

THE LIFE HISTORY OF THE SEA-HORSES (HIPPOCAMPIDS).

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In the ordinary works on fishes or natural history very little is said about the interesting little fishes popularly known as sea-horses. Many details, however, have been published in isolated notes or buried in general articles, which only one familiar with ichthyological literature would be likely to know about or even to find by using the current bibliographies. For the benefit of those interested in the group the notes here presented, brought together for a general work on fishes, are published.

I.

The sea-horses (Hippocampids) vary in form, but all are compressed and incapable of flexing the body sideways to any very considerable extent, the plates having extensions which are buttressed against cor-

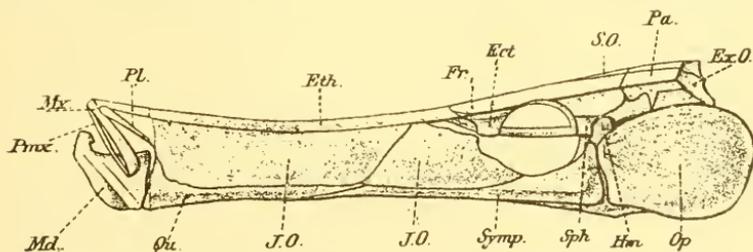


FIG. 1.—BROAD-NOSED PIPE-FISH (*SIPHONOSTOMA TYPILE*). SKULL FROM SIDE SHOWING ELONGATION OF FACIAL BONES, SMALL MOUTH AND JAW BONES, AND ABSENCE OF PREOPERCLE. (AFTER SCHÄFF.) B. O., BASIOCCIPITAL; Ect., ECTETHMOID; Eth., ETHMOID; Ex. O., EXOCCIPITAL; Fr., FRONTAL; Hm., HYOMANDIBULAR; J. O., INFRAORBITAL; Md., MANDIBULAR; Mx., MAXILLARY; Op., OPERCULUM; Pa., PARIETAL; Pl., PALATINE; Pmc., PREMAXILLARY; Pt., PTEROTIC; Qu., QUADRATE; S. O., SUPRAOCCIPITAL; Sph., SPHENOTIC; Sym., SYMPLECTIC.

responding ones of the preceding and succeeding plates, thus prohibiting any decided lateral movements. The tail is more or less curved downward, and in typical forms highly prehensile; it is quadrangular in section.

The head in front of the eyes, or snout, is prolonged in a tubiform manner as in the pipe-fishes (*Syngnathidae*), and the mouth and jaws are small and at the end of the tube; the preopercle is absent and the operculum greatly enlarged.

While there is essential similarity in such characters, as to the cranium there is considerable dissimilarity between the pipe-fishes and the sea-horses as will be evident from the accompanying figures.

The best known of these fishes are the typical sea-horses, but other members of the family are much less aberrant from the pipe fishes, and indeed grade into them. There are in fact two distinct groups or subfamilies, the Hippocampines and Solegnathines. These differ in form and the form is determined partly by, or perhaps expresses, the development of ridges of the body.

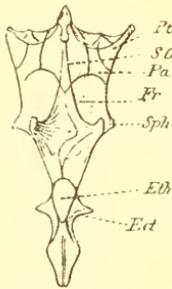


FIG. 2.—SEA-HORSE (*HIPPOCAMPUS RAMULOSUS*). SKULL FROM ABOVE. (AFTER SCHÄFF.) (For lettering see Fig. 1.)

The Hippocampines have the upper ridge of the caudal region terminated forward under the dorsal fin, and the lower caudal ridge continuous with the lateral ridge of the trunk; the nuchal plate is more or less elevated, crowns the back of the head, and is connate with the preceding plate.

Two typical and nearly related genera (*Hippocampus* and *Acentronura*) show these characters in perfection; three others (*Phyllopteryx*, *Haliichthys*, and *Phycodurus*) share them in different degrees.

The typical sea-horses (*Hippocampus*) have the trunk compressed and relatively deep backward, the occipital region is surmounted by a sort of "coronet," and the tail is robust and rolled inward. The mature males have a pouch under the fore part of the tail with a small opening or slit in front.

The likeness to the conventional knight of the chessboard is much more marked than to a horse's head; indeed, if a spirula-shell or coiled worm were attached to the base of a chess knight the sea-horse would be well imitated. The ancient name *Hippocampus* is therefore very apt, being derived from the Greek *hippos*, horse, and *kampe*, worm or caterpillar. But let no one be deceived by superficial resemblance of parts. The head of the fish and that of a horse are essentially homologous, but here real likeness ends; the contracted part of the sea-horse does not correspond to the neck of a true horse, but to the fore part of the abdomen, there being no true neck in the fish; the lower part of the "neck" of the fish is really the hinder part of the abdomen, and the anus marks its hinder boundary.

The peculiar modification of the finless tail deprives it of its loco-

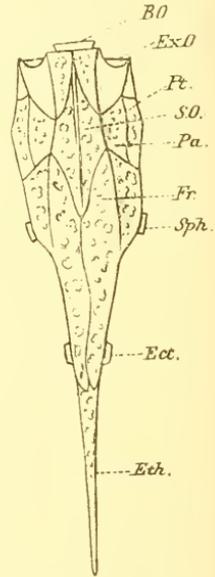


FIG. 3.—BROADNOSED PIPE-FISH (*SIPHONOSTOMA TYPHLE*). SKULL FROM ABOVE SHOWING DIFFERENCES FROM SEA-HORSE. (AFTER SCHÄFF.) (For lettering see Fig. 1.)

tor faculty, but a new function—prehension—results from its power to curl inward, and, to some extent, sideways.

The species are numerous, and one or more may be found in almost every tropical and temperate sea. Somewhere near three dozen species have been described, and of these one (*Hippocampus hippocampus* or *antiquorum*) is a common European fish, and half a dozen are inhabitants of north or middle American seas. One of them (*Hippocampus hudsonius*) extends northward in the Atlantic as far as Cape Cod, and another (*Hippocampus ingens*), one of the largest of the genus, in the Pacific to San Diego.

Strongly marked and bizarre as is the form, the fishes nevertheless are not conspicuous in the midst of their natural surroundings, and indeed the little animals appear to be able to readily adapt themselves to their environment. Kent (1883) tells that "some very extraordinary colored specimens" of the common Mediterranean species (*Hippocampus hippocampus*) were given to him: some were "bright red, others pale pink, bright or light yellow, and even almost pure white, with many other interblending shades. Such colors had apparently been assumed by the fish in keeping with and as a means of concealment among the brilliant vegetation and zoophytic growth indigenous to the locality from whence they were derived. These tints in confinement gradually disappeared, until the fish had assumed the normal light-brown or speckled hue by which they are generally characterized."

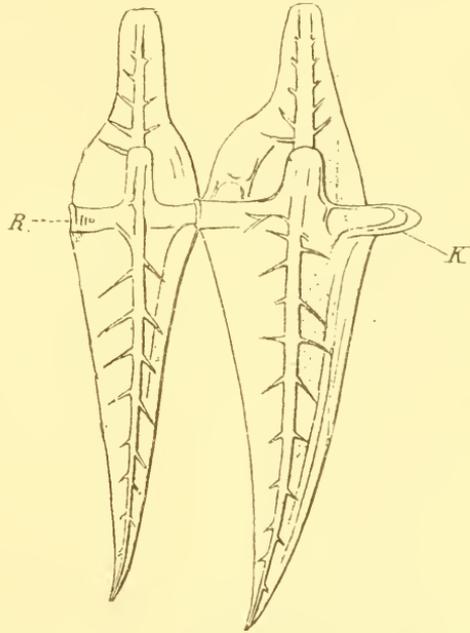


FIG. 4.—SEA-HORSE (*HIPPOCAMPU. RAMULOSUS*). TWO MIDDLE SIDE-SHIELDS SHOWING MANNER OF INTERLOCKING BUTTRESSES (K. R.). (AFTER SCHÄFF.)

II.

The attitudes and movements of the sea horses are eminently characteristic. The most frequent is a state of rest, with the tail wound around the stem of a plant or some other substance and the body is then carried nearly or quite erect. Such is the most frequent position, but notwithstanding the apparent rigidity of the cuirass, almost every other attitude consistent with such a form may be assumed. The

body may be thrown outward at various angles and even downward and the tail wound around a plant in a double coil. Once in a while one eye may roll toward you, while another may be passive or look backward or in an opposite direction. It becomes obvious that the little fish can move its eyes independently of each other and in entirely different ways.

A comical effect is produced by the way in which the little fishes peer at some object, reminding one of the actions of a very near-sighted person.

Releasing itself at length from its support, one may slowly progress, still in a vertical position, its tail curved inward, its dorsal fin rapidly undulating and reminding one of a screw propeller, its pectorals vibrating in harmony. The rapidity of the undulatory or vibratory movements of the dorsal and pectorals is especially noteworthy.

Incaised as it is in an almost inflexible coat of mail, progression can not be effected by lateral flexion of the body as in ordinary fishes, and flexion in a vertical direction is limited.

With such limited powers of progression, a nice adjustment of organs is called for, and Dufossé has explained one method. The air bladder is comparatively large and always distended by a quantity of gas so exactly in harmony with the specific gravity of the body that this entire body is a hydrostatic apparatus of extreme sensibility. A proof of this is that if a single bubble of gas no larger than the head of a very small pin be extracted, the fish immediately loses its equilibrium and falls to the ground, on which it must crawl till its wound has been cicatrized and a new supply of gas secreted by the internal membrane of the bladder.

III.

Another noteworthy peculiarity is a faint sound which is sometimes evoked. Kent, while making "some colored sketches" of the fishes, had two "isolated in separate glass receptacles some few yards apart, when unexpectedly a sharp little snapping noise was heard at short and regular intervals to proceed from one of the vases placed on a side table, and to which a response in a like manner was almost immediately made from the vase close at hand. On seeking for the cause, the sound was found to proceed from the mouths of the little *Hippocampi*, which were thus conversing with, or signaling to, one another. The noise observed was produced by the muscular closing and sudden expansion of the lower jaw, and much resembled in strength and tone the snapping sound produced for a similar purpose, but in this instance with its claw, by the little scarlet prawn (*Alpheus ruber*)," relatives of which occur along the southern coast of the United States.

The mechanism which produced the sounds emitted by the sea horse was explained at length by Dufossé in 1874 to whose memoir reference may be made by those who wish to learn details. Suffice it here

to note that Dufossé found that the fishes had the power of making long series of movements so slight and so rapid that they evade the sight, but are appreciable to touch, and consequently are simple quiverings or vibrations (*frémissements*), and that these quivering movements are accompanied by sounds which, however, are rarely distinctly audible (*commensurables*). The sounds are produced by females as well as males; notably in the spawning season, when they are both more frequent and more intense.

IV.

The natural food of the sea-horses consists mainly of small crustaceans, such as copepods, sand-fleas (*Gammarids*), and the opossum shrimps (*Mysids*) as well as the young of higher forms. Such being not readily obtainable by aquarium keepers, Kent improvised for his aquaria "a successful substitute in the form of the larvæ of the common gnat" or mosquito (*Culex pipiens*) and "other water insects."^a

The mode of feeding is curious. A supply of amphipodous crustaceans may be supplied to them and a fish will slowly move toward one, peering at it, approaching the mouth to it, and suddenly the animalcule may disappear without any perceptible movement of the jaws as though the fish had sucked it in. But the amphipod (or other animal) must be at rest or on the ground or a plant; for the fish is too slow to get one moving; nevertheless it must be alive. The fish may throw itself on its side or in any other attitude most fit to get hold of the coveted "bug."

V.

As the season for reproduction approaches the sexes become prepared for it. The mature female's cloaca or "genital papilla" is somewhat extended and becomes a kind of intromittent organ for the transfer of her eggs to the male. The receptive male's pouch becomes thickened and vascular and thus prepared for the reception of the eggs and the nutriment of the embryos. The males, as usual in fishes, are somewhat smaller than the females.

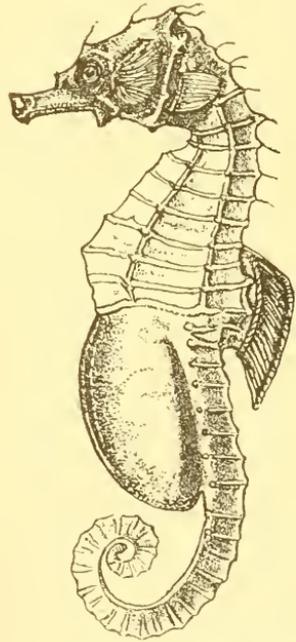


FIG. 5.—SEA-HORSE (HIPPOCAMPUS HUDSONIUS). MALE WITH DILATED POUCH. (AFTER KAPP.)

^a The many sea-horses in the aquaria at St. Louis (1904) were fed almost entirely on the larvæ of trout and salmon; the yolk-sac of the latter was broken before the larva could be swallowed.

Curiosity is naturally excited as to the manner in which the eggs are transferred into the narrow-mouthed ovigerous sack of the male. Many have watched, but, so far as known, the only one who has caught the female and male in the act of transfer was Dr. Filippo Fanzago. In May, 1874, the doctor observed the approach of the two in an aquarium at Naples. The approach was not once for all, but oft repeated and very short each time. The male remained passive and the egg-burdened female advanced toward him and pressed the aperture for the extrusion of the eggs against the mouth of the male's pouch. At the most a few eggs—perhaps not more than a single one—were passed from the female to the male and then she retreated. After a not very long interval it varied—she again approached and another transfer was made. Five times Fanzago observed this strange kind of copulation in a short space of time (in breve spazio di tempo), but exactly how long is not stated. He hoped to be able to make further observations, but has left no other records. The eggs are doubtless fertilized during the act of transfer.

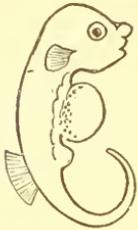


FIG. 6.—SEA-HORSE (HIPPOCAMPUS HUDSONIUS). VERY YOUNG WITH YELK-SAC. (AFTER LOCKWOOD.)

The ovigerous pouch is especially adapted not only for the reception of the eggs but for the sustenance of the newly hatched offspring. Dufossé (1874) found that there was a lining mucous membrane which had the faculty of secreting an aëriform fluid. Further, this function is liable to pathologic deviation, in which case the bladder may become stopped up and the fish be unable to control itself and carried to the surface of the water, where it remains helpless till death follows.

Lockwood (1868), before the investigations of Dufossé, found out for himself that the pouch may actually contribute in some way to the sustenance of the brood. "At the time of receiving the spawn the wall of the pouch is not less than 3 lines thick and well stored internally with fat. At the time of expulsion of the developed fry the same sack is not half a line thick and hangs flaccid on the animal, a mere thin membrane."

If the male would relieve itself of its burden it uses its tail. Lockwood has described the operation as he saw it. "Bending this ap-

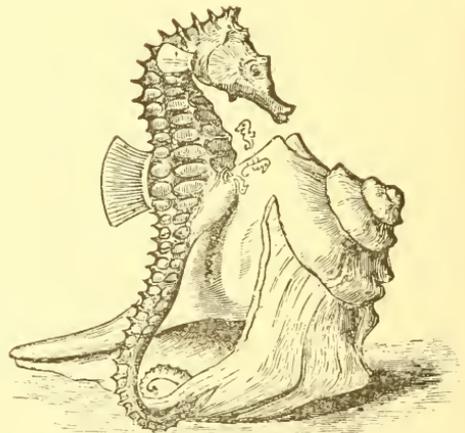


FIG. 7.—SEA-HORSE (HIPPOCAMPUS HUDSONIUS). MALE DISCHARGING YOUNG FROM POUCH. (AFTER LOCKWOOD.)

pendage upward like an inverted crook, thus imparting to it muscular rigidity, the animal pressed it against the bottom of the embryonal pouch, which occupied the lower part of the abdomen, thus pushing its contents upward, and forcing them out of the opening on the top of the sack, the creature all this time sustaining its normal, erect position in the water." Another may take advantage of the presence of some object on which it can get a purchase—a winkle shell, for instance. A "winkle afforded real help in the labor of extruding the young" to another male observed by Lockwood. This operation "is in no sense a parturient process, but on the contrary is entirely mechanical, and in the present case was effected in the following manner: With its abdomen turned toward the shell, its tail attached to the under part of it, the body erected to its full height, the animal, by a contractile exertion of the proper muscles, would draw itself downward and against the shell, thus rubbing the pouch upward, and in this simple, yet effective way, expelled the fry at the opening on top of the sack." This is not a continuous operation, but each effort was "followed by a few minutes of rest," and the extrusion of the young "lasted for nearly six hours, from three to six individuals being set free at a time." The young then are fully developed.

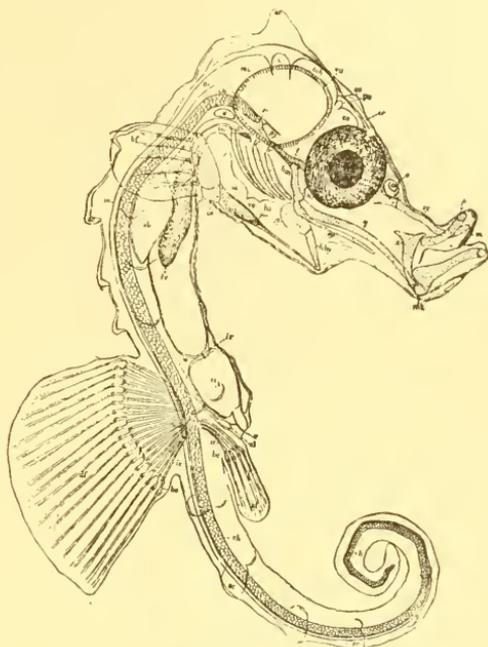


FIG. 8.—SEA-HORSE (*Hippocampus hudsonius*). YOUNG, VIEWED FROM SIDE AS A TRANSPARENT OBJECT. (REDUCED FROM RYDER.) *ab*, AIR BLADDER; *af*, ANAL FIN; *al*, URINARY VESICLE OR BLADDER; *av*, VENOUS SINUS; *au*, AUDITORY CAPSULE; *b'*, *b''*, *b'''*, FIRST, SECOND, THIRD, AND FOURTH BRANCHIAL ARCHES OF THE RIGHT SIDE; *ba*, BULBOUS AORTA; *bc*, BASIRADIAL CARTILAGES; *bf*, BREAST OR PECTORAL FIN; *c*, CEREBELLUM; *ce*, CEREBRUM; *ch*, CHORDA DORSALIS OR NOTOCHORD; *cs*, CORACOSCAPULAR ARCH; *cy*, CERATOHYAL CARTILAGE; *df*, DORSAL FIN; *e*, INTERNASAL CARTILAGE; *hh*, HYPOHYAL CARTILAGE; *hm*, HYOMANDIBULAR CARTILAGE; *ic*, INTERRADIAL CARTILAGES OR BASALIA OF FIN RAYS; *iv*, INTESTINAL VALVE; *lv*, LIVER; *m*, MEDULLA SPINALIS OR SPINAL CORD; *mo*, MOUTH; *mb*, MID-BRAIN; *mk*, MECKEL'S CARTILAGE; *mo*, MEDULLA OBLONGATA; *mt*, METAPTERYGOID CARTILAGE; *na*, NASAL PIT; *oc*, OESOPHAGUS; *p*, PARACHORDAL CARTILAGE; *pn*, PINEAL GLAND; *py*, PITUITARY BODY; *q*, ROD-LIKE QUADRATE CARTILAGE; *rc*, ROSTRAL CARTILAGE OR PROLONGATION OF THE TRABECULAR CORNU; *r*, RECTAL PORTION OF INTESTINE; *s*, SPIRACULAR OUTLET OF THE GILL-CHAMBER; *sc*, DERMAL SCUTES OR PLATES; *sy*, ELONGATED SYMPLECTIC; *t*, TRABECULE CRANII SEEN FROM THE SIDE; *tc*, TEGMEN CRANII; *v*, VENT OR ANUS; *vc*, VENTRICLE OF HEART; *w*, WOLFFIAN OR SEGMENTAL DUCT; *x*, SUPRA-ANGULAR CARTILAGINOUS ELEMENT, THE RUDIMENT OF THE SUPRAMAXILLARY.

After the exclusion of the young, connection between them and the parent ceases, so far at least as recourse to the pouch is concerned. Unlike the open-pouched pipe-fishes the sea-horses apparently can not readmit the young to the shelter of its small-mouthed sack-like pouch. It was Lockwood's "belief that with the sea-horse the termination of development is the end of their solicitude for the young."

The newly born young, 5 to 6 lines in length, are quite unlike the parent fish in some respects, while in others they resemble him. The scales are undeveloped, and instead of the pipe-like mouth the snout is short and broad; nevertheless the general form is similar to that of the adult, and the tail, though shorter and rounded, is incurved inward. The tail is immediately utilized, we are told by Lockwood.

VI.

The species of *Hippocampus* are numerous (between 30 and 40), but the many common characters are so much more prominent and striking than the specific ones that the latter are apt to be lost sight of and overshadowed by the former. The distinctions between the species are chiefly based on the length and number of rays of the dorsal fin, the number of rings encircling the body, the comparative lengths of the body and tail behind the anus, the depth of the body or distance across from the dorsal ridge to the ventral, and the relative length of the head and snout in front of the eyes. These are supplemented by the comparative development of the tubercles or spines, of the coronet at the crown of the head or nape, of the filaments with which the body may be covered, and the color. In illustration of such, figures are given of four species.

The common eastern American sea-horse (*Hippocampus hudsonius*) has a long dorsal with about 19 rays, about 45 (10+32-35) rings, the tail longer than head and trunk combined, the snout short but appreciably longer than rest of head (1.3-1.4:1), and the depth of the body approximately equals the length of the head. The coronet is little developed, the tubercles and spines weak, and the filaments rather few, short, and mostly simple. The color is dusky and spotless (but blotched) and the dorsal has a submarginal dark band.

The sea-wrack sea-horse (*Hippocampus zosterae*) of Florida contrasts with the common species of the north in most of its characters. It has a short dorsal (covering only 3 rings) with about 12 rays, about 41 (11+30) rings, the tail rather shorter than the rest of the body, the snout extremely short and not more than half the rest of the head, and the depth of the body great and almost equal to length from snout to margin of pectoral fins. The coronet is high, the spines are well developed, and the filaments moderate and often branched. The color is olive green, more or less mottled, and the dorsal has no distinct

submarginal band. It is, according to Jordan and Evermann, "the smallest known species of sea-horse, abundant in shallow water in the lagoons, always found clinging by its tail to the sea-wrack (*Zostera marina*)."

With these two species, two from Japan first described not long ago (1901) by Jordan and Snyder may be compared. The descriptions

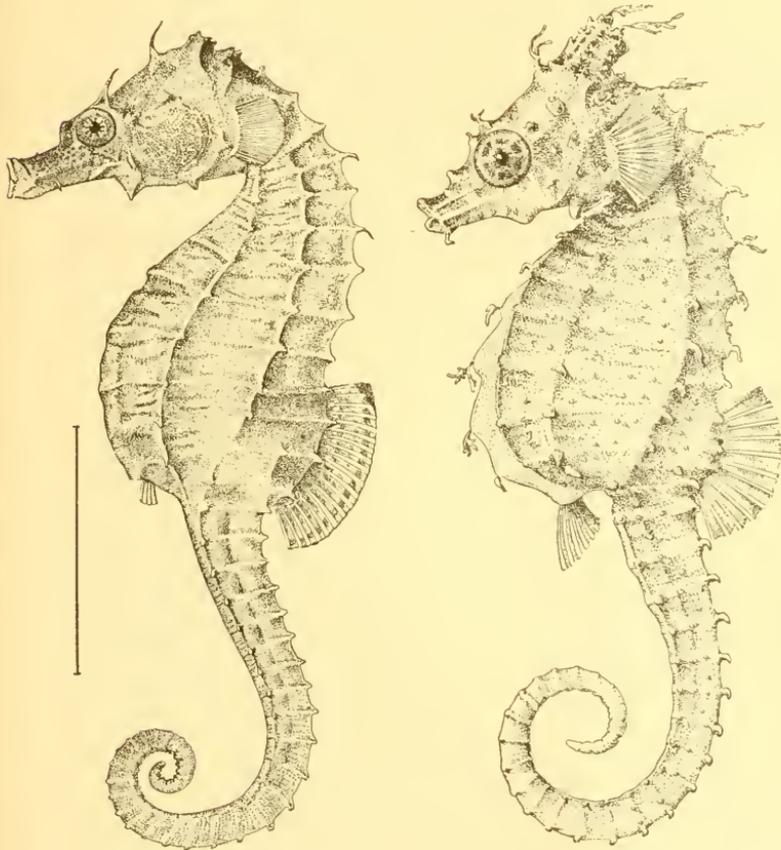


FIG. 9.—SEA-HORSE (*HIPPOCAMPUS HUDSONIUS*). FEMALE. (AFTER JORDAN AND EVERMANN.)

FIG. 10.—SEA-HORSE (*HIPPOCAMPUS ZOSTERE*). FEMALE. (AFTER JORDAN AND EVERMANN.)

here given will furnish hints enough to discriminate between them and others and indicate the range of variation.

VII.

Certain Hippocampines of southern seas, especially the *Phyllopteryx foliatus* and *Phycodurus eques*, develop exaggerated characteristics, which are more or less manifest in the ordinary sea-horses. The

cutaneous appendages, which are merely tags of skin in most species, become greatly developed, especially about the tail, and simulate in a remarkable degree the appearance of the seaweeds in which they are wont to lurk.

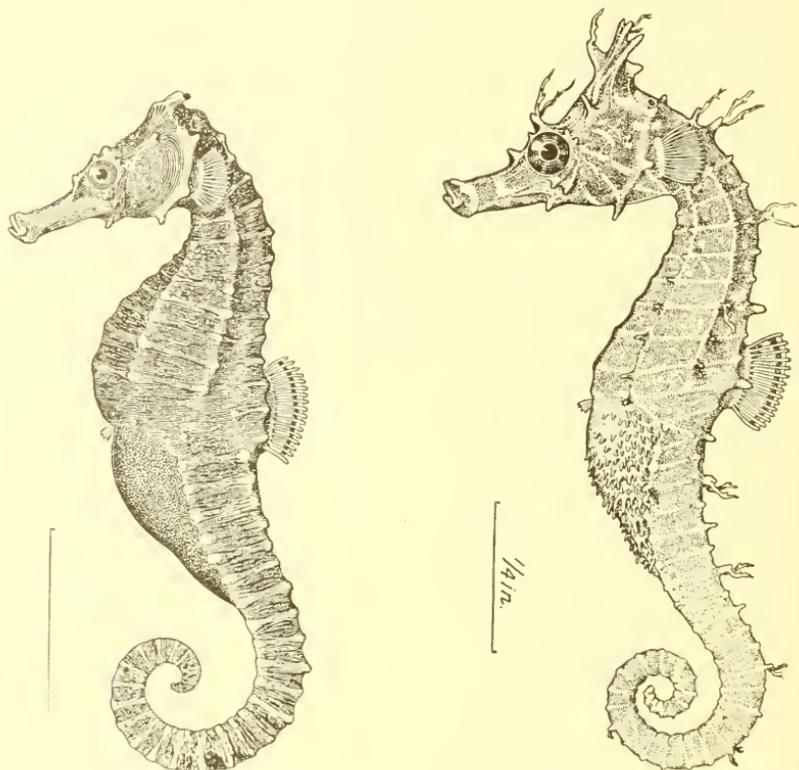


FIG. 11.—SEA-HORSE (*Hippocampus aterrimus*). MALE.

FIG. 12.—SEA-HORSE (*Hippocampus snyderi*). MALE.

The Solegnathines have the upper ridge of the caudal region deflected and continuous into the lateral ridge, while the lower caudal ridge is continuous with the ventro-lateral ridge of the trunk; the nuchal plate is not elevated and not connate with the head. Nothing is known respecting their habits.