and a spirally coiled thread. When the animal comes in contact with its enemies or its prey thousands of these stinging-cells burst,

ejecting forcibly the long filament; this bears a sharp point and is often barbed, while the noxious liquid in its core renders the tiny wound it makes sufficiently poisonous to benumb or even kill. The ejection of these minute weapons may be compared to blowing out the fingers of a glove when these are tucked in.

The Anemones are extremely voracious; they are not content with feeding on the pieces of meat given them, but also catch living worms, crabs, snails and fishes which are often much larger than themselves.

They move from one place to another very rarely and then very slowly. If they are disturbed, they contract themselves into such small masses, forcing out the sea-water they have taken up, that they are almost unrecognisable. Their tenacity of life is extraordinary and enables them to be kept easily in aquaria. In some cases one and the same individual has been kept alive for over 50 years in small aquaria. — Some Anemones are eaten by the poorer classes of Naples.

Of the numerous kinds of Anemones many are richly coloured; we would mention especially the common Opelet (**Anemonia sulcata,** fig. 49, "Ardichella") which grows in hundreds on the rocks, like flowers in a bed. Finer even than this is one which has up to the present time only been found in the Bay of Naples, the **Alicia** (Fig. 110). It lives at great depths and being of rare occurence is not always present in the Aquarium. The cloak Anemone (**Adamsia,** fig. 143) is interesting on account of its habit of sharing the possession of some whelk- or other shell with a hermit-crab, by which it allows itself to be carried about (tank 23, see p. 83). On the slightest contact it draws in its tentacles. The Orange-red **Cereactis** exhibits fine colouring (fig. 53). A small species, **Heliactis,** often settles in large numbers on the walls on the south side tanks, especially Nr. 1.

Cerianthus differs from the other Sea-anemones in not being fixed; it lives in a loose covering which it makes deep in the sand, only a small portion of its body projecting (tank 22). A green specimen of *Cerianthus* has lived in this tank since 1882; at that time its body was $1^1/_2$ inches long and $2^1/_2$ thick, now its length and breadth are 10 times as much and the crown of outstretched tentacles has a diameter of 10 inches.

Corals.

Proceeding from the Actiniæ we can now more easily understand the structure of the **Corals.** If the Anemones had the power to deposit a calcareous covering on the outside of their body, or a similar skeleton within their body-wall, these hard parts would, after the death of the animal, be termed corals. The fine orange-coloured Coral, **Astroides** (fig. 52), which lives on the rocks of tank No. 9, may be considered as an Anemone provided with such a calcareous framework. Spreading out their rings of tentacles the numerous animals side by side present the appearance of an orange-coloured carpet, but then their framework is not visible. Only after the orange-coloured animal has died and decayed away, the remaining grey calcareous skeleton or framework becomes visible: this can be seen in several parts of the tank, looking not unlike honeycombs, each comb being the skeleton of a single animal. The coast of Italy is in many places covered with this coral and those who have made by boat the beautiful trip from Amalfi to Scaricatoio will have had ample opportunity of seeing the orange belt it forms on the rocks immediately below the water-line. Similar corals form the large reefs which are met with in the southern seas (even as far north as the Red Sea) stretching often for miles, and several fathoms deep. Their colouring is often exquisite.

Closely allied to Astroides is **Dendrophyllia** (Fig. 107), the skeleton of which consists of pure white carbonate of lime and forms large branches. The polypes are of the colour of sulphur and comparatively large. In the Aquarium the yellow polyps tend to disappear after a few months and there remains then only the white skeleton, resembling a dead tree, which becomes overgrown by algæ and small organisms. One would hardly doubt but that the coral was dead and yet after some months or even after a year the slumbering life revives again, the branches become covered with yellow tissues and at the ends polyps expand.

The branching of the corals takes place by means of the two methods of reproduction termed "fission" and "budding" respectively. In the case of fission one organism splits into two or more parts, each of which will develop into a new complete individual. This process has often been observed to take place; it has also been successfully brought about by dividing a living animal into suitable pieces, which have then been allowed to grow on and form complete polypes. A similar fission takes place in the case of the Coral-polypes, but with this important difference, that the division does not extend down to the base of the animal but that both pieces remain attached to one another; both give rise to calcareous skeletal substance which naturally remains connected. In this manner arises gradually a coral colony and in the course of cen-

turies those immense coral-reefs of which mention has been made above. The second and even more rapid process of reproduction is that of budding, which is familiar to all in plants. In this case the parental polype remains intact, but at one point or other of its body a new growth begins from which, as from a bud, a new individual is formed. This in the case of Corals does not separate from the first individual but remains attached to it. The whole colony is either supported internally or surrounded externally by the calcareous framework or covering, which the individuals form themselves; when they are dead, this retains the appearance of trees or bushes, or assumes other curious shapes. But whatever may be their form or colour, it must always be remembered that these "corals" are not the coral-animals themselves; they are only the hard, skeletal parts, which have been formed by millions of small polypes. Of these many hundreds of generations have already died, while their offspring, the present generation, stretch out their delicate tentacles like tiny feathery crowns from the pores of the coral-trees.

Of these tree-like corals we would mention first the Sea-finger ("Deadmen's-fingers"), **Alcyonium** (fig. 104), the skeleton of which does not form a united framework, but consists of numerous loose calcareous spicules, so that the animals are able to swell themselves out by taking up a large amount of sea-water. Such a colony of *Alcyonium*, which when contracted appears like a yellow or pink piece of sponge is hardly to be recognized when expanded to its full size. It then becomes almost transparent, and over the whole surface appear the outstretched polyps like little flowers.

The Sea-Pen (**Pennatula,** fig. 103) can also swell itself out at pleasure by taking in sea-water. When not thus expanded the body is flabby and the animal to all appearances dead; but when it has taken up sea-water it becomes beautifully transparent and erect, and the leaflike lappets are studded along their upper edge with delicate polypes.

The skeleton of the White Coral, **Isis** (fig. 105), consists of alternating pieces of horny and calcareous matter; in the Red Coral which belongs to the same family, the skeleton is composed entirely of carbonate of lime or chalk.

The great value of the Red Coral, **Corallium rubrum** (fig. 108), for ornamental purposes is due to its beautiful colour, and the hard texture of its skeleton, enabling it to take a high polish. The ancients valued corals greatly, but they had a wholly erroneous idea of their nature, an idea shared even now by many people; they considered the Coral to be a plant, which remained soft while in the sea, but which became suddenly hard on being taken out of the water. But if a branch be examined, as soon as it has been fished from the sea, it will be found to be enveloped by a coating, also of red colour, just as the wood of a tree is enveloped by its

bark. Such a branch replaced carefully in a large vessel of fresh sea-water will after a short time show at numerous points of its surface the expanded coral-animals, each with its eight feathery tentacles. Each individual has the structure of a polype, as described above, and is organically connected with all the others by means of canals, which transmit food from one living polype to the other. In the covering, besides these canals, are numerous microscopic spindle-shaped particles of carbonate of lime; the axis is formed by a fusion of such particles. This structure of the coral is very readily distinguished under the microscope, by the aid of which instrument all imitations can easily be detected. The Red Coral reproduces by means of eggs or by buds. There exist separate male and female colonies, besides those which bear both sexes; sometimes, too, hermaphrodite polypes (individuals with both male and female reproductive organs) are found. The egg develops within the maternal polype into a pear-shaped organism, which makes its way out through the mouth of the mother-polype and swims about freely for some time; after this it fixes with one end and becomes transformed into a polype, which forms new individuals by budding and thus gives rise to a new colony.

The Red Coral is a gift of the Mediterranean. Here it grows on rocky banks near the coast at a depth of from 40 to 100 fathoms, rarely deeper, and is especially obtained on the Ionian Islands and on the coasts of Algiers and Tunis. In the seventies coral-banks were discovered off Sciacca in the South-West of Sicily, the extraordinary richness of which caused a crisis in the Italian coral trade. For some years past, however, only dead pieces of coral have been found on these beds, the colonies having apparently been destroyed by a submarine earthquake. Of late Japan has been dangerous to the Italian coral industry, but the Japanese coral is far behind the better kinds from the Mediterranean both in beauty and evenness of structure, in spite of the richness of the banks in the far East.

The apparatus for coral-fishing consists of a cross made of heavy wooden beams to which are attached pieces of old nets, untwisted rope-ends and other such material; the whole is dragged by means of a strong rope over the bottom of the sea. The branching corals are entangled in the nets and ropes, break off and are pulled up with them. To use the corals, the "bark" with the polypes is brushed off and the outermost layer of the skeleton filed away; afterwards it is ground with emery-powder and oil, and finally polished with steel. The beads are turned and pierced on a lathe, figures are cut out with graving-tools. The value of corals varies greatly, even before they are worked. The thicker roots are often perforated by boring animals (worms and sponges) and fetch between 5 and 20 frs. per kilogramme. Good ordinary pieces are sold at 40—70 frs. and choice, salmon

coloured pieces 400—500 frs. and even more, but the pieces vary greatly with the fashions.

In the Bay of Naples also, some rocks arise out of the muddy bottom about half-way between Naples and Capri on which the Red Coral grows. From there the fishermen of Santa Lucia take every 3—5 years 100—200 kilogrammes each, and thence come also the examples in tank 21. Usually, however, these do not live long, as they are mostly fished in the summer and cannot withstand the great difference between the Aquarium temperature at this time of year and that of the sea-bottom. If they are taken in autumn they remain alive for half a year or more. A preserved piece is to be found in a small glass on the floor of the tank.

Medusæ or Jelly-Fish.

Those who come from northern seas and remember to have found on the sands ugly and offensive masses of jelly, will find it difficult to associate with these the large **Rhizostoma** (fig. 83) and **Cotylorhiza** (fig. 84), or with the smaller **Pelagia** (fig. 80), **Tima** (fig. 82), **Olindias** (fig. 81), **Carmarina** (fig. 79) etc., which he sees here swimming around; yet those lumps were nothing more than the corpses of similar animals. The Medusæ change in appearance after death much more rapidly than most other animals because they consist chiefly of water (95—98%). Their almost complete transparency, the beauty of their movements, and their often brillant colouring, make them very attractive objects. As they swim, they take the form of a mushroom or an open umbrella, the regular opening and closing of the umbrella driving them along. From the centre of the bell hangs a long, generally hollow, gelatinous stalk, also transparent; it is provided at the end with an aperture, the mouth. In some jelly-fish, however, such as *Cotylorhiza* and *Rhizostoma* the stalk is shorter and divided into a number of small lappets, each of which bears a mouth leading into a common cavity, the stomach. From the edge of the umbrella hang down long tentacles, which the animal can contract at will or elongate to a considerable extent. These tentacles are provided with numerous stinging-cells, such as have been described in the case of the Actiniæ (see p. 63); and, as there, they afford an efficient means of defence for the delicate body. The unpleasant stings occasionally experienced in sea-bathing are generally due to contact with these jelly-fish. Some species, indeed, which attain a size of one to two feet and a weight of 50 to 60 pounds, can sting very seriously.

A few species shine at night with a greenish light; thus *Pelagia* has received the specific name of *noctiluca*.

Some kinds of fish spend the early part of their life unmolested and apparently protected beneath the umbrella of *Rhizostoma* or *Cotylorhiza*, while other Medusæ eat fish after having first attacked and wounded them with their batteries of stinging-cells.

The migrations of Medusæ are of special interest. At certain periods enormous quantities are met with in active or passive migration. The shoals of Medusæ thus found are so large that ships are often impeded in their course for days together, the animals swimming in so dense a mass that a stick, plunged into their midst, remains upright as if driven into something viscid, and ordinary rowing boats can scarcely force their way through. These migrations are yet to be explained.

While many Medusæ develop directly from eggs in the usual way, others reproduce themselves by a complicated and peculiar process known as *Alternation of generations* which was first discovered by the poet Adalbert von Chamisso (see p. 101) and first established as an important biological law by the zoologist Steenstrup. It may be summed up as follows. An individual *A* produces individuals which are not like itself, but of quite a different nature, and which we may call *B*. *B* also gives rise to individuals unlike itself, but like *A*. In other words: for *A* to reproduce *A*-forms, an intervening form *B* is necessary. In the case of many Medusæ — not of all — this intervening form appears as the so-called

Hydroid-Polypes,

which have entirely the appearance of plants and are essentially similar to branches of corals. Generally they rise from eggs produced by Medusæ, branch by fission and budding and thus, form just as the corals do, larger or smaller colonies. At fixed periods they produce buds which separate from the colony and swim about as Medusæ. These again lay eggs, which give rise to new Polypes. But this is not the case in all species. In some the Medusæ always remain attached to the colony, and then they are usually so reduced in size and organisation, that they are scarcely to be recognized as Medusæ at all.

The Hydroid-polypes are found in enormous masses on stones, reefs and rocky coasts among the sea-weeds. The animals, which form these colonies, live on the smallest crustacea, worms, infusoria, etc., which come within reach of their tentacles and are stunned by the action of their stinging-cells.

In the Aquarium they are represented by the very delicate **Aglaophenia, Antennularia, Tubularia** and **Pennaria** (figs. 111—114). Many of these colonies go through a stage of degeneration, during which the polyps disappear from the branches, which are reduced to stumps; after some months of latent life, however, the colonies regenerate again.

Siphonophora.

These, among the most wonderful of the inhabitants of the sea, are at once the delight and the despair of the naturalist. For the wonderful form and beauty of their body is associated with such delicacy, that it breaks to pieces at the slightest touch. Nevertheless, the fact that, especially in calm weather, specimens of **Physophora** (fig. 89), **Forskalia** (fig. 92), **Hippopodius** (fig. 90) and others may be seen in the Aquarium is due to the particular care used in their capture (see p. 58). But it will easily be understood that it cost much more trouble and countless experiments before a successful method was found of preserving these "noli me tangere" so that they could be put up in alcohol and sent to the zoological museums.

The Siphonophora are looked upon by most naturalists as free swimming colonies, that is to say, creatures which consist of more than one individual, yet together form a single unit. It is not rare to find individuals of one species thus united; the corals form one of the most striking examples. The case of the Siphonophora, however, is somewhat different: for, while all the individuals of a colony of corals are built up on the same plan, so that each has the same functions and would be able to continue its life alone, the colonies of Siphonophora are composed of very differently formed individuals (polymorphs) which divide among themselves the different functions of the colony. Special nutritive polypes undertake the nutrition of the colony; special bell-shaped individuals, like medusæ, perform the swimming movements; true medusæ are charged with the reproduction. In short, we have a "division of labour" taking place as it does among the ants and bees; but with this difference, that among them the polymorph individuals (the workers, drones, queen) are separate one from the other, whereas in the Siphonophora they are inseparably united.

For the most part the Siphonophora colonies are drawn out lengthways (e. g. **Forskalia,** fig. 92) and the single individuals are then arranged as if attached to a long thin string. On the other hand in the beautiful blue Sallee Man, **Velella** (fig. 91), this common stalk is replaced by a wide stiff disk overshadowing all the polypes and bearing on its upper surface a triangular crest, which catches the wind like a sail and enables the colony to drift along on the surface of the water.

In all groups of marine animals, from these simple ones up to the fishes, we find kinds, the colours of which compete with those of tropical birds and butterflies in splendour and variety. And so — a compassionate reader will think, on reading in another place (p. 110) of the deafness of the sea-beasts — these poor creatures are compensated for the lack of one sense by the joy at the sight of their gloriously coloured companions: for all these tints are naturally

there to be seen. A very natural supposition — but still an error! The aquatic animals see no colours; most probably they observe no more of them than a colour-blind person — that is to say the difference of brightness alone. And further, water animals are much less capable of observing differences of form than are their relations on land. The fishes even, with their highly organized eyes, can see clearly at close quarters only, and thus in a very narrow field. Their eyes, too, when at rest are focused for near objects (not as in land animals, for distant ones), and they "accomodate" by approaching the lens to the cornea (not as in birds and mammals by a change in shape). The reason for the deficient development of the sense of sight in aquatic animals is a physical one, namely the relatively slight transparency of the water.

Ctenophora.

Like Siphonophora and Medusæ and many other inhabitants of the high seas, such as some Molluscs, Annelids, Crustaceans and even fishes, the Ctenophora have transparent bodies. The reason for the possession of this "vanishing-cap" must be sought for in the advantage which they gain by such a character. Probably the advantage consists in the difficulty which their enemies have in seeing them, and in the facility with which they can surprise and capture their prey. These transparent animals, even the delicate Ctenophora and Siphonophora, are often voracious robbers, frequently swallowing animals which one would suppose might easily overcome them. Inside the cavity of *Beroe* or in the pendant stalk of a Meduse are often seen small fish which the apparently delicate organism dissolves and digests.

In the Bay of Naples the following Ctenophora occur: the barrel-shaped, comparatively tough **Beroe** (fig. 85); the much more delicate **Callianira** (fig. 87), **Eucharis** (fig. 86) consisting chiefly of water; and lastly the curious Venus' Girdle, **Cestus Veneris** (fig. 88). All of these attract the attention of the observer by the beads of light which seem to run over the body in various directions, displaying all the colours of the rainbow. This curious play of colours is caused by innumerable little plates, which are placed in vertical rows one above the other, and are moved up and down with great rapidity. By them the rays of light are reflected in such a way that the colours of the rainbow, which make up white light, appear separately. These plates, arranged in rows like the teeth of a comb, have caused these organisms to be called Ctenophora ("comb-bearers").

Echinoderms.

This group of animals comprises the Sea-urchins, Sea-stars, Sea-cucumbers, and Feather-stars. They are especially interesting to those not acquainted with marine life, for no member of the group occurs either in fresh water or on land and the visitor meets them as quite new forms.

Some are almost spherical (fig. 7), others are flat like a leaf (*Palmipes*, p. 4), others again star-shaped (figs. 1 and 3); some are cylindrical, something like a cucumber in shape (figs. 9, 11); and lastly some have the form of a flower attached by a short stalk, and seem to possess sepals and petals (fig. 6). The skin of these animals contains a large number of different but regularly arranged calcareous plates. In the Sea-urchins these plates are fixed together so closely, that the spherical body seems to consist of a solid inextensible substance; in the Starfishes the plates are more losely connected one to the other, and allow the body a certain amount of flexibility so that the arms (the term applied to the rays of the starfish) can be bent upwards and downwards and from side to side. (These movements are best seen, when a starfish is lying on its back and tries to turn over on its under surface. At the request of the visitors the attendant will turn a starfish on its back.) The Brittle-stars are able to perform snake-like movements with their arms, and can move along with great agility. The Feather-stars can even swim by using their long thin feathered arms like whips. The skin of the Sea-cucumbers is entirely leathery, and contains instead of the calcareous plates inumerable extremely small pieces of carbonate of lime, often of very curious shapes such as anchors and rosettes; they are consequently able to straighten their body and bend it again in any direction.

In the Sea-urchins and Starfishes one can scarcely observe these calcareous plates on account of the large number of spines and other processes with which they are covered in life. But on dead specimens — the attendant has always some at hand — one can easily see the immense number and definite forms of these plates which compose the round dwelling.

How can Sea-urchins and Starfishes move about in the water? In answer to this question we must ask the reader to observe carefully some specimen which is attached to the glass front of the tank. He will then notice on the side towards the glass numbers of fine threads which bear at their extremities each a small sucker. These threads are very mobile, stretch themselves and contract again like so many worms, and are easily fixed to the glass. These "sucker-feet" are hollow, and the animal forcing water into them causes them to elongate considerably. They are then fixed in the right direction to some firm object and by shorten-

ing them again the animal draws itself along. The water necessary for the expansion of the feet is taken into the body by a special system of canals (which have nothing to do with a blood-system) leading to every one of the feet.

These feet are equally important to the Sea-urchins to catch their prey. If any animal upon which they can feed comes into their vicinity, they protrude some of these feet till they reach its body. Should it not notice in time the attack which is being made upon it, or not be strong enough to tear the attached sucker-feet, it is lost and, caught like Gulliver by the Liliputians, is slowly drawn into the mouth and then gradually devoured. But, so as not to be recognized too soon in stalking their prey, many Sea-urchins cover themselves on their upper surface with all sorts of stones, shells, and pieces of sea-weed, and are thus more often successful.

The mouth of the Sea-urchins and Starfishes is on the lower surface of the body, and is therefore only visible when they lie on their back or are attached to the glass on the front of the tank. Many Sea-urchins have five strong teeth of very complex structure; others lie always buried in the sand and swallow it, so as to digest whatever organic substances it contains. The Starfishes have no teeth, but the walls of their alimentary canal secrete such strong juices that they can kill animals which they have caught with their sucker-feet and brought to their mouth. In this manner *Asterias*, the stomach juices of which contain a strong acid, dissolves parts of the shells of the mussels, snails and sea-urchins which it catches and sucks out the soft parts through the holes thus made. If this Starfish catches a fish which is too large to be swallowed, it turns its stomach inside out, surrounds its prey with it and digests it outside the body. For this reason *Asterias* and *Astropecten* are both dangerous guests on oyster-beds.

Like some of the Sea-urchins, most Sea-cucumbers live by swallowing sand and mud and digesting adhering organic particles. Some (e. g. *Cucumaria*, fig. 9) manage matters very differently. They remain motionless on a stone or other prominent object, stretching out their large branching tentacles and carrying them one after the other into their mouth, sucking off the small animals which in the meantime have settled upon them. With a little patience this proceeding may be easily observed.

Some Sea-urchins (e. g. *Dorocidaris*, fig. 7) have very long spines; in these cases, however, the sucker-feet can be extended to great length, for they must always reach beyond the spines. In many cases we find between the spines special moveable stalks bearing small pincers, which can also seize small objects. — The Starfishes have primitive eyes at the ends of the arms.

Many Echinoderms have a great capacity for regeneration. If one breaks off one or more arms of a Starfish or Brittle-star they rapidly grow again. True, a lizard can re-grow its tail after it has been broken off; but the starfish-arms are capable of more than merely growing out again. A separated arm is able to give rise to the whole middle piece and the remaining arms, and as long as the newly formed parts are still small we get the so-called "comet forms". To break the arm off a Starfish may appear to be a cruel form of torture, but it cannot be so, for otherwise the animals would not do it of their own accord. For there are Starfish which, without appreciating the efforts of the anti-vivisectionists, practice vivisection on themselves. They break themselves into two nearly equal pieces, each of which proceeds to grow into a perfect animal. This is a normal form of reproduction called "Schizogony" which these animals make use of besides the usual method by means of eggs. The Sea-cucumbers too have a remarkable habit. When the water in which they are living becomes foul, they throw out the whole of their intestines; but as soon as normal conditions set in again they regenerate them.

A glance at the Starfish, Brittle-stars and Feather-stars shows that the Echinoderms (like the Corals and Jelly-fish) are built on a plan which is fundamentally different from that of the higher animals such as insects or mammals. The plan on which these latter are formed is well-known to be a bilaterally symmetrical one, but that of the Echinoderms is radial. Their body is arranged with the organs disposed about a central axis like the sepals, pedals and stamens of a flower. If we make the comparison with a five-petalled flower, we have the same number of radii, as those which make up the fundamental plan of Echinoderm organisation. It is however very remarkable that the young free-swimming stages of this group (for they, too, enjoy this happy youth, before changing into the creeping adult) are in no way radially symmetrical, but bilateral, like the higher animals. For a long time this has given the zoologists food for thought, but of late the development of Echinoderms has been of interest to them in another respect. The very transparent eggs not only give an insight into the finest processes of the commencement of embryonic development, they not only supply the main material for a close study of the problems of heredity, but it has also been possible to cause the development of young Sea-urchins through *artificial parthenogenesis*, that is, the replacement of normal fertilization by a purely chemical process.

The whole company about which we have been telling all these tales, while neglecting our duty of introducing its members personally to the visitor, is to be found together in tank No. 1. Below is a list of their names arranged in families with notices on their appearance, habits, special peculiarities, etc.

1) **Feather-stars** (*Crinoidea*). Of these there is one species only in the Aquarium: **Antedon rosacea** (fig. 6) in straw-coloured, orange-coloured, blood-red, or spotted brown and white varieties. Generally they hold on to coral-branches, so as to appear like flowers, growing on submarine trees.

2) The **Starfishes** (*Asteroidea*) are represented in the Aquarium by the genera **Luidia** (fig. 5), **Astropecten** (fig. 1), **Asterias** (fig. 3), **Echinaster** (fig. 2), **Palmipes,** and others.

3) The **Brittle-stars** (*Ophuroidea*) are also present, but attract the attention of the layman much less. To them belongs, for example, **Ophioderma** (fig. 4).

4) The **Sea-urchins** (*Echinoidea*), on the other hand, are very conspicuous. The large yellow ovaries (roe) of **Strongylocentrotus** and allied species are eaten in Naples raw as we eat oysters. **Sphaerechinus** (fig. 8) is of a beautiful violet or reddish-brown colour; and **Dorocidaris** (fig. 7) is remarkable on account of the size and thickness of its spines, which are few in number, and on which hydroids and banacles sometimes settle.

5) The **Sea-cucumbers** (*Holothuroidea*) are very common in the Bay of Naples, and the Aquarium contains about half a dozen kinds, among which are **Cucumaria** (fig. 9), mentioned above, the brown **Holothuria** (fig. 10) and the flat **Stichopus** (fig. 11).

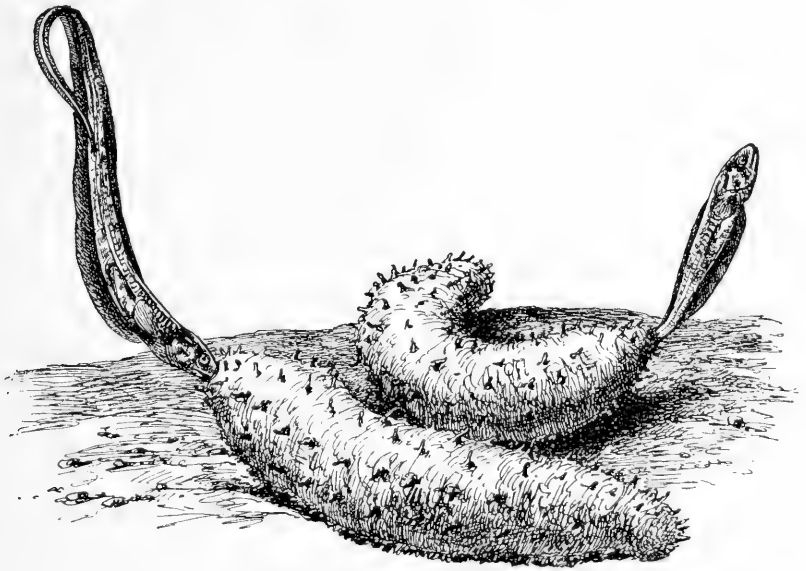


Fig. 160. Two Holothurians with *Tierasfer*. On the left a fish is entering; on the right one has the front part of its body projecting out.

These Holothurians are very remarkable in harbouring within their bodies a fish of 8—10 inches in length, **Fierasfer acus,** which pokes its head out of the anus of its host (fig. 160). It eats small crustaceans but has to come out of the Holothurian to catch them. Some kinds of Sea-cucumbers are considered a great delicacy by the Chinese; what they call "Trepang" is nothing but the body of *Holothuria edulis* and other kinds deprived of its intestines and dried in the sun or by the fire. Thousands of people, chiefly Malays and Chinese, are employed in its fishery and subsequent distribution; entire fleets put out every year to the coral islands between New-Holland and New-Guinea, where the fishing is most profitable; but the result of their labour is only palatable to the European taste when strong relishes have been added.

Annelids (Ringed Worms).

The name "worm" calls up in most minds a feeling of aversion, since it is generally associated with such unpleasant forms as slimy earth-worms and bloodthirsty leeches, tapeworms and trichinosis. While the English word includes, besides these, Cleopatra's asp ("the pretty worm of Nilus") and St. George's dragon ("the laidly worm"), the group of which we are treating is more definite and less terrible. Indeed, in the sea we find the large group to which the common Earthworm belongs, the Annelids, competing in delicacy of form and beauty of colouring with the most lovely Sea-anemones and other brillant inhabitants of the deep. This will impress itself on the reader as soon as he takes a look at the worm-tank (Nr. 22) of our Aquarium, which more resembles a garden of miniature palms than a collection of worms.

The feathery spiral crowns of **Spirographis** (fig. 120) wave about at the end of their slender stalk, the brilliant red tassels of **Protula** (fig. 121) protrude from white calcareous tubes of irregular form, while in another place a confused mass of such tubes is dotted over with hundreds of many-coloured brushes, **Hydroides** (fig. 122), all as delicate as flowers, reminding one more of the children of the goddess Flora than of animal forms. And yet all these organisms are true worms which have built these leathery or calcareous tubes for the protection of their soft bodies; the feathery palm-like crowns are the gill-branches round their heads. Touch one of these tiny crowns ever so slightly, and instantly it disappears into the tube; the worm has withdrawn itself into its abode, where it waits until the supposed danger has passed. Then, slowly and carefully, a bunch of plumes looking like a camels-hair brush will be pushed out of the tube; they will unwind and spread out again in all their glory. Even a slight disturbance of the water will frighten some of these worms into

their hiding places; and in some of the smallest kinds this sensitiveness goes so far, that they feel even the momentary darkening of the tank caused by a cloud drifting across the face of the sun. The fact that the brilliant red gills of *Protula* become bleached after some months in the Aquarium is probably also to be put down to an effect of the light.

In the sea we may often see a natural garden of this kind. Looked at through the clear water of a rocky coast it is an enchanting sight, and always yields a rich harvest to the naturalist, not only of these worms, but of many other animals which have taken up their abode amongst them. All these worms are fixed to rocks or wood or have the lower part of the tube stuck into the ground, and several species settle in such masses on the bottoms of ships that their progress is considerably retarded. Not all Tube-worms secrete calcareous shells or leathery ones, like those mentioned above; some saturate the sand in which they burrow with a slimy secretion from their skin and form in this way delicate tubes of sand. Such are possessed by **Arenicola,** the lug-worm, so much used as bait in England. In the same manner **Terebella** forms a dwelling, and its orange-coloured tentacles may be seen protruding from the sand at the bottom of the tank, twisting about in all directions in search of food. Others cement together small stones, shells, and other similar objects (Shell-binders), while some encase themselves with mud, or form long horny tubes, open at both ends and resembling the shaft of a feather: **Onuphis.**

All these animals, when young, are entirely differently constituted. From the eggs issue free-swimming larvæ of very curious form, which after a while fix themselves to stones or weeds, and then by a complete metamorphosis change into the worm-like animal and encase themselves with a tube.

Fig. 161.
Alciopa Cantrainii,
1/2 nat. size.

Besides these tube-inhabiting Annelids, of which all the warmer seas possess a variety of beautifully coloured kinds, there is a second group, no less rich and varied: the free-living Annelids. The Bay of Naples has long been celebrated among zoologists as one of the richest localities for these worms. Still only a small portion are suitable for the purposes of an Aquarium, as most of them live secluded in the mud or in the cracks of the rocks. One of the finest is the Sea-mouse, **Aphrodite** (fig. 130), the bristling coat of which reflects with a bright metalic lustre all the colours of the rainbow. Its nearest relation is the very common **Hermione,** which in spite of its beautiful name is a dis-

gusting animal, the hooked spines of which penetrate into the hand that touches them, and cause inflammation. **Alciopa** (fig.161) is as transparent as the jelly-fish and other pelagic animals, and like them lives near the surface of the sea. It is rarely seen in the Aquarium (Tank Nr. 20), since the capture of such animals, as already mentioned, depends much upon the weather (see p. 58).

Polyzoa or Bryozoa.

The name *Polyzoa, i. e.* multiple animals, was given to this group from the fact that they live in large colonies, like corals. By the German school they are always called *Bryozoa* or moss-animals; a name which arose from the moss-like or coral-like growth which these colonies form.

The graceful net-like frill of **Retepora** (fig. 115), or the branching stem of **Myriozoum** (fig. 116), may easily be mistaken for corals, to which, however, they are by no means allied. Careful investigation has shown that the little animals which form these growths, and live together in colonies, are very different from, and more highly organized than, the polypes of a coral.

The Polyzoa are widely distributed in all seas, and present a wonderful variety of form. A kind very common on the British coast and well known to all visitors to the sea-side is the leaf-like growth of **Flustra,** the sea-mat, the colour and texture of brownish white paper.

Crabs, Lobsters, Shrimps, Barnacles, etc. (Crustacea).

In the great family of the Crustaceans the reader has at least one old friend, namely the lobster. We will make use of this animal, then, as an introduction to the other members of the class, which although sharply divided off from other divisions of the animal kingdom has within itself many diverse forms. The friend just mentioned belongs to the most highly organized group, to the ten-legged crustaceans, or *Decapods*, and to the long-tailed (*Macrura*) division of them.

The Lobster, **Homarus vulgaris** (fig. 44), is, on the whole, an enlarged copy of the fresh-water crayfish; and visitors will easily recognize, from examining the large specimens in the Aquarium (tank Nr. 6), what are the principal features of its organisation. The body is divided into an anterior part, consisting of head and chest, which is really jointed but covered on the upper surface by an unjointed shell (*carapace*); and a posterior part, composed of a number of rings forming the "tail" of the Lobster, which terminates in a fin composed of broad, flat plates. The anterior portion bears the stalked eyes and two pairs of antennæ or feelers, one pair very long, the other short and forked. Behind these,

and on the under surface is the mouth, furnished with six pairs of appendages or feet modified for purposes of mastication. Of these first we have a pair of mandibles followed by two pairs of maxillæ, forming the "jaws" of the Lobster. Then there are three pairs of "foot-jaws" or maxillipedes, used by the animal to hold and turn about his prey or food, while the jaws proper are employed for biting and chewing. The working of this apparatus (in which an upper jaw does not work against a lower as ours do when we are chewing, but the jaw of one side grinds against that of the other), can be very well seen while the animal is eating. Behind the foot-jaws we find five pairs of walking-legs, the first three pairs of which end in pinching claws. The claw of the first pair of these walking-legs are of immense size and strength, and serve as weapons of attack or defence. The tail also bairs a pair of limbs on each joint; they are termed the swimming-legs, but serve in the female Lobster to carry the eggs.

If we observe the Lobster more carefully, it seems to be constantly fanning itself with the feathery tassels on its foot-jaws, and often performs similar movements with its abdominal legs. This is its method of breathing. Just as man renews the air in his lungs by the contraction and expansion of his chest, so the Lobster, by these movements of its feet, causes fresh water to flow to its gills, which lie under its shell at the base of the legs. Another noticeable action is the constant twitching of the smaller pair of feelers; these probably serve as olfactory organs, while the larger ones are the organs of touch.

An important event in the life of a crab or lobster is the periodical *moult*, more frequent in young than in older animals. For the skin of the crustacean has not only the function of separating and protecting the organism from the outer world, as is the case in other groups; it also has the same function as the bones have in vertebrates, that of skeleton. To the shell of the lobster the body and leg muscles are attached as to the bones, and the separate pieces of the shell are moveable on one another just as bones are. On account of this function the skin must be hard like bones (it consists of a substance called *Chitin*), and being hard it cannot give and stretch as the body grows within. From this follows that the crustacean can only grow by cracking its skin, or at least the hard outer layer. When this occurs all the organs and also the inner soft layer of the skin enlarge. The skin then forms a new hard layer which serves as shell until the next moult. When the time for moulting arrives, when, one might say, the lobster is ready to jump out of the skin, the shell crackes at the hinder end of the carapace and through this slit the animal works its way slowly out. The back part comes out first and is followed by the thorax and head, the whole being a tiresome and often dangerous business since all limb-joints, the large claws, the eyes,

feelers, jaws and gills must all be drawn out of their narrow cases. Even the stomach, into which the skin extends, gives out its lining, covered with small teeth and ridges, through the mouth! Often the animals have to sacrifice one or both claws, and they are in great danger until the new covering has hardenend sufficiently; so they instinctively seek a place of retreat during the process of moulting. Animals which have just shed their skin look very handsome in their new and bright apparel, but they are blue not red. A Lobster only assumes a red colour after death, while a Craw-fish is red in life.

Of the habits of the Lobster which can be observed in the Aquarium, we would only mention that of digging holes and ditches in the mud, partly for hiding-places and partly for burying food; also its suspicious behaviour towards its companions, with which it often engages in deadly combat, trying the gigantic strength of its claws with only too much success. One might imagine that these huge claws were too weighty even to be carried, far less to be used as weapons, but it must be remembered that they are far less heavy under water than they are in the air. The invalids with shortened feelers and broken claws, sometimes seen in the tanks, are unfortunate individuals wounded in battle or during the period of moulting. But they do not long remain cripples, for crustaceans possess the power of *regeneration* too, and after one or two normal moults they are again in possession of all their limbs. The real home of the Lobster is on the coasts of Northern Europe, where its capture forms an important part of the fishing industry. It is caught in creels or "pots", into which it is enticed at night by baits of meat; these it relishes greatly, whether they be fresh or putrefying. In the Mediterranean Lobsters are more rare.

In the next tank (Nr. 7) the reader will find a near ally of the Lobster, the Spiny-lobster or Craw-fish, **Palinurus vulgaris** (fig. 47), another culinary asset of the Mediterranean (called "Aragosta"). A glance will show the difference of the Craw-fish from the true Lobster: the absence of great pinching claws, the spiny shell and the enormous antennæ immediately strike the eye of even the casual observer, and further comparison will reveal a host of less obvious differences. In their habits both animals agree, but the Spiny-lobster is more sociable and more lively; it likes to climb the rocky sides of the tank, which it does with great agility, and it feeds on shell-fish, which it cleverly opens with the strong claws of its first pair of legs. It is much more common in the Mediterranean than the Lobster, and is caught on all the rocky coasts of the Bay of Naples. At the length of 10 inches it commences to reproduce, the young being quite transparent creatures, flat as a leaf, for which reason they are called *Phyllosomae*. The Craw-fish lives very well in captivity. It is one of the few aquatic

animals capable of producing sounds: the friction of the basal joint of the antenna against the carapace produces a grating noise.

An allied kind is the Flat-lobster, **Scyllarus latus** (fig. 46), a clumsy animal which spends the greater part of its life in some crevice of the rock. Its broad back is generally covered with mud and brown algæ, and is often mistaken for a stone. It uses its front pair of feelers, shaped like two broad shovels, as weapons of defence; and whilst feeding it covers its food with them. In tank Nr. 23 the Lesser Flat-lobster, **Scyllarus arctus,** is often to be found; a more brilliantly coloured and livelier fellow.

Of the smaller long-tailed kinds we would mention the Shrimps and Prawns, such as **Crangon** and **Palaemon** (fig. 145), remarkable for their lively jumping. They inhabit all the rocky coasts in large numbers, and are the staple food of many animals: in tanks Nr. 20 and 23 of the Aquarium they are largely used for feeding purposes. Their movements when walking or swimming are easy and graceful, and they are so sensitive that they feel the least disturbance of the water and respond to it by tremendous leaps.

Two rare Shrimps, not always present in the Aquarium, are **Stenopus** (fig. 131), and **Penaeus** (fig. 132). The latter is exceedingly palatable, and, as it has a very thin skin, would be very valuable as an article of food if it were only a little more common. In the Bay of Gaeta it is largely caught under the name of "mazzacuogno".

We now turn to a curious group intermediate between the long-tailed Lobsters and Shrimps, and the short-tailed Crabs. To this group belongs the beautiful **Galathea** (red with blue stripes; tank 23) but more especially the *Hermit-crabs* or **Pagurids** (figs. 143 and 144).

A whelk-shell walking about on crab's legs and carrying sea-anemones on its back — such is the impression made on anyone looking for the first time at a Hermit-crab (tank Nr. 23). This droll figure fascinates us at once and creates in us a desire to know something more about it. The problem is simpler than it seems, and has the following explanation. The Hermit-crabs live in deserted whelk-shells. When they escape from the egg they are just like the young long-tailed prawns; but very soon their previously straight tail begins to twist itself spirally, and the time has come for the small animal, which is scarcely half an inch long, to look out for a shell. If it finds an empty one suitable for its size, it puts its tail into it; but if it does not, it first eats out the whelk and then takes possession of the shell. In the course of many generations the hind portion of the body has become so accustomed to a borrowed covering that it is quite soft, and resembles an unjointed sack (fig. 162) possessing at its extremity a pair of rudimentary legs; with these it holds so fast to the shell, that in trying to extricate the animal you may very often tear

it to pieces. The shell thus serves as a protection and is usually so large, that the Hermit-crab can withdraw itself entirely from view in case of danger. Growth brings great difficulties for the Hermit-crab: firstly, that common to all crustaceans, of moulting, and secondly the special change of home. For when he has increased in size he must naturally exchange his old house for a more roomy one and this he does with great circumspection. When he has found a shell suitable for his purpose he first examines it carefully all over, poking his claw far into the cavity to

Fig. 162. *Pagurus striatus*, taken ont of its snail-shell, to show the soft, worm-like abdomen.

assure himself that there is nothing suspicious lurking within it; then if all is right he cautiously prepares to effect the removal. He gets hold of the shell with his claws, places it in an upright position with the opening towards himself and, with one quick dart, forsakes his old home and slips into the new one, as if he knew what a tit-bit his soft juicy body would be for some hungry fish.

But why should often three or even six Sea-anemones be attached to the shell occupied by the Hermit-crab, and yet be in no way organically connected with the crab? It is evidently a mutual benefit association formed by the crab and the

anemones, for their common good. We can soon see that the hermit-crab is the real soul of the company, its founder and president, but the anemone is by no means a sleeping partner. We know already how concerned the crab is about the safety of his soft body; but even within the whelk-shell he does not consider it really secure — and that not without good reason, since it is no trouble for a turtle to crack the shell or for an octopus to squirt some poison into it (p. 89). Experiment has shown, however, that in the presence of the anemones these enemies keep their distance: while octopods pounce at once upon hermit-crabs in naked shells, they do not dare to touch those to which anemones are fixed — their past experience of the stinging-cells of the anemone overcomes their appetite for hermit-crab. Thus the crab has this advantage from the association, that his house is overgrown by living batteries of stinging-cells, the fire from which puts his enemies to flight. The anmone, too, gets her share, for she walks around on the agile legs of her friend; and this is not only an unexpected pleasure for a beast condemned to sit still throughout life — these promenades bring a more material gain. If one watches a Pagurus eating, or two fighting for a tasty bit of food, the anemone always gets the crumbs which fall from the table of her friend. And so that nothing shall be lost the little sea-anemone *Adamsia palliata*, the regular companion of **Eupagurus Pridauxii** (fig. 144) sits on the shell so that her mouth is turned downwards.

The way in which the association of these two diverse life-companions is kept up and how it is re-established after disturbances presents to us a difficult problem in animal psychology. For the hermit-crab decorates his house with sea-anemones himself and if one takes the anemones away from the shell and scatters them about in different places in the Aquarium, the crab collects them again and holds them with his claws on the shell until they have attached themselves again. And the same thing takes place on changing houses: he does not leave his old companions behind on the cast off shell, but takes them off and carries them over to the new one. Moreover, while the anemones shoot out their sting-cells at any other touch, they allow their friend the hermit to do what appears to him good.

In the same tank (No. 23) other curious things are to be seen running around: yellow or bluish lumps at one side of which is a hole with a hermit-crab looking out of it. These too are whelk-shells, but so overgrown by a sponge (*Suberites*), that the form of the shell is often quite unrecognizable. At the same time the sponge dissolves the calcareous substance of the shell until eventually there remains only the hole inhabited by the crab.

The life of the Hermit-crabs in the Aquarium is rich in varied and amusing scenes. The droll flights of the little troop, the way

they tumble about, flee and follow each other up, the impudent seizures of some and the resolute defence of others during the common meal invariably excite the laughter of the spectator, who is often greatly surprised at the artful and calculating ways of the little creatures. In these habits the Hermit-crabs rank next to the true Crabs, to which we will now turn our attention.

The long tail (abdomen) of the craw-fishes and whole class of long-tailed forms is a powerful and muscular organ of locomotion: at one stroke it carries them far through the water. But it is rather a doubtful blessing to them, for in the first place they can only use it to move backwards and in the second place it tastes good and that is their ruin. What trouble their abdomen gives to the Hermit-crabs the reader has learned, and he will therefore congratulate the crabs on having been clever enough to reduce this appendage to a minimum, for which reason they are called *Brachyura* (short-tails). The abdomen of this group of Decapods, of which the Shore-crab, **Carcinus** (fig. 136) is a well-known member, has become a small round or triangular plate bent in under the fore-part of the body and invisible from above. The body is developed in a transverse direction and is either *triangular*, *square* or *round*.

The instincts of the *triangular* Crabs remind one of those of the hermits. They delight to deck themselves out with different things. Thus **Maja verrucosa** (tank 13) and **Lissa** (fig. 138) often carry on their backs and legs a forest of sea-weeds and animal colonies (Polyzoa, Hydroids, etc.); thus, too, the species of **Inachus** (fig. 139) drag round on their long thin legs all kinds of plants and sea-squirts. In short, as many of these animals as one collects, so many different toilettes does one find. And what is their use? They afford the best possible concealment from enemies and from prey. For all these objects have not fastened themselves on the crabs, but have been artistically placed there by the crab itself — we dare hardly say intentionally, but by reason of an inherited instinct which impels the animal to disguise itself in this way. All triangular Crabs are exceedingly slow in their movements, and dressed up in this way they resemble most closely a stone overgrown with sea-weed, especially as they have the habit of remaining quite motionless when alarmed. The apparatus for affixing these foreign bodies consists of a number of hooked bristles which are distributed all over the shell; and on these the crab deftly fastens with its claws the algæ and other ornaments. The Larger Spider-crab, **Maja squinado** (fig. 70), a crab already known to the ancients, and figured on some coins, even puts small stones and mussel shells on its back, but when fully grown scorns all dress. **Lambrus** (fig. 140) departs from this custom and depends more upon its large and strong claws than upon concealment.

Some of the Crabs with a *square* body have similar habits. **Dorippe lanata** (fig. 142) gets hold of any living or dead object within its reach, holds it above its body with the claws of the two last pairs of legs, and walks about thus concealed. Sea-cucumbers and ascidians, crabs and starfishes, fishes' heads, bits of glass or wood, in fact anything and everything which can serve as a shield, is annexed without further ado. Naturally, when the desired shield happens to be a living animal, there often ensue very laughable conflicts between the instinct-obeying crab and its reluctant victim. **Dromia,** the Woolly-crab (fig. 141), covers itself so completely with an orange-coloured sponge (*Suberites*, p. 62), or with a colony of compound ascidians, that, if you look at the animal from above, only its legs are visible. Here, too, the living coat, which increases in size as fast as the crab, is held on by means of the two last pairs of legs. The formation and position of these legs are best seen in the rare **Homola Cuvieri** (tank No 3). This animal often loses its protection covering, in being hauled up from the considerable depths in which it lives, and, finding no suitable substitute in the Aquarium, it nevertheless holds its hind legs up, as if carrying a burden. This, together with the long stilt-like form of the legs makes it a grotesque sight.

The Crabs with a *round* body behave very different, for they are extremely clean. **Calappa,** the Bashful-crab (fig. 134), seeks protection by burying itself in the sand. With a few vigorous movements of its large shovel-like legs it sinks itself up to the eyes in the sand, and carefully surveys the country from this retreat. **Ilia** (fig. 133) acts in the same way. A touching example of friendliness has been observed in Calappa. As mentioned above, immediately after moulting and before the hardening of the new armour, crustaceans are helpless against their enemies. In the time of their need the *Calappas* protect their younger companions by taking them under their broad and strong claws, until the shells have become hard again.

The most highly developed kinds of this group are the Shore-crabs, of which we will only mention **Carcinus** (Green Crab, fig. 136), **Eriphia** (fig. 137) and **Lupa** (fig. 135). Their agility and slyness are surprising and, together with their power of living and moving on land, point to a further progress in their organisation. Those who have tried to catch one will remember the difficulty in obtaining even one of a hundred, and will have noticed how cleverly the little fugitive availed itself of every hiding-place, and how boldly it defended itself when finally driven into a corner. The strong *Eriphiae* are especially ready to fight, and with their strong claws they violently pinch every thing which is held out at them. In the Aquarium they have been seen to break thick glass tubes. If one picks up a crab by a claw or a walking-leg, the limb remains in the hand and the crab runs off, for more than other crustaceans

are the crabs possessed of the capability of *Autotomy*, that is, they can break off their legs at a particular spot near the base. The lost limbs soon grow again. Out of the water all Shore-crabs can live a considerable time and move about with as much agility as in their native element.

The Mantis Prawn (**Squilla Mantis,** fig. 146) belongs to the group *Stomatopoda* which, although superficially resembling the long-tailed Decapods, are really quite distinct. This crustacean is named after the well-known Praying Mantis (*Mantis religiosa*) owing to a similarity in the shape of the fore-limbs. These appendages resemble the arms of a boxer ready for the fight. The muscular joints, which, at rest, are folded in a zig-zag, can be shot out suddenly and with great force so that the sharp, ivory-hard and toothed terminal joint is deeply buried in the victim. The Mantis Prawn has a long body composed of segments, the suppleness of which is especially noticeable when it is cleaning itself. This is done with two small brushes each on a long, thin, jointed stalk. With these cleaning-organs, it brushes itself with infinite care, often for hours on end, and now the eyes and feelers, now the mouth and its appendages, now the legs and joints of the body are brushed and stroked, till no foreign particle is left adhering to them. The female does not attach the eggs to the abdomen but forms them into a little cake which she carries between the mouth-parts until the young hatch out. This takes at least two months and during that time she fasts.

It is a well-known fact that it is difficult to find on land a spot where there are no insects — even the best powder is often powerless against them! In the sea the crustaceans replace these ever-present animals. Even the species of the types described above are very numerous and of world-wide distribution, but of the untold masses of the smaller kinds belonging to the remaining orders, the specialist alone has any imagination. The seas swarm with them, but they do not lend themselves to exhibition in the Aquarium and so we will treat of some of them only, and in a few words.

Almost all the year round most of the tanks, especially Nrs. 7 and 11, contains swarms of very minute, lively shrimps, which play about over the sand like a swarm of flies. These are not the young of some larger shrimp, but fully grown animals, the Opossum-shrimps or *Mysidea*, belonging to the group of *Schizopods* (split-feet). Owing to their numbers and voracity they are dangers to fish, especially those with naked skins (*Lophius*, *Trygon*) at which they are continually nibbling. On the other hand young fish delight to chase them, and in tanks where such are present none of the little crustaceans are to be seen. The Schizopods are characterized by having limbs resembling two-pronged forks. The Decapods described above have also, in a very young stage,

such forked limbs and for this reason are probably descended from animals resembling these Opossum-shrimps. In the tail-fan these animals carry a pair of curious organs which were for a long time considered as ears, but are now recognized to be balancing organs (*Statocysts*).

Most genera of the *Amphipoda*, the next group, of which the reader perhaps knows the common Freshwater Shrimp (*Gammarus pulex*), live in the sea. **Phronima,** the Hermit-screw (fig. 163) is especially interesting. It is a perfectly transparent pelagic animal, and curiously enough makes use of the young *Pyrosoma* (see p. 100) as a dwelling, eating out its centre so as to form a small barrel. It fastens itself to this house by means of its front legs and protrudes the hind end of its body, the legs of which perform rapid strokes which propel the animal, together with its house, through the water. This invertebrate Diogenes uses its transparent tub as nursery too, keeping the young there for some time after they are hatched. It is caught on the surface of the sea, together with jelly-fish and other "pelagic animals" especially in the months of winter and spring, and will be found occasionally in tank Nr. 20.

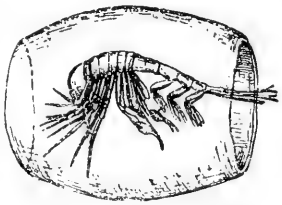


Fig. 163. *Pronima sedentaria* in its barrel.

Less pleasant is the acquaintance which the visitor to the Aquarium makes with the marine *Isopods* and those who know their relations the wood-lice will expect nothing very pleasing from them. A large number of the marine Isopods have taken to a parasitic mode of life and many of these forms (the so-called Fish-lice) have for their victims (or, as one eupemistically expresses it, hosts) the fishes which live in the aquarium tanks. Parasitism is always a vice, but here we meet with it in a particularly repulsive form, so that the visitor will not be sorry if no fish are visible at the moment with these blood-suckers attached to head, eyes, mouth, throat, gills or tail. The parasites are of about two inches in length and belong to the genera **Anilocra** and **Cymothoa.** They fix themselves with fourteen sharp sickle-shaped claws so firmly that the tortured fish strive in vain to rub them off. Levelling justice has, however, happily seen to it that on these parasites others prey, in the manner of the wellknown rhyme: —

Big fleas have little fleas
Upon their backs to bite 'em,
Little fleas have lesser fleas,
And so at infinitum.

The rich intake of nourishing fish-blood gives the Isopods material for the production of a numerous brood, which the mother

carries around with her in a so-called brood-pouch. After hatching, all the young develop into males with organs and functions of such, and these same males then change into females. The male and female organs are thus not developed simultaneously as is usually the case in hermaphrodite animals.

We could specify other Isopods as examples of the degrading influence of this mode of life, and of the depth to which the parasites sink from the hights on which their ancestors stood and their relations still stand. The sessile habit, however, can exercise a similar influence on animals originally free-living, changing them out of all recognition. Proof of this is furnished by the *Cirripedes* (tendril-feet), popularly termed Barnacles, which are externally so unlike shrimps or crabs, that they have only in recent times been properly understood. Even Cuvier looked upon **Balanus,** the Acorn-barnacle (fig. 164), and **Lepas,** the Goose-barnacle (fig. 129), as mollusks; and it was not till much later that their early stages and their anatomy revealed the fact that they belonged to the Crustacea.

Fig. 164. *Balanus perforatus*, on a rock, 1/2 nat. size.

The general public will therefore also experience some difficulty in accustoming its mind to the fact that these animals are undoubtedly relations of the well-known species of Crustacea. This may be more intelligible when it is told why we suppose that the curious form of the animal, reminding one of the shell of some fixed mollusk, is due to a far-reaching degeneration. In their early youth, these animals are very small, active and free-swimming, with a pear-shaped body and three pairs of swimming-legs. This larval stage is common to all the lower kinds of Crustacea and is termed the "Nauplius" stage. But after several moults this larva fixes itself by its head to some convenient object, and now the skin begins to secrete the calcareous covering, which consists of several plates completely hiding the animal, and only allowing the delicate legs to protrude from a slit-like aperture. These delicate jointed appendages can be seen waving perpetually in both *Balanus* and *Lepas*, serving to create a current bringing food to the mouth (see p. 58).

Balanus forms a belt all round the rocks just at the surface of the water, and these barnacles are so securely attached that they cannot be washed off by the waves. At low-tide they bear the greatest heat of the sun, lasting out till high-tide with the least drop of water, which they retain in their tightly closed shell. *Lepas* (when present, in tank No. 22) prefers to attach itself

to floating objects; it is found in large numbers on ships, drift-wood, etc. Its name of Goose-barnacles is due to the fable according to which they are the young of the goose called, after them, the Barnacle-goose. This myth, which is traced back to the end of the 12th century, in all probability arose from the desire of the priesthood of that time to increase the small range of a Lenten bill of fare, by deriving the geese from marine animals.

Mollusca.

The term Mollusks, *i. e.* soft-bodied animals, is applied to Snails, Slugs, Poulps, Bivalves and their allies, because they have no skeleton which enters into the mechanism of their movements; neither an internal one like that of the Vertebrates, nor an external one like that of many Worms and all Crustacea. Besides this point they differ from the above mentioned groups in not being jointed. Very many Mollusks are provided with a shell and have a head very distinctly marked off from the body and bearing eyes and tentacles.

We will begin with the highest group of the Mollusks, that of the *Cephalopoda* or Poulps. Their head bears 8 or 10 arms or feet, arranged in a ring round their mouth, and this has given rise to their scientific name. Most striking of these in the Aquarium is the eight-armed Devil-fish (ital. Polpo, the Polypus of the Greek) **Octopus vulgaris** (figs. 72 and 73), which is very common on the rocky coasts of the Mediterranean.

If one were to institute a competition for the prize of ugliness between all the inhabitants of the Aquarium, the Octopus would be an easy winner. In shape (or better, shapelessness), skin (warty like a toad), movements — in everything is it repulsive! This is an impression which can only be overcome, and indeed quite changed, by close observation.

On the sack-shaped trunk, which contains the internal organs, is the head like a knob, with the two eyes and the 8 long arms, moveable in every direction, extensible and bound together at their bases by a broad membrane. Hidden in the middle of the arms is the mouth, furnished with a pair of jaw having the form of a parrot's beak. As the animal breathes, there may be noticed a membranous flap which alternately opens and shuts, and laterally a projecting tube ("funnel") which also opens and shuts, its movements alternating with those of the membranous flap. The flap allows the water to enter the "mantle-cavity", or hollow part of the bag, in which hang the gills; the water which has been used for respiration is then forced out through the "funnel", the flap being kept closed. The usual mode of progression is climbing and crawling by means of the arms, which thus function as feet. The arms are stretched out and grasp some object by means of their double row of suckers; they then shorten and draw the

animal after them. The Octopus only swims when escaping from some danger or when pouncing on a swimming prey. The swimming movement is brought about by the violent ejection of water from the mantle-cavity through the funnel, the arms being at the same time extended forwards (fig. 72). The back-kick thus produced drives the animal rapidly through the water, the hind end of the body first. Food consists chiefly of crabs, which, after being caught and carried to the mouth by means of the arms, are quickly paralyzed by a poisonous fluid secreted by the salvary glands. Then the juices are sucked ont of the body, the solid parts not being swallowed. Mussels are also eaten by the Octopods. They shove a stone between the gaping valves of the mussel-shell to prevent their closure and then suck out the soft parts. They lie in wait for their victims hidden in crevices in the rocks and in the Aquarium they collect large stones behind which they conceal themselves. Their power of changing their colour and of producing all sorts of warts and wrinkles on their otherwise smooth skin enables them so closely to counterfeit their surroundings, that they can only be distinguished with difficulty. When well fed they grow rapidly in the Aquarium; in about $8^1/_2$ months the weight of one animal rose from 65 to 2400 grammes. Sometimes they suffer from a strange illness which must be considered as a form of psychosis: the animals eat their own arms down to short stumps, at the same time refusing all other nourishment and soon dying.

Octopods are caught on all shores of the Mediterranean and chiefly in wicker baskets ("Nasse") or in small pots ("Lancelle") into which they crawl, or they are speared. They are common in the fish-markets of Naples, as they are largely eaten, the young examples being especially esteemed.

A very near ally of *Octopus* is **Eledone moschata,** the Musk-octopus, much smaller and with only one row of suckers on each arm. They are very shy and try to hide themselves from view. When taken out of the water they give out a strong odour of musk. As they are quite common they are often brought to market, but are generally only eaten by the common people.

One of the most interesting and most important of the Cepalopods is the Sepia or Cuttlefish (**Sepia officinalis,** fig. 78). Their body is oval, somewhat flattened, and with a membranous fin running down both sides. Beneath the dorsal skin is the "cuttle-bone", found often on the English coast and given to captive canaries to sharpen their beaks. The eight arms are much shorter than those of the Octopus and are generally carried closely applied together; between them is hidden another much longer pair of arms which can be shot out to catch crabs or fish.

The most noticeable characters in *Sepia* are the excretion of an inky fluid and the change of colouring in the skin. Both of these they have in common with the other Cephalopods, but they

make more frequent use of them. The sepia used by artists is the product of a gland, the so-called ink-sack, the contents of which can be squirted out through the funnel; a small quantity is enough suddenly to envelop the animal in a black cloud, which hides it from its pursuer. The ink is extracted, dried and brought to market; even that of fossil species can still be used. — The wonderful play of colours on the living animal is due to large cells (chromatophores) which are situated in the skin and are filled with finely divided dark colouring matter; as these cells contract (become globular) and expand (become flat), a continuous change of colours takes place. Stripes, spots and markings make their appearance and disappear again according as the animal is at rest or is irritated. The Cuttlefish have complete control over this change of colours. This is seen from the protective colouring, which they assume when they lie on the sand or on dark rocky ground; in either case they can hardly be distinguished. — The males court the females with great ardour, and in their excited state produce most brilliant colours over their body. The female lays large, black, pear-shaped eggs and fixes them singly to corals and algæ, usually close together, so that they form large grape-like clusters (often visible in tank Nr. 19). As soon as the young are hatched they show their proficiency in changing their colouring and emitting the sepia.

The Cuttlefish is an important article of commerce: its flesh is eaten, if with less relish than that of the Octopus or Squid. The cuttle-bone is used for polishing wood and as tooth-powder. Besides catching them with ground-nets and spears, the fishermen make use of two peculiarities of the animals; they decoy the females by placing *Pistacia* twigs in the water, on which they lay their eggs for preference, and alure the males by towing a living female on a line behind a rowing boat.

The Calmar or Squid (**Loligo vulgaris,** fig. 15), very common in winter, is unfortunately very delicate for the Aquarium. Like a swarm of birds, slowly beating their fins, these transparent animals swim backwards and forwards, without turning round, until they die, usually only a few days after their capture. The slightest disturbance puts them in a state of great alarm and causes their milk-white bodies to show the most lovely red tints. Noticeable for their size are the large iridescent eyes. The eyes of Cephalopods are relatively and absolutely larger than those of any other known animal. The weight of the eyes can be $^1/_4$ that of the body and a giant "Kraken" caught off Ireland had eyes 15 inches in diameter. They can be fed with small shrimps and will be seen to use their long arms like the cuttlefish. Their flesh is eaten very generally; the "pen" — corresponding to the cuttle-bone — is translucent, flexible and shaped like a feather. Like Sepia they secrete ink; hence the Italian name of *calamajo* (ink-pot).

The females hang their eggs in gelatinous translucent strings on to corals or branches of land-plants which have fallen into the sea. In the Aquarium the eggs develop as far as the hatching out of the young.

It is certain that the Cephalopoda can attain enormous dimensions, and from occasional specimens have probably arisen the legends of the Kraken, if not of the sea-serpent. Thus Pliny relates a story of an animal of this kind, which came at night to the fish-tanks of Carteja, and frightened the dogs away by its snorting and its terrible arms. The head which was shown to Lucullus, was as large as a barrel, and its arms were so thick that a man could scarcely clasp them, and measured 30 feet in length. Monfort tells of an Octopus that tore a couple of sailors from the rigging of a ship near St. Helena; the end of one of its arms, caught in the tackle, was hewn of and measured 25 feet. On the coast of Newfoundland in 1875 an extraordinary number of such gigantic animals were found either dead or dying on the surface of the sea. On the average they must each have weighed half a ton; their long arms reached a length of 40 feet. On the coasts of Alaska, Japan, New-Zealand and on the Pacific island of St. Paul similar monsters have been observed; remains of them have also been found in the stomach of the Cachalot, which proves that there are fearful struggles between these sea-monsters. In any case it is well known that many whales eat almost exclusively cephalopods and the same is true of many large fishes and sea-birds.

Like the Cephalopods, the *Gastropods* (Snails and Slugs) have a head distinctly marked off from the body; it is devoid of arms, but there is present a so-called foot, *i. e.* a portion of the body is flattened out like the sole of a foot and is used for crawling, which is generally the only means of locomotion possessed by the Snails. In many kinds the viscera are contained in a spirally coiled, calcareous shell, the snail-shell, into which the rest of the body can be retracted. The shell is secreted by the mantle, a flap of the skin, and is held on the animal by means of a spiral muscle. The foot frequently carries a horny or calcareous lid, which closes the mouth of the shell when the body of the animal is retracted. The collections of shells in museums give some idea of their beauty and brillant colouring, as also of the great variety of their forms; most are marine. The most important ones found in the Aquarium are the following.

The Ear-shell, **Haliotis** (fig. 125) has a very flat ear-shaped shell with a large opening, and a row of holes through which tentacle-like processes of the foot protrude. Internally the shell is coated with the most lovely mother-of-pearl, and is therefore frequently used for ornamental purposes.

The Helmet-shell, **Cassis** (fig. 20), is also commercially a very important shell. The shells of the largest specimens are used in

the cutting of the well-known cameos. Suitable pieces are sawn out of the shell and their outer surface ground down, while the inner surface remains in its natural conditions; the relief is worked out of the many-coloured layers by means of a graving tool such as is used for cutting corals.

The Snail **Natica** (fig. 22) possesses to so high a degree the power to take up water into the cavities of its foot, that it can become three times as large as it is in the normal condition. It can also crawl at a fast pace, contradicting the proverbial slowness and laziness of its group.

Murex (fig. 23) is represented in the Aquarium by several species, which played an important part in former days, furnishing the Tyrian purple which was used by the ancients for their festal garments. The colouring juice, the secretion of a gland of these snails, is white or pale yellow when fresh, but turns yellow and green when exposed to sunlight, and finally purple. The shade of violet produced depended on the amount of the dye used, so that the dyer was able to produce any tint. In ancient times this dyeing industry was practised all over Italy and Greece. Now-a-days it has entirely disappeared, although this colouring matter has been proved so sensitive to light as to be well suited for printing photographs on silk.

The "Triton's horn", **Tritonium** (fig. 17), is a large, clumsy snail with long tentacles and a long extensible proboscis. It crawls about slowly at the bottom of the sea at considerable depths, and lives on animal food. The heavy shell was used by the Romans as a martial horn, and is still used by the people as a signal. For this purpose the tip is cut off, and the opening thus formed is the mouth-piece of the trumpet. The murmuring sound, like that of the waves, which is heard on holding this or other large shells to the ear, is very likely due to the resounding within the coiled shell of the numerous waves of sound always present. In quite still places no noise is heard in such shells.

The Tun, **Dolium** (fig. 16), is the largest snail of the Mediterranean, with a thin, rounded shell. Its body has dark brown spots on a white ground and is provided with a large proboscis. A curious fact in connection with this animal is that its large salivary glands secrete a fluid which contains over 3 per cent of free sulphuric acid and about $^1/_2$ per cent free hydrochloric acid. The animal squirts out considerable amounts of this acid fluid in order to soften the hard calcareous skin of the Echinoderms which it eats, and perhaps also in self-defence. It is still a puzzle how these strong corrosive acids are produced by the animal and how they can be stored up. For some years past *Dolium* has become more and more rare in the Gulf.

An interesting animal is the Worm-shell, **Vermetus** (fig. 123), from the fact that it is not able to move about freely like the

other snails, but is fixed to one spot. At first sight its shells are just like the calcareous tubes of *Protula* (see p. 76). But on closer inspection may be recognized the head of the snail with its two short tentacles, very different from the brightly coloured gills of the worms. These animals feed on the small crustacea and worms in their neighbourhood, and when alarmed, they withdraw themselves into their tubes. To the inner wall of the latter they also fix their eggs; from these free-swimming larvæ are hatched, which afterwards fix themselves to some rock. In the Aquarium the tubes grow towards the strongest light.

Allied to the above mentioned snails is a group of Mollusks which differ in having their gills attached behind their heart instead of in front. They are devoid of a shell or only possess a very small one which is hidden by the mantle, as in the land-slugs. This group includes:

The Sea-hare, **Aplysia** (fig. 18), a fairly large dark-brown animal with two pairs of tentacles, the posterior pair of which are carried erect and are something like the ears of a hare. The mantle is continued into two large wing-like flaps. They generally creep about lazily over the rocks; but if they want to swim, they begin to flap their "wings" till they have raised themselves from the ground. Once afloat they swim very well and fairly fast, but not for long. When annoyed they give out a very beautiful violet and also a white liquid, which serves as a protection like the sepia of the Cuttlefish. The ancients already were aware of the poisonous nature of the white secretion, for their writers record its use for the preparation of poisonous and magic draughts; those who partook of these were supposed to linger on in agonies until the Sea-hare died. The Sea-hares live on vegetable matter and graze in hundreds on the fields of sea-weeds. It is interesting to see them when stones covered with sea-weeds are brought into their tank; they creep forth from every corner to get at the food, and in a few hours the stones are bare. With the help of this food they live a long time in the Aquarium; they grow to considerable size and often lay their eggs in long thread-like masses, of yellow or violet colour, on the walls of the tank. — In tank No. 3 may be further observed the two flattened snails **Pleurobranchus** (fig. 21) and **Umbrella** (fig. 19). The shell of the latter is quite flat and the foot relatively very high.

One of the finest animals belonging to this group is **Tethys** (fig. 102). Its body is white and semi-transparent, and carries an exceedingly broad head. On both sides of the back are attached the delicate transparent gills, and besides these there are large spotted appendages which fall off very easily and were therefore formerly considered as parasites. Tethys is not rare in the Gulf and is scooped up from the surface of the sea in buckets by the fishermen. Like the pelagic animals, however, it only lives for

a short time in the Aquarium. They swim by throwing the head first to one side and then to the other, the body helping by violent writhings. The stomach is often full of young fishes.

Equally beautiful in colour but of smaller size is **Aeolis** (fig. 101). **Doris** also (fig. 100) with its dorsal tufts of feathery gills belongs to this group. Frequently they may be observed laying eggs, which are generally enclosed in a mucilaginous mass and arranged in ribands or strings.

Snails too are present among the pelagic animals (see p. 57). Swimming among the transparent Medusæ and Ctenophora, we have curious Keeled Snails (*Heteropoda*) and Sea-butterflies (*Pteropoda*). Especially in spring and autumn, when the sea is full of pelagic life, these two groups make their appearance; in the Aquarium, however, they only last a very short time (tank 20) and belong therefore to the rarer guests. Of the *Heteropoda* we would mention **Pterotrachea** (fig. 97), a perfectly transparent, long and thin animal with a curved proboscis, and a fin of the shape of an axe-head. This fin is in reality the foot of the snail. The visceral hump is of a brown colour with a silvery sheen. The animal swims very actively but, curiously enough, with the fin uppermost, the body giving energetic strokes from side to side and the fin swinging to and fro like a pendulum. Their protusible tongue is armed with sharp hooks, and with it they catch the lesser pelagic animals, and even eat one another. The same is true of **Carinaria** (fig. 98) which is distinguished from *Pterotrachea* by the possession of a small transparent shell. This animal is even capable of digesting the stinging organs of *Physalia*, a large Siphonophore, the sting-cells of which are deadly to much larger animals.

The *Pteropoda* are curious because externally they differ in almost every point from the typical snails. The head is only indicated by the mouth and the rudimentary tentacles. The body is often covered by a delicate shell. The most striking feature is a pair of large wing-like fins, which are attached to the head or neck and are used by the animals as wings; hence the Neapolitan name *farfalle di mare* (Sea-butterflies). The most common genus **Hyalea** (fig. 99) has a delicate horny shell of brownish colour, and large fins which are perpetually beating. It appears in swarms, but only lives a day in the Aquarium (tank 20).

The oysters, mussels, etc. belong to the Bivalves (*Lamellibranchia*), the lowest group of the Mollusks. They are distinguished from the snails by their shell, which consists of two pieces which are hinged, and are brought together by means of one or two muscles, but open by an elastic external ligament when the muscles are relaxed. The absence of a head is a characteristic feature of this group. The protrusible "foot" (fig. 165 on the left) serves as organ of locomotion. The body is covered on both sides by the leaf-like gills, and the latter by the two mantle-flaps which

secrete the two pieces of the shell. This shell is like the binding of a book, the leaves of which are represented by the two mantle-flaps and four gill-plates. The *cilia* or hairs which cover the gills and the mantle, by their beating movement create a current which is constantly bringing fresh water from the surroundings to the gills, so that the latter are well aërated. At the same time this current serves to bring microscopic animals and other food material into the mouth of the animal (see p. 58). Those mollusks which burrow deep into the sand allow a pair of long tubes (siphons)

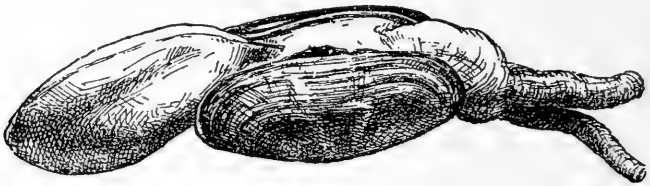


Fig. 165. *Solecurtus strigilatus*, 1/2 nat. size, on the left the foot, on the right the respiratory tubes.

to protrude a little, and through these take in and pass out a current of water (e. g. **Solecurtus,** fig. 165). — The Bivalves are generally either fixed permanently like the oyster, or they burrow to some depth into the sand; a very few can swim about freely or can jump.

We will commence the description of the Bivalves with the Oyster — Honour to whom honour is due. **Ostrea edulis** (fig. 124) is properly no aquarium-animal but, as all know, one for the table, being much more attractive on the plate than behind glass and more to be enjoyed with the tongue than the eyes. For its exterior is modest, the shell flat and irregular and overgrown with all sorts of animals and plants. But the rougher the shell, the more tasty is the kernel, especially when covered with the white hieroglyphics of Tube-worm borings. — The young oyster swims freely for a short time only and then settles on rocks or wood, cements its shell to the substratum, and gives itself up to the task of cultivating a good taste and of producing millions of eggs and sperm. It spawns in the summer months.

The Oyster lives in all seas with the exception of the Baltic, and often makes its way up into the rivers. In Europe and North America they are artificially reared on "Oyster-beds", as they are not only an article of luxury but (especially in England and America) one of general consumption. The number of Oysters eaten in England in a year is said to be 2000 millions, while America consumes 4000 millions. Artificial culture was already practised by the ancients; at the tables of Imperial Rome oysters were never wanting, and epicures declared the best to come from the Lake Lucrinus at Bajæ. Brindisi, too, was one of the principal

localities, as is Taranto at the present day, for the culture of the Oyster. At the present time Oysters are cultivated in Lake Fusaro near Naples, where they grow to a considerable size. The Oysters in Lake Lucrino are imported from Taranto . In the Mare Morto, too, near Capo Miseno, Oysters have been reared for some years past.

The Edible Mussel, **Mytilus galloprovincialis** (fig. 24), has the well known, almost triangular, blue-black shell. The animal has a so-called byssus-gland with which it produces long horny threads, which fasten it to rocks and woodwork. If it wants to leave its home, it produces a new byssus with its finger-like foot and then it tears the old byssus away; by repeatedly doing this it moves very slowly onwards. As in the seas of northern Europe, the Mussel is extensively cultivated in the Gulf of Naples, and especially at Taranto ("Cozzeche di Taranto") and Spezia; stakes of wood are let down into the water and from time to time drawn up, and the adhering Mussels removed.

Pinna (fig. 127) is a large, thin-walled, club-shaped shell, which is fixed in the mud by its narrow end. It also possesses a byssus which, however, is much longer and composed of finer threads than that of the Mussel. These silken threads were formerly used for the manufacture of gloves, stockings and even entire garments; in the 18th century there existed at Naples and Sicily large works for spinning them. The shells of Pinna also yield occasionally pearls, but these are of very little value. The fable of the crab, *Pinnotheres*, acting as watchman to its host, the *Pinna*, has been believed from the most ancient times up to the present day; similar crabs are known to frequent some other Mollusks, Ascidians and Sponges. It is doubtful whether in any case the host derives benefit from its lodger.

Avicula (fig. 126) is remarkable as a very near relation of *Meleagrina margaritifera*, the Pearl-oyster, which produces the finest pearls. These are nothing more than secretions of carbonate of lime with which the animal covers up extraneous bodies — whether parasitic worms or not has lately been questioned. Each pearl, however, contains as its centre some foreign object and in this way man can cause the production of pearls, a fact of which the Chinese have taken advantage to make pearls of various forms.

A shell of interesting habits is **Lithodomus** (fig. 26), which is always found in holes in rocks or coral reefs. The animal is a favorite delicacy and often appears in the markets. It is not yet understood how it works its way into the stone; its shell is perfectly smooth and so it cannot file its way in, as the Piddock, **Pholas** (fig. 27), does with its rough shell armed with hard ridges. Probably Lithodomus secretes a fluid which acts upon the limestone and dissolves it. The holes they make are quite smooth inside. The Temple of Serapis at Pozzuoli has made these shells

of interest, as its columns have a zone 6 feet high marked with the holes formed by them. It is hence concluded that the temple must have sunk under the level of the sea for a time and then been raised again.

Deeply buried in the sand may be found the Razor-shells, **Solen** (fig. 166) and **Solecurtus** (fig. 165), which are sought after as delicacies. They are sold on the market with other edible shells as Fruits of the Sea (*Frutti di mare*), and are eaten raw.

Fig. 166. *Solen vagina*, 1/2 nat. size, on the left the foot, on the right the respiratory tubes.

While all the above named bivalves afford examples of the still-life of the ocean, the Cockle and Scallop are by no means slow of movement. The Cockle, **Cardium** (fig. 152), is a genus comprising many species; it derives the Latin name from the form of its shell. The animal has a long bent foot of a brilliant red colour, and knows how to make good use of it. It presses it on the ground, stiffens it out by forcing blood into it, and in this way clears a distance of several feet; this jumping seems a most surprising movement for a shell to make, but it is not solely restricted to the Cockles. They can also burrow very rapidly in the sand, using the bent foot as a hook. It is a very toothsome shellfish and is collected in enormous quantities on the British and French coasts.

The Scallop is one of the most widely known shells, the largest species, **Pecten jacobaeus** (Fig. 25), having been used for ages by the pilgrims returning from the Holy Land as a decoration of their hats and dress. The animal bears all round the margin of the mantle numerous short tentacles, and small beady eyes which shine like precious stones; these can easily be seen when the shell is open. Their mode of progression is remarkable. An animal which has been quietly lying on the floor of the tank will unexpectedly raise itself from the bottom and jump through the water with quick leaps in an upward direction. This is brought about by the snapping to of the valves of the shell and it is easily to understand that the back-kick on squirting out the water would suddenly cause the animal to move. The direction of the movement is, however, puzzling, for instead of moving with the hinge in front, it does so in the direction of the free edge of the shell. The explanation of this is that the opening through which the water is forced out lies close to the hinge. The larger species have a flat and concave shell. The latter is used for culinary purposes, to carry the "Ragout fin en coquille".

Tunicata.

The visitor looking into tank Nr. 4 has the impression of a flower-bed planted with all kinds of brilliant growths. Around a hill crowned by palms (see p. 76) there arise between green or brown bushes of sea-weeds, here groups of white translucent double-tubes, there single knobbed lumps, many looking like ground-glass, and others as if made of wrinkled brown leather, or again red sacks with two points, one above and one at the side. From the walls hang down white tubes and many spots are overgrown with crusts in which delicate star-shaped markings can be detected. Here is still-life, as still as that of plants, so that the life in it is hardly detectable. But these placid shapes too are animals and an attentive look will show movements in the larger examples: the opening or shutting of the two apertures. These animals — called Ascidians, Tunicates or Sea-squirts — which so much resemble plants, of all the invertebrate animals most closely approach the vertebrates and have given rise to endless controversies among zoologists studying the ancestry of the higher animals. We will give now the most important points about their structure and development.

The Tunicates receive their name from the outermost layer of the body, the so-called tunic or mantle. In *Phallusia*, the largest species in the Gulf, often attaining 10 inches in length, the tunic is thicked and knobbed and, as in all these animals, consists of a substance which is chemically almost identical with the woody substance (cellulose) of plants. In the mantle are two openings; through the uppermost water streams in and comes out again through the side one. The entering water goes into a roomy cavity the walls of which consist of a network. Through the meshes of the net the water passes into another chamber, into which the excrements, eggs, etc. also issue, and thence passes through the side opening to the exterior. The mesh-work just mentioned is the gills. At the base of the large cavity commences the gut, and the water serves both for respiration and to bring nourishment: minute organisms and other food-particles being led into the gut. The heart of the Tunicates has a remarkable peculiarity. It does not drive the blood constantly in one direction through the body, as in other animals, but beats a certain number of times first in one direction and then in the opposite, so that the direction of the flood of blood is continually changing.

The Tunicates are exclusively marine animals and almost all sessile. They either remain single like **Phallusia** (fig. 29), the translucent **Ciona** (fig. 30), which settles down of its own accord in large numbers on the walls of the tanks, and the orange-red **Cynthia** (fig. 28) — or they form colonies, in which the component

individuals are connected the one with the other by processes of the mantle-base. The *Compound Ascidians* are a third group, in which a number of individuals are united in a common covering and grouped in definite manner. To these last belong **Diazona** (fig. 31), and the various species of **Botryllus,** which form patches on the rocks of the tank; the arrangement of the individuals in the shape of rosettes can in this case be seen with the naked eye. **Pyrosoma** is a free-swimming Compound Ascidian (fig. 96), a hollow gelatinous cylinder from which the separate individuals project like the pegs on the cylinder of a musical box. It belongs to the pelagic fauna, and materially helps to produce the wonderful phosphorescent appearance of the sea. It is only rarely seen in the Aquarium (tank Nr. 20), being of irregular occurrence in the Bay of Naples. In the Indian ocean there have been found specimens of several metres in length.

The life history of the Ascidians is extremely interesting. From the eggs escapes a free-swimming tadpole, with lashing tail, containing an organ which at the commencement has great similarity with the "notochord" of Vertebrates. The "notochord" is a supporting rod, round which the back-bone is formed; in the lowest Vertebrates it persists throughout the life of the animal, but in the larval Ascidians it gradually decreases, and vanishes entirely when the tadpole becomes fixed. The theory has been scientifically established, that every individual in developing passes through stages, which represent the form of its ancestors; to take a simple example: the fish-like form of a frog's tadpole indicates that the ancestors of the frogs were fishes, in other words that the frogs have descended from fish-like Vertebrates. Now the young Ascidian has a notochord, an eye, and an ear: that is to say: it is adapted to the life of a swimming animal. We believe therefore that the ancestors of the Ascidians were probably swimming animals allied to the Vertebrates, but now sadly degraded through the ignominy of a well-protected life. Allied here is *Amphioxus*, to be described at the end of this chapter. This also possesses a "notochord", which, however, it retains throughout life.

All Ascidians are hermaphrodite, *i. e.* each individual is at once male and female. But besides the sexual reproduction, in which fertilized egg-cells produce the above-mentioned larvæ, asexual reproduction takes place by the process of budding. "Runners", like those of strawberry plants, arise from the base of the mantle, and on these arise buds which grow into new individuals, thus producing the colonies.

Opposed to the sessile Ascidians we have the free-swimming *Salpae*. The transparency of their bodies stamps them as pelagic animals which drift about like the jelly-fish on the open sea, and are occasionally carried by currents to the coasts, where they

very often find their way into the nets of the fishermen, much against the wish of the latter. In the Aquarium they will be almost always seen in spring and autumn (tank Nr. 20) where the structure of the larger kinds, such as **Salpa maxima-africana** (fig. 95), may be readily followed. The outer wall of the barrel-shaped body is like the tunic of the Ascidians, and presents a hole at each end. The throat is in *Salpa*, however, literally nothing but gill-slits, its wall being represented only by a slanting bar (observe vibrating hairs) leading from the mouth to the stomach across the great swimming-cavity. When this is filled with water, the mouth is closed, and the muscular bands, which surround the body like hoops of a barrel, are forcibly contracted. This contraction forces the water out through the hinder or outgoing pore and the animal is jerked forwards. It thus sucks its way through the water. At the hinder end of the body (left in fig. 96) a brown globular mass, the stomach and intestine, will be noticed. In front of it lies the transparent heart, in which the reversal of the blood-stream mentioned above can be very well observed.

The development of the *Salpæ* is of great interest. The poet Chamisso, who was also a very good zoologist, was the first to observe on his voyage round the world, that in *Salpa* the offspring does not resemble the parent form, but the grand-parent. Thus in one species we have two forms which alternate with each other (cf. p. 69); one form he found always as a single individual, whereas the other one occured in chains consisting of a large number of individuals. Later observations have entirely confirmed the accounts of this "Alternation of generations" of the *Salpæ*. In the Aquarium visitors will find both chains (fig. 93 and 94) and single individuals (fig. 105) of the same species; the chains are sometimes of considerable length, or they may form a closed ring (fig. 94). The members of such a chain are exactly alike, and are hermaphrodite. Their eggs never hatch into chains, but always into single individuals, which are not only different anatomically from their parent but also never produce eggs. Instead of this they give rise to buds, which are small chains of *Salpæ* and are liberated after attaining a certain size. Like *Pyrosoma* the *Salpæ* are phosphorescent animals.

In connection with the Tunicata we may mention the Lancelets, which are looked upon as the lowest vertebrate animals. The Neapolitan Lancelet, **Amphioxus lanceolatus** (fig. 65) is scarcely 2 inches long, colourless and translucent; its only skeleton is a notochord; it has no head. Instead of a heart it has pulsating vessels containing colourless blood, and like the Tunicates it has

a throat perforated with many gill-slits. But its development is even of greater interest to zoologists than its anatomy; for it resembles greatly that of the Ascidians (cf. p. 100) and points to a near relationship of these two groups. From common ancestors the fishes, amphibians, reptiles, birds and mammals have risen to become more and more highly organized while regressive development has given the *Amphioxus*, hardly to be recognized as a vertebrate and the Ascidians which have degenerated to a plant-like mode of life.

Amphioxus lives in the sand of flat coasts and resembles worm more than a fish. It is found in thousands along the beach of Posilipo and similar tracts of the Bay of Naples, where its presence is recognized by a strong smell of iodoform. It was first found on the British coasts by Mr. Couch in 1831; within the last few years several kinds of Lancelets have been found in other seas.

In the Aquarium it can only be kept, if a plentiful supply of sand be in the tank (the little open one in front of tank Nr. 10). In this it burrows immediately and only comes out at night or if disturbed.

Fishes (Pisces).

And when the reader reaches this chapter about beasts he knows so well, he will either shut the book to — *quel giorno più non vi legemmo avanti* — or perhaps he will be glad to be among old friends once more, and will read on to see if he can find out something more about them. We only hope he will find the second plan worth while.

Anatomists classify fishes into cartilaginous and bony, biologists into ground-livers and free-swimmers and gourmands into edible and non-edible. We will consider all three points of view, and will commence with the cartilaginous fishes.

The *cartilaginous* fish, or at least those which find their way into the Aquarium, are mostly bottom fish and mostly not eatable; but on the other hand the larger kinds are said to be often very palatable. To the cartilaginous fishes belong the Sharks and Dog-fish and the Skates.

The word Shark will cause the reader to think at once of those gigantic robbers of the ocean, which have become the terror of sailors. He will therefore be a little astonished to find the Sharks of the Aquarium scarcely a yard in length, and will probably look upon them as either young Sharks or not as genuine ones. We would therefore remark that amongst the many kinds of Sharks there are small ones which are nevertheless "true Sharks", as both they and the more common Dog-fish agree in their characteristics with the larger species.

A comparison of the Rock Dog-fish (fig. 167), with the Bass (fig. 168), a bony fish, both of which are in tank No. 10, will quickly reveal the essential features of the sharks and their differences from the more highly-developed bony fishes. The Bass is covered over its whole body with silvery fish-scales, has its mouth at the anterior extremity, two large moveable gill-

Fig. 167. *Scyllium catulus*, 1/6 nat. size.

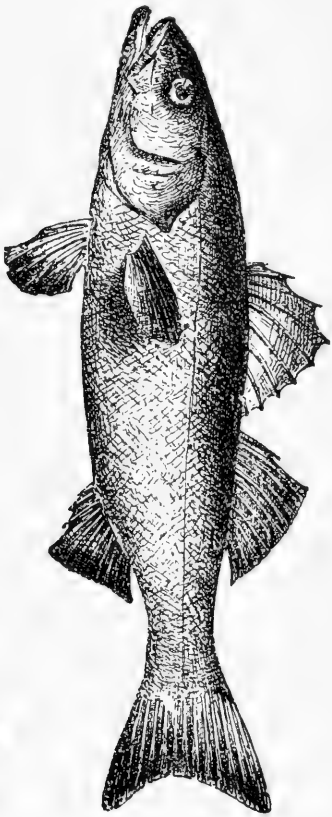


Fig. 168. *Labrax lupus*, 1/6 nat. size.

covers, staring eyes not provided with lids, and nasal apertures distinct from the mouth. The body of the Shark on the other hand is not covered with scales, but with bony spines, which cause the skin to feel rough. The mouth is on the under side of the head in the form of a transverse slit from side to side, and the neck has five or more gill-slits on each side, but no gill-cover. The eyes are provided with moveable eye-lids, the nostrils com-

municate with the mouth, forming a "hare-lip", a condition passed through the embryos of all higher Vertebrates. These external characteristics alone would distinguish the Sharks from the bony fishes, but there are besides many differences of internal structure. The skeleton of the Shark, Ray, or Dog-fish, is all gristle, there being no bone except in the spines of the skin; where this bends over the jaws, they are enlarged to form the teeth. The anatomy in general is less advanced in specialization than that of the bony fishes. The commonest genus is the Spotted Dog-fish, **Scyllium,** of which two species exist in European seas, **S. catulus,** the Rock Dog-fish, or Bounce, as it is frequently called, and **S. canicula,** the Little Dog-fish or Morgay. The first is about a yard, the latter about two feet in length, so that they both belong to the smaller kinds. They are lazy fishes, which seek their prey usually at night-time, and lie hidden in the corners of the tank during the day. They are fed on dead fish, which in daylight they find chiefly by their sense of smell, as their eyes are then quite useless; they search about close to the bottom of the tank and only notice their food when they touch it with their snout. In greed they are not far behind their relations the large Sharks and can manage huge mouthfuls with their large well-toothed jaws. They are, however, able to fast for considerable lengths of time and some *Scyllium catulus* wihch were given nothing to eat for months showed no signs of weakness.

The Dog-fishes pair in the Aquarium. The female lays its eggs singly on branches of coral (*e. g.* tank Nr. 10 on the right) or attaches them to bushes or rocks. They are contained in rectangular, leathery capsules known as *Mermaid's* or *Sailor's purses*, semi-transparent and white when first laid, but afterwards becoming yellowish brown. The corners of the case are provided with long horny filaments, with which the fish attaches the eggs to the corals or other objects by swimming round and round them as the egg is being pushed out of the body. Thus the eggs are prevented from being covered by the mud, which is one of the many enemies of the embryo. The development of the embryo can be very well observed owing to the transparency of the case. In tank 21 eggs are hung up close to the glass, and in these the embryos and their movements can be examined. In advanced stages the young fish can be seen with a bunch of external gills, at either side of the neck, and the large yolk attached by a hollow cord through which the food substance is passed into the alimentary tract. Gradually the provisional gill-threads disappear, and the colouring of the body becomes more distinct. When the yolk is consumed, the young Dog-fish is ready to hatch: it forces its way out through one end of the egg-case, where the two plates of which it is formed are not firmly united, and then swims about freely in the tank. These young stages have of recent years be-

come very important in scientific research, and zoologists have drawn largely upon the material which this Aquarium provides. Economically, however, the Dog-fish is of very little use. Its flesh is of indifferent quality and only eaten by the poor; the skin (shagreen) is used for polishing, and the liver yields a certain amount of oil. Almost all sharks are viviparous, so that *Scyllium* is an exception to the rule.

The Smouth Hound or Ray-toothed Shark, **Mustelus** (fig. 59), is only rarely to be seen in the Aquarium. This is one of the most harmless of sharks; its blunt flat-topped teeth are not fitted for devouring anything but crabs and mollusks, which it captures at great depths. When placed in tank Nr. 10, it swims about at first in a very lively manner with most graceful movements of its glossy body, but it soon tires, and finally cannot lift itself from the bottom of the tank; nor will it touch any food in captivity. Its flesh is quite good eating.

The Angel-fish or **Squatina** (fig. 61), which forms a connecting link between the Sharks and the Rays, is an unsightly beast. It must have come by its name in the well-known way: *lucus a non lucendo*, for its characteristics are far from angelic. It is ugly, stupid, lazy and greedy possessing these qualities to a greater degree than almost any other fish. The big uncouth beast rests always on the bottom (being often taken for dead), half hidden in the mud, lying in wait for other animals which it swallows unchewed. If they are too large it swallows them in jerks as more and more room is made in the stomach by digestion. Its very indifferent flesh is eaten by poor people, its rough skin is used for graters, sheaths for knives, and other purposes.

The true *Rays* have a flat body compressed from above, which has on its upper darker surface the eyes and two openings leading to the gills. On the lower paler surface are situated the mouth, the nasal aperture and the gill-slits. They are typical bottom-fish and feed on other ground-animals.

The most interesting of these fishes is the Electric Ray (**Torpedo,** fig. 64), which was known to the ancients for its strange power of giving electric shocks. Its slimy body is almost circular in shape and contains two large "electric organs". Each of these consists of several hundreds of hexagonal columns of a gelatinous substance, which are supplied by a number of branching nerves with curious terminations. These organs give rise to a strong electric current when the animal is irritated; this can be demonstrated with a telephone or a small electric lamp which glows at every discharge.

To experience the whole shock, the fish must be touched at the same time on both sides. The shock is not so strong as that of the South American Electric Eel, but is still sufficiently painful in an adult Ray. The shocks become feebler when repeated fre-

quently. The electric organ is used both defensively by the Torpedo and also for killing or at least numbing its prey. A young specimen is always kept in a small open tank, in front of tank Nr. 10, for visitors to try the electric power of the fish. The Torpedo lames and kills its prey by these shocks; it makes use of a physical means where the sea-anemones and the Octopods use chemical means, through their sting-cells and salivary-glands respectively. The victim on which the Torpedo prefers to use its noiseless lightning is the mullet (*Mugil*, p. 114). Whenever it sees such a fish approaching it rises from the mud on which it is usually lying and throws itself against the victim. Overcome half by fright and wholly by the electric shock the poor mullet falls to the ground and is swallowed. The Electric Ray is one of the most common fishes of the Bay of Naples and in spite of its poor flesh is often brought to market. They bring forth living young ones, 8—14 at a time. The very young embryos have still the spape of sharks and only later on become flattered and disk-shaped.

Of the other Rays the Skate, **Raja** (fig. 67), and the Sting-ray, **Trygon** (fig. 62), are found in the Aquarium, but the latter more rarely. The former have a lonzenge-shaped body of brown colour, and a tail armed with a number of small spines. They lay their eggs in capsules, which are cast ashore on the beach of the North Sea and are called *Skate-barrows*. The Sting-rays are of dark violet colour and have a long slender tail. The latter bears a strong spine which is in connection with a poison gland. It can cause painful wounds which are fatal to other fish. The young are brought forth living.

The fish is the type of swimming animal. Although there are animals which swim in almost all other classes, from the lowest up to the mammals, yet the conception of a swimming animal is embodied in fishes. Fishes can only move from one place to another by swimming and that are no fishes which cannot swim. From this arises the popular use of the word fish, applied to animals which are not fish at all, such as the devil-fish, cuttlefish, cray-fish and jelly-fish. While in many swimmers in other classes of the animal kingdom the swimming organs are limbs or other processes of the body, in almost all fish the sole locomotory organ is the muscular trunk (especially the hinder part) which drives the animal through the water by its wave-like movements. The fins act as keel or rudder alone. The Skates form an exception to this rule, moving by wave-motions of the side-fins, the body being stiff — the Sea-horses form another exception (p. 112). Now there are many fish which make little use of this capability of swimming but spend their lives on the floor of the sea, where they lie on the sand or mud in wait for their prey and only seldom swim around. These are the Bottom-fish. We have already met a number of them among the Cartilaginous fishes and will

now consider the bottom-living *Bony-fishes*. Most of those in the Aquarium are to be found in tank Nr. 24.

The Star-gazer, **Uranoscopus** (fig. 148), is an ugly brown fish with a large thick head and a body tapering off behind like a wedge. The small eyes are placed on the top of the head, hence its name, and the wide mouth is bent upwards. It generally lies buried in the sand and there often practises an ingenious stratagem. It protrudes from its mouth a long worm-like filament, which grows on its lower jaw, and lets it move about in the water. This allures fishes, which are anxious to catch what they suppose to be a worm, but are suddenly gulped in by the *Uranoscopus*. When disturbed from its sandy retreat, it swims about for a short time, but soon falls to the ground and with its shovel-like fins burrows into the sand again. It is very common in the Bay and is often seen on the market.

The Weever or Sting-fish, **Trachinus** (fig. 147), is somewhat similar. It is small and slender and has bright shining eyes. When freshly caught and placed in the Aquarium, it soon drops to the bottom of the tank and buries itself up to the eyes in the sand. When fed, it darts rapidly out of its hiding place and snaps up the food before it has fallen to the ground. At the same time (and also when angered) it erects its dorsal fins, the foremost of which has very sharp and poisonous spines. The wounds they can inflict are dangerous, as they often cause violent inflammation.

The Fishing-frog or Angler-fish, **Lophius** (fig. 57), is especially well provided with the means of attracting its prey. It is probably the most hideous monster among the fishes of the Mediterranean. The enormous flat head occupies almost three quarters of the body, and the wide mouth is provided with rows of murderous-looking teeth. The mud-coloured monster lies half-buried at the bottom of the tank and gazes upwards with its large expressionless eyes, while the small lappets and outgrowths of its lower jaw are moved about at each breath it takes. From time to time it raises the fin-rays of its head as a bait and lets their lappets move about. Thus it is a "Compleat Angler" with rods and bait and is always ready to engulf with its gigantic mouth the any small fish which fall into the Trap.

A peculiar group of bottom-fish are the Flat-fish, or *Pleuronectids*. Skates are indeed also flat-fish, but flattened in quite another manner. The Skates are flattened from the back to the belly, on which they lie. The true Flat-fish (Plaice, Soles, Turbot, etc.), however, are compressed laterally, that is from one side to the other, and hence lie on one side, the right or the left according to the species. Now many other fish, such as Bass, Herrings, etc. are laterally compressed, and many to no less degree than the Pleuronectids, but the essential difference is this. Whereas the Bass etc. are symmetrical, that is, they look the same from one

side as from the other, the Flat-fish are asymmetrical. On one side, the lower, they are pale coloured, and on the other, the upper, dark and, moreover, both eyes are placed on the dark side. A young Flat-fish lacks these characteristics, being quite symmetrically formed and it is exceedingly interesting to follow the gradual migration of the lower eye to the edge of the head and then up on to the upper surface, finally reaching a position close to the other eye. This change in position of the one eye necessitates a twisting of the skull-bones. The use of this modification is obvious: since the Flat-fish lies on one side on the sand, it would be useless to have one eye directed downwards towards the ground. — The upper side of the Flat-fish possesses to a high degree the power of matching itself to the colour of the bottom in a most remarkable manner. This protective colouring makes it at times very difficult to distinguish the specimens. The eyes will be the first objects to reveal themselves to the spectator; they can be moved about independently of each other in all directions, raised up or retracted, so that the fish commands a complete view of its surrounding. It catches its prey, consisting of small fish and shrimps, by darting upwards and forwards with lightning-like rapidity. It swims with great skill, by wave-like motion of the body, the dark side being uppermost. A few strokes of the loose flaps of skin which encircle the body suffice to throw up sand enough to conceal the animal again, and then it will remain for hours awaiting its next prey.

Economically the Flat-fishes are very important, as their flesh is very delicate and keeps well, so that it can be transported to considerable distances. Some of them attain a large size. England, Germany, France, Holland and Denmark consume enormous numbers of Flat-fish and in the Italian markets, too, they are greatly prized. They are caught with the Trawl-net, and also with the line. The chief kinds of Flat-fishes are the Flounder, the Turbot and Halibut, the Sole and Plaice. Only the smaller species can be kept in Aquarium; generally the Turbot, **Rhombus maximus** (fig. 150) and the Sole, **Solea vulgaris** (fig. 151).

Allied in habits to the fishes just described are those which have adopted the crevices of the rocks as their home and there lie in ambush for their prey. Foremost amongst these is the Sea-scorpion or Sea devil, **Scorpaena** (fig. 43), a heavily shaped fish with a broad head and mouth, large spiny fins, and curious appendages on its skin in form of lappets, horns or ribands. They hide themselves in the crevices of the rocks, and can mimic the colouring so wonderfully that visitors will not be able at first to distinguish them (tank Nr. 6). Some, in the semi-darkness of the water, bear a most striking resemblance to a rock covered with sea-weeds, so that they easily escape the notice of their enemies and also of their prey. — Such similarity of the appearance

of an animal with that of its surroundings in shape and colour has already been mentioned on various occasions, whether it arises accidentally or through purpose. It is to be found in Flat-fish (p. 108), Octopus (p. 90), Crabs (p. 84), and Jelly-fish (p. 68). It is also frequently to be observed in land animals, as protective coloration in the sand-yellow desert-animals and the snow-white ones of alpine and polar regions, or as mimicry in flies resembling bees and locusts looking like pieces of plants, etc.

Allied to the Sea-scorpion is the Goby, **Gobius** (fig. 68), a small dark ground-loving fish generally hidden in a crevice of the rock or in a bunch of algæ, but more fond of movement than *Scorpaena*. They lay their eggs in all possible situations (plants, empty snail-shells, broken pottery, glass-tubes, etc.), each species, however, making use of only one kind of object for this purpose. The male protects the eggs until they hatch and defends them boldly against every enemy.

The numerous species of the Blennies, **Blennius,** are small, very agile, predatory fishes which live in large troops in those parts of the coasts, which are covered with sea-weeds. Their mobile bodies are continuously darting about and, should danger threaten, they disappear at once into some hiding place. Their curiosity and "cheek" is extraordinary, and causes them to snap at everything, and to annoy whatever cannot protect itself. They nibble off the gills of the tubicolous worms, they make dashes for the eyes of crabs and fishes, and they worry the ascidians till the latter die. So they behaue with all helpless animals. The finest and largest species is the Butterfly-fish, **Blennius ocellaris** (fig. 158), which possesses a large black eye-like spot on each side of its dorsal fin.

Hidden away similarly among the rocks we find the Rockling, **Motella** (fig. 149), which belong to the family of the Cods.

The transition from these fishes, tied more or less to the bed of the sea, to the freely swimming fishes is formed by some good swimmers, which, nevertheless, have a preference for the bottom or the coasts and at times remain stationary like the previous kinds, at another times swimming for considerable distances. To this group belong several species of Gurnards, **Trigla** (fig. 76). The Gurnards have a peculiar way of "walking" about on the sand by means of the free rays of their pectoral fins (which are destitute of membrane), the so-called "fingers". The hinder part of the pectoral fins is very large and usually brilliantly coloured and enables the fish to leap out of the water. They are predatory fish, with a widely opening mouth, which will gulp down tremendous morsels. Gurnards are remarkable on account of the peculiar grunting sound they emit when taken out of the water. It is said not to be a real vocal sound, but only a frictional noise produced by the rubbing of certain hard plates of the gill cover against underlying parts.

It is a great rarity for aquatic animals to produce sounds. If some crustaceans and fish can make noises, these are so rare and can be heard only at such short distances that one can almost neglect them. Under the water no sound-waves can arise and even the howling of the tempest and the clash of thunder do not penetrate into this realm of everlasting silence. Now, where no sound-waves can be produced, no organs can develop to make the waters vibrate with sound. The land animals, and those, too, which live in the water but breathe air, can hear, but the aquatic animals are deaf. They can only perceive those waves of the medium which the land animals recognize as sounds, as a trembling or shaking. Courtships, which the land animals so often accompany with music, battles between attacker and victim which make the air tremble with the roaring of anger and the shrieks of pain, these are no less eager, no less fierce beneath the water: but here ardour, hunger and the agony of death are silent, and even were they not so, there would be no ear to hear them. The miracle of St. Antony and the fishes is more marvellous than it is usually considered to be.

A near ally of *Trigla* is the Flying-gurnard, **Dactylopterus** (fig. 77), which, however, in spite of its name does not use its large pectoral fins for flying through the air. The Flying Gurnards live in shoals at the bottom of the sea. Their flesh is tough and tasteless. They grunt like *Trigla* when caught. They are only occasionally seen in the Aquarium.

Like the gurnards the Red Mullet, **Mullus** (fig. 74), lives in flocks on the muddy beds of the sea, feeling about for food with the two long barbules of its lower jaw. In the Aquarium the play of these tactile organs can be well studied. Sometimes they are moved about slowly, and with great deliberation, in the mud, sometimes they vibrate rapidly or are laid back into a furrow of the lower jaw. The Roman gourmands prized this fish very greatly and, when it was the fashion, they paid incredible sums for large specimens. These fish were brought to the guests in glass bowls living, and, so as to enjoy the wonderful play of colours which they show, were allowed to die slowly in the hands of the women. Nowadays the Mullet, under the name of *Triglia* in all Italian markets, is a much sought-after but not very expensive fish. Young Mullets, which live near the surface of the open sea change the colour of their skin to correspond with that of the water as the migrate in towards the coast where they live when adult. In youth they are blue, but later become yellowish-green. They compose the greater part of the masses of small fish which are eaten in Naples as "Fragaglia".

The Eels, too, are inhabitants of the rocky beds. The Conger Eel, **Conger** (fig. 58), and the Roman Eel, **Muraena** (fig. 66), will be found in tank No. 11 where they generally hide themselves in

the pots and vases and only let their heads be seen. In the sea they hide in the same way among the rocks. The Conger Eel is a very voracious fish which sometimes reaches the enormous length of 6 feet; and even in captivity, thanks to its tremendous appetite, attains very considerable dimensions. After the attainment of a certain size, however, it regularly dies, because the sexual products, which it is unable to deposit in the aquarium, increase too much within the body. It is not very much prized in the market, but forms a cheap food for the poorer classes.

The *Muraena* differs from the Conger in the absence of pectoral fins and in the beautiful colouring of its skin. It will, however, share its abode, and often two or three will be found crowded in a very small space. Their snake-like motion when swimming, their brilliant colour, the tall fin-like crest, and the curious head with its fixed eyes and constantly gaping mouth give them a very remarkable appearance. The Romans, as is well known, took endless trouble to be well supplied with this fish and went so far as to close off small bays of the sea for breeding them. According to Pliny, a certain Hirius is said to have placed before his friends 6000 Murænæ on the occasion of Caesar's triumphal procession. Crassus was the owner of a large Muræna which he decked out with gold ornaments and cared for in every conceivable way, burying it after its death and weeping over its grave. Vedius Pollio is said to have drowned several of his slaves as a punishment for some fault in his Murænæ ponds, as he had heard that, when fed on human flesh, the Murænæ were more delicate. Even to-day the Muræna is greatly prized, and the classic Bay of Pozzuoli is one of its most famous marts. They are caught in creels or pots, called "nasse", or with the line, on which they sometimes struggle with great violence and are not easily overpowered, as they are very vicious and too smooth and slimy to be firmly held. The fishermen rightly consider their bite poisonous, for some of their sharp teeth are connected with a poison-gland. Recently it has been proved that their blood acts as a violent poison (as does that of the Common Eel) when injected into the blood of a mammal. — In the Aquarium they can be kept for years, but sometimes they suffer from a parasitic worm (*Trematode*), which settles on them in masses and by injury to the skin kills them. Luckily there is a ready remedy for this disease. The fish are put in fresh-water once or twice for about five minutes, which they readily stand but which destroys the parasites.

Up to now we have only met among the fishes rather repulsive characteristics. Greed, voracity, cunning, venomousness — such atributes are of course necessary in the stern struggle for existence; but it is pleasant to come to a fish which is the personification of harmlessness and amiability and which combines these good

qualities with an appearance as charming as original. This creature is far removed from waylaying enemies with snares and deceit, nor, incredible as it may appear, is it waylaid by others. It will certainly be no stranger to the reader, who knows the Sea-horse (**Hippocampus,** fig. 154), if only from the dried examples which are offered for sale in the sea-side towns. The shape of the animal, resembling that of a chessman, is not much different dried from living, but only by closely observing the fishes in life can one get an idea of the grace of movement, of the idyllic family life and of the comprehension of the proper relations between man and wife shown by them. What a picture of philosophical introspection they offer with the tail clasped round some piece of seagrass or branch of coral and the head thoughtfully sunk on the breast. How they move around with their bodies swaying in graceful and elegant lines, borne along by the hardly noticeable flickering of the back-fin; how they nod and bow and sway up and down with expressive gestures; how they follow one another or swim in pairs or coil their bodies together in gentle pastime! This playfullness is most marked in the autumn which is their breeding-season and then the couples may often be seen billing together like a pair of turtle-doves, and at this time too they dress in yellow or red instead of unassuming olive-green. "Yes, but what is to follow?" you ask, "of course it is the same here as all the world over: 'für den Spatz ist das Pläsir, für die Spätzin sind die Pflichten'!" On the contrary, it is just the reverse, honoured defender of woman's rights! For the Sea-horses are most pronounced feminists, and, truth to tell, egg-laying is the only domestic duty which the husband has left over for the wife to do. As soon as she has performed this unavoidable task, her husband hurries up to enclose the eggs in a pouch formed by the skin on his under side. Thus he carries them around until the children are old enough to swim about alone. With a knowledge of their coming independance the little ones let their father know, by the increasing livliness of their movements, that it is time for them to come out. Thereupon the worthy parent makes affirmative bows, which cause his body to bend in and the pouch to open, and at each movement a number of youngsters emerge until all are free and gaily swimming around. There is nothing more charming than to see a swarm of these little creatures, looking like question-marks, a quarter of an inch in length.

The Sea-horses belong to the "tuft-gilled" fishs or *Lophobranchiae*, and another genus of the same group are the Pipe-fish, **Syngnathus** (fig. 153). They inhabit the fields of sea-grass, the dead leaves of which they imitate in form and colour. Particularly talented in this respect is *Nerophis*, the smaller of the species to be found in tank No. 25. It shows the same degree of resemblance to the leaves of the sea-grass Cymodocea as the Stick-insect does

to twigs, and when the *Nerophis* coil their tails round these leaves holding their bodies stiffly stretched out, it is almost impossible to distinguish them from the leaves themselves — until one suddenly discovers that such a tuft of sea-grass is made up of more Pipe-fish than leaves. The male Pipe-fish also looks after the brood of young.

The freely swimming fish to which we shall now turn contain most of the well-known sea fish. They pass most of their life floating or swimming, and thus prove that they have a complete mastery over the element in which they live. But a number of them also frequent the coasts, from habit or in search of food; while others swim about to greater distances, or may, like the pelagic fish, become independent of coast and sea-bottom and live in the open water.

We shall first treat of those kinds which frequent the coasts, beginning with the *Labroida*, characterized by their large protrusible lips and conspicuous by their brilliant colouring. The brightly coloured Wrasse, **Labrus** (figs. 37 and 39), and the Peacock-wrasse, **Crenilabrus** (fig. 38), belong to this group; they swim about with a curious jerking motion. The gaily coloured **Labrus festivus** is interesting on account of the close watch the jealous male animal keeps over its brood. One male of an allied species, *L. tardus*, lived in the Aquarium for over 15 years. During the whole time he showed himself to be the tireless courtier of all females in the tank, both of his own and other species, and knew how to put to flight all rivals. The small **Julis pavo** and **Coris vulgaris** (figs. 156 and 157) are graceful and brilliant fishes darting about the tank. They are possessed of intense curiosity and great greediness, devouring instantly anything that is thrown to them. They are very sensitive to the cold, and retire into the sand at night; so that on a nocturnal visit to the tank only their heads can be seen protruding from the sandy bed. In cold wintry weather, they remain in the sand all day, and always take refuge there when alarmed. — The larger species of *Labrus* and *Crenilabrus* may often be seen resting at the bottom of the tank leaning against a rock or stone, reminding one of the ground-loving fish.

Nearly allied is **Xyrichthys** (fig. 155), which behaves exactly like *Coris*, and the small **Heliases** (fig. 32), troops of which play about on all steep coasts.

In sharp contrast to these lively fishes are the phlegmatic Sea-perches, the largest and most easily kept of which is the **Serranus gigas** (fig. 56). It loves to remain for hours on the same spot, generally where the water enters the tank, sometimes in an upright position with widely opened mouth and gill-cover, seeming to enjoy the stream of freshly aërated water which passes through its gills. When alarmed it takes refuge under some arch

of the rocks and from there darts out on its prey with rapid and unerring aim. All its habits characterize a cautious, timid fish, loving safe hiding-places; and with this view the observations of the fishermen agree. It is greatly valued and sought after in the Italian markets, going by the name of *Cernia*, and fetches good prices. — The small Lettered-perch, **Serranus scriba,** (fig. 71) with a brilliant colouring, resembles in shape, though not in appearance, its larger relation. It has received its name from the marking like Arabic writing upon its gill-covers. — **Anthias** also belongs here. It lives mostly in depths of 100 to 300 metres on a rocky bottom and it has therefore taken considerable trouble to accustom it to life in the Aquarium, where it gladly hides itself in clefts in the rocks. — We may also mention in this connection the fine rose-coloured **Apogon** (fig. 33). For reasons unknown, the Maltese fishermen have given it a nick-name which the zoologists have also adopted, that of King of the Mullets (*rex mullorum*).

Much more lively than the "giant" *Serranus* is the Bass or Sea-dace, **Labrax lupus** (fig. 54). It is a predacious fish, occurring in the Mediterranean and the Atlantic, and was well known in Roman times. It attains a length of three feet and is one of the most delicate fishes in the market, where it is known as *Spinola*. It is usually found near the coasts and sometimes proceeds some way up the rivers. In stormy weather it approaches the coast in large numbers to feed on the crabs which are carried away by the waves. It is generally caught with the line, large specimens offering very energetic resistance. In the Aquarium it lives for years and will spawn freely.

Perhaps the most common fishes in the Bay are the different species of Grey Mullet, **Mugil** (fig. 45). They are easily distinguished by their slender, silvery-grey bodies, and their curious lips. The upper lip is provided with a notch into which fits a process of the lower lip. They swim around everywhere along the coast in shoals and feed on soft and decaying substances. In the Aquarium they will be seen feeding on the sea-weeds and on decaying animal and vegetable products, so that they are distinctly useful animals. Two specimens of *Mugil chelo* have lived here for 20 years. Their flesh is very good, and as they are very common they form a staple article in the Italian markets (*Cefalo*).

Almost always there are in the Aquarium (tanks 2, 7, 10, 13, especially 5) a number of pretty fish about which the same is true as of good women: nothing interesting can be told of them! After one has amused oneself by looking at the swarm in tank 5 for a while, suddenly this or that fish attracts the attention; and one says: "Surely I know that face!" and some good friend is remembered of whom the fish reminded one — which, by the way, is no flattery for the said friend, for if the shapes and expressions of the faces of these fish be varied, yet there is some-

thing stupid in all of them. First come the Sea-breams, much sought for by fishermen on account of ther splendid flesh. They comprise the Snapper (**Pagellus erythrinus,** fig. 35), **Box** (figs. 12 and 13), and smaller allied kinds, such as for instance **Oblata** (fig. 14). When in the sea they hunt together in large numbers the smaller Crustacea and other animals, though in part they live on vegetable food. Besides these we have larger kinds, such as the Sar, or Goatbream, **Sargus** (fig. 41), **Smaris** (fig. 75) and the more rarely found Black Bream, **Cantharus** (fig. 40); of which last one specimen lived for five years in the Aquarium. The most valuable are the Gilt-head, **Chrysophrys** (fig. 34), and the Toothed Bream, **Dentex** (fig. 36), with metallic marking on the upper half of the body. The former is caught all over the Mediterranean, often in salt water and brackish lakes and lagoons, where it feeds on shell-fish and is therefore caught with such bait. The Romans bred them in ponds, the Lucrine Lake yielding a large supply. The Toothed Bream is the largest of all, attaining a length of 3 feet and weighing over 20 pounds. It is a predatory fish and often takes the catch out of the nets. In the Aquarium it displays great activity and agility; one of these, also, lived here for 5 years and was only killed by an accident. By the side of the brilliant Breams the black Sea-crow, **Corvina** (fig. 55), is conspicuous by its sombre appearance. It is a quiet fish, usually associating with companions of its own species, and examining the bottom of the tank with great deliberation. **Umbrina** (fig. 48), which is very like it, is of more rare occurrence.

Of the family of Herrings may be mentioned — besides the Herring itself, **Clupea harengus,** which occurs only rarely in the Bay — the Pilchard or Sardine, **Clupea pilchardus,** and the Anchovy, **Engraulis encrasicholus.** The latter was known to the ancients. Anchovy-fishery is only of importance on the French coast, for the so-called *Anchovy* which is imported from Norway is nothing but the Common Sprat, **Clupea sprattus.** Sardines, on the other hand, are as frequent on the English as on the French coasts, but are known to our fishermen as Pilchards. The French Sardines differ only in size; the fish are cleaned, salted, plunged into boiling olive-oil, and packed in the tins with which we are familiar; they are sold annually to the value of 10 to 15 millions of francs. The experiment has been made with some success of similarly treating the English Sardines.

The whole genus *Clupea* is ill-suited for a life of captivity, and the Sardines will never be seen in the Aquarium; all experiments to keep them have resulted only in their rapidly losing their scales and dying. Visitors, however, will probably have an opportunity, during their stay in Naples, of recognizing them in their fried condition at the dining table, as they are much eaten, under the name of "Alici".

Of the order of *Plectognathi* with an immobile lower jaw, which is almost confined to the tropics, the Aquarium contains two species. Some, such as the Sea-hedgehog, the Globe-fish and Trunk-fish, will be already known to the visitor from dried specimens in the Natural History Museums; those in the Aquarium are the Sun-fish, **Orthagoriscus** ("Pesce mola") and the File-fish, **Balistes** ("Pesce porco", fig. 69). It is unfortunate that the Sun-fish is only to be seen in the Aquarium in summer, and then only seldom and that therefore only few visitors can convince themselves that such a monster really exists. For it does not appear to be a whole fish, but fish-head flattened sideways, with an oval outline; the whole hind part of the fish seems to be absent. Along the back edge runs a narrow, thick fin (the tail-fin, which is kept although the tail itself is absent), from the upper and lower ends of which a larger fin rises up. By the movements of these this swimming head is moved slowly through the water in the tank. In the sea however, it must be able to move more quickly than one would think, for in its stomach are to be found Sardines, Cuttlefish and other agile creatures. In spite of the evil odour which the animal gives out even when still living, it is much prized by zoologists, less for itself than for the masses of parasites present in all its organs. — The File-fish, which belongs to the same order owing to its narrow mouth and scanty, large teeth, is normally built, if somewhat short for its breadth. From spring to winter it is a constant inhabitant of the Aquarium. In the summer it is lively, inquisitive and companionable, but its company is sometimes uncomfortable and dangerous for its mates. It was formerly in the same tank with the turtle, but it always snatched away the food from the latter, and when moved to the tank with the craw-fish, it bit their eyes out! When the temperature falls towards 18° C it always becomes indolent, loses its appetite and invariably perishes in the winter.

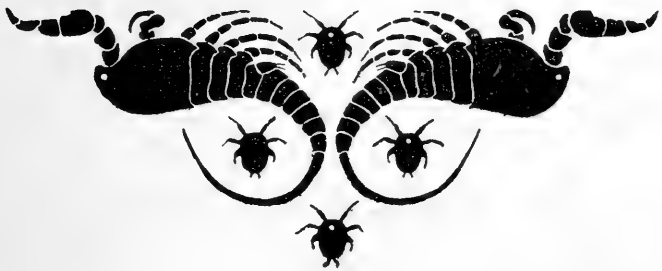
In tank Nr. 9 live two small fish, the delicate Trumpeter, **Centriscus** (fig. 51) with the long beak, and the Cuckoo-fish, **Capros** (fig. 50). In colour they resemble their companion, *Anthias* (p. 114) and, although caught in depths of 50 fathoms, they live well in captivity.

The Cuckoo-fish belongs to the Mackerels which are a family of true free-swimming fish. Almost all members of this group are inhabitants of the open sea, which spend their whole life swimming and drifting and only approach the coasts to lay their eggs. During these periods they are the object of extensive fisheries, more especially the Tunny. It is very difficult to accustom the fish to a life in the Aquarium. They are shy and always in a state of rapid motion and soon knock themselves to death against the walls of the tanks, the Sword-fish even dying as soon as it is taken out of the water. Besides the Cuckoo-fish, only one small

relation of the Mackerel, **Lichia** (fig. 42) is regularly in the Aquarium during the summer months.

Reptiles (Reptilia).

Even less than the Mackerels can the Dolphins be exhibited in the Aquarium, in spite of their confidence in man, for which they were famed even in ancient times. Thus the Turtle, **Thalassochelys** (fig. 63) remains the only air-breathing vertebrate which we can introduce to the visitor as an inhabitant of the tanks. In the Mediterranean other kinds of turtles are found, but they do not occur in the Tyrrhenian sea and cannot therefore be placed in the Aquarium. Although the animal appears somewhat helpless and unwieldy, yet the fishermen have to be very cautious in catching it, as it defends itself with its powerful jaws which are able to inflict painful wounds. Even in captivity the turtle continues to bite on occasions, even its own relations. After a time, however, it becomes phlegmatic, floats for hours on end at the surface of the water or lies on the ground, occasionally using its paddle-like limbs to rise up and fill its lungs with fresh air. They stand the cold of winter badly, but some have lasted through several years. Their food consists of small animals such as crustaceans, fishes, etc. The turtles can attain a weight of 400 pounds and a length of three feet. The back-shield is brown, while that underneath the body is yellowish. This turtle is in the pleasant position of being quite useless to man. Neither is it slaughtered to make tasty soup nor roasted to remove the upper layer of the shield more easily, for its flesh has an impleasant taste, and its armour is quite unsuited to the preparation of tortoise shell ornaments.



Index to Part Second.

T.

U.

V.

W.

X.