in which food accumulates, while the upper coil is the intestine proper. In *Echinus,* but not in the Cidarids, a narrow tube branches from the gut at the beginning of the first coil, runs alongside the stomach, and re-enters the gut at the end of the coil ; this, which is called the siphon, permits a flow of water through the gut however full of food the stomach may be. Round the gullet is a jaw-appara­tus, consisting essentially of five hard, pointed teeth, the ten Jaw- pieces in which they are held, five struts between the pairs of jaws, and five cambered stays for the attachment of ligaments to keep the whole apparatus in position. The jaws are worked by muscles in such a way as to draw the teeth together or apart, inwards or outwards. This apparatus is often called “Aristotle's lantern,” though it is extremely doubtful whether Aristotle *(Hist. Anim.* iv. 5) was alluding to this structure. The whole of it is covered by the membrane lining the body-cavity, and from the space thus enclosed there

pass to the exterior five pairs of hollow branched appendages, the external gills; the five notches through which the gills passed can be seen in the dried test of an Echinus from which the mouth- membrane has been removed, but not in the test of the piper-urchin or other Cidarid, because there the gills are not develoçed.

The prickles that cover the test are better studied in the piper- urchin. (fig. 2), where some of them are very large and, from their resemblance to the drones of a bagpipe, have suggested the name of the animal. Each of these large spines or radioles is attached to a rounded tubercle by an enclosing ligament and outer coat of muscles, the base of the radiole being hollowed to fit on the tubercle. Thus the radiole can be moved in any direction. The attachment of the larger radioles is protected by a ring of smaller ones. These and the other small spines protect the sea-urchin, as its prickles protect a hedgehog; the larger ones may also help the animal to move or to fix itself firmly against the shock of waves. Some urchins, especially the purple egg-urchin, bore holes even in very hard rocks, and by stretching out their radioles they can hold themselves immovably in their holes; how they bore the holes is not known with certainty. Besides radioles, small pincer-like appendages called pedicellariae are attached to the test by similar ball-and-socket joints. Each consists of a long stalk bearing three blades which can meet at their points; on the inner surface of each blade is a cushion of sensitive

skin, and often a gland which secretes a poison. The pedicellariae were once supposed to be parasites, but they are really organs of the urchin of the same nature as the radioles; they are of four different forms, three of which undoubtedly serve for defence, while the shortest ones clean the test from impurities and sand-grains that fall between the radioles. Sea-urchins other than Cidaríds also bear on the test minute sensory organs called sphaeridia, each consisting of a small hard knob, supported by a stalk which may­be partly calcified but always contains many nerve-fibres. It is generally supposed that they are sensitive to vibrations in the water, and to any change from the normal position which the animal may assume or be forced into. Such a regular urchin as has here been described Jives with the mouth downwards, preferring a hard floor, on which it creeps by its podia and its radioles, constantly scraping the algae and seaweeds from the rock with its teeth and so feeding itself. If it does not bore a hole, or is not protected by long needle- like radioles, it may grasp bits of sea-weed or other objects with its pedicellariae and hide beneath them from the fish that seek it for food.

The Irregular urchins (fig. 3) have been modified for another way of life. Some of them live in mud or ooze, through which they creep. The mouth

has moved forward,

has lost its jaws and

often has a lip, projecting so as to scoop

up the mud. The

prickles have become

smaller, often almost

silky, and are generally directed back­

wards so as not to

oppose the passage of

the body. The podia

of the under surface

still aid locomotion,

but those of the upper

surface, which are

concentrated in five

petal-shaped areas,

act mainly as gills.

These urchins often

assume a heart shape,

owing to the greater

development and

sinking in of the front

petal. The sand-

dollars and their allies,

which live half-buried

in sand without moving through it, retain a more or less circular outline, as well as the central position of the mouth, which has not lost its jaws; the anus, however, has moved to the side, while the podia of the upper surface are concentrated in petals and many of them modified into branched gills. The sand-dollars proper are very thin and flat, but the shield-urchins *(Clypeaster,* &c.) have the central region of the upper surface raised in a boss, which reaches above the sand, so that the animal can still breathe though the whole body is hidden. In many Irregular urchins the petals of the ambulacra are deeply sunk, and serve as a nursery for the young, which are covered by the spines of the parent.

Sea-urchins live only in the sea, from between tide-marks down to all but the greatest depths. The abyssal forms have very thin tests, which are often flexible. Urchins eat all kinds of animal and vegetable food, and are themselves attacked by fish, by star- fish, and even by other urchins. The ripe egg-bunches are a favourite article of diet with dwellers round the Mediterranean; in other respects sea-urchins are of small importance to man, being neither useful nor harmful. In olden times the larger radioles were recom­mended to be powdered and taken as a remedy for the stone.

For details of classification, see under *Echinoidea,* in the article Echinoderma.

SEA-WOLF, also Sea-cat and Wolf-fish *(Anarrhichas lupus),* a marine fish, the largest of the family *Blenniidae* or blennies. In spite of its large size, it has retained the bodily form and general external characteristics of the small blennies. Its body is long, subcylindrical in front, compressed in the caudal portion, smooth and slippery, the rudimentary scales being embedded and almost hidden in the skin. An even dorsal fin extends the whole length of the back, and a similar fin from the vent to the caudal fin, as in blennies. The pectorals are large and rounded, the pelvic fins entirely absent. Its dentition distinguishes the sea-wolf from all the other members of the family. Both jaws are armed in front with strong conical teeth, and on the sides with two series of large tubercular molars, a biserial band of similar molars occupying the middle of the palate. By these teeth the sea-wolf is able to crush the hard carapaces or shells of the crustaceans and molluscs on which it feeds; that it uses