s, the other one-fourth of an inch. These free rays
d by the fish as feelers, in the same way as the barbel
chin. The pectoral fins measure one and an eighth
in length, and have one very minute free ray. On
in is one barbel half an inch in length. The nostrils
uble; from the back of the anterior nostril is a minute
. The eyes are circular, and three-quarters of an inch
Both upper and lower jaws are armed with minute
The whole surface is covered with exceedingly small
uped scales, which are not plainly visible except by the
a magnifying glass.

the description given by Lesueur, Storer, Lindsley
DeKay, no mention is made of the free rays of the ven-
ins. They are as distinct and noticeable as the barbel
e chin, and more so when swimming.

is thought by some that *Lota compressa* and *Lota macu-*
are identical. I am not sufficiently versed in ichthyol-
to be a dictator or judge in the matter, yet the habits
dimensions of the two are so dissimilar as to lead me to
ose that they are two distinct species. The *Lota macu-*
is two feet in length at maturity. The largest *Lota com-*
ssa ever known was the one described by Lindsley,—
en and a quarter inches. The *Lota compressa* probably
s the salt water, as it is taken in ascending the Connec-
t or its tributaries in the spring of the year, in company
fish from the salt water ascending to spawn. So few
e been taken that it may not be wise to be positive in
assertion, yet I have no doubt, in my own mind, that it
fact. Four have been taken to my knowledge within six
s of my office, within a few years, and all have been
en in the spring. Three of them were taken in company
h the Lamprey eel (*Petromyzon Americanus*), in pots
for them, and the fourth (the one in my possession) was
ght in a fine net with a promiscuous collection of fish.
The Spotted Burbot, on the contrary, lives exclusively in
sh water.

As I have called the attention of the fishermen in this vicinity to the rarity of this fish, I shall probably get specimens that would otherwise have been thrown away, and hope to gain farther information respecting this uncommon species.

SALT AND FRESH-WATER CLAMS.

BY EDWARD S. MORSE.

We choose these two animals for description since they are accessible to all. The inland student may rake from the pond or river the fresh-water clam, or mussel, in quantities, while the sea-side student has only to step into the market and order the salt-water clam by the bushel.

In presenting such descriptions for study, it is always best to cite as examples those forms which are most abundant, so that whatever statements are made can be quickly verified by an examination of the object described. A general knowledge once attained of the common animals, prepares one to enter farther into the study of zoölogy, and enables him, through the facts already garnered, to use his information in the prosecution of new investigations. We commence, then, with the description of an animal, about which little has been said except in books professedly scientific; an animal, however, long and well known from the cheap and excellent food it affords, and from its no less importance in providing bait for our fishing fleets.

That the daintiness of the clam for food was known to the aborigines of this country, is well attested by the huge piles of broken clam shells scattered along our eastern coast, and now buried beneath a foot or more of soil. Mingled with these piles the archæologist reaps a rich harvest of Indian relics, such as implements made of bone, fragments of pottery, etc.* These are the only evidences of by-gone

*In the NATURALIST, Vol. I, p. 561, Prof. J. Wyman describes the contents of some of these beds, with illustrations of the various relics.

tribes which have left their records in the remains of their feasts.

From an old book published in London in 1636, entitled "New England's Prospect," etc., it would appear that the squaw performed the hard work then, as now, and that, unimpeded with trailing skirt, she waded over the mud-flats in search of clams for her indolent master. From this book we make the following extract, more quaint than elegant, describing the "kinds of shell-fish."

"The luscious lobster, with the crab-fish raw,
The brinnish oyster, mussel, perriwigge,
And tortoise sought by the Indian Squaw,
Which to the flatts dance many a winter's jigge,
To dive for cockles, and to dig for clams,
Whereby her lazy husband's guts she cramms."

The shells also came in good use as table utensils, and from a work published about the year 1676, entitled "New England's Crisis," by Benjamin Thomson, the prologue commences thus:

"The times wherein Old Pompion was a saint,
When men fared hardly, yet without complaint,
On vilest cates, the dainty Indian maize
Was eat with clamp shells out of wooden trays."

Thus much for its historical interest; and now let us at once enter into an examination of the animal itself. A clam, as we find it in the market, does not certainly present a very inviting appearance. The two bluish white shells hold within an unintelligible yellowish mass, while projecting from one end is a wrinkled blackish lump, that upon being irritated withdraws within the shell, throwing out at the same time a stream of water, the shells meanwhile shutting together tightly. To appreciate the natural appearance of the animal, we must place it in its natural element—the sea-water. Be sure and get a dish long enough for its first stretch. A shallow pan twelve or fifteen inches in length will be sufficient. Having filled the pan with fresh sea-water and immersed our clam in it, we wait patiently, or leave it for a while, perhaps half a day; but finally the

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blackened tube, improperly called the "head," gradually protrudes beyond the margins of the shell. Slowly extending, it attains the length of three or four inches, and now we notice that this organ has two openings at the end, beautifully fringed with appendages like little feelers, and mottled with the richest brown. And this tube, then, is really a double tube leading to the body of the clam. Notice carefully the opening and you will see a current of water pouring in at one of them, and as steadily flowing out of the other. These currents are produced by the tremulous motion of innumerable minute hairs, or cilia, which line the interior of the animal.

The clam has no power to seek its food, being confined to its burrow in the sand or mud. Its food consists of minute particles of organic matter floating in the water, and thus it is through the medium of the ingoing current of water, that nourishment is carried to it. While the water conveys food to the mouth, it is also charged with oxygen to revivify the blood; for the clam has blood, and a heart, and vessels to circulate it. What admirable uses do we see already in the so-called head of the clam. Lying buried as it is to a considerable depth in the mud, these tubes are thrust to the surface to conduct the pure water laden with nourishment for the stomach and gills. The water, as it passes out through the other tube, carries with it all excrementitious matter and other waste from the body.

In the "Annals and Magazine of Natural History," Messrs. Alder and Hancock describe the appearance of these currents. From their account we extract the following: "We lately have had an opportunity of observing *Mya arenaria* in its native haunts, and watched the play of its siphonal currents under very favorable circumstances. This species, at the mouth of the Tyne, buries itself to a depth of six or eight inches in a stiffish clay, mixed with shingle; and in shallow pools left by the tide the tubes may be seen just level with the surface of the muddy bottom in full action.

The mud lies closely packed against the walls of the tubes, so that nothing is seen but the expanded lips of the siphonal orifices fringed with numerous tentacles. When it happens that the surface of the water is only a little above these orifices, a strong current can be distinctly seen to boil up from the anal siphon, and another, with a constant steady flow, to set into the branchial one."

On plate 1, fig. 2, is represented a clam in its natural position in the mud, showing the extent to which the tubes, or siphons, can be extended; and in Fig. 1 a clam is represented with one of the shells—the left shell—removed. As we remove the shell, we are forced to separate two muscles which hold the shells, or valves, as they are called, together. The valves are forced apart by an elastic substance that occupies the little tongue-shaped tooth of the shell near the hinge, and in order to keep the valve together, the clam has to exert a constant force by contracting the muscles. The moment the muscles relax, the elastic substance forces the valves apart, acting as a piece of India-rubber would act if placed within the hinge of a door, and the door closed against it. Fig. 4, plate 1, represents a section of the valves of a clam, showing the elastic substance, L, and the transverse muscle, M.

Having opened the clam, we find lining the shells within a thin membrane called the mantle. Its border which follows the edges of the shell, is thickened and united, except a small slit through which the so-called foot projects. This organ has the power of excavating a hole in the mud. According to one writer, it assumes a variety of shapes while digging: "now a dibble or spade, a trepan or pointed graving tool, a hook, a sharp wedge."

The abdomen occupies the centre line of the body, and forms the principal edible portion of the clam. It contains the ovary and liver,—the liver being recognized by its dark color. (For the different parts see plate 1, and explanation of the plate.) The mouth of the clam is directly under the

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forward transverse muscle. It will be seen by the position of the mouth, that the so-called head of the clam is not the head at all. One may call it the tail with more propriety, though it is simply two tubes united together, projecting from behind for the purposes before mentioned. On each side of the mouth are a pair of lappets or palpi; these probably assist in directing the minute currents of food into the mouth. The mouth opens almost directly into an irregularly shaped stomach. The intestine, after several turns in the abdomen, passes along the back, going directly through the heart, and terminates above the posterior muscle. Fig. 7, plate 1, represents the heart as seen from above. This consists of a ventricle (V) and two auricles (A), one on each side, which takes the blood from the gills. The gills are two in number, and hang from below the back, on each side of the abdomen. The thickened portion of the base of the tubes, commonly called the shoulder, are muscles to draw in the tubes. Space will not allow us to enter farther into the anatomy of the clam. We may add, however, that nearly all bivalves are organized in a similar way. We give a transverse section of a fresh-water mussel to show the various organs. (See the plate and explanation.)

The clam is used for food in Europe, Asia and America. Jeffrey says, "it forms one of the numerous articles of Chinese diet, being brought to market after having been boiled for a long time, and cooked with a seasoning of which onions are a base. The people call it Tsega." Fabricius states that in Greenland the clam is eaten by the walrus, Arctic fox, and birds.

In the fresh-water clam, instead of two long tubes covered by one sheath as in the sea-clam, we have two short tubes, one only being separate, the other merging into the mantle, which is open throughout; though by reference to the plate it will be seen that the tubes bear a general resemblance to those of the sea-clam. In the fresh-water clam the elastic substance opening the shells is outside, and pulls them apart when the

muscles relax (Pl. 1, fig. 5). While the sea-clam lies buried in the mud, head downward, with but little power of locomotion, the fresh-water clam has the faculty of moving through the mud or sand in which it lies partially embedded. Fig. 6, plate 1, represents the natural attitude of the Unio, or fresh-water clam. It will be seen that the tubes are above the level of the sand. The foot is very large, and with it the Unio is enabled to move along slowly, the shell wedging its way through the sand, leaving a groove or furrow along the river bottom, and often the collector takes advantage of these tracks in finding them.

But little is known regarding the development of the sea-clam, or Mya, as it is technically termed, but it is similar to that of the Unio. In these the eggs issue from the ovaries, and find their way into the cavities of the outer gills. There they develop until they are furnished with a little triangular shell, large enough to be recognized by the unassisted eye. At this stage they are discharged by thousands into the water, and are left to take care of themselves. It has been ascertained that they attach themselves by a little thread to the river bottom, thus preventing them from being swept away, though it is probable that not one in a hundred ever reaches maturity, as fishes and other aquatic animals feed upon them. Fig. 8, plate 1, represents the shell of the young Unio.

Many of the common fresh-water clams produce pearls, though the black mussel, with a white pearly interior, oftentimes produces pearls of considerable clearness. These pearls are caused by particles of sand or other irritating substance getting in between the mantle and shell. This irritates the animal, and this irritation causes the animal to deposit upon the particle layer after layer of pearl. In China, the natives taking advantage of their knowledge of the way in which pearls are formed, have shown their ingenuity by making flat lead castings of their little idols. These they insert in a species of fresh-water clam, by first wedging the shells