THE LUMPSUCKER; ITS RELATIONSHIP AND HABITS

By THEODORE GILL

One of the most interesting of fishes from several points of view is the common Lumpsucker of the North Atlantic. Its skeleton is cartilaginous to such an extent that it was ranked by the old naturalists with the cartilaginous fishes; by later naturalists, although referred to the bony fishes, it was associated with forms subsequently found to be in no wise related, and not until quite recently has its true relationship been discovered and proved; it exemplifies a certain phase of retrograde development. It is at once the type of a peculiar genus (*Cyclopterus*) and a very distinct family (*Cyclopterids*).

I

The Cyclopterids, or Lumpsuckers, have a short, swollen, oviform body, large abdominal cavity, a circular sucker formed by the united

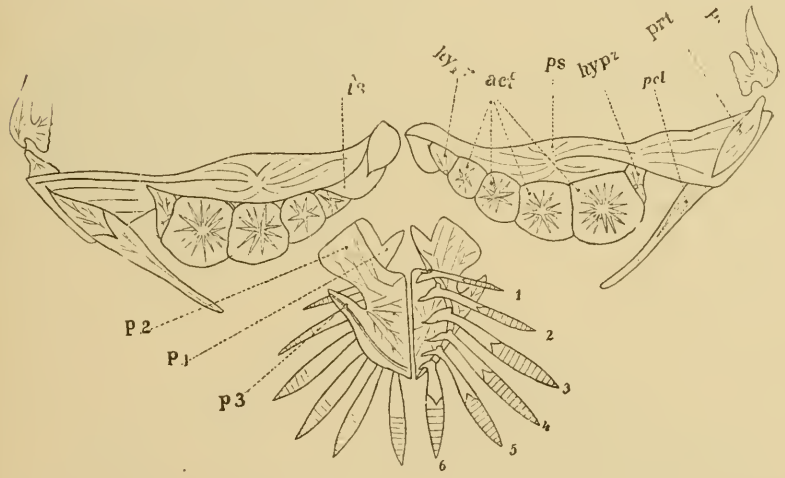

Fig. 32.—Skeleton.—Scapular arch and pelvis of the Lumpfish, the right-hand figures representing the external surface, the left-hand figures the internal surface of those bones. After Borckert.

a, actinosts 1–4.
hypr, hypercoracoid.
hypo, hypocoracoid.
is, interscapula.
*p*1, Anterior pointed process
*p*2, Anterior broad process.
*p*3, lateral process.
pcl, postclavicle.
prt, posterotemporal.
pt, posttemporal.
ps, proscapula (cœnosteon).
1–6, ventral rays.

ventrals, a short anal, generally a short, soft dorsal, and, typically, a more or less distinct spinous dorsal, but sometimes none at all.

Such are the chief superficial characters common to all the species; but if we would appreciate the distinctness of the family, we must examine the skeleton. The species are few, but the differences between them great. All those that are certainly known are confined to the cold northern seas and most of them to the high Pacific Ocean or Bering Sea. The two best known, however, are inhabitants of the North Atlantic; one of these, the name-giving member of the family, is familiar to all frequenters of the high northern waters; the other, *Eumicrotremus spinosus,* is a more northern form, beyond the ken of most civilized men, and, being a small and deep-living form, has received no popular name.

A peculiar characteristic of the Cyclopterids, and especially of the common Lumpsucker, is the extreme reduction of the osseous elements and the inverse development of the cartilaginous skeleton. The extent of the cartilage is such that a skeleton cannot be made, or at least kept, like that of an ordinary fish, but shrinks and becomes distorted and shriveled up. All the bones, however, are there, but existent in a reduced state or as thin membrane-like pieces fastened to the cartilaginous mass. On account of this condition of the skeleton, the old writers on ichthyology were greatly misled as to the relationship of the fish, and Linnæus, in his classification, ranged the fish with the sharks, rays, sturgeons, and some others in a group which he called the order Chondropterygii. It has, however, not the slightest affinity with any of those fishes, but is really most nearly related to the Sculpins or Cottids, which have the bones firm and well ossified and very little persistent cartilage.[1] Like them, nevertheless, the Lumpsuckers have the second suborbital bone after the preorbital broad and obliquely prolonged to the inner margin of the preopercle to connect as a stay with the latter. Coördinate with this structure are numerous modifications of the skeleton which essentially resemble corresponding ones of the Cottids. Especially noteworthy are the characteristics of the bases of the pectoral fins. (See fig. 32.)

II

The species of Cyclopterids are few, but so distinct that there are almost as many genera as species. Only eleven species are definitely

[1] The characteristics and affinities of the Lumpsuckers have been considered by the present writer in an article "on the relations of the Cyclopteroidea," in the Proceedings of the U. S. National Museum for 1890 (XIII, 361–376, pls. 28–30).

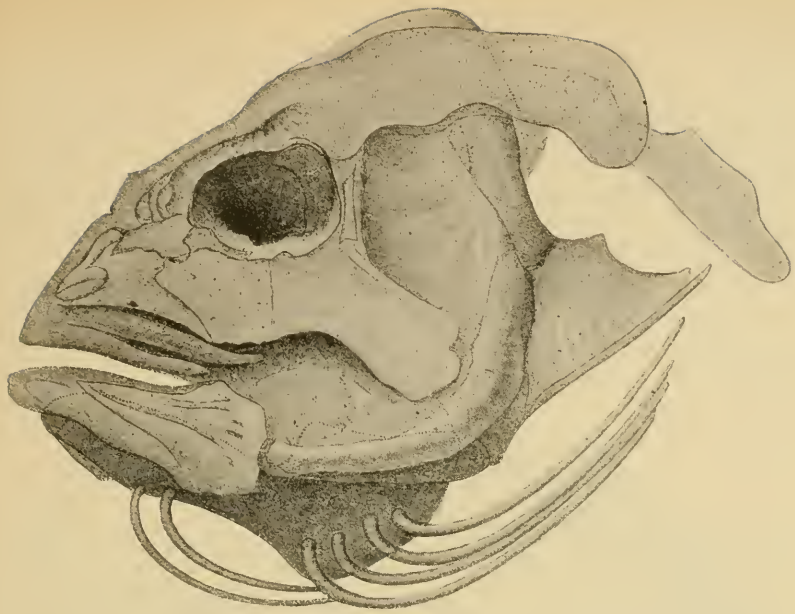

Fig. 33.—Skull of Lumpfish, second suborbital developed as a stay (Garman).

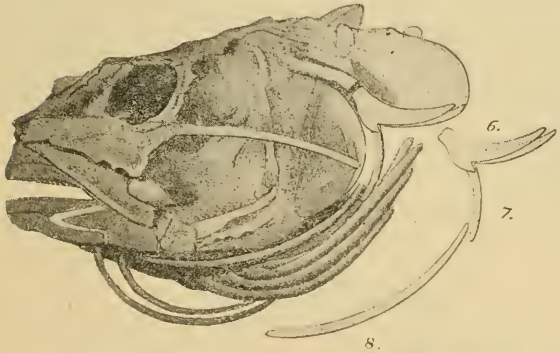

Fig. 34.—Skull of *Liparis*, for comparison with that of Lumpfish (Garman).

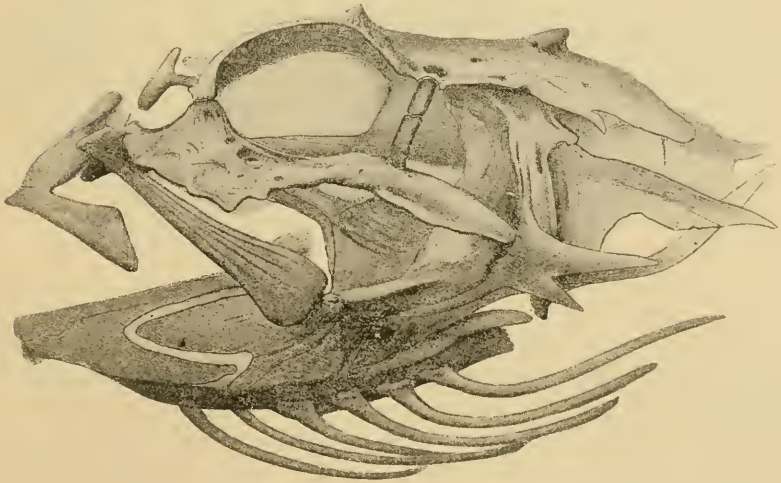

Fig. 35.—Skull of Sculpin, for comparison with that of Lumpfish (Garman).

known, but they are so greatly differentiated that no less than six genera have been provided for them; four of these genera include or are more or less closely related to the common Lumpfish and combined in one subfamily (*Cyclopterinæ*) contrasted with another (*Liparopinæ*) including the other two genera.

The CYCLOPTERINÆ have a well-defined spinous dorsal, although in the adults of the common Lumpfish it is overgrown by the skin and tubercles. The subfamily includes four genera which are superficially distinguishable by the following characters:

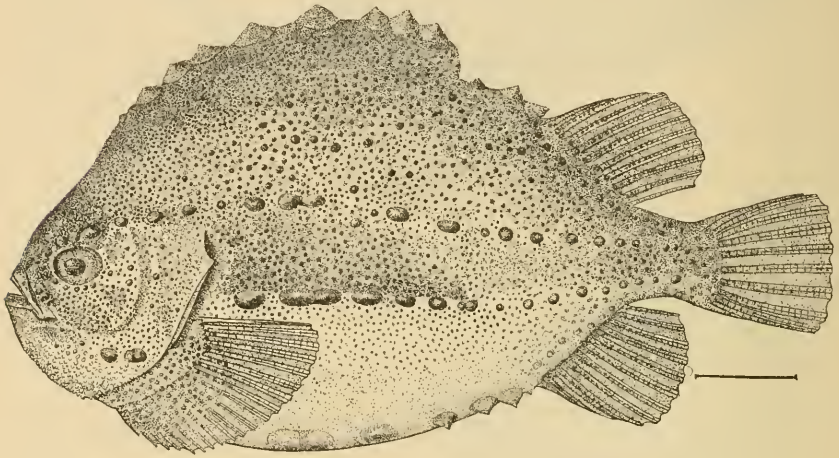

FIG. 36.—Common Lumpfish or Lumpsucker, *Cyclopterus lumpus*. After Goode.

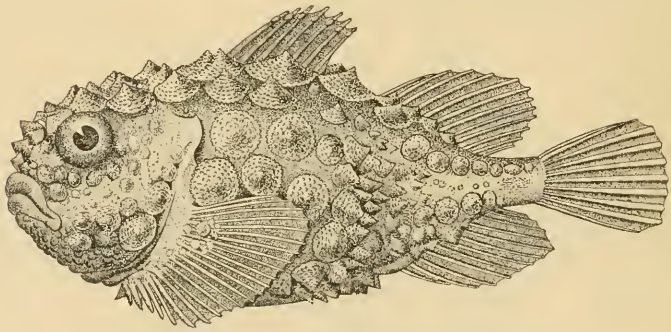

FIG. 37.—*Eumicrotremus spinosus*. After Collett.

Cyclopterus has large tubercles well separated, but arranged in seven regular longitudinal rows, and the first dorsal becomes overgrown and lost to view with maturity. The branchial apertures are moderate. The *Cyclopterus lumpus* is the only recognized species.

Eumicrotremus has large tubercles closely but irregularly arranged, and the first dorsal remains developed through life. The branchial apertures are much reduced. Four species are known, the *E. spinosus* of the arctic Atlantic and the *E. orbis, E. pacificus,* and *E. brashnikowi* of the northern Pacific.

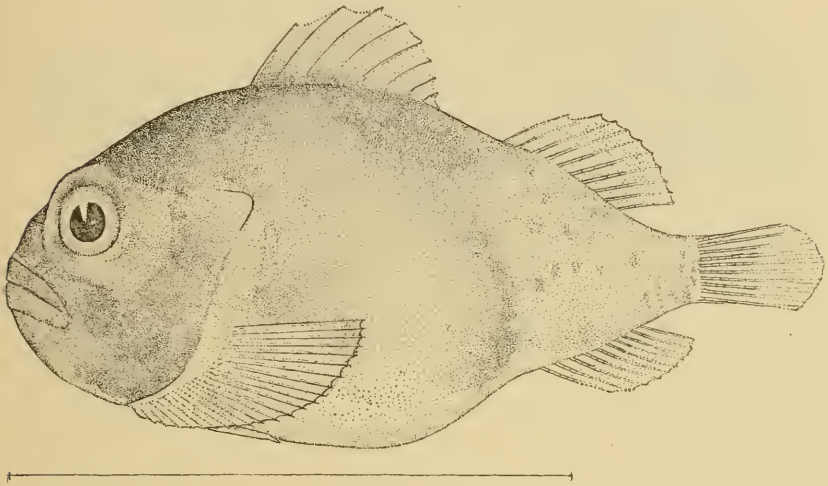

FIG. 38.—*Lethotremus muticus.* After Jordan and Gilbert.

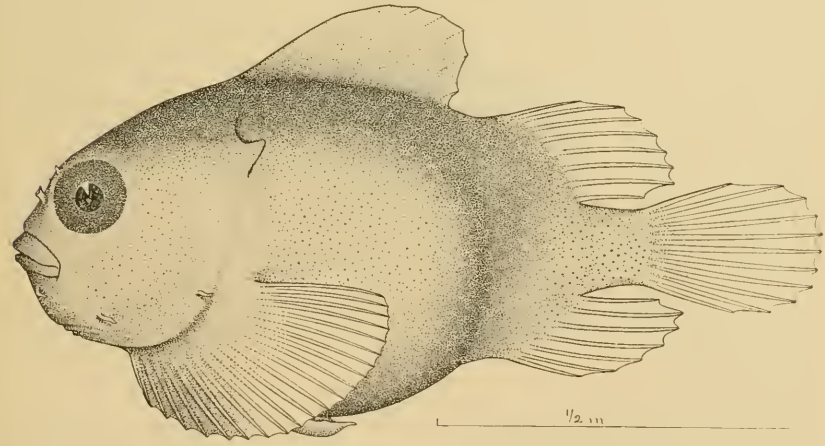

FIG. 39.—*Lethotremus awæ.* After Jordan and Starks.

Lethotremus has no large tubercles, the skin being naked or with few scattered spinules, and the first dorsal is well developed and sustained by 6–8 slender spines. The branchial apertures are very

much reduced. Two species are known from the North Pacific, *L. muticus and L. æwæ*.[1]

FIG. 40.—*Lethotremus vinolentus*. After Jordan and Starks.

Cyclopteroides has small spinigerous tubercles well separated, but arranged in eight regular longitudinal rows and the two dorsals are partly enveloped in the skin; the ventral disk is abdominal and further back than in the other genera. The only species (*C. gyrinops*) has been found in Alaskan waters.

FIG. 41.—*Cyclopteroides gyrinops*.
After Garman.

The LIPAROPINÆ have no external spinous dorsal, the back in front of the soft dorsal being completely finless. Two genera have been distinguished.

[1] Another species has been added to *Lethotremus* as *L. vinolentus* by Jordan and Starks. It differs apparently in physiognomy as well as by the development of the fins and the presence of scattered spinous tubercles on the head and fore part of the body; it is scarcely a natural associate of the other species, and doubtless Jordan and Starks may hereafter distinguish it generically. The only known specimen was in poor condition and obtained in Puget Sound near Seattle.

Cyclopterichthys has the skin perfectly smooth and the dorsal short, as in the other Cyclopterids. The only species (*C. ventricosus*) is an inhabitant of Bering Sea.[1]

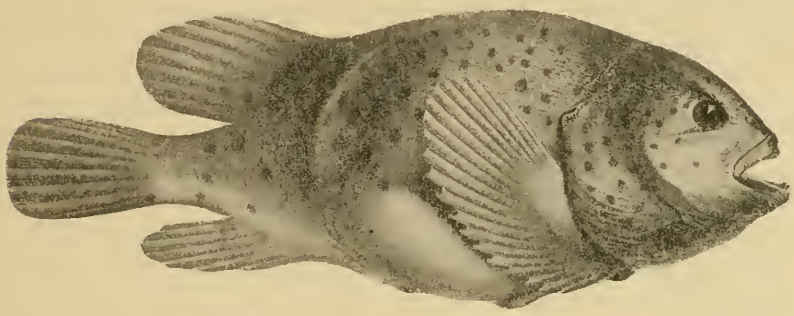

FIG. 42.—*Cyclopterichthys ventricosus.* After Steindachner.

Liparops has the skin in front of the dorsal surmounted by a row of bony tubercles and the dorsal comparatively long. A single species (*L. stelleri*) is known from Kamchatka.

III

The genus *Cyclopterus* has as the chief distinctive characters a massive body, very high arched back, skin covered with large tubercles in seven rows, a median dorsal and three lateral on each side, and much smaller scattered tubercles over the rest of body and head, small head, moderate branchial apertures (large in comparison with other genera of the family, extending from a level above the eyes to the front of the pectorals), the soft dorsal and anal pushed far back and opposite, and the spinous atrophied and concealed by the overgrown tubercles in adults. The type and only known species is the strange-looking and celebrated Lumpsucker.

The name *Cyclopterus* (meaning circular fin) was given by Linnæus in allusion to the circular form of the combined ventral fins.

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[1] A second nominal species has been added to *Cyclopterichthys* and named *C. amissus.* It is based on a sketch of a fish caught at Telly Bay, Magellan Strait, made by a naval officer, and was the only material Professor Vaillant had to determine the species. It has, however, been admitted by Mr. Garman (The Discoboli, 1892, p. 42), who has cited "Gill, 1891, Pr. U. S. Nat. Mus., XIII, 366," as also adopting it. The present writer, however, especially stated "the so-called *Cyclopterichthys amissus* has no real standing in the ichthyological system."

The popular names are many and several somewhat significant. Besides Lumpfish and Lump alone, Lumpsucker is given, and recalls both the "lumpy form" of the body and the suctorial character of the ventral fins. Paddlecock or Paidlecock, as well as Cock-paidle, Scotch names, are reminders of the crest of the back, which has some resemblance to a cock's comb, as well as the toad, whose skin its own is not unlike; the sexual differences, so apparent when mature, have obtained contrasting names, for the female is distinguished as the Hen-paidle, and the sexes are frequently spoken of as cock or hen, or, on account of the differences of color, Red-paidle and Blue-paidle. Other names less used are Sea-owl and Hush-bagaty. Lumpfish is the generally accepted name of the Americans.

Lumpfish is evidently cognate with Lumpfisk of the Baltic shore, Lump of the German and Netherlanders, and Lomp of the French. Paidle and Paddle have been ascribed to the verb to paddle, but are much more likely cognate with the Dutch and Danish Padde, the name of the toad. One of the Danish names of the Lumpfish, indeed, is Hafpadde or Sea-toad.

IV

The Lumpsucker's distribution in the North Atlantic is wide both in a horizontal and vertical direction. As a lover of cold waters, however, its range southward does not extend below the Bay of Biscay along the coast of Europe, nor beyond Chesapeake Bay along the American coast, and there rarely.[1] Its range northward (as elsewhere) is probably limited by the conditions of its oviposition and development, so that it does not thrive in the high Arctic Ocean. Its chief resorts are along the Scandinavian coasts and those of Scotland as well as Greenland, and along the northern American shores to Cape Cod. Within such limits, in almost all suitable places, it is one of the most common of fishes.

It is a "bottom-fish," generally keeping close to or on the bottom, but its range is great, extending from tide-limits to a depth of between 100 and 200 fathoms. The bottom mostly affected is a rocky or stony one and, by means of its sucker, it often adheres to such

[1] A female lumpfish over 18 inches long was recently obtained by fishermen near the entrance to Chesapeake Bay, and carried to Washington as an unknown and curious specimen. Word was sent to the Smithsonian Institution, and Mr. Barton A. Bean went to the wharf and obtained it. None of the observers had ever seen or heard of the like. The specimen is now in the collection of the U. S. National Museum.

and remains inactive for a long time—many minutes. However, it is by no means restricted to such, but, according to Smitt, "may sometimes be found swimming freely about in the open sea. This does not depend entirely on the circumstance that it attaches itself to floating objects and drifts about in their company, for it also displays considerable activity in the pursuit of its prey and in its migrations to the spawning place."

It nevertheless frequently avails itself of foreign objects. "Ekström mentions its habit of attaching itself to the wooden floats or buoys used to support the herringnets" in Sweden, but individuals may even make use of living fishes. An instance was published by Couch of one that had secured a hold on a mackerel, the two having been caught together in a drift net in water of considerable depth. Probably in this instance the attachment resulted from fright. The tenacity with which a Lumpsucker can adhere to another body is remarkable. Pennant long ago told that, when put "into a pail of water," by its sucker it fixed itself "so firmly to the bottom that on taking it by the tail the whole pail by that means was lifted, though it held some gallons." McIntosh found this observation to be quite accurate. "The whole can be lifted by seizing the fish, and a greater weight than 43 pounds (which was that of pail and water) could readily be raised in this manner."

The Lumpsucker's movements in progression are characteristic. Buckland (1880) considered that, "though an awkwardly built fish, it is a good swimmer. The tail is the propelling power, and the fish moves it with great velocity and an action not unlike a clumsy woman running." Such a course, however, could only be maintained for a short time, and while good for a rush, would not suffice for a long tour. The rushes are most observable during the season of incubation, when the male assumes charge of a bunch of eggs. Then the usual lethargic and peaceful fish becomes an active as well as vigilant guardian of the future progeny. He rushes at an intruder, especially an intruding male of his own kind, "with the utmost fury" and wonderful agility. One, like Fulton, could scarcely believe "that so clumsy and usually sluggish a fish could swim so fast."

The feeding habits of the Lumpsucker are peculiar. The fishermen of some places, especially along the coast of Belgium, according to Van Beneden (1876), maintain that "the *Cyclopterus lumpus* feeds on nothing but the excreta of other fishes," and Van Beneden even endorsed this belief to the extent of affirming that "the examination of the animal's stomach confirms their assertion," and consequently he ranked the fish among "crotophagous species." Later (1902)

Fulton recorded the results of the examination of "considerably over three hundred specimens of Lumpsuckers." "The stomachs of a large proportion of them were either empty or filled with a watery fluid of about the same specific gravity as ordinary sea water." One hundred and forty-four of the fishes thus examined were caught "in the nets of the salmon fishers," and had approached the shore to spawn. The concentration for this purpose may partly at least account for the emptiness of the stomachs. "The great majority of the stomachs of female fishes examined" by Fulton "were either empty or contained a thin fluid differing little, if at all, from sea water. The stomachs containing food which could be most easily identified were usually those of male fishes." The food was chiefly composed of small crustaceans, especially isopods or amphipods, and cœlenterates, such as Beroids and Pleurobrachia.[1]

In fact, crustaceans, medusans, worms,[2] and shell-less mollusks are the main sources of supply, but the medusans were thought by Lilljeborg (1884) to have been ingested rather for the small hyperioid crustaceans that lurk about them than for the jelly-fishes themselves. Some incautious little fishes are also captured by it. Murie, indeed, found on one occasion about a hundred "whitebait" (the young of herrings and sprats) in the stomach of a single Lumpsucker. Other observers have examined the stomachs of many individuals, especially females in the breeding season, without finding anything "save a quantity of fluid," but, as Fulton has well remarked, "this is no doubt owing to their being mostly caught during the breeding season, when food is usually not taken by fishes." An incident told of by Fulton (1906) aptly illustrates the limitation of the fish's power and its abstinence while guarding the eggs whose care it has assumed. One day Fulton "dropped on the top of the egg-mass" a male was guarding "a little common swimming crab, about 1¼ inches in breadth, which, apprehending danger, clung tightly in one of the snout-depressions on the surface of the eggs. It was amusing to watch the Lumpsucker ineffectually trying to rout him from the hollow in which he had taken refuge, the blunt snout of the fish preventing a hold being got on the crab. He tried again and again to dislodge or seize the crab. At last the crab turned partly on its side and extended its widely opened chelæ as if to defend itself, which

[1] A detailed account of Fulton's observations may be found in the 20th Annual Report of the Fishery Board for Scotland, part 3, pp. 497-500.

[2] Prof. McIntosh (3d An. Rep. F. B. Scot., p. 61) obtained "a large female" which emitted "fully matured" ova whose "stomach was distended with fine specimens of *Nereis pelagica, L.*"

gave the fish its opportunity. It seized the crab in its mouth and swam off with it to the furthest corner of the tank, where it dropped it." Under other conditions, doubtless, it might have at once swallowed it.

V

The spawning season is quite long, extending from February to June, the season depending somewhat on the temperature and place, but even in a single place it may be prolonged. McIntosh, for instance, found that at St. Andrews "it ranges from February to May," and he was corroborated by Fulton (1906), who found that the spawning season for Scotland generally extended "from February to nearly the end of May." In one year noted by McIntosh (1886) "it was especially late, probably from the severe and long-continued winter. The young captured during the first ten days of July therefore showed considerable variation in size." Fabricius records that in Greenland oviposition occurs about the end of May or the beginning of June, the abbreviation of the season doubtless being determined by the brevity of the summer.

The male parent has been long known to keep a watchful guard of the eggs of the female, and it has been even claimed that he made a nest. McIntosh, however, especially asserts (1886) that "the *Cyclopteri* form no *nests,* the ova being deposited chiefly on the sides of rocks and stones." Often the precious burden is laid in such low water as to be almost exposed at low tide, and the zealous male, regardless of danger, is then so careless of self as to permit a close examination. McIntosh (1886) has given interesting details respecting one he had observed:

"About the middle of May a male *Cyclopterus* was found a short distance from low-water mark in a broad runlet with his head close to a mass of ova placed in the seaward edge of a stone. The stream of sea-water was so shallow as to leave the stone partly exposed, and was quite insufficient to float the fish, which was 11½ inches in length. Accordingly, for a considerable period twice daily the devoted male had to lie in the runlet on his side, a portion of his body, including the upper opercular region (in this position), being above water. From the situation of the ova on the stone just described the current of the runlet flowed into the mouth of the fish, which, in the warm sun of June, must have been less comfortable than under ordinary circumstances—a fact which is at variance with the 'accidental' theory formerly mentioned. The cool and ever-changing stream, however, sufficed for aëration, the movements of the hy-

oidean apparatus and the mandible, as well as the direction of the stream, causing a current over the upper as well as the lower branchiæ. Thus, although the action of the branchial apparatus and the heart was occasionally a little hurried in the warm sun, no serious effect ensued. For five or six weeks this faithful male was found at low water in this position, sometimes on one side and sometimes on the other. In order to test it still further, Mr. Scharff removed the fish a couple of yards from the eggs and placed it on a stone. It wriggled actively into the water, at once rushed to the ova, and assumed its former position with the snout almost touching the eggs. The same ensued when it was placed in the runlet at a somewhat greater distance. The solicitude of the males for the ova which they have under charge was further illustrated by the occurrence early in May of a heavy sea, which swept masses of the ova from their positions all along the rocks. As soon as the sea became calm numerous anxious males, like 'pilgrims,' were seen by the laboratory attendant (who had been familiar with the sites) seeking for their lost charges. Many of these masses of eggs were found on the beach, so that the statement is probable.

"As soon as the eggs were hatched the male was released, and the young spread themselves over the rock-pools in the neighborhood in hundreds. It is unlikely, however, that they are dispersed by specially adhering to the body of the male, though they quickly cling to anything and even to each other. Their home appears for some time to be the littoral region and especially the rock-pools, and they are occasionally found in considerable numbers in August, when the larger examples caught with a hand-net measured about 7/8 inch. They adhere to the blades of the tangles and other seaweeds, and in the mazes of these find that safety (from the ready application of their suckers) which would be denied them in the open sea. When caught in the tow-net inshore it is generally along with floating littoral seaweeds with which they have migrated."

Fabricius (1780), generally a reliable authority, has told an extravagant story of the valor and ability of the paternal Lumpfish. According to him it fears no enemy; even if the Wolf-fish, armed, though it be with terrible teeth, approaches its nest, it is wont to pursue it and, fastening on its neck, bite and worry it to death. One who knows the comparative structure of the two fishes must find it difficult to credit such a tale. Nevertheless Fulton (1906) does "not think the story of Fabricius . . . need be doubted. The courage and pugnacity of this usually docile and inoffensive fish seem boundless when it is protecting its eggs, and in contests of this

kind it not infrequently happens that courage and determination count for as much as strength and the power of inflicting real injury." In this case it is the ability and not the courage of the fish that need be doubted. The Wolf-fish that could be bitten and worried to death by a Lumpsucker must be small and weak indeed. McIntosh asserts that "even in its larval condition the young [Wolf-fish] makes an easy prey of the young [Lumpsucker]." The Lumpsucker's ability as a fighter is, in fact, very limited. His frame and jaws are weak; his teeth small and insignificant as weapons. As Fulton remarks, "his capacity as a defender of the eggs lay more in his power of butting than of biting, for which his mouth is not well adapted."

The female naturally becomes proportionately turgid with the growth of her eggs, and is "dark leaden blue or slaty colored"; the male assumes a bright reddish hue about his fins and his belly.

There is a considerable disparity in size between the sexes, the females averaging considerably more than a foot in length, while the males are less. Seventy "lumpsuckers taken from a salmon stake-net in the Bay of Nigg," Scotland, "between 2d May and 24th July" of one year, were measured by Dr. Fulton; of these 40 females averaged nearly 16 (15.8) inches in length and 6 pounds and 6 ounces in weight, while 30 males averaged 11 inches long and only a pound and 14 ounces in weight.

The eggs themselves are noteworthy for their gay and diverse colors. According to Fulton, "when examined in the ripe female before extrusion they are usually reddish or salmon tinted, but may be lilac, pale violet, pale brown or pink. On extrusion they are pink, but this tint fades on exposure to light, and gives way to a faint greenish or yellowish hue; later they become dark, owing to the development in the embryos." In mass, they may constitute a quarter to a third or more of the total weight of the mother. "The average for three specimens examined" by Fulton was "27 per cent." The same observer found that "the eggs measure about 2.2 mm.–2.6 mm., and have a volume of 4.18 cc." He estimated "them to number from 79,758 to 136,764 in females a little over 18 inches long. The fecundity of the Lumpsucker is therefore high."

The favorite time for sexual congress appears to be night. Doubtless then males and females chiefly meet, but their manner of approach and love play, if any, have not been reported. Probably there is a mutual excitation and play of the sexes. Then the female deposits a mass of eggs on some suitable ground and they are duly fecundated by a male fish. Perhaps there may be male rivals in

waiting for this function, and a fight then ensues. The deposit of eggs is made on the bare rock or stones or the ground, generally "about low-water mark."

As a rule, the female lays all her eggs "at one time," but occasionally they are deposited in two or perhaps more lots. "One of the females" observed by Fulton "deposited her eggs in two lots after an interval of thirteen days. The eggs in the ovary, just before extrusion, are bathed in a plentiful fluid, but they are not adherent; when the fingers are passed through the mass, the feeling conveyed resembles that of contact with a mass of half-boiled sago. Around the eggs the secretion is syrupy, and on separating them glutinous threads pass between them. This substance hardens in sea water and binds the eggs into a large, compact, spongy mass, leaving narrow channels between them by which water enters."

Some excellent observations were made in 1906 by Dr. T. Wemyss Fulton, in Scotland. A couple of males were confined in an aquarium with two females, both of which "laid their eggs in the same corner." On the 24th of March one victorious male assumed charge of both deposits and "showed throughout the whole period" of development of the eggs "the most rancorous and persistent animosity to the unattached one. The latter, on the other hand, displayed the greatest fear of his successful rival." The male "which was worsted in the nuptial fight never regained courage to attempt further contest for his rights, but displayed a most craven spirit from first to last, lurking in the darkest part of the tank as far from his rival as he could get. * * * Whenever the guarding male saw his late opponent moving, even a comparatively little way from his retreat, he rushed at him with the utmost fury. * * * and the other male made off with equal speed and often attempted to jump out of the water, or was partly knocked out. On such occasions so much commotion was made that waves were created in the tank and the other fishes were alarmed. These were the only occasions that the guardian left the eggs for a few moments. The animosity was kept up during the whole period of the experiment, * * *. The females took no part at all in looking after the eggs. * * * They lay indolent and quiet at the back of the tank for some days." The victor male enjoys exemption from the further intrusion of a beaten rival.

The guardian male, while constant in his attention to his charge, varies in his position; sometimes he rests by the side of the mass and sometimes he may turn his back on the eggs and cling to a corner or wall next to which they have been laid. The Lumpfish

in the aquarium which Fulton observed would mostly "lie behind them, with his snout against them, and obviously keenly attentive to his surroundings as well as to the responsible duties of his office." Not infrequently, however, he would attach himself by his sucker to the wall of the tank next to the eggs, with head upward. A sea-anemone close to the eggs was never interfered with.

FIG. 43.—Male Lumpfish guarding egg masses. (Sea-anemone at right undisturbed.) Modified after Williamson and Fulton.

But something more than vigilance against intruders is required of the parent fish. The charge assumed by him demands still more active duties. In the case of the fish observed by Fulton, after a time "the guarding male was observed to fan gently the mass of eggs with his breast fins, clearly for the aëration of the eggs, but for some time the action was leisurely performed and was by no means so striking as it became later." Some ten days after the assumption of his charge the male resorted to a still more efficient means of aëration. "Placing his mouth about an inch or so from the spawn, he spouted water out upon it, the action of the gill-apparatus being thus reversed. * * * This curious action was most purposive and effective. The current created was so strong as to sway the algæ growing on the side of the tank in the neighborhood as well as the tentacles" of a sea-anemone close by the eggs, "and even

to cause the whole mass of eggs to rock visibly backwards and forwards. This action was done at brief intervals and from this time onwards. Later, when the eggs were hatching, it was redoubled, and great activity was shown with the fins. The movement thus created in the water very probably helped the escape of the larval fishes from the eggs. At this time the 'pumping' or 'blowing' action was at the rate of fifteen or sixteen in ten seconds, and in the pauses the fins were kept vigorously at work."

For more than a month this guardianship of the eggs was kept up and for most of the time no food whatever was taken. If any was dropped near him or on the eggs, such as mussels, he would remove them; a little crab dropped on the eggs was, after some effort, caught and carried away to be dropped instead of eaten, as already told. This vigilance and restraint at length changed his appearance. He "lost his brightness" and became dingy; naturally he also became thin and was infected with ecto-parasites (*Caligi*) and appeared sometimes exhausted by his onerous task and prolonged fast. But "that this was not entirely due to those causes was shown when the supply of water was increased, and when it was directed to his corner. After a refreshment of this kind he moved about with vigor, energetically spouting water on the eggs and fanning them with his fins." Not until the 26th of April was the watchful male persuaded to take a mussel, but after that "on some days he ate as many as five; any excess he carried off and ejected, as before; and at the beginning of May he was as alert, active, and pugnacious as ever." Once persuaded, he occasionally accepted food several times afterwards.

At last, on the 5th of May, "42 days after the eggs were deposited and fertilized," larvæ began to issue from the eggs; for the first few days "the tadpole-like larval lumpsuckers were found in small numbers in the overflow-filter every morning, and they slowly increased in numbers. They were very active, swimming with great rapidity by a lashing movement of the tail, a large yolk containing an oil globule at the right side being conspicuous. Up to the 22d of May, or almost exactly two months from the time the eggs had been spawned, and seventeen days after they had begun to hatch, the conditions described continued. The young lumpsuckers were appearing in greater numbers, but still not in such abundance as one might have expected. The largest number was about two or three hundred a day. They were also to be seen adhering to the glass front of the tank, and numbers were thus accounted for. None were

observed on the back of the male, a habit sometimes attributed to them."

No more eggs were hatched after the 22d of May. "The greater number were still unhatched on that day," but the remainder of the mass of eggs were "black and fetid" and many of the larvæ were "dead and white" and "floating on the water." "Clearly the aëration had not been sufficient for the interior of the egg-masses." Fulton believed that, under natural conditions, "the time taken for the hatching of all the eggs is prolonged, for it is difficult to understand how the larvæ could make their way from the interior of the mass by the narrow channels between the eggs if the eggs there were hatched as soon as those in the exterior."

Doubtless, under natural conditions, protected by the vigilance of the father fish, a large majority of the eggs are hatched and the larvæ escape to live a free life for more or less time. Doubtless, too, a greater loss of life is then incurred than during their hatching period, for they no longer enjoy their father's care. Their early developmental history has been detailed by A. Agassiz (1887), W. C. McIntosh, and A. T. Masterman (1897).

As soon as the eggs are hatched the male is released and the young disperse all around, resorting to the rock-pools in the neighborhood in hundreds. The rock-pools and the littoral region in general are the chief resorts "for some time." There they were found by McIntosh and Masterman, in Scotland, to later adhere to the blades of the tangles and other sea-weeds, and in the mazes of these they would "find that safety (by the ready application of their suckers) which would be denied in the open sea. They are also common in the neighboring waters inshore, being carried hither and thither on the floating littoral sea-weeds."[1] (See also p. 140.)

[1] The young are protected to a considerable extent by assimilation to surrounding objects. According to W. A. Smith (11th Rep. F. B. Scotl., p. 390), "perhaps the simplest and most interesting example of such assimilation is to be found in the young of the Lumpsucker." Smith observed "the young in multitudes, when the capsules were being thrown from the" olive-green seaweed amongst which they lived, hovering about "and making no effort to escape, further than dodging alongside one of the capsules which was an exact counterpart of itself, both in size and general tone of coloring." H. C. Williamson (17th Rep., p. 128) also called attention to the fact that young Lumpsuckers "were found at the surface on drifting pieces of Fucus." Smith, probably mistakenly, thought that these young, "only one inch in length," were "probably a year old or thereabouts," and that fishes weighing "12 or 14 pounds must be of great age." Tosh estimated the age of an inch-long (22 or 23 mm.) fish to be five months.

VI

The newly hatched larvæ are about a sixth to a quarter of an inch (4-6 mm.) long or a little more. "They are tadpole-like—with the remains of yolk, the oil-globule, occupying the right side, while the marginal fin is continuous, dorsally and ventrally. The caudal has only embryonic rays, and there is a thickening (hypural) beneath the notochord in this region. The short breast-fins show indications of true rays. The circulation in the vessels of the yolk-sac goes on in jerks, so different from the continuous rapid currents in the arteries of the tail and other parts. The dorsal aorta bends downward just within the tip of the notochord. The young Lumpsuckers swim very actively by rapid vibrations of the tail and the pectorals. The heavy anterior end of the body is thus favorable for progression." Such were the larvæ obtained by McIntosh and Masterman in early May. "By the 12th day the fish has increased considerably in bulk, and measures 6.75 mm."; the yolk has disappeared, the fins become differentiated, the two dorsals especially showing distinct rays; the anal, however, though rayed, is "joined to the caudal by a strip of larval fin without rays;" and the caudal is still heterocercal.

FIG. 44.—Young Lumpfish 4 mm. in length. After A. Agassiz.

From this earliest stage with the continuous fin round the long postanal region there is a regular development into the adult stage.

FIG. 45.—Young Lumpfish 10 mm. long. After A. Agassiz.

FIG. 46.—Young Lumpfish 20 mm. long. After A. Agassiz.

The tail end becomes abbreviated and concentrated; a division ensues between the caudal, dorsal, and anal fins; the heterocercy diminishes and is at length replaced by the homocercal tail; the first dorsal, originating in a protuberance which becomes quite upraised, finally becomes distinctly developed, and lastly the dermal appendages are developed, the lateral tubercles extending from the

shoulders first, then the larger tubercles behind from the pectoral region. The concentrated oviform shape is the last phase assumed.

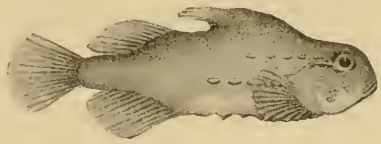

FIG. 47.—Young Lumpfish 34 mm. long, showing rows of tubercles. After A. Agassiz.

The essential cyclopterus form thus acquired, further development is chiefly in the line of increase in size and bulk. The growth is rather slow. When a year old, the young fish is about two inches or more in length.[1]

Maturity is probably attained during the third or fourth year. According to Fulton (1892) the "average length" of a mature female is about 18 inches and that of a male between 10 and 11 (10.8) inches.[2] An average-sized female would weigh about 10 pounds.[3]

VII

A considerable diversity of opinion prevails respecting the gustatory quality of the Lumpsucker. In many places (as in the United States, Canada, and even in France) it is seldom or scarcely ever eaten. One of the objections against it is on account of its smell, or because, as Moreau and Day euphemistically state, "it diffuses an odor which is by no means pleasant." Moreover, "the quality of its flesh is said to be affected by the season, it becoming worthless after spawning," according to Day. It is also said "to dissolve in the mouth like mucilage or oil." In England, formerly it was more

[1] According to J. R. Tosh (12th Rep. F. B. Scotl., 1893, pt. 3, p. 333), a fish caught June 1, 1887, 53 mm. long, had a "calculated age" of a year, the probable month of spawning" having been May. (See also p. 145.)

[2] Fulton's deductions (10th Rep. F. B. Scotl., p. 239) were based on 30 individuals and a ratio of 6 females to 24 males.

[3] According to Fulton (9th Rep., p. 253), one female 18⅝ inches long, weighed 10 pounds 10 ounces; another, 18½ inches long, 10 pounds 9½ ounces, and a third, 17⅛ inches long, 7½ pounds. The eggs varied from 79,758 to 136,764; the smallest number was yielded by an 18½-pound fish. The mean ratio of weight of mature ovaries to that of fish is more than a quarter (266.51) and varies at least between 223 and 348 (9th Rep., p. 245).

used than now. Sir Thomas Brown (1662) declared it to be "esteemed by some as a festival fish, though it affords but a glutinous jelly, and the skin is beset with stony knobs after no certain order." Buckland thought that the males are best as food, their flesh being soft, rich, and oily—doubtful recommendations for Anglo-American tastes. In Scotland and northern England the fish appears to be held in higher esteem than elsewhere; "some inhabitants of Edinburgh deem it second only to the Turbot if fried or baked," and in Berwickshire "the cock especially is reported to be excellent when fried or baked." Scotch appreciation of the value of the fish is betokened in "The Antiquary" of Walter Scott. The knowing hero, Jonathan Oldbuck, puts the Turbot or Bannock-fluke and male Lumpsucker on a par. "I'll bid you fair, I'll bid you a shilling for the Fluke and the Cock-padle, or six-pence separately," and closes with the fishwife by giving half-a-crown for the two "and a half-a-dozen o' Partans [crabs] to make the sauce" (chap. 11). The sister housekeeper, while objecting to the price, does not object to the comparative valuation (chap. 14).

On the other hand, along the west coast of Scotland, "the fishermen boil them down with vegetables for their pigs"; for that purpose at least they "consider them to be fattening food."

Fabricius long ago (1780) told that the Greenlanders eat the flesh cooked or dried, as well as the skin from which the tubercles only have been taken; the ovaries are also used, cooked with the liver or dried, while the eggs themselves are eaten raw.

Tosh has recorded (1894) that along the eastern coast of Scotland "the fishes are very abundant," and "when they come close inshore to spawn they are a great nuisance to the salmon fishermen."

Olden belief and superstition assigned to the Lumpfish a curative value, doubtless on the principle that, being ugly and uncanny, it must have sanative qualities. According to Ekstrom and Smitt, in the Danish Mörkö, "the few specimens that are caught are never used as food. They are employed only as a remedy for ague. For this purpose the fish is thoroughly dried in an oven and pounded to a powder. The powder is then taken in corn-brandy, in doses of a spoonful." Verily, the sick have been made to suffer among the ignorant!