



















Memoirs of the Museum of Comparative Zoölogy

AT HARVARD COLLEGE.

VOL. XIV. No. 2.

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Division of Fishes  
U. S. National Museum

AUG 3 - 1894

Garman

*Dr. Leonhard Stejneger,  
with compliments of  
the Author.*

# THE DISCOBOLI.

*CYCLOPTERIDÆ. LIPAROPSIDÆ. AND LIPARIDIDÆ.*

By S. GARMAN.

WITH THIRTEEN PLATES.

CAMBRIDGE, U. S. A. :  
Printed for the Museum.  
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# THE DISCOBOLI.

CYCLOPTERIDÆ, LIPAROPSIDÆ, AND LIPARIDIDÆ.

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THOUGH there are several of the more rare Discoboli unrepresented in the Museum's collections, it possesses so many duplicates of certain species, in addition to rare or undescribed types of others, that, because of the uncertainty and confusion existing in the literature as to the validity of species and genera or their affinities, the facilities here provided for a study of the group are in themselves sufficient inducements for the undertaking. But, besides these, many of the drawings now published had been made long ago, by Mr. Roetter, to illustrate a projected work for the institution to have been written by Prof. F. W. Putnam. At the instance of the Director of the Museum of Comparative Zoölogy, this paper has been prepared to utilize those drawings, and to make the work the more complete he kindly permits the use of a number of drawings from his own work on the Young Stages of Osseous Fishes. Excepting the outline sketches, the remainder of the illustrations are by the pencil of Mr. J. H. Blake, from specimens herein described. The notes made by Professor Putnam for his intended work were published by him, under the title "Notes on Liparis and Cyclopterus," in the Proceedings of the American Association for the Advancement of Science, Vol. XXII., page 337, 1874.

## IN GENERAL.

The species belonging to this group are provided with a disk, the transformed ventral fins surrounded by a marginal fold of the skin, below the anterior portion of the body, for the purpose of attaching themselves to rocks or other objects to prevent being dashed about by the waves or the currents. This adhesive apparatus is usually spoken of as the sucking

or sticking disk. Its presence on species known to Cuvier induced him to designate them as Discoboles, or disk-bearers. One of the most familiar forms is that of the common Lump-fish, *Cyclopterus lumpus*, also called Lump-sucker, Sea Owl, Paidle, or the male Cock Paddle or Red Lump, and the female Hen Paddle or Blue Lump. In other languages we meet with such names as Lompe, Gras-mollet, See-hase, Bauchsauger, Snotdolf, Havpadde, Steenbider, Rognkjaekse, and Nepisa, applied to the same fish. In shape the Lump is rather short and clumsy, blunt, thick and high forward, slender in the caudal region, roughened all over with tubercular scales, as if for protection when at the mercy of the billows among the rocks, and, as if still more to suit the surroundings, it has flesh that might be described as gelatinous or mucilaginous, and a skeleton that is hardly more than cartilage. Lump-fishes reach a length of a couple of feet, and a weight of twenty pounds. In places they are numerous at particular seasons, but, though found to agree with the stomachs of some people, they are not objects of much consideration in the markets. Several species have been recorded.

Others of the Discoboles are more elongate than the Lumps, more like slender tadpoles in shape, with a longer and stronger caudal region, and consequently more force in swimming. The common species of *Liparis*, *L. liparis* and *L. Montaguï*, are good representatives of this section of the group. Vernacular names for these are Sucker, Sea Snail, Seeschnecke, and Ringbug. These have so many features in common with the Lumps that their kinship is not called in question. Closely allied in shape and general structure to the *Liparis* are a number of species that possess neither sucking disks nor ventral fins, yet the agreement in the other important details of structure, as exemplified by such items as the stomach, the cæca, the suborbitals, and the opercles, is so close that there is no doubt of the propriety of retaining them in the group. They are deep-sea species, and it is probable that, descending from the shoals to the ooze-covered floor of the ocean, in leaving the rocks and currents they left behind them the need of the disk, and lost it through disuse. However the loss may have been brought about, it is very evident that we have species without disks that must be included among the Discoboles.

Though the Discoboli are not the only disk-bearers among the fishes, they are easily distinguished from others, *Gobiidæ* and *Gobiesocidæ*, which, through possession of an organ similar in location and utility, apparently



have as much claim to the designation. The Discobole has a suborbital bone that reaches back across the cheek to the preopercle; it has slender opercular bones and numerous pyloric cæca; and its disk, not always present, includes the transformed ventral rays. Neither Gobioid nor Gobiocoid has either the suborbital bone or similarly transformed ventral rays. The adhering organ of the Discobole is formed by modifying the ventral fins; that of the Goby is secured by the addition of a dermal fold, a sac, in front of the ventral rays and below the bases of the fins; and that of the Gobiocoid is obtained by the growth of a dermal disk between the ventrals and behind the coracoids.

It is because of greater variety in their uses that the ventrals are more subject to differentiation than the other fins of these and other fishes. Elsewhere I have pointed out special modifications of the pelvis and ventrals of Selachians, notably on the Potamotrygons of South American rivers, or, more recently, in the union of the two fins to form a single one on *Balistes vetula*, and may in this place note the peculiar tube-like mittens for the reception of the ventrals of *Chaunax pictus* when the abdomen is distended. As is well known, on some fishes these fins have become foot-like; on others, they are reduced to mere filaments; rarely they are scale-like; a few have but one of the pair, and others have, like *Paraliparis*, lost both.

The food of the species with which we are at present more interested is in part that of most carnivorous fishes, — small fishes, crustacea, mollusks, worms, and the like. The long intestine of the Lumps suggested that at some portion of the year they might be accustomed to more or less of a vegetable diet; the contents of the stomachs confirm the idea, and show that vegetation forms a portion of their subsistence.

#### DISTRIBUTION.

All of the species are found in the colder waters. Their approaches to the shoals are made early in the spring, for the purpose of depositing their spawn, and they would seem to have returned to the depths again before the wintry temperature has been greatly changed by approaching summer. While it is pretty well established that the Lump occurs in the Mediterranean, it certainly is more at home northward from France, along the shores of England, Scotland, Iceland, and Greenland. On our own coasts it has been found as far to the south as New York. A second species,

called the Spinous Lump, from the North Atlantic, descends to considerable depths. A third and a fourth species of the family *Cyclopteridae* are described from the North Pacific. A couple of peculiar Lumps with a single dorsal fin, *Liparopsidae*, were discovered in the North Pacific, and recently Professor Vaillant has indicated a third from the Straits of Magellan. Of the genus *Liparis*, of the *Liparidae*, three species occur in the North Atlantic, four in the North Pacific, and three in the Antarctic regions, near the southern end of South America. *Careproctus*, of the deep-sea forms in the family, has the disk much reduced in size; three of its species are from the North Atlantic, and one from the North Pacific. Another of the genera from great depths, *Paraliparis*, of the same family, has entirely lost the disk, and with it all traces of the ventral fins have disappeared; three of its species, as at present recognized, are Northern Atlantic, and one has been reported from the North Pacific. From the foregoing it might be shown that the Discoboles are more numerous toward the Arctic regions, but the fact that the small amount of investigating thus far done at the far South has discovered so large a proportion of the whole number of species noted makes it appear very hazardous to assume that they are any less abundant in that direction. If, in connection with this, we take into account recent discoveries in deep-sea work, we can, to say the least, hardly avoid admitting a possible distribution of the Discoboles from one of the icy zones to the other through the frigid waters of great depths. The conditions far below the ocean surface in the torrid zone, as to temperature, pressure, and existence of animal food, not being essentially different from those obtaining in localities in which some of the forms are known to occur, there seems to be no apparent reason why we should not expect to meet with representatives of one or another of the genera, or with allied forms hitherto unknown, in the results of future explorations of the sea bottom in the equatorial regions. With an ascertained existence in the North and in the South, and again in portions of the deep sea, anticipation of a distribution of these fishes that shall be more or less extensive throughout the greater depths of the ocean from the Arctic to the Antarctic does not appear at all unreasonable.\* In the surface waters of the

\* In collections placed in my hands by Professor Agassiz for investigation since this work has been in press, I find sufficient grounds for announcing the confirmation of these suggestions, and the fact of the existence of a subequatorial distribution of the Discoboli. The material is of that recently gathered in the Pacific by the Steamer "Albatross" of the United States Fishery Commission. Among the fishes collected by this vessel there are species of both *Careproctus* and *Paraliparis* that

tropical and subtropical seas, the Gobioids and Gobiesocoids are abundant, but there are apparently no representatives of the Discoboli.

#### HISTORICAL.

Knowledge of the Discoboli previous to the time of Gesner is so indefinite and uncertain that it can hardly be said to have existed. In tracing the origin of one of the generic names now in use, it becomes necessary to make references to earlier writers; but the term had no application among the fishes properly included in the group before the appearance of Willughby's work. To eliminate confusion as far as may be from the general history, that of each of the different subdivisions has been arranged separately under a distinct heading.

*Liparis*. — In book thirty-second, chapter eleventh, "Animalium omnium in mari viventium, centum septuaginta sex genera esse," of Pliny's Natural History, this name is given as that of one of the fishes in the list of marine animals. In Holland's translation the spelling is changed to *Lyparis*. There is no sufficient clue to the identity of the species. Salviani, 1554, Gesner, Artedi, and others, give references to Pliny for the name, without attempting identification. Belon, 1553, describes and figures one of the herrings (*Clupeidæ*) as *Liparis*. Rondelet, 1554, bestows the title on a very different fish, the figure of which bears some resemblance to the more slender genera of the *Sparidæ*, such as *Boöps*, *Smaris*, and *Mæna*. The only agreement between the forms to which these authors have applied the designation appears in an elongate shape, and especially in being very fat, from which the word "liparos" (*λιπαρός*) derives its applicability. Neither has any other claim to present consideration than lies in the possession of the name indicative of fatness or oiliness. Gesner, 1558, copies from both Belon and Rondelet; Aldro-

were secured southwest of Panama, in depths of more than 1,700 fathoms, and in temperatures of about 36° Fahrenheit. The species are described and figured in the forthcoming ichthyological report on these researches of the Commission. One species is named *Careproctus longifilis*, because of the slender prolongations of the upper rays of its pectoral fins. The type is black, much compressed, very slender, and in a total length of more than four inches and a quarter the head and body together measure only an inch, of which the head alone is more than half. The disk is very small, one sixth of an inch in length, little larger than the eye; the nostrils are tubular; and the caudal is acuminate. A second species is given the name *Paraliparis fimbriatus*, on account of the prominent fringes formed by the lower parts of the pectoral fins, like those of *P. membranaceus*. Its type is black anteriorly, and behind the body it shades into light grayish. In total length it is more than four and three fourths inches, of which the head and body occupy an inch and five eighths. As in the first species, the nostrils are tubular, and the caudal is acuminate. The head is more depressed and broadened.

vandi, 1613, also draws from them. Jonston, 1649, copies from Aldrovandi, makes a reference to Pliny, and, agreeing with Belon, fixes the name on a herring. Charleton, 1677, refers to Rondelet. Willughby, 1686, page 135, Plate H 6, Fig. 8, is indebted to the same author; he also, page 115, applies the name to a species of Gunnellus. In the Appendix is to be found the first use of the name in connection with a member of the group in which we are at present interested: "*Liparis nostras, Dunelmensibus et Eboracensibus, The Sea Snail, i. e. Linax marinus dictus, Piscis Rondeletiana Lipari forte idem,*" page 17, in all likelihood refers to one or both of the species now called *Liparis liparis* and *L. Montagu*. The figure, H 6, Fig. 1, has no ventral disk, and otherwise is scarcely recognizable; it has more likeness to species of Lycodes than to any of the disk-bearers. The description by Dr. Johnson does not satisfactorily fix the type; most of what he gives relates to the common name, the disk, and the condition of the flesh. Ray, 1713, notes *Liparis Rondeletii* and *L. nostras* of Johnson. Artedi, 1738, was no doubt inspired by Willughby and Ray in establishing the genus *Liparis* with *L. nostras* as the type. He adds, with its synonymy, the *Liparis* of Rondelet as a second form,  $\beta$ . That he used *Liparis* as a generic name is sufficiently evident from the introduction of the two forms, and the care with which he separated his references, giving Johnson, Willugh. Append., p. 17, for the first, and Rondelet and Willugh., pp. 135, etc., for the second. Gronow, 1756, unable to reconcile Belon, Rondelet, and Artedi, renamed the genus *Cyclogaster*, making *L. nostras* the type, and using the name given by Artedi as a synonym. Linné made no mention of any species of the Liparids until 1766, when he made Artedi's *Liparis* a species under *Cyclopterus*. Scopoli, 1777, adopted the genus from Artedi, and gave a pertinent diagnosis. Duhamel, 1777, Vol. II. p. 492, resuscitates the *Liparis* of Belon, correctly placing it with the sardines and herrings. La Cépède, 1800, formed two subgenera, without Latin names, under *Cyclopterus*, the second of them to contain *C. liparis* and *C. lineatus*. Rafinesque, 1815, provides the name *Liparius*, without characterization, possibly intended for *Liparis*. Oken, 1816, placed *Liparis* as a subgenus under *Cyclopterus*. Cuvier, 1817, retained it in this rank. Fleming, 1822, makes it a genus, containing only species now included. Bonaparte, 1846, follows Fleming. Günther, 1861, recognized the genus to be the type of a subfamily, *Liparidina*, under the family Discoboli. Gill, 1861, made a similar disposition, naming the subfamily *Liparinae*,

which he changed to *Liparidinæ*, 1864, and later to *Liparididæ*, 1872, when, in his Gobiesocoeida, with the families Gobiesocidæ and Cyclopteridæ, he used it as that of a distinct family. In 1873, Gill rearranged the group, giving it the name Cyclopteroidea instead of Discoboli, and ranking it as a superfamily to contain the Cyclopteridæ, with one subfamily, the Cyclopterinæ, and the Liparididæ with two, the Liparidinæ and the Careproctinæ; but in his latest publication on the subject, 1891, he suppresses his subfamily Careproctinæ, and adds that of Jordan, 1882, the Amitrinæ, but changes the name to Paraliparidinæ. Günther, 1887, places all the genera in a single family, Discoboli, without indicating other distinctions than those recognized as generic.

*Liparididæ*.—The typical genus of this section is *Liparis* of Artedi, founded on the species afterward named *Cyclopterus liparis* by Linné. *Careproctus* was characterized by Kröyer, 1862, from a form named by him *C. Reinhardi*. It had previously been noted by Reinhardt as *Cyclopterus gelatinosus* of Pallas, 1769, from which satisfactory distinctions have not yet been pointed out. Its prominent features are curved simple teeth and a long tenuous caudal, which lose some importance when studied in such types as *L. major*. *Actinochir* of Gill, 1864, was a genus based on one of the forms described by Fabricius as *Cyclopterus liparis*; it is not separated from *Careproctus*. *Neoliparis* of Steindachner, 1875, was intended to include *Liparis mucosus* as a subgenus. The characters assigned were a low membranous connection of dorsal and anal with caudal, and a supposedly distinct anterior portion of the dorsal, neither of which seems to furnish sufficient reason for separation from *L. Montagu* or *L. liparis*, on which species the dorsal rays, continuous under the skin, acquire a peculiar development at particular times. *Paraliparis* of Collett, 1878, was distinguished by the absence of the ventrals; its species are deep-sea forms. *Amitra* of Goode, 1881, was discarded by its author for *Monomitra*, 1884; its type, *M. liparina*, was identified by Günther, 1887, as a *Paraliparis*. *Gymnolycodes* of Vaillant, 1888, was disestablished by that author, with the remark that its type, *G. Edwardsii*, was closely allied to *L. micropus* Gthr., if not the same. *Enantioliparis* of Vaillant, 1888, included an Antarctic form, *E. pallidus*, which we may not separate from the species of *Liparis*. The genera of this section of the Discoboli, those here adopted, include *Liparis*, *Careproctus*, and *Paraliparis*. *Liparis*, however, is made to contain as subgenera *Liparis proper* and *Careliparis*.

*Cyclopterus* and *Lumpus*.—“De Orbe scutato,” the third chapter in book fifteen of Rondelet’s work, *De Piscibus*, 1554, may possibly have been intended for the Lump-fish. The figure is a caricature. Dorsal and anal fins are absent, and the ventrals are doubtfully indicated by faint lines on the thorax that with the aid of some imagination may represent a disk. The fish was a stout-bodied one, with four rows of tubercles on each flank; these, with the statement of its occurrence on the coast of Holland, and the remote resemblance of the given vulgar names with those there used, increase the probability of identity. Gesner, 1556, under Schnottholf refers to Rondelet. His reference to Albertus Magnus is of very questionable application. Though he was not dealing with the specimens, his text leaves no doubt that he included the Lump with the *Diodons* and *Tetrodons*. This is more evident in the *Historia Animalium*, Liber IV., 1558, page 747. On page 745 Gesner copies *Orbis* of Rondelet, but is not misled by it. In the same volume, *Paralipomena N* and *O*, page 1284, he gives figures of *Lumpus anglorum* and *Orbis gibbosus*, which, with the text, fix their identity with the Lump. Both are copied by Aldrovandi, 1613. Schonevelde, 1624, under the name *Lepus marinis*, gives a better idea of the fish and the uses of the disk. Philemon Holland, 1635, in his translation of Pliny’s *Natural History*, for *Orbis* and *Orthragoriscus* of the original, has “The Lompe, Paddle, or Sea Owle, and the grunting Molebout.” Jonston, 1649, copies from Gesner. A third figure, *Leo marinis*, Plate XL. Fig. 8, is given, which also bears resemblance to one of the *Discoboles*, *Cycloptericthys ventricosus*, but the lack of text leaves the matter undecided. Merrett, 1667, makes reference to the Lump. Willughby, 1686, copies Rondelet’s *Orbis* from Gesner. With *Lumpus anglorum* of the latter, he has a better description than any previous one; the ventral fins are said to coalesce in the disk, which is likened to that of the *Gobies*. In the Appendix to this work Tyson makes an attempt at the anatomy. Ray, 1713, treats of *Lumpus anglorum*, from Gesner, as also Dale, 1732, and others. Duhamel, 1782, adds very good figures under the same name.

*Cyclopterus*, as applied to this fish, appears first in the earliest edition, 1735, of Linné’s *Systema*. It was placed in all the editions previous to the tenth as one of the *Branchiostegi*, with *Lophius*, *Ostracion*, and *Balistes*. In the tenth, 1758, another species was added, *C. nudus* (not now included), and the genus was made the first in the extensive Group VII.,

the Thoracici. In the twelfth edition, 1766, he added a third species, *C. liparis*, the *Liparis* of Artedi, and transferred the genus to the Amphibia nantes, where it was retained by Scopoli, 1777. By Gmelin, 1789, it was replaced in the Branchiostegi, as enlarged by the addition of *Mormyrus*, *Tetrodon*, *Diodon*, *Syngnathus*, *Pegasus*, and *Centriscus*. This author brought together in the genus five of the species still recognized as *Discoboles*: *lumpus*, *spinosus*, *ventricosus*, *gelatinosus*, and *liparis*. The genus *Cyclopterus* was adopted from the first by Artedi, Gronow, Scopoli, Forster, Gouan, Bloch, and others. Klein, 1744, gave it the name *Oncotion*. La Cépède, 1800, divided it into two subgenera, calling them first and second; the former contained *C. lumpus*, *C. spinosus*, *C. minutus*, and *C. gelatinosus*, with *Gobiesocidæ*; the latter, *C. liparis* and *C. lineatus*. Rafinesque, 1815, gives three names to what was known of the *Cyclopteri* by previous authors, *Lumpus*, *Cyclopterus*, and *Liparius*; but his subdivisions amount to nothing, being without characterization. Oken, 1816, makes three subgenera of the genus, or four, counting *Cyclopterus* as one; to do this he uses *Liparis* Art., *Lepadogaster* Gouan, 1770, and *Gobiosox* La Cépède, 1800. Cuvier, 1817, removing the *Gobiosoces*, retains in the genus the subgenera *Cyclopterus* and *Liparis*; Bonaparte, 1831, has the same arrangement. Nilsson, 1832, retains the subgenera, but changes one of their names to *Lumpus*. Storer, 1839, uses *Lumpus* for the name of the genus, and *Cyclopterus* for the subgenus. Fleming, 1822, restored both *Liparis* and *Cyclopterus* to full generic rank, and retained in each the typical species only.

*Cyclopteridæ*. — This family, as established by Bonaparte, 1831, contained the *Gobiosoces* with *Cyclopterus* and *Liparis*. It was an improvement on Cuvier's family, the *Discoboles*, 1817, because it no longer was burdened with *Echeneis* and *Ophicephalus*. Rafinesque's family, *Plecopodia*, 1815, was still more comprehensive than that of Cuvier, since it included the *Gobiidæ*, with others not retained by the latter; it was formed by uniting the *Plécopodes* of Duméril, 1806, with the *Plécoptères* of the same author. Duméril's *Téléobranches Plécoptères* contained *Cyclopterus* and *Lepadogaster*. Rafinesque's *Plecopodia* comprised the genera *Gobius*, *Plecopodus* (*Gobioides* LaC.), *Lepadogaster*, *Piescephalus*, *Cyclopterus*, *Lumpus*, and *Liparius*. Bonaparte, 1837, in his *Systema Vertebratorum*, made the *Cyclopteridæ* the first family of his order *Cycloidei*; he also

established the subfamily *Cyclopterini*, an apparent equivalent of the family itself. *Les Chondrosés Pteropodes* of Duméril, 1856, were made up of Lepadogaster, Cyclogaster, Gobiesox, Cyclopterus, Chironectes, Lophius, and Malthea. Bleeker, 1859, adopted the order *Cyclopteri*, and placed within it the families *Cyclopteroidei*, with the single genus Cyclopterus, and the *Gobiesocioidei*, with Gobiesox and its properly related allies, and also including Liparis. Günther, 1861, made Liparis the typical genus of his subfamily Liparidina, which with the Cycloptera constituted the family Discoboli. Gill, 1861, did not differ in regard to the contents of the family, but named it *Cyclopteroideæ*. His subfamily names were Cyclopterinae and Liparinae; of the latter he made Liparidinae in 1864, and Liparididae in 1872, on raising it to family rank. In Gill's *Gobiesocoidæ*, 1872, he included the Gobiesocidae, the Liparididae, and the Cyclopteridae. The *Cyclopteroidea* of Gill, 1873, contained only the Cyclopteridae and the Liparididae, the Discoboli of Günther.

In the present revision the family Cyclopteridae is restricted to the genera Cyclopterus, Eumicrotremus, and Cyclopteroidea, the rank of the second being somewhat doubtful. *Cyclopterus* of Linné, 1735, was established on the common Lump of the North Atlantic. *Eumicrotremus* of Gill, 1864, was based on *C. spinosus* Fabr., an Arctic and deep-sea form. *C. orbis* Gthr. belongs with this species; it is obtained in the North Pacific. *Cyclopteroidea* is a new genus, characterized below, from the North Pacific.

*Liparopsidae*.—This family is here arranged for a couple of genera, at present known from the North Pacific, Cycloptericthys and Liparops. *Cycloptericthys* was characterized by Steindachner, 1881, from what he took to be a new species, *C. glaber* (not *C. glaber* from Steller, 1831), but which was identified by others with *C. ventricosus* of Pallas, 1769. *Liparops* is based on Cyclopterus Stelleri of Pallas, 1831, the *C. glaber* of Steller's manuscript.

*Discoboli*.—Cuvier, 1817, brought together Lepadogaster, Gobiesox, Cyclopterus, Liparis, Echeneis, and Ophicephalus in a group to which he gave the name *Discoboles*. At the hand of Latreille, 1825, the name was written *Discobola*, and at that of Griffith, 1834, it became *Discoboli*. The division *Cyclopodii* of J. Müller, 1843, contained the following: "die



Gobioiden, die Discoboli (Cyclopterus, Liparis, Gobiesox, Sicyases, Cotylis, Lepadogaster) und die Echeneiden." Müller's family *Gobioidei*, 1846, is the same as his Cyclopedi of 1843. Richardson's *Discopodes*, 1860, contained the Discoboli and the Gobiesocidæ. The *Discoboli* of Günther, 1861, are Muller's Discoboli after the elimination of the Gobiesocidæ. In 1880 an arrangement was published by Günther, in which the Discoboli and Gobiidæ were brought together to make up a division, to which was given the name *Acanthopterygii Gobiiformes*. As specified above, the *Gobiesocoidea* of Gill, 1872, included all of Günther's Discoboli, and also the Gobiesocidæ, but his *Cyclopteroidea*, 1873, contained only the Discoboli as limited by Günther, 1861.

## RELATIONS.

The adoption of the Discoboli in the present essay, with the limitations assigned by Günther, is not to be interpreted as an agreement with the expression of relationship he indicates by placing the group, a family in his system, together with the Gobiidæ for a separate division. The affinities existing between these families do not seem to be of a character that warrants such an arrangement. More recent systems, in which the Gobies are placed farther away, and the Cottoids brought nearer, better express the natural order. It may be doubted whether Pallas had a clear idea of the relationships of the Cyclopteridæ, but at any rate his comparisons were not far out of the way. He closes his description of the anatomy of *Cyclopterus ventricosus*, 1769, after the enumeration of three or four particulars, with the sentence, "Reliquæ fere ut in *Cottis quibusdam*." The hint contained in this led to nothing, for we find that Hermann, 1783, after quoting Pallas and discussing the matter in several places, retains the Discoboli in the Branchiostegi near Diodon and the Gobies, while he puts *Cottus* in the Thoracici with Echeneis. Retz, 1800, in his edition of the Fauna Suecica, placed *Cyclopterus* between *Gobius* and *Cottus*, manifestly a better arrangement than that originally adopted by Linné. It was Pallas again, in 1831, in his description of *Cyclopterus callyodon*, who first pointed out the clue by which the closer alliances have finally been traced. His statement, "A maxilla superiore utrinque processus sub cute tenuis osseus, quasi zygoma, per discum operculorum," called attention to a feature previously unnoticed in these fishes, which, whether the disk is present or not, readily serves

to connect them each with the other and with the members of the large group containing the Cottoids, Scorpaenoids, and allies, the cheek-boned fishes (*Paricostichthyes*), all of which possess a common character in the prolongation of one of the suborbitals backward toward the preoperculum. It was not, however, until Putnam, 1874, began the study of the group, that the full significance of this cheek bone was developed and the real affinities with the Cottoids determined. The publication of the outcome of his investigations, "Notes on Liparis and Cyclopterus," has brought about a more accurate understanding of the relations of the group as a whole, and of its position in the system.

In the present study various comparisons have been made for the purpose of determining the degrees of relationship existing between the several families of the Discoboles, and also between them and allied groups. There is nothing in the results obtained that declares with any emphasis against the conclusion that the closest affinities are with the Cottoids. Within the group it is found that the nearest approach is made by the Cyclopteridæ, and that the Liparididæ have diverged more from the progenitors common to these disk-bearers and the Cottidæ. Excepting, in cases, the shape and the disk, the agreement in general features with the latter is rather close. This is shown by comparison in the fins and their attachments, particularly in the connection of carpals and pubes with the claviculars, in the elements of the skulls (Plates IX. and X.), especially in the suborbital stay and the opercles, in the branchiyls, in the teeth, in the gills, in the stomach, in the cæca, and in the urogenital apparatus. The general correspondence is very noticeable in regard to the glossohyal and basibranchial elements, which are either suppressed in part or greatly reduced in size. The apparent difference in shape and the softness of the bones notwithstanding, it is Cyclopterus that is to be placed nearest to Cottus. Without going far into details, reasons for this will be found by comparing the opercular bones and the expansion and connection of the suborbital process (Plate X. Figs. 28, 30, 32, 33, 19"). In the Liparididæ the other opercular bones are more reduced, while the preoperculum is more expanded in the upper limb, and the suborbital process is more slender and crosses the preoperculum to its hinder edge. Better agreement also exists between the brain of Cyclopterus and that of Cottus; in both the brain is shortened, and cerebellum and hemispheres are small as compared with the optic lobes. Liparis has a more elongate brain, and

the optic lobes are comparatively much smaller. A number of particulars may be mentioned in which *Cyclopterus* differs from *Cottus*, as shape, disk, obsolescent pleurapophyses, toothless vomer, cephalic spines, smooth gill rakers, multiplicity of cæca, elongation of intestine, simple bladder, etc., but their character is not such as weighs greatly against those tending toward closer relationship. The branching bladder and the unmodified ventrals of *Cottus* lose much of their apparent importance as distinguishing characters on closer investigation. General form, firmness of skeleton, toothed gill rakers, smaller number of cæca, shorter intestine, well developed pleurapophyses, and other features in which *Liparis* and *Cottus* agree better, can hardly be considered of sufficient importance to counterbalance those tending to place *Liparis* farther away than *Cyclopterus*.

The adhesive apparatus on the ventral surface of certain Gobiidæ and on the Gobiesocidæ formerly caused these forms to be located with the Lumps and their allies. The disk of the Gobies differs greatly from that of the Gobiesoces, and in either case the organ is structurally very different from that of the Discoboles, while there is little in the balance of the anatomy to suggest close affinities with the latter. In fact, modern ichthyologists, recognizing the lack of anything in skeletal or other features on which to predicate an approach to near relationship, have generally agreed in placing all of the mentioned types at a considerable distance from one another.

#### DESCRIPTIONS.

In the majority of Discoboli the shape resembles that of the larvæ of toads and frogs. That portion of the body including the visceral cavity is broad and massive, while that behind the chamber is narrowed and slender, as in tadpoles. In one section of the group, the anterior portion is the longer; in another, it is the shorter. Though the application of the name was caused by the disk, the latter is not always present; some species have lost it so completely as to be without evidence of former possession of either disk or ventrals. When present, the adhesive apparatus is formed of the ventral fins, the six rays in each being transformed into ribs for the central portion, which is surrounded by a dermal fold as a margin. The skin varies in the different genera from tough and covered with tubercles to very tender and slimy. Ordinarily the flesh is described as gelatinous, and the attachments of the skin are not of the most firm, and in some cases are of

the slightest. Certain species possess two dorsal fins; on others the two are more or less perfectly confluent, and on some the spinous dorsal would seem to have been lost. The head is short and broad, the snout blunt and rounded, and the mouth, small to moderate, is anterior. The teeth are small, either subconical or tricuspid, and the number of series in function varies from a couple to half a dozen or more forming a pavement. In some cases the eyes are very small, in others they are of moderate size; their direction is lateral or obliquely upward. Quite generally there are six branchiostegal rays; so far as we know there are no exceptions to this number. The gill openings are rather narrow to very narrow; sometimes they extend downward upon the bases of the pectorals, but often they are situated entirely above the fins. The gill membranes are united with the isthmus and the shoulders. Usually there are pseudobranchiæ in addition to the three gills and a half; they are said to be absent in a particular species. None of the Discoboles possess air bladders. The stomach is siphonal, and bears a cluster of cæca around the side of the pylorus. The skeletal structure is almost cartilaginous in *Cyclopterus*, the osseous matter being small in quantity and arranged in thin plates, forming chambers as in *Lophius*; from this it varies to more solid and firm in species of *Liparis*. Throughout the genera the operculum, the suboperculum, and the interoperculum are reduced in size; most so perhaps in some *Liparididæ*, where these bones are slender and spine-like. On *Cyclopteridæ* they are thin, but broader and more like blades. A common feature of the Discoboli is the prolongation of the third suborbital bone to the preoperculum across the cheek. The Lumps have this suborbital rather broad, thin, flexible, and slightly drooping backward; on certain *Liparids* it is slender, styliform, nearly straight, and extends to the hinder edge of the preopercle.

The following synopsis includes the known members of the group.

## FAMILIES AND GENERA OF DISCOBOLI.

Body cavity elongate; caudal region short;		
disk present; teeth simple;		PAGE
dorsals two; skin tubercular,	CYCLOPTERIDÆ,	19
barbels none; tubercles in rows,	CYCLOPTERUS,	20
tubercles not in rows,	EUMICROTREMUS,	34
barbels present,	CYCLOPTEROIDES,	37
dorsal one,	LIPAROPSIDÆ,	40
skin smooth; dorsal short,	CYCLOPTERICHTHYS,	40
skin tubercular; dorsal elongate,	LIPAROPS,	42
Body cavity short; caudal region elongate,	LIPARIDIDÆ,	43
disk present,	LIPARINÆ,	45
teeth tricuspid, simple in older <i>Careprocti</i> ;		
caudal more or less distinct,	LIPARIS,	45
vertebræ less than forty,	<i>Liparis</i> ,	47
vertebræ more than forty-five,	<i>Careliparis</i> ,	62
caudal indistinct, tenuous;		
teeth simple, at least in older stages,	CAREPROCTUS,	71
disk absent, no ventrals,	AMITRINÆ,	80
caudal indistinct, tenuous,	PARALIPARIS,	80

## CYCLOPTERIDÆ.

Anteriorly the form of the Lump-fishes is stout, thick, and deep; behind the body cavity, which occupies the greater portion of the length, it rather abruptly becomes weak and slender. The head is short and broad, sub-quadrangular in transsection; the snout is short and blunt; the mouth is of moderate width, anterior, and opens slightly upward; the teeth are small, subconical, and arranged in a band or card; the eyes are of medium size and have a lateral outlook. All of the members of the family have pseudo-branchiæ, three and a half gills, six branchiostegal rays, small gill openings, numerous pyloric cæca, and an elongate intestine. In their lower portions the broad rounded pectorals extend forward under the throat, along the sides of the disk. The vertical fins are not of large extent; the caudal and the two dorsals are quite separate. The disk is comparatively large. Early in life the skin is tender and naked; later it grows tough and is covered with roughened or spine-bearing osseous tubercles. Semi-cartilaginous describes the skeleton with tolerable accuracy; the small amount of bony

matter lies in thin plates, often forming cells and chambers similar to those to be noticed in the bones of *Lophius*. The third suborbital is thin and broadens as it extends back to the preopercle. The interopercle is more blade-like than in the *Liparididæ*. On one genus the pores around the mouth are tubular, and form barbels.

When Bonaparte, 1831, first used the family name *Cyclopteridæ*, he included *Liparis* with the *Lumps*. In the present writing the family is made up of Günther's subfamily of 1861, *Cyclopterina*, with the addition of a genus of recent discovery, first characterized in these pages.

#### GENERA AND SPECIES OF CYCLOPTERIDÆ.

		PAGE
Barbels none; disk anterior, sub-cephalic,	CYCLOPTERUS,	20
larger tubercles in rows, separated,	<i>C. lumpus</i> ,	21
larger tubercles not in rows, crowded,	EUMICROTREMUS,	34
shaped more like the Lump,	<i>E. orbis</i> ,	36
shaped more like a Diodon,	<i>E. spinosus</i> ,	34
Barbels present; disk central, subabdominal,	CYCLOPTEROIDES,	37
lateral tubercles minute,	<i>C. gyrinops</i> ,	37

#### CYCLOPTERUS.

Body more or less compressed toward the back, somewhat triangular in a transverse section at the first dorsal, covered with conical, rough, bony tubercles; head short, thick, subquadrangular in a cross section; snout blunt, rounded; mouth anterior, opening slightly upward; teeth simple, small, arranged in a band; eye moderate, lateral; dorsals two; caudal distinct; disk moderately large, anterior. On the species properly belonging to *Cyclopterus*, the first dorsal fin with age becomes completely hidden by the skin, and the larger tubercles of the flanks, though in regular series, have a scattered appearance. On the larger specimens of the species belonging to *Eumicrotremus* the large tubercles are very irregularly disposed and close together. The history of *Cyclopterus* as a genus begins with Linné. Fleming, 1822, says of it: "This genus has been subdivided into (1) *Cyclopterus*, having the body furnished with ridges of tubercles, as *C. lumpus*, and (2) *Liparis*, having the body smooth, as *L. vulgaris* and *Montaguï*." This subdivision left the genus as recognized at present.

**Cyclopterus lumpus.**

**Plate VIII. Figs. 1-3, 15-17; Plate IX. Fig. 2; Plate X. Fig. B; Plate XI. Fig. 10;**  
**Plates XII., XIII.**

*Cyclopterus lumpus* Linné, 1735, Systema Naturæ, ed. 1, — 1738, Art. Syn., p. 57, Gen., p. 62, — 1740, Systema, ed. 2, 52, — 1740, ed. 3, 55, — 1744, ed. 4, 81, — 1747, ed. 5, 60, — 1748, ed. 6, 41, — 1748, ed. 7, 41, — 1756, ed. 9, 43, — 1758, ed. 10, I. 260, — 1760, ed. 11, I. 260, — 1766, ed. 12, I. 414, — 1767, ed. 13, I. 414; Pontop., 1763, Atlas, I. 618; Beckmann, 1772, Linn. Syst. Nat., I. 102; Müll., 1774, Linn. Natursyst., III. 330; Müll., 1776, Zool. Dan. Prodr., 39; Ascan., 1777, 1806, Icon., IV. 4, pl. xxxiv.; Fabricius, 1780, Fauna Groenl., 131; Bloch, 1780, Skr. Ges. Nat. Fr. Berl., I. 247, — 1784, Oecon. Naturg. Fische Deutschl., III. 103, pl. 90; Höslin, 1781, Lehr-Buch üb. Nat. Syst., I. 577; Mohr, 1786, Forsög, 61; Bonnat, 1788, Ichth., 26, pl. 20, fig. 63; Gmel., 1789, Linn. Syst., I. 1473; Walb., 1792, Art. Gen. Pisc., 484, — 1793, Klein. Ichth. Enod., Index, 32; Donnd., 1798, Zool. Beitr., III. 812; Cuv., 1798, Tabl. Élément., 326, — 1817, R. An., II. 226, — 1829, ed. 2, II. 346, — 1836, ed. 3, I. 573; Wilh., 1799, Unterh. Naturg., IX. 125, pl. xvi. fig. 48; Retz, 1800, Fauna Suec. Linn., 327; Heppé, 1800, Abb. u. Beschr. Fische, 256, pl. 60, fig. 119; Georgi, 1801, Geog.-Phys. Nat. Beschr., VII. 1907; Castel, 1801, Hist. Poiss. Bloch, VIII. 121; Schn., 1801, Bloch. Syst. Ichth., 197; Donov., 1802, Brit. Fish., pl. 10; Sonn., 1803, Hist. Poiss., V. 217; Shaw, 1804, Gen. Zool., V. 388, pls. 166, 167; Turt., 1806, Linn. Syst. Nat., I. 904; Quensel, 1806-24, Svensk Zool., 49, pl. 52; Oken, 1816, Lehrb., III. 135; Rathke, 1822, Meck. Arch. Physiol., VII. 493; Rosenth., 1822, Ichthyot., 16, pl. 19; Hofm., 1823, Tidsskr. Naturw., II. 373; Anslin, 1828, Syst. Beschr., IV. 66, pl. 62; Faber, 1828, Tidsskr. Naturw., 251, — 1829, Naturg. Fische Islands, 49; Flem., 1822, Phil. Zool., 387, — 1828, Brit. An., 190; Fée, 1830, Linn. Syst. Nat., ed. prim. reed. curante Fée, 70; Pall., 1831, Zoogr., III. 72; Nilss., 1832, Prodr. Ichth. Skand., 61, — 1855, Skand. Faun. Fisk., 232; Grifé, 1834, An. King. Cuc., X. 501; Ekstr., 1834, Fisk. i Mörkö Skärgård, — 1835, Die Fische in den Scheeren von Mörkö, 108; Kielsen, 1835, Icon. Pisc., pl. xviii.; Ross, 1835, Nat. Hist. Second Voy., p. xlvi; Jen., 1835, Brit. Vert., 471; Schinz, 1836, Naturg. u. Abb. Fische, 258, pl. 86, fig. 4; Kaup, 1836, Thierreich, III. 67; Rich., 1836, Fauna Bor. Amer., III. 260; Yarr., 1836, Hist. Brit. Fishes, II. 270, — ed. 2, II. 365, — ed. 3, II. 343; Templeton, 1837, Charlesw. Mag. Nat. Hist. (2), I. 412; Wilson, 1838, Ichth. in Encycl. Brit.; Reinh., 1838, Ichth. Bidr. Groenl. Fauna, 108, 116; Swains., 1838, Nat. Hist. Fish, II. 339; Johnst., 1838, Berw. Nat. Club, I. 174; Fries, 1838, Vet. Ak. Handl., pl. iv. fig. 1; Parn., 1838, Fish Firth of Forth, 380, Mem. Wern. Soc., VII.; Gmel., 1839, Gemein. Syst. Nat., Fische, 72, pl. 12, fig. 21; Schill., 1839, Naturg. Fische, 90, pl. 14, fig. 3; Val., 1840, R. An., ed. ill., 310; Selys-Longch., 1842, Faune Belge, 240; Dub. & Kor., 1844, Vet. Ak. Handl., 116, pl. 3, fig. 8; Guerin-Méneuv., 1844, Icon., 35, pl. 62, fig. 2; Kröy, 1845, Danm. Fiske, II. 489; Gaim., 1851, Voy. Isl. & Groenl., Poiss., pl. 8; Gron., 1854, Cat., ed. Gray, 38; Ham., 1854, Brit. Fishes, II. 250, 404, pl. 13, fig. 2; Thomp., 1856, Nat. Hist. Irel., IV. 215; Gill, 1861, Cat. Fish E. C. N. Amer., 47, — 1864, Pr. Phil. Ac., 190, — 1865, Can. Nat., Aug., — 1873, Cat. Fish E. C. N. Amer., 21, — 1891, Pr. U. S. Mus., XIII. 368, pl. xxviii. fig. 1 (fr. Goode), fig. 3 (fr. Boreckert), pl. xxx. fig. 1; Gthr., 1861, Cat., III. 155, — 1880, Introd. Study of Fishes, 484; Schleg., 1862, Dier. van Nederl., Vissch., 53, pl. 6, fig. 1; Couch, 1863, Hist. Brit. Fishes, 183, pl. 105; McIntosh, 1862-66, Pr. R. Soc. Edinb., V. 614, — 1875, Fish St. Andrews, 174, — 1886, Ann. Nat. Hist. (5), XVIII. 81; Smith, 1868, Pr. R. Soc. Edinb., 1865-66, 355, — 1888, P. R. Phys. Soc. Edinb., 143, pl. 7, fig. 8; Coll., 1875, Norges Fiske, 63; Hilgand., 1878, S. B. Nat. Fr., 156; Goode, 1879, Bull. Essex Inst., XI. extr. p. 11, — 1884, Fishery Industr. U. S., 253; Bean, 1879, Bull. 15 U. S. Mus., 115, — 1880, Pr. U. S. Mus., III. 83; Winth., 1878, Nat. Tidsskr., 3 R. XI. 290, pl. 1, figs. 1-13, — 1879, Prodr. Ichth. Dan., 19; Buckl., 1881, Brit. Fish., 125; Moreau, 1881, Poiss. Fr., III. 349; A. Agassiz, 1882, Pr. Am. Ac. Arts & Sci., XVII. 286, with 2 pl. of young stages; Jord. & Gil., 1882, Bull. 16 U. S. Mus., 747; Dresel, 1884, Pr. U. S. Mus., VII. 250; Hensen, 1884, Viert. Ber. Comm. Wiss. Unters. deutschen Meere, 301; Möb. & Hein., 1884, Viert. Ber. Deutsch. Meere, 204, 226, fig.; Day, 1884, Fish. Grt. Br. & Ire., I. 179, pl. 55; Hans., 1885, Zool. Dan. Fiske, 39, pl. 6, figs. 11, 12; Jor., 1887, Rep. U. S. F. Com., 1885, 904; Boreck., 1889, Anat.-phys. Unters. Haftscheibe, p. 7, pl. 1.

*Lumpus anglorum* Gesner., 1558, Hist. Anim., IV. 1284; Aldrov., 1613, De Pisc. et Cetis, 479, — 1623, De Pisc., 180; Joust., 1649, De Pisc. et Cet., 40, pl. xiii. figs. 1, 2; Sibbald, 1684, Scotia illustr.,

Part 2, II. 24; Willugh., 1686, Hist. Pisc., 208, pl. N. 11, — *L. gibbosus*, N. 10, fig. 2; Ray, 1713, Syn. Pisc., 77; Duham., 1782, Traité Gen., IV. 308, pl. 24; De Kay, 1842, Zool. N. Y., IV. 305; Stor., 1846, Synops., 481, — 1867, Hist. Fish. Mass., 208, pl. 32, fig. 2 (both pub. in Mem. Am. Acad.); *Lumpus vulgaris* McMurt., 1831, Cuv. An. King.; Stor., 1839, Rep. Fishes Mass., 151; Knight, 1866, Fishes Nova Scotia, 16.

*Cyclopterus minutus* Pall., 1769, Spic. Zool., VII. 12, pl. 3, figs. 7-9; Fabr., 1780, Fauna Groenl., 135; Bonn., 1788, Ichth., 27; Gmel., 1789, Systema, I. 1475; Walb., 1792, Art. Gen. Pisc., 485; Donnd., 1798, Beitr., III. 815; Schn., 1801, Bl. Syst. Ichth., pp. xxiii, 3; Turt., 1806, Syst. Nat., I. 905; Cuv., 1817, R. An., II. 227, — 1829, R. An., II. 346, — 1836, R. An., I. 573; Griff., 1831, An. King., X. 502; Ross, 1835, App. to Sec. Voy., p. xlvi; Rich., 1836, F. B. Amer., III. 262; Fries, 1838, K. Vet. Ak. Handl., 226; Val., 1810, R. An., ed. ill., Poiss., 311.

*Orbe gibbosus* Gesn., 1558, Hist. An., IV. 747, 1285. *Piscis gibbosus* Aldr., 1613, De Pisc., 450, — 1623, De Pisc., 180. *Lepus marinus* Schonev., 1624, Ichth., 41. *Orbis oceani* Worm, 1655, Mus., 269; *Cyclopterus* sp. Art., 1738, Gen. Pisc., 62, — Linn., 1746, Fauna Suec., 103, — Gron., 1754, Mus., I. 56, — Linn., 1759, Anim. Specierum, 91, — Gouan, 1770, Hist. Poiss., 223. *Oncotium* Klein, 1744, Miss., IV. 49, — Ascan., 1777, Icon., pl. 34. *Oncotium gibbosus* Klein, 1744, Miss., IV. 50, and *Oncotium* (3), pl. xiv. fig. 5, — Walb., 1792, Art. Gen. Pisc., 583, — 1793, Kleinii Ichth. Enod., 67. *Cyclopterus heptagonus* Linn., 1754, Mus. Ad. Frid., I. 57. *Cyclopterus* Houtt., 1764, Nat. Hist., VII. 248, pl. 60, fig. 5. *Cyclopterus pavoninus* Shaw, 1797, Nat. Misc., IX. pl. 310, — 1804, Gen. Zool., V. pl. 167, fig. 1. *Cyclopterus pyramidatus* Shaw, 1804, Gen. Zool., V. 300, pl. 167, fig. 2. *Cyclopterus careuleus* Mitch., 1815, Trans. Lit. & Phil. Soc. N. Y., I. 480. *Le Cycloptère lompe* LaC., 1800, Hist. Poiss., II. 52, pl. 3, fig. 1. *Gobius minutus* Müll., 1808, Zool. Dan., IV. 38, pl. 151 B, figs. 1-3, — Risso, 1810, Ichth. Nice, 159. *Cyclopterus coronatus* Couch, 1823, Nat. Hist. Cornw., 47, — Ann. Nat. Hist., II. 382, — Thomps., 1840, Ann. Mag., V. 216.

*Lump-sucker* Pennant, 1776, Brit. Zool., III. 133, pl. 21, figs. 1, 2, — 1812, Brit. Zool., III. 176, pl. 24.

*Lump-fish* Low, 1813, Nat. Hist. Orkn., 177.

B. 6; D. 6-8/11; A. 9-10; V. 6; P. 20; C. 12-14; Vert. 29 (11 + 18).

Body massive, compressed, subtriangular in transverse section through the middle, belly flattened, depth nearly equal to half the total length in large specimens; the portion behind the abdominal chamber much compressed, and less than half the length of the body proper. Head short, about one fifth of the entire length, subquadrangular in transverse section, forehead broad, flattened, nape high; snout short, broad, blunt; mouth wide, anterior, opening with a slight upward direction, extending backward almost to a vertical from the front margin of the eye. Eyes lateral near the top of the head, as long as the snout, one fourth as long as the head, and one third as wide as the interorbital space. Forehead broad, depressed, convex. Nostrils small; hinder smaller, near the eyes on the interorbital space; anterior farther forward, half-way to the mouth, with a short tube. Gill opening moderately wide, its lower third in front of the base of the pectoral. Fins with rounded margins, rough with small tubercles. First dorsal distinct on very young individuals, variable in shape, thick and fleshy with weak rays in older stages. Second dorsal distinct, broad, rounded. Caudal, broad, subtruncate or rounded posteriorly. Anal moderate, opposite the second dorsal, which it resembles in shape. Pec-



torals broad, rounded, fringed, not indented at the sides of the disk. Disk little longer than wide, about the width of the head, or nearly three fourths of the length of the latter. Skin thickly sown with small irregular sub-conical tubercles, the sides of which are roughened with small conical protuberances. On older individuals larger longitudinally compressed tubercles form a vertebral series from the nape over the first dorsal; a series of three others stands at each side of the space between the dorsals; a row of larger ones extends from the supraorbital region along the flank to the upper part of the tail; a series, starting a little above the pectoral, passes to the lower portion of the tail; and a third lateral series reaches along each edge of the lower surface from the side of the disk to the anal. The fleshy ridge enveloping the first dorsal is subject to considerable variation; it usually continues forward on the nape, and becomes indefinite at the occiput. The following formula is given for British specimens: D. 4-6/10-11; A. 9-10; P. 20-21; V. 6; C. 10-11.

In alcohol the colors are brownish or olive to grayish, the tubercles being darker. In life the tints vary from yellowish or greenish in the young, to more or less brilliant red in the males, or bluish to dark brown in females. Spots, blotches, cloudings, or other markings, are not infrequent.

In March and April the Lumps are said to approach the shore for the purpose of depositing the eggs. After these are laid, the female goes back to deep water, leaving the male to guard the ova until hatched. More than 200,000 eggs have been counted in the ovaries of a single female. Soon after hatching, it is stated, the young ones attach themselves to the male by their disks, and he also retires to the depths, carrying the brood with him. This statement of Johnston, 1838, is not confirmed by the observations of Prof. A. Agassiz, 1882, by whom the young were found close to the shore, among the eel-grass, near low-water mark. A very close resemblance between the smallest Lumps and the Liparids is evidence favoring a common ancestral form. Lump-fish are sometimes taken by hook and line on the feeding grounds of the cod; more often they are captured in nets; and occasionally they are thrown on the beaches by heavy storms. Specimens have been reported of near twenty pounds in weight, measuring twenty inches or more in length. They are eaten by natives of Greenland and Iceland in times of scarcity of better fishes, but they seem to find no place in the markets farther southward. Their food is that of the majority

of carnivorous fishes, — crustaceans, worms, mollusks, and fishes, mixed with which more or less of vegetable matter is found in the stomachs of some specimens.

#### ANATOMY.

Plate VIII, Figs. 15-17; Plate IX, Fig. 2; Plate X, Fig. B.

*Skeleton.* — Much the greater part of this skeleton is soft semi-cartilaginous or gelatinous. A small amount of osseous material exists in thin lamellæ, frequently forming chambers and cavities, upon and around which lies the softer matter. If separated from the soft, the bony substance of a fifteen-inch skeleton weighs less than an ounce. The following description is taken from a specimen having twenty-nine vertebræ, ten of which are without hæmal processes. Near the middle of the body the vertebræ are longer than either the anterior or the posterior, which are about equal in length. Both centra and spines have a bulky appearance; the former are broader and higher than long. The ultimate centrum bears a pair of broad posteriorly vertically expanded processes, and beneath the lower of these a narrower one, for the base of the caudal. Support for the anterior short rays of the caudal fin is provided by the inflated blade-like spines of the penultimate vertebra. There are but fifteen rays in the fin. All of the vertebral spines incline backward less than forty-five degrees from a vertical. Parapophyses and pleurapophyses are rudimentary, and often imperceptible.

In the first dorsal there are seven rays, all unsegmented, the foremost articulated with the second interneural. Eleven rays, all segmented except the first, occur in the second dorsal. Between the dorsals there are two interneurals that bear no fin rays. The anal fin has eleven rays, all of which are segmented except the first two; the anterior articulates with an inter-hæmal apparently formed by consolidation of two. All of the pectoral rays are segmented; the upper twelve are branched, the remaining seven are simple, and the lowest one is only about one third of the length of the uppermost.

Great modifications have been brought about in the pelvis and the ventral fins through the development of the adhesive apparatus. The pubic bones, Plate VIII, Figs. 15 to 17, have extended forward, broadened, and become concave on their lower surfaces as a foundation for the disk. On their inner edges the pubes are in contact, as in the Cottoids; the sharp process reaching directly forward from each is much enlarged, and has a

ligamentary attachment with its fellow. Above this process, a short, much wider one reaches up and forward to meet the clavicle of the same side, to the inner (hinder) side of which it is firmly fixed; and above and behind this second process there is a narrower pointed one, rising near the middle of the upper side of the bone, to which are attached the ventral muscles. With this expansion of the pubic bone the ventral rays have been carried along, attached near the margin on the under side, and have been separated more widely, and also each has extended its base toward the centre of the disk, as well as outward. While the basal portion of the ray has broadened and lengthened, the segmented outer extremity has been comparatively undeveloped, and appears to be telescoped by the base. On the spinous ray of each ventral, in addition to the articulation below the pubic, there is a process upward, against the side of the latter, which contributes much to the firmness of the structure. All the ventral rays on young individuals show signs of segmentation; on older ones, these become obsolete on one or two of the anterior rays.

Of the shoulder bones the clavicle might be described as a long, broad thin bone, that, by a twist above its middle, has its upper section turned half-way around, so that its vertical plane is at right angles with that of the lower. The upper portion lies flat against the side, while the lower is transverse and slightly concave on its front surface. From the middle of the hinder surface of the lower section a thin backward extending blade, composed of the scapula, the four carpals, and the coracoid, forms the base of the pectoral fin. The latter occupies two thirds or more of the length of the clavicle. The carpals are large and thin, nearly as wide as long, and each joins the clavicle; they together form a series between the scapula and the coracoid, the former of which is smaller and the latter larger than the average carpal. Behind the inner edge of the clavicle at the side of the coracoid is a strong process, extending back and downward, to the inner side of which the second process of the pelvis is attached. A transverse section of the upper portion of the clavicle is subtriangular in outline, the inner side being longer and concave, and the outer sides irregular. The postclavicle is a long narrow curved bone, pointed at its lower end, and broadened and flattened at its upper, where it is firmly fixed to the inner side of the upper end of the clavicle. Its position approaches a vertical, and its point of attachment is at a considerable distance above the scapula or the base of the pectoral. On the outer side of the clavicle,

opposite the upper end of the postclavicula, is attached the lower end of the supraclavicula, a rather broad spatulate bone, which in its upper fourth underlies and is united to the inner side of the post-temporal.

As a whole, the skull of *Cyclopterus* (Figure 2 of Plate IX. and Figure B of Plate X.) is short and broad, and in consequence the various bones of which it is composed, and the brain cavity, as also the brain, are to be described in similar terms. The small amount of ossification notwithstanding, the bones may be distinguished with tolerable readiness. On the specimens at hand, not yet fully grown, the bony matter does not extend completely over the space allotted to each, as in better ossified fishes, but the margins are rounded, and spaces are thus left in which there is nothing but gelatinous matter. The bones are squamous; the thinnest have but a single broad plate of osseous matter. This substance is disposed somewhat in this manner: if the bone reaches but a single surface, the earthy material lies in a thin plate near that surface, while at the inner side of the plate, from its centre of ossification, thin laminæ radiate inward and toward the edges; but if appearance is made at two surfaces, there is a thin plate at each, and these are united at the bony centre by radiating laminæ forming cells and chambers between the plates or cups at the articulations. The top of the head is broad and convex; its outline is subtriangular, the width across the occiput being little less than the length to the mouth. Though uneven, the crown has no great prominence, that of the ethmoid and that of the supraoccipital being the most marked. Each frontal (1) is about as broad as long, and sends out a thin projection to overhang the greater portion of the orbit of its own side of the head. The parietals are of medium size, flat, wider than long. On the supraoccipital (8) the crest is a low rounded prominence, and the base is comparatively broad and rounded at the lower edge. The paroccipitals also are broad; backward they form a wide blunt angle. Being without deep excavations for the muscles between mastoid and occipitals, the skull presents a full and massive appearance in its posterior aspect. On the back the squamosal rises to meet the paroccipital between the mastoid and the exoccipital. In its upper half, the post-temporal (46), thin, short, and moderately wide, is applied to the skull over the suture between mastoid and squamosal; in its lower half, it is bent downward and lies on the upper portion of the supraclavicula (47), by which means the shoulder girdle is connected with the skull.

As seen from below, exoccipital, mastoid, and alisphenoid are in con-

tact; the separation of the two former by the squamosal being very narrow; their margins are segments of circles, in the first two semicircular, and in the third a still larger part of a complete circle. The basioccipital is short, and widens anteriorly so as to expose itself as a triangle at each side of the basisphenoid. Its comparative width is a prominent characteristic of the latter. A little more than half of the outer border of the mastoid is in contact with the hyomandibular; the articulation is close behind the middle of this edge. About one fourth of the upper margin of the hyomandibular (23) joins the post-frontal, very little of which is exposed toward the side. From the front much more of this frontal is to be seen; its outline includes rather more than a semicircle, the width being perhaps a little greater than the height. A thin projection extends over the front part of the orbit. All that is shown of the ethmoid is the low rounded prominence; below this it meets the vomer in a moderately wide suture between the prefrontals. The vomer is toothless; its front face is very steep. Each turbinal (20) has an expanded comma-shape, with the apex directed toward the eye. On the surface in the lower half of the length they are concave; elsewhere they are thin and flat.

The upper limb of the intermaxillary (17) is nearly as long as the lower. In the osseous portion of the former there appear to be two processes, the outer one shorter; but the cartilaginous substance fills them out, and continues toward the vomer as a thick and rounded prolongation of the bone. Toward the mouth this section becomes wider and angular. The lower limb bears the upper teeth; as it approaches the angle of the mouth, it tapers to a point. At the upper end the maxillary (18) is broad, and curves inward and backward, under the intermaxillary and the forward end of the palatine (22); it is somewhat inflated under the suborbital, but tapers and becomes slender at the outer extremity. The anterior suborbital (19) is larger than the second; it overlies and is firmly attached to the end of the palatine, which separates it from the head of the maxillary. The third suborbital (19') sends back a long, thin, rather broad process, that droops toward the edge of the preoperculum. Only a single post-orbital (19'') was discovered; it was very slender, and extended over the greater part of the space behind the eye toward the post-frontal from the suborbital process. The hyomandibular (23) is about one and a half times as deep as broad, and the

length of its frontal suture is nearly the same as the distance from the mastoid to the articulation with the operculum. In shape the metapterygoid (27) approaches a semicircle; a part of the hinder margin is incomplete, however, where connected with the hyomandibular by membranes. The quadrate (26) is of moderate size, and the symplectic (31) is elongate wedge-shaped, and firmly fixed at its lower end just inside of the notch in the quadrate. Posteriorly the pterygoid (24) and the entopterygoid (25) make a wide and firm junction with quadrate and metapterygoid; anteriorly, they make a similar union with the broad, stout palatine. Both dentary (34) and articular (35) are strong; the first has a slight prominence on the lower side at the symphysis, and the second projects downward somewhat behind the first. The angular (36) is small, has striate sides, and bears some resemblance to an inverted decanter.

The operculum (28) is triangular, stout at the articulation, from which ridges pass toward the outer angles, concave on the outer surface, and thin at the outer margin, where it overlies the suboperculum. The latter (32) is thin and elongate; one branch extends up to the middle of the anterior edge of the operculum, the other is very slender, lies below the outer opercular border, and extends a trifle behind it; anteriorly this bone is wider, and the forward margin is concave. The interoperculum (33) is thin, rather wide, and moderately long; it is wider at the junction with the suboperculum, and is more firmly attached to the epihyal than to the articular.

Though basihyal (39), ceratohyal (38), and epihyal (37) are stout and bulky, the stylohyal (29) is but slender. The apparent weakness of the latter finds some compensation in the attachment with the interopercular. Below the basihyals the urohyal (42) extends outward as a low knob; behind this the lower border is indented. Two groups are formed of the six branchiostegals (43) on each side; the two in the anterior are slender, and the four in the other are stouter and longer.

One of the characters heretofore assigned the family is "tongue fleshy, and free all around." The accuracy of this might be called in question, since the tongue so called is not fleshy, is not free all around, and is not strictly speaking a tongue. In this fish the tongue has become obsolete, and with it the glossohyal has disappeared. The remaining hyoids and the bones of the entire median branchial section are crowded and bunched together in a mass on the floor of the mouth that answers

well as a substitute for a tongue. It is to this that reference is made in the above quotation. Following the glossohyal toward obsolescence, the basibranchials are reduced to little rounded lumps of cartilage, hardly longer than broad. Between the pharyngeals and the hyals the lower ends of the branchial arches are compressed and packed close upon each other. In individuals there is some irregularity in the development of the lower elements of the arches. That at hand discloses a minute basibranchial above the urohyal, a second between the first hypobranchials and extending as a wedge partly between the second pair, and a third at the ends of the hypobranchials of the third arch. A small lump in front of each of the lower pharyngeals indicates the position of the hypobranchials of the fourth pair of arches. Through compression of the lower ends of the arches into such a limited space, the distance from the mouth to the esophagus is made quite short. The passages between the gills extend the length of the ceratobranchials. Each of the latter, except in the fourth arch, is provided with two series of seven to nine gill teeth at each side; the posterior arch has but a single series. These teeth are thick, short, simple, pointed cartilaginous structures, on some of which the points are hooked. All of the epibranchials are short. Those of the first arches are small, and composed of a basal portion as broad as long, and a slender apical prolongation of about the same length as the base. No upper epibranchial is found. The lower pharyngeals are elongate club-shaped, and bear a rounded bunch of conical teeth on the anterior fourth of the length; the upper on each side form a single bone, in which the components are indistinct, connected with the epibranchials of the posterior three arches.

*Viscera.*—The esophagus is short, and has a slight constriction at the stomach. The stomach is large, and shaped somewhat like a horse-shoe; its cardiac portion lies in the upper part of the body cavity, and turns slightly to the left, while the pyloric section lies below, and turns forward and to the right. Around the pylorus there are, in this specimen, forty-two elongate cæca, which unite and reunite in such a manner as to form six parcels, each opening into the intestine by a separate aperture immediately below the valve. The intestine is about twice the total length; the rectum is larger than the balance, and separated from it by a valvular fold. In shape the liver is subtriangular; it is moderately

large, and has two lobes, of which the left is the larger, thicker, and broader, while the right is small and short, little more than a continuation of the left, from which it is separated, in the older specimens, by a shallow indentation of the hinder margin. When the female is heavily burdened with eggs, the left lobe is crowded downward. The gall bladder is small and rounded; its duct opens into the intestine near the pylorus. The spleen is small, and subject to considerable variation in shape. Anteriorly the kidneys are large, thick, and separated; posteriorly they are most often fused. The ureters join before reaching the bladder, the contents of which pass out through the anal papilla behind the anal aperture. Unlike that of the cottoid, the bladder is simple, without horns. The testicles are elongate and separate; their ducts meet that from the bladder on entering the inner wall of the abdomen. Each ovary approaches a kidney-shape; posteriorly the two unite and discharge by a common duct.

The discovery of considerable amounts of sea mosses, weeds, and grasses, with portions of crustaceans and small fishes in the stomachs, establishes the fact that *Cyclopterus*, as was anticipated from the peculiarities of the intestine, is in the habit of feeding on vegetation.

*Brain.* (Plate VIII. Figs. 1-3.)—In comparison with the entire bulk of the animal, the brain of the Lump is very small. A specimen measuring twelve inches in length has a brain that, including the olfactory lobes and the rhomboidal sinus, measures about half an inch in length, five sixteenths of an inch in width across the optic lobes, and one fourth of an inch in depth, to the bottom of the hypophysis. Its general features are those of the Cottoid; hemispheres and cerebellum are smaller than the optic lobes, and the entire brain is short, as if crowded together more than in the Liparids. Excepting the wider separation of the olfactory, the shape of the brain and the distribution of the nerve roots are not greatly different from those of *Cottus groenlandicus* and *C. octodecimspinosus*. Figures 1 and 3 represent the olfactory nerves as crooked near the lobes; in other specimens there is no such bend. At the forward extremity the olfactory nerve is distributed, in the nasal sac, in a rosette similar to that of *Liparis Agassizii* (Plate III. Fig. 4), except in that it has wedge-shaped intrusions between the outer ends of the rays reaching from the centre, which give it more resemblance to a fungoid



coral on its upper face. This nerve is much longer than in *Liparis*. Small Lump-fishes show each hemisphere to be rather smaller than the cerebellum; in large ones the cerebellum is smaller than the hemisphere. In the small ones, again, the optic nerves are larger than the olfactory, but with age the latter gain more than the former. As in *Cottus*, the optic lobes are much larger than the hemispheres; the disproportion is greater than in the *Liparids*, as may be seen by comparing Figure 1 with Figures 4 and 9 of Plate VIII. The optic nerves partly originate in the inferior lobes. The epiphysis is neither large nor prominent. The cerebellum is nearly equal in size to one of the hemispheres, varying with age; on each side of it and behind it a considerable portion of the rhomboidal sinus is exposed. Toward the sinus and at its sides the medulla is broadened; the restiform bodies make a slight prominence behind each of the optic lobes. The infundibulum being very short, the hypophysis is sessile; its central portion lies below the meeting of hemispheres and optic lobes. The inferior lobes are of moderate size; at their posterior extremities they form a transverse prominence, extending down behind the heart-shaped hæmatosac. The spinal chord extends nearly or quite to the end of the column; it is without glandular enlargements.

#### EARLY STAGES.

##### Plates XII. and XIII.

The following account of the young stages of the Lump was published by Prof. Alexander Agassiz in the Proceedings of the American Academy of Arts and Sciences, Vol. XVII. p. 286, Plates IV. and V., 1882. With his permission, both the plates and the accompanying text are here reproduced:—

“In the youngest stage of this species I have had occasion to examine (Plate XII. Fig. 1), measuring 4 mm., the caudal fin was already partly separated from the dorsal and ventral embryonic fin. The spiny rays were also indistinctly indicated in those fins. The pectorals were large, the rays gradually diminishing in length towards their junction with the sucking disk (the modified ventrals on the abdominal side). The anterior dorsal is formed evidently, as in *Lophius*, at an early stage, and separates, as in that genus, the anterior and posterior parts of the embryonic dorsal fin. The younger stages of *Lumpus* (Plate XII. Figs. 1-4) are noted for

the great length of the urostyle. The head of the younger stages is remarkable for its great length and breadth (Plate XII. Figs. 1-4). The great prominence of the pigment spots on the anterior part of the young fish, as far as the base of the dorsal and ventral embryonic fins, gives the young *Lumpus* a very striking appearance. It resembles somewhat the armored Fishes of the Old Red, and we are strongly reminded of the restorations of *Coccosteus* in such stages as those of Plate XII. Figs. 1 and 3. With increasing age and size (Plate XII. Figs. 3, 4), the young *Lumpus* is more uniformly covered by pigment cells, the posterior part of the body becomes less transparent, more fleshy, and it loses its ancient look, resembling more, at this stage (Plate XII. Fig. 4), the young of *Batrachus*, which may, indeed, be said to be a permanent condition of this stage of *Lumpus* (with the exception of the absence of the sucking disk in *Batrachus*). The posterior dorsal and the ventral have become well separated from the caudal fin, which in Plate XII. Fig. 4, has nearly completely lost its ganoid shape, having become almost symmetrical. The urostyle, however, is still marked by its great length. The permanent rays of the median fins are well advanced (Plate XII. Fig. 4); the paired fins have not changed materially since the last stage (Plate XII. Fig. 3). There is great diversity in the coloring of the young of *Lumpus*. In the youngest stages (Plate XII. Figs. 1-3) the head, in a line drawn nearly vertically below the base of the anterior dorsal, is of a light chocolate brown, with a darker brown band extending from the nostrils above the eye to the base of the anterior dorsal. A light blue band extends from the rear of the eye to the top of the operculum, and in front of the eye to the nostrils. A blue spot of similar tint is found at the posterior base of the dorsal, and at the base of the caudal extremity of the posterior dorsal. The rest of the body is straw-colored. The young of the stage represented in Plate XII. Fig. 4, were usually of a bright olive green, darkest towards the dorsal side, with the same blue band extending towards the operculum from the rear of the orbit, with one or two round blue spots above the level of the pectorals along the lateral line. Other specimens were of a bluish neutral slate tint, uniformly spotted with darker pigment cells, with the same blue band between the eyes, above the nostrils, and behind the eyes. This was also the coloring of the oldest of the young specimens caught (Plate XIII. Figs. 1, 3), resembling in general the bluish coloring of the adult, only of a darker tint.

“The intermediate stages varied greatly in coloring; some were of a yellowish brown spotted with chocolate-colored patches, with light greenish bands behind the eyes, and five rounded spots of the same color along the lateral line, and a similar number of larger spots along the base of the posterior dorsal, extending, in some specimens, along the median dorsal line of the body to the colored band extending between the eyes. Other stages, with a similar arrangement of elliptical spots of a bluish tint along the dorsal and lateral lines, were of a reddish brown color, with pigment patches of a darker greenish or of a brownish color, the abdominal region being of a lighter color.

“In the stage of Plate XIII. Figs. 1, 2, the anterior part of the body already assumes somewhat the angular outline characteristic of the adult, though these young stages are all more elongated than the adult, having also the head comparatively well separated from the posterior part of the body. The young in the stages of Plate XIII. Figs. 1, 2, do not as yet show any traces of the prominent rows of spiny tubercles formed in the adult. These were developed to a slight extent in young *Lumpus*, measuring 34 mm. in length (Plate XIII. Figs. 3, 4): a line beginning to form along the anterior slope of the anterior dorsal, a less prominent horizontal row on a level with the line of the orbits close to the eyes, a third lateral one along the body at the level of the upper extremity of the operculum. This, the most prominent of the rows, consisted of large elliptical protuberances, through which spiny processes projected (Plate XIII. Figs. 3<sup>a</sup>, 3<sup>b</sup>), and a last row of somewhat smaller tubercles along the median line of the abdomen behind the ventrals. The anterior dorsal fins of these young stages (Plate XIII. Figs. 3, 4) resemble greatly such permanent anterior dorsals as exist in *Chironectes*, for instance.

“In the older stages (Plate XIII. Figs. 1-4) the anterior dorsal has become well separated from the posterior, the median fins are entirely isolated, with well developed fin rays, and the caudal has become symmetrical. The pectorals are somewhat larger, but otherwise they and the ventral fin disks (Plate XIII. Fig. 3 c) do not differ much from their condition in younger stages. The early development of the pectorals seems a marked characteristic of all embryos of osseous Fishes.

“These young stages of *Lumpus* were all collected close to the shore; they were found living among the eel-grass at Nahant, near low-water mark. Günther has figured (An Introduction to the Study of Fishes,

1880, p. 485) the young of *Cyclopterus spinosus*. Of these stages, the youngest correspond to the oldest stage of *Cyclopterus lumpus* here figured, the oldest measuring over 45 mm. in length."

### EUMICROTREMUS.

The most important distinctions as yet pointed out for *Eumicrotremus* are the irregularity of the large tubercles on the flanks, and the fact that the first dorsal is not hidden so early in life as in *Cyclopterus lumpus*. The eyes and disk are larger. The genus was founded by Gill, 1864, upon *Cyclopterus spinosus* of Müller.

#### *Eumicrotremus spinosus*.

##### Plate XI. Figs. 1-3.

*Cyclopterus spinosus* Müll., 1776, Prodr. Zool. Dan., p. ix; Fabr., 1780, Fauna Groenl., 134, — 1798, Nat. Hist. Selsk. Skr. i Kjøb., IV. pt 2, 27, pl. ix. fig. 2; Bonn., 1788, Ichth., 27; Walb., 1792, Art. Gen. Pisc., 485; Donnd., 1798, Beitr., 814; Wilh., 1799, Unterh. Naturg., IX. 131; Sch., 1801, Bl. Syst. Ichth., 198, pl. 46; Sonn., 1803, Hist. Poiss., V. 256; Cuv., 1817, R. An., II. 227, — 1829, R. An., II. 316, — 1836, R. An., I. 573; Faber, 1829, Naturg. Fische Islands, 53; Rich., 1836, F. B. Amer., III. 263; Wilson, 1838, Ichth. in Encycl. Brit.; Reinh., 1838, Ichth. Bidr. Groenl. Fauna, 108, 116, 134; Kröy., 1847, Nat. Tidsskr., III. 262; Gaim., 1851, Voy. Skand., Poiss., pl. 4, fig. 2; Gill, 1861, Cat. Fish E. C. N. A., 47; Gthr., 1861, Cat., III. 157, — 1877, P. Z. S. Lond., 293, 476, — 1880, Introd. Study Fish., 485, fig., — 1887, Challenger Rep., XXII. 66; Malmg., 1864, Om Spetsb. Fisk-fauna, Oef. k. Vet. Ak. Föch., 509; Jord. & Gil., 1882, Bull. 16 U. S. Mus., 746.

*Eumicrotremus spinosus* Gill, 1864, Pr. Phil. Ac., 190, — 1873, Cat. Fish E. C. N. A., 21, — 1891, Pr. U. S. Mus., XIII. pl. xxix. fig. 2 (fr. Collett); Bean, 1879, Bull. 15 U. S. Mus., 115; Goode & Bean, 1879, Bull. Essex Inst., XI, p. 12 of ext.; Coll., 1880, Norske Nord.-Exp., Fiske, 67, pl. 2, fig. 13, J. & G., 1882, Bull. 16 U. S. Mus., 957; Dresel, 1884, Pr. U. S. Mus., VII. 219; Stein., 1886, Jan. Mayen Exp., III., Fische, 106; Jor., 1887, Rep. U. S. Fish Comm., 1885.

*Le Cycloptère épineux* LaC., 1800, Hist. Poiss., II. 59.

*Lumpus spinosus* Stor., 1816, Synops., 482.

B. 6; D. 6/11; A. 10; P. 21.

From the material before us this species appears to be less compressed than either *C. lumpus* or *C. orbis*. In a transverse section, in front of the first dorsal, it is nearly round, whereas in either of the others such a section is considerably higher than wide. Compared with them in regard to length, it may be described as elongate. How much of this difference in form is to be credited to individual variation, we cannot at present determine. Bearing in mind the variations seen in a lot of specimens of *C. lumpus*, it does not seem at all impossible that *C. spinosus* and *C. orbis* may have to be united, as has been suggested by several authors; but

unless other specimens show closer approaches than these, they certainly are better kept separate. The depth of body in *C. spinosus* is contained about two and a quarter times in the length, without the caudal; the length of the head is less than its height, and is little more than one fourth of the length to the caudal fin. Crown convex, orbit large, less than one third of the length of the head. Mouth moderate, reaching a vertical from the forward margin of the orbit. Teeth small, simple, subconical, in a narrow band. On younger examples the anterior dorsal is quite distinct, and does not form a continuous arch with the outline of the back in front of it, as in the Lump, but aged specimens approach the latter more nearly in these respects. Between the two dorsals the space is less than the length of the base of the first. On its posterior margin the caudal is subtruncate, with the angles rounded off. All of the fins have rounded margins. Each of the conical tubercles with which the skin is covered is rough with small projections on its sides and base. Some of the tubercles in diameter of base measure nearly or quite as much as the width of the orbit. The largest appear in a group of eight or nine on the middle of the flank, and in several series from the crown to the base of the second dorsal. One of the large ones stands at each side of the space between the dorsals. A couple of moderate-sized ones are seen in front of the shoulder. Those on the entire caudal region are smaller, as also those below the head and body.

A young specimen about an inch and a quarter in length has a similar outline in transverse section, as wide as high, is abruptly compressed behind the abdomen, and shows the first dorsal as free and distinct as the second. The back is somewhat arched under the base of the anterior. The inter-orbital space is slightly concave, one fourth wider than the orbit, and one fourth narrower than the disk. Disk nearly one third wider than the orbit. The entire body is covered with irregular-sized spiny tubercles. On the sides of each tubercle the small spines are slender and bristle-like, and their development is comparatively greater than that obtaining among them on older examples. Later in life it is the central portion, or cone, of the tubercle that develops, while the lateral outgrowths remain small. On the young individuals the larger scales occupy the spaces behind the pectorals, above the opercles, and at the sides of the first dorsal. Dr. Günther, 1880, figures some young specimens an inch in length, some with tubercles, others without them, and shows the fins to be angular early in life. Our Figures 1-3 of Plate XI. were drawn from a specimen taken at Eastport, Maine. Up to

the present time, the species has been found only in the North Atlantic and the Arctic Oceans. In the Museum of Comparative Zoölogy there is a small individual taken in Massachusetts Bay. It is less than half an inch long, but has the flanks occupied by numerous tubercles, and the dorsals distinct. The rays of the anterior dorsal are rather long. At each side of the anterior portion of the disk there is a white spot, and from the operculum a white stripe extends back above the pectoral to the middle of the flank; otherwise the colors resemble those of the specimen figured. Possibly, as suggested above, *C. orbis* from the North Pacific belongs with this species; however, as our specimens plainly show the features that induced the original separation, it seems preferable to make no change until possessed of material sufficient for a more definite comparison.

The color is olivaceous to brownish, very likely reddish in life, clouded with darker.

#### **Eumicrotremus orbis.**

*Cyclopterus orbis* Gthr., 1861, Cat., III. 158.

*Eumicrotremus orbis* J. & G., 1880, Pr. U. S. Mus., III. 451. — 1881, Pr. U. S. Mus., IV. 62.

*Cyclopterus (Eumicrotremus) spinosus* J. & G., 1882, Bull., 16 U. S. Mus., 746.

*Eumicrotremus spinosus* Bean, 1881, Pr. U. S. Mus., IV. 247, 271; Coll., 1880, Norske Nord.-Exp., Fiske, 49 (part).

B. 6; D. 7 / 9; A. 10; C. 10.

Body compressed, thick, short, and high; head short, higher than wide, flattened, supra-orbital angles prominent. In the specimen described, badly shrunken by drying, the height of the body is nearly half of the entire length, while the height of the head is contained in the distance from the snout to the base of the caudal nearly twice, and the length of the head in the same distance nearly two and a half times. Eye large, about three and a half times in the length of the head. Teeth numerous, small, subconical, in pavement, four or five series. Anterior dorsal much as in a specimen of *C. lumpus* of three inches in length, the sides of the fin covered with spines of moderate size, the spinous rays seven in number. The upper outline of this fin is much like that of the Lump, in being arched backward, or crescentic. The ten rays of the second dorsal are very distinct; the membranes are not so tuberculate as those of the first. Entire body and head covered with spiny conical tubercles, the largest in a group of seven or eight on the flank behind the pectorals, another on the forehead, and those on the supra-ocular ridge. A single large one stands at each side of the space between

the dorsals. Those on the flanks are in contact, and on an example four and one half inches in length there are several that exceed half an inch in diameter. The sides of the tubercles are roughened by multitudes of fine sharp spines. Under chin and throat the tubercles are smaller, close together, and very numerous. The origin of the first dorsal is above and a very little in front of the gill opening. The latter is above the base of the pectoral, behind the eye; its width is hardly as great as that of the orbit. Professor Collett gives a good figure of *C. spinosus*; to compare the specimen from which these notes are taken with it, the Pacific representative is higher and more arched in front of and over the first dorsal, the depth of body is greater in proportion to the length, and the spines above the lateral line, from the space between the dorsals to the back of the skull, are a great deal smaller. These differences are such as may obtain on individuals, it is true, but until direct comparisons of series from the Pacific are made with others from the Atlantic it is hardly worth the while to throw *C. orbis* in with *C. spinosus*. The two species are very closely allied, but with our specimens it does not seem best to bring them together as one.

St. George's Island, Bering Sea.

### CYCLOPTEROIDES.

Body short, thick, slightly depressed anteriorly, compressed posteriorly. Head broad, short; snout short, obtuse; suborbital produced to connect with the preoperculum, widening backward. The bases of both dorsals are thickly enveloped in skin and flesh. Ventrals united, forming a large adhesive disk. Chin with tubular pores, or barbels. Teeth small, subconical. Gill openings narrow; gill membranes united and attached to the isthmus. Gills three and a half. Pseudobranchiæ. Six branchiostegal rays. Intestine long. Like *Cyclopterus*, to which it is closely allied, this genus appears to derive a portion of its food from vegetation.

#### *Cyclopteroides gyrynops.*

Plate XI. Figs. 4-9.

B. 6; D. 8/9; A. 9; P. 24; C. 10; Cæca 10 or 11.

Body oblong, compressed toward the dorsals, broad toward the belly, subtriangular in transverse section, abruptly compressed in the posterior por-

tion between the second dorsal and anal, deep near the abdomen, and tapering rapidly to the caudal fin. Belly flattened, two thirds as wide as long. Head short, one third of the total, as long as high, wider than long, interorbital space concave transversely and slightly so longitudinally, steeply inclined on snout and sides; cheeks swollen; mouth anterior, somewhat oblique, little wider than interorbital space, not reaching a vertical from front of eye; lower lip interrupted for a short distance at the symphysis; chin with a series of four barbels on each side, formed by tubular prolongations of the pores similar to those of the nostrils. Teeth very small, conical, slightly hooking backward, in five rows at the symphysis, some of which are shorter and do not extend so far toward the sides as the others. Nostrils small, tubular, the posterior between the eyes, and the anterior half-way between the posterior and the mouth. Eyes moderate, lateral, as long as the snout, less than one fourth of the head, prominent above the outline of the forehead. Gill opening very small, covered by the spine-like angle of the opercle, at a distance above the base of the pectoral equal to about twice its own width.

Skin covered with mucus, with four series of very small, distant, one- to eight-spined tubercles on each side; one series on each side of the median line of the forehead along the sides of the bases of the dorsals, another from each orbital ridge backward on the flank parallel with the first, another behind each eye, and the fourth at the lower edge of the gill opening. Below the last series the skin is quite bare.

Ventral disk as long as the head, as broad as long, or broader, nearly twice as far from the caudal as from the mouth. Dorsal fins very thick at their bases, enveloped in loose skin through which the rays may be distinguished, separated by an interspace; first higher, originating above the gill opening; the base of the second higher in front, and the posterior rays more free from the thick skin. The extremities of the rays are all weak, and in most cases have been carried away. That the caudal fin was pointed is indicated by the strength of the median rays; in other words, the fin was longer in the middle. Pectorals broad, rounded in the upper part posteriorly, reaching as far backward as the hinder edge of the disk; lower border but little indented, if at all, with ends of rays prolonged as a short fringe.

Color brown, approaching a chocolate, belly light. There is a dark brown blotch between the eyes, another from each eye through the anterior nostril to the mouth, one below the eye to the throat, one or two back of the eye



on the opercle, a larger one behind the gill opening, several small ones close along the bases of the dorsals, and an elongate band on the hinder part of the flank and on the base of the caudal portion. Peculiar marks exist in a brown blotch, on each side of the hinder part of the abdomen, on which is a bunch of three white spots, like a clover leaf, in a white band reaching toward the flank at each side of the hinder margin of the disk, and in a white spot at the posterior ends of the branchiostegal rays.

Total length a little less than two inches.

*Hab.* — St. Paul's Island, Alaska.

#### ANATOMY.

*Viscera.*—The esophagus is short and thick. The stomach is large; its shape resembles that of a horseshoe or a letter U. On leaving the esophagus it turns toward the left side, and, passing back, crosses the chamber and turns forward on the right. The pylorus is surrounded by ten or eleven elongate cæca that do not appear to unite with one another, but which enter the intestine by as many distinct openings immediately below the valve. Within the stomach there is a large quantity of seaweed, somewhat like dulse or sea-moss, and parts of a number of small crustacea. Apparently the intestine is more than one and a half times the total length. The spleen is elongate and slender. Forward, the kidneys are thick and large; posteriorly they taper, and toward the middle of the abdomen they unite. The bladder is large and simple; beneath it, between the papilla and the first ray of the anal fin, the skin assumes the appearance of a prominent blister. In the specimen, less than one and seven eighths inches long, the eggs are nearly ready for exclusion, and the ovaries have an elongate kidney-shape. They discharge through a common duct, meeting that from the bladder behind the vent. The liver lies below the stomach; its left lobe is very large, broad and long, subquadrate, while the right is small, short, and continuous with the left, the slight indentation in the hinder margin being the only separation. The gall bladder is quite small, and rounded in shape.

The presence of such a quantity of vegetable matter in the stomach, taken in connection with similar discoveries in stomachs of *Cyclopterus*, indicates that the consumption of such food is characteristic of the family.

**LIPAROPSIDÆ.**

The deterioration of the first or spinous dorsal, seen in the Lump-fish, has apparently proceeded so far in the Liparopsidæ as to cause the disappearance of that fin. Each of the two genera in the family has but a single dorsal, the posterior. On one genus the fin is short and situated near the caudal, on the other the fin begins near the middle of the back and extends nearly to the origin of the caudal. The genera are further distinguished by dorsal tubercles in one case, and by a naked skin in the other. The shape is somewhat like that of the Diodons, bulky, thick, broad, and longer forward, in the section containing the visceral cavity, and short and greatly reduced in size behind it. The head is short, broad, and thick, the snout short and blunt, the mouth terminal, the teeth are subconical, the eyes lateral, the branchiostegal rays six in number, the gill openings narrow, the gills three and a half, the pseudobranchs small, all, with disk, pectorals, and caudal, as in the Cyclopteridæ. Until recently this family has been known only from the North Pacific. A short time ago a second species of Cyclopterichthys was named by Vaillant from a sketch of a fish taken in the Straits of Magellan, which would extend the distribution to the Antarctic regions.

		PAGE
Dorsal short; no tubercles,	CYCLOPTERICHTHYS,	40
Dorsal elongate; tubercles present,	LIPAROPS,	42

**CYCLOPTERICHTHYS.**

Form resembling that of the Diodons, massive anteriorly, thick and rounded to the dorsal, thence compressed to the caudal. Head broad, short, moderately arched, sides steep. Skin thick, soft, naked. Gills three and one half. Gill opening a narrow slit, above the pectoral. Gill membranes united, joined to the isthmus. Pseudobranchiæ. Teeth simple, hooked, in few series. Orbital ring connected with the preoperculum. Dorsal single, posterior. Ventrals united, forming an adhesive organ. Steindachner, 1881, established the genus upon his species *C. glaber*, afterward identified with *C. ventricosus* of Pallas.

**Cyclopterichthys ventricosus.**

*Cyclopterus ventricosus* Pallas, 1769, Spicil. Zool., fasc. 7, p. 16, pl. 2, fig. 1-3, — 1831, Zoogr. Ross.-Asiat., III. 74; Bonnat., 1788, Ichthyol., p. 28, pl. 20, fig. 66; Gmel., 1789, Syst. Linn., I. 1476; Walb., 1792, Art. Gen. Pisc., 487; Donud., 1798, Beitr., III. 816; Georgi, 1801, Geogr.-Phys. Nat. Besch. Russ. Reichs, VII. (3d pt.) 1967; Sonn., 1803, Hist. Poiss., V. 263; Shaw, 1804, Gen. Zool., V. 394; Turt., 1806, Syst. Nat. Linn., I. 905; Cuv., 1817, R. An., II. 227, — 1829, R. An., II. 346, — 1836, R. An., I. 573; Rich., 1836, F. B. Amer., III. 263; Val., 1840, Cuv., R. An., ed. ill., Poiss. 501.

*Lepadogaster ventricosus* Bl. Schn., 1801, Systema, p. 3.

*Lumpus ventricosus* Stor., 1816, Synops. N. Amer. Fishes, 482.

*Cotylys ventricosus* Gthr., 1861, Cat., III. 498.

*Cyclopterichthys glaber* St., 1881, Ichth. Beitr., X. 14, pl. 8.

*Cyclopterichthys ventricosus* J. & G., 1882, Bull. 16 U. S. Mus., 745.

D. 10; A. 8-9; P. 20; C. 10. (Pall., *C. ventricosus*.)

D. 9; A. 7; P. 20; C. 11. (St., *C. glaber*.)

Body stout, thick, short, smooth, abruptly compressed behind the body cavity. Caudal portion nearly two fifths of the total length. Head about one third of the length without the caudal, broad, depressed but convex on the crown, blunt and broadly rounded on the snout. Mouth wide, anterior, opening slightly upward, corner under the middle of the eye. Teeth small, hooked, simple, in two series in front, and but one toward the sides. Pallas says of the dentition: "Maxillarum margines ossei, denticulis minutis, curvulis, obtusiuseulis, inordinatis et inæqualibus, passim geminatis asperi; quorum in superiore maxilla interiores majores." Eye lateral, its diameter contained about seven times in the length of the head. Dorsal short, behind the abdominal chamber, its upper extremity extending behind a vertical from the base of the caudal, margin rounded. Anal smaller than the dorsal and opposed to it, though originating a trifle farther back. Caudal subtruncate, rounded. Vent almost directly in the middle of the total length. Disk subcircular, with a broad cutaneous margin.

Brownish, with numerous scattered, small, rounded spots of darker.

The following is the account of the anatomy given by Pallas:—

"*Pleura intus aterrima. Acetabulo* subjacent musculi quatuor robustissimi, contractioni et dilatationi ejusdem servientes.

"*Renes* statim ad caput oriuntur e duobus lobis posterioribus ad spinam in unum coaliti, et spinæ longitudinaliter incumbentes. *Ureteres* e posteriore parte duo, quorum quilibet ad peculiarem vesicam tendit.

"*Vesica urinaria* gemina, in quovis alvi latere una, sine exemplo amplissima; utraque postice producta coalescit in *Cloacam* communem seu collum *ano* insertum, arctissime clauso; qui presso abdomine urinam cum impetu emingit.

"Reliqua fere ut in *Cottis* quibusdam."

*Hab.* — Kamtchatka; Sea of Ochotsk.

**Cyclopterichthys amissus.**

*C. amissus* Vaillant, 1888, Miss. Sci. du Cap Horn, Poiss., 33; Gill, 1891, Pr. U. S. Mus., XIII. 366.

This species was named by Professor Vaillant from a sketch. The description gives us no data concerning teeth, fin rays, etc., for comparison with the Northern species. What was drawn from the sketch is all that is known of it.

“ Il représente, vu de côté et de dos, un animal d'une forme assez caractéristique pour qu'on puisse le rapporter, sans trop de hardiesse, au genre *Cyclopterichthys* fondé par M. Steindachner pour le *C. glaber* Steind., pêché dans la mer d'Okhotsk. Le poisson pris par le *Volage* est également diodonforme, avec une seule dorsale courte, très reculée, répondant à une anale de même aspect. Les proportions générales en sont très exactement données: la longueur totale était de 360 mm.; la hauteur du corps et la longueur de la tête égales, 150 mm.; celle-ci occupe donc un peu plus des deux cinquièmes de la première, tandis que dans l'espèce typique elle n'en fait que le tiers. Ce caractère paraît suffisant pour justifier une distinction spécifique et je proposerais d'appeler ce nouveau poisson le *Cyclopterichthys amissus*.

“ Tout le corps est de couleur lie de vin clair, parsemé de taches de la même teinte beaucoup plus foncée, passant sur la joue au brun. Iris jaune doré.

“ Il provient de la baie Tilly (détroit de Magellan).”

## LIPAROPS.

For the present the characters of this genus are those of the only species that has come to the notice of ichthyologists. It appears to be closely allied to *Cyclopterichthys*. Among the features by which it is to be distinguished are the elongate dorsal, the tubercles, and the dentition. Only one species is known.

**Liparops Stelleri.**

*Cyclopterus Stelleri* Pall., 1831, Zoogr. Ross.-As., III. 73.

*Cotylin Stelleri* Gthr., 1861, Cat., III. 499.

*Cyclopterichthys Stelleri* J. & G., 1882, Bull. 16 U. S. Mus., 745.

This species was made known through the description given by Pallas, from manuscripts left by Steller. The Zoographia Rosso-Asiatica is one of the rarer books; comparatively few libraries possess it. Consequently the student often finds it difficult of access. Because of this we have reproduced in this place all that the author has given concerning the species.

As its value to an investigator is greatest in the exact form in which it was originally published, it is given in that shape.

“CYCLOPTERUS STELLERI.

“C. tuberculis osseis dorsalibus simplici serie ante pinnam dorsalem.

“Cyclopterus glaber, acetabulo rugoso intra pinnas pectorales, *Steller. obs. ichth. manuscr.*

“Raro in mari Camtschatcam alluente, præcipue circa portum SS. Petri et Pauli capitur. *Stellerus* tantum e siccato specimine descripsit et a Camtschadalis acceperat: hanc speciem in tantam magnitudinem excrescere, ut scaphas eorum evertere valeat, ideoque ab illis timeri; de qua fabula ipse dubitat. Ipsam *Stelleri* descriptionem propono:

*Descr.* “Oblatus piscis dodrantem longus erat, in diametro ubi crassior, quatuor uncias crassus, a capite ad caudam formam ovalem obtinebat. *Colore* erat nigricante, undique glaber, in medio dorso tantum series *tuberculorum* aderat, usque ad pinnam dorsalem. *Mandibula* inferior superiore dimidia uncia (rhenol.) longior, utraque bifida. *Lingua* crassa. *Dentes* ad oras utriusque mandibulæ exigui” (addo e specimine sicco Musæi Petropolitani: inæquales, obtusiusculi, inordinati; in superiore maxilla in ora tuberculiformes, interius autem majores). “*Oculi* exigui, in summis lateribus capitis, ultra unam unciam ab extimo rostro remoti. *Valva branchialis* valde magna; *ossicula* branchiostega sex at vero valva cum membrana branchiostega non movetur, nec aperitur, sed *ostio* spherico saltem in lateribus patet, et supra hoc ostium *appendicula* mobilis pro lubitu clauditur et aperitur, eadem ratione ac in Cobitide *Trenia*. *Anus* tertiam partem corporis inchoat. *Pinna* in dorso unica, in medio dorso incipit et fere ad caudæ initium pergit. *Pinnae postbranchiales* pectoralibus aliquanto altiores. *P. pectorales*, quæ *Cl. Artedi* ventrales perperam dicuntur, *acetabulum* utrinque ambiunt, in summitate concretæ, nec multum solutæ sunt. *Pinna* post anum semuncia ab ano incipit, ac deficit ubi p. dorsi. *Cauda* post anum subito gracilescit. *Acetabulum* intra p. pectorales (ventrales, magnitudine denarii misnici).—Interna in sicco pisce deerant.”

LIPARIDIDÆ.

A greater resemblance to the tadpole is seen in the shape of the species of this family than occurs in either of the preceding families. Forward, the body proper is broad, rounded, and more or less depressed; backward, rather more than half of the total length is made up by the much compressed post-abdominal section. The head is short and broad, the snout wide and blunt, the mouth of moderate width and nearly or quite terminal position, and the eyes, medium to very small, are lateral. Teeth tricuspid to simple, very small, villiform, in a number of rows forming a pavement or card. Branchiostegals six. Gills, three double and one single. Pseudobranchiæ present, said to be lacking in one species. Gill openings small, above the base of the pectoral. Pectorals broad, the bases extending forward under the throat. Ventrals, when present, below the head, between the pectorals, transformed into a small adhesive disk,

absent in some species. Caudal fin elongate, distinct, or united with dorsal and anal. Anal and dorsal long, the latter rarely with the portion containing spinous or unsegmented rays distinct from the other. Skin smooth, excepting a sexual outgrowth in breeding season, thin, not firmly attached. Vessels of the lateral system cephalic. Olfactory nerves short. Stomach siphonal, U-shaped, with cæca. Intestine elongate.

Skeleton with a somewhat larger proportion of osseous matter than that of the *Cyclopteridæ*. As in that family, the skull is full on the back, as if truncate, and has no passage for muscles extending forward between the mastoid and the occipitals. Third suborbital very long, slender, and spine-like, posteriorly reaching toward the posterior margin of the preoperculum. Upper limb of preoperculum expanded. Operculum much reduced; its shape with some resemblance to that of a boot, the sole directed down and the toe backward. Suboperculum slender, like an inverted V with the limbs curved outward, the anterior extending forward along the preoperculum, and the posterior reaching back under the lower border of the operculum. Interoperculum long, styliform, reaching from suboperculum to articular, frequently mistaken for one of the branchiostegal rays.

Between the members of this family and other Discoboles prominent distinguishing features are seen, in the shorter body as compared with the caudal sections, the greater number of vertebræ, the peculiarities of the fins, and the development and shapes of the opercular bones.

Reasons for separating this family from the *Cyclopteridæ* and placing it farther from the *Cottidæ* exist in the continuous dorsal, the connection of dorsal and anal with the caudal, the more complete transformation of the ventral rays, the more slender and spine-like suborbital process, the expanded upper limb of the preoperculum, the styliform interoperculum, the shorter olfactory nerves, and the more elongate brain.

## GENERA AND SPECIES OF LIPARIDIDÆ.

## LIPARINÆ.

		PAGE
Disk present;		
caudal more or less distinct; teeth tricuspid,	LIPARIS,	45
vertebræ less than 40,	LIPARIS,	47
D. and A. scarcely reaching C.;		
D. notched; fin rays, approximately,		
D. 30, A. 24,	<i>L. Montaguï,</i>	47
D. 36, A. 27,	<i>L. mucosus,</i>	52
D. and A. confluent with less than half of C.;		
D. without a notch;		
D. 33, A. 24-29,	<i>L. calliodon,</i>	54
D. 32-36, A. 28-32,	<i>L. liparis,</i>	57
D. 28, A. 24,	<i>L. antarctica,</i>	61
vertebræ more than 45,	CARELLIPARIS,	62
D. and A. confluent with half or more of C.;		
D. 41-44, A. 32-35,	<i>L. Agassizii,</i>	62
D. 39, A. 33,	<i>L. tunicatus,</i>	65
D. 44-45, A. 36,	<i>L. Steineni,</i>	66
D. 47-49, A. 39-40,	<i>L. pulchellus,</i>	67
vertebræ?		
D. and A. confluent with C.; C. acuminate,	<i>L. pallidus,</i>	70
caudal indistinct, tenuous; teeth simple, in adults,	CAREPROCTUS,	71
D. 35-37, A. 35-36,	<i>C. micropus,</i>	72
D. 40, A. 33,	<i>C. major,</i>	72
D. 50, A. 45,	<i>C. gelatinosus,</i>	76
D. 54-55, A. 45-46,	<i>C. Reinhardi,</i>	78

## AMITRINÆ.

Disk absent, no ventrals,	PARALIPARIS,	80
D. 58, A. 53,	<i>P. rosaceus,</i>	80
D. 59, A. 51,	<i>P. bathybius,</i>	81
D. 67, A. 54,	<i>P. liparinus,</i>	82
D. 70±, A. 70±,	<i>P. membranaceus,</i>	83

## LIPARINÆ.

## LIPARIS.

The fishes placed in this genus are mostly small; in general their outlines resemble those of larval anurous batrachians. The anterior portion of the body, containing the abdominal chamber, is usually short, broad, flattened beneath, and somewhat angular toward the dorsal fin, while the hinder part is elongate, much compressed, and tapering. The

more important of the distinguishing features may be summarized as follows: head short, broad, rounded; snout short, blunt; mouth anterior; lips distinct; teeth small, numerous, in a cardiform band, tricuspid on intermaxillaries and dentary, simple on pharyngeals; eyes lateral, small to medium; nostrils, two on each side, with short projecting tubes; olfactory nerve short; brain elongate; glossohyal rudimentary or absent; gills three double and one single; gill rakers with denticles; pseudo-branchiæ present; gill opening small, above the pectoral; branchiostegal rays six; branchial membranes not free; tubes and pores of the lateral system forward of the gill aperture; dorsal and anal elongate, more or less closely united with the caudal, with some anterior rays unsegmented; pectorals broad, procurrent under the throat; ventrals transformed into an adhesive disk, situated below the gills between the pectorals; skin thin, loosely attached, smooth, excepting a sexual outgrowth on males in breeding season; stomach siphonal; pyloric cæca numerous; intestine elongate; urinary bladder large, simple; kidneys long, fused a portion of their length; liver large, with partial divisions into lobes; gall bladder small, rounded; skeleton not heavily ossified, less in deep-sea forms; upper limb of preoperculum expanded backward; operculum small; suboperculum narrow; interoperculum elongate, styliform; third suborbital produced backward, in a long, slender process, to the hinder edge of the preoperculum.

The species of *Liparis* inhabit the colder waters of the North and of the South of both Atlantic and Pacific, ranging to great depths. Among those frequenting the shores, if not also the others, vegetation seems to form a portion of the food. The contents of the stomachs are miscellaneous lots of small marine animals (crustacea, worms, mollusks, small fishes, etc.), mixed with which are quantities of sea-weeds. Some variation exists in regard to feeding habits among the different species. The teeth of some show no signs of wear from hard food, but in *L. mucosus* they are ground off and blunted, no doubt by contact with the hard-shelled crustacea and hard-scaled agonoid fishes, remains of which are found in the stomachs. Very likely *L. pulchellus* turns his peculiar snout to account by rooting in the mud or sand among the plants, or in turning over the pebbles. Certain species are fitted for a life in beds of sea-weed, others are probably more abundant in rocky places.

By structural differences the genus may be divided into two sub-



genera. The first of these is *Liparis*, properly so called, which has tricuspid teeth, less than forty vertebræ, and a strong, curved frontal ridge, convex in front, crossing the interorbital space. This division will include *L. liparis*, *L. Montagu*, *L. calliodon*, *L. mucosus* (*Neoliparis* of Steind.), and possibly others. In the second group we should place species like *L. pulchellus* and *L. Agassizii*, which agree with the preceding in dentition, but differ in having more than forty-five vertebræ and broader frontal regions on which the transverse ridge is less or scarcely perceptible. The name *Careliparis* is applied to this section. *Liparis Agassizii* lacks the greater development of the anterior ends of turbinals, suborbital chains, and maxillaries brought about in the angular snout of *L. pulchellus*, but otherwise is closely allied. *Careproctus*, comprising species in which the skull is higher, with a moderate frontal ridge, and which have the tail more attenuated, and the teeth simple, in the older individuals at least, is by some authors made a subgenus of *Liparis*. Characters of particular ones certainly make separation rather difficult, yet from the general average it seems better to regard its species as generically distinct. To this group we should assign *L. Reinhardt*, *L. gelatinosus*, *L. micropus*, and *L. major* (*Actinochir* of Gill). Besides the species enumerated, there are several that cannot be placed on account of the insufficiency of the descriptions. *Liparis tunicata* Reinhardt, with forty-six vertebræ, probably belongs with *L. pulchellus*; though differing in proportions, it is evidently closely allied to *L. Agassizii*.

*Liparis* as a genus originated with Artedi, 1738. The diagnosis given by Scopoli, 1777, prevents rejection on account of the early date or of the insufficient characterization.

#### LIPARIS.

#### **Liparis Montagu.**

Plate VII. Fig. 6-20. Plate VIII. Fig. 8-11.

*Cyclopterus Montagu* Don., 1805, Brit. Fish., III. pl. 68; Mont., 1811, Mem. Wern. Soc., I. 91, p. 5, fig. 1; Jen., 1835, Brit. Vert., 473; Johnst., 1838, Berw. Nat. Club, I. 175; Buckl., 1881, Brit. Fish., 96; *C. Montacuti* Turt., 1807, Brit. Fauna, 115.

*Liparis Montagu* Cuv., 1817, R. An., II. 227, — 1829, R. An., II. 346, — 1836, R. An., I. 573; Flem., 1822, Phil. Zool., 357, — 1828, Brit. An., 190; Yarr., 1836, Brit. Fish., II. 277; Temp., 1837, Ann. Mag. N. H. (2), I. 412; Wilson, 1838, Ichth. in Encycl. Brit.; Thomp., 1839, Charlesw. Mag. (2), III. 586; Val., 1836-50, Cuv. R. An., ed. ill., Poiss., 511; Krøy., 1845, Dan. Fiske, II. 519, — 1847, Voy. Scand., pl. 13, fig. 1, a-f, — 1862, Nogle Bidr. til Nord. Ichth., Nat. Tidsskr., 3 R., I. 243, extr. p. 11; White, 1851, Cat. Fish., 110; Ham., 1854, Brit. Fish., II. 252, 404; Thomp., 1856, Hist. Irel., IV.

221; Lützk., 1860, Nat. For. Vid. Medd., extr. p. 57, — 1887, *Dijmphna*, Kara-Havets Fiske, 139, 504; Gth., 1861, Cat., III. 161; Schleg., 1862, *Nederl. Visschen*, 61; Couch, 1863, *Brit. Fish.*, II. 193, pl. 107, fig. 1, 2; Gill, 1864, *Pr. Phil. Ac.*, 193, — 1873, *Cat. Fish. E. C. N. A.*, 21; Put., 1874, *Pr. A. A. S.*, 335; McInt., 1875, *Fish St. And.*, 175, — 1885, *Rep. Mar. Lab.*, 434, pl. 16, fig. 5, *Fish Scotl.*, App. F, 55; Coll., 1875, *Norges Fiske*, 63, — 1879, *Vid. Selsk. Forh. Chr'a*, extr. p. 37 (varieties *principalis*, *maculatus*, *annulatus*, *striatus*, *pictus*, *obscurus*, *liparoides*, and *Ekstromi*); Malm, 1877, *Göt. & Boh. Fauna*, Rygg., 103, 451, pl. 7, fig. 1; Goode & B., 1879, *Bull. Essex Inst.*, XI. extr. p. 12; Bean, 1879, *Pr. U. S. Mus.*, II. 20; Winth., 1878, *Nat. Tidsskr.* (3), XI. 272, pl. 1, figs. 14–16, — 1879, *Nat. Tidsskr.*, 3 R. XII. *Prodr. Ichth. Dan.*, 20; Jor. & Gil., 1882, *Bull. 16 U. S. Mus.*, 743; Möb. & Hke., 1884, *Viert. Ber. Unt. Deutsch. Meere*, 204, 225, fig.; Day, 1884, *Fish. Brit. & Irel.*, I. 186, pl. 56, fig. 2; Hans., 1885, *Zool. Dan.*, Fiske, 40, pl. 6, fig. 13, pl. 7, fig. 1; Jor., 1887, *Rep. U. S. F. Comm.*, 1885, 903; Smith, 1888, *Pr. R. Soc. Edinb.*, 144–149, pl. 7, fig. 10.

*Liparis Ekstromi* Lützk., 1865, *Vid. Medd. Nat. For. Kbh.*, 221; Winth., 1879, *Nat. Tidsskr.*, 3 R. XII.; Hans., 1885, *Zool. Dan.*, Fiske, 41, pl. 7, fig. 3. *Liparis lineatus* Malm, 1865, *Förh. Skand. Naturf.*, 9 Møte, 412. *Liparis maculatus* Malm, 1865, *Förh. Skand. Naturf.*, 9 Møte, 412, — 1877, *Göt. & Boh. Fauna*, 103, 461, pl. 7, fig. 3. *Liparis vulgaris* Malm, 1877, *Göt. & Boh.*, *Fauna*, 103, 447, pl. 7, fig. 2. *Liparis barbatus* Stuck., 1884, *Bull. Ac. Belg.* (3), VIII. 74, pl.; Bean, 1879, *Pr. U. S. Mus.*, II. 20.

*Liparis* — Gill, 1865, *Canad. Nat.*, Aug. *Liparis* (sp.?) allied to *L. arctica* Put., 1867, *Stor. Fish. Mass.*, 280.

*Montagu's Sucker* Penn., 1812, *Brit. Zool.*, III. 183; Couch, 1863, *Hist. Brit. Fish.*, II. 193, pl. 107, fig. 1, 2. *Gobius* Müll., 1806, *Zool. Dan.*, IV. 16, 38, pl. 134 & 151 A. 1–3. *Liparis gobius* Cuv., 1829, *R. An.*, II. 227, — 1836, *R. An.*, I. 573; Schag., 1838, *Vet. Ak. Handl.*, 248; Val., 1840, *Cuv. R. An.*, ed. ill., Pois., 511. *Cyclopterus (Liparis) liparoides*, and *gobius*, Nilss., *Prodr. Ichth. Scand.*, 62. *Lepidogaster cornubiensis* Thomp., 1835, *Pr. Z. S.*, 81. *Liparis reticulata* Couch, 1863, *Brit. Fish.*, II. 195, pl. 107, fig. 3.

B. 6; D. 28–33; A. 23–27; P. 29–30; C. 14–17; Vert. 38–39; Cæca 22.

Form rather elongate, stout anteriorly, compressed and tapering behind the abdominal chamber, depressed on head and snout, and flattened under the belly. Body cavity about three sevenths of the length without the caudal, or three eighths of the total length, longer in females than males. On an average specimen the length of the head equals its depth, which equals either depth or width of body, and is contained four and two thirds times in the length, excluding the caudal fin. Snout broad, blunt, rounded, twice as long as the eye, one third of the length of the head. Mouth moderate, anterior, its angles anterior to half-way from eye to end of snout. Lips slightly swollen; lower short, interrupted below the symphysis of the jaws, a little more than one third of the width of the mouth. A secondary lip, or fold, above the upper, with six to eight notches, at the openings of the pores. Teeth small, in pavement, alternating in the different series, base round, apex compressed, tricuspid. From each side of the middle of the chin a series of seven pores extends backward and curves up the side of the head to a line from the eye to the gill opening. The upper pore is about midway between the opening and the eye; five of the pores are on the lower surface. In the edge of the fold just above the

upper lip, on each side, there is a second curved series of six pores, of which the last one is close behind the eye. Three of these pores are in the edge of the fold, forming notches or scallops; the fourth is just above its end, and the fifth is on the cheek below the eye. There are three pores near the upper edge of the gill opening, at the extremity of the lateral line. Eye small, half as long as the snout, one sixth as long as the head, or two fifths as wide as the flattened interorbital space. Posterior nostrils between the eyes, with very short tubes; anterior in front of these, with longer ones. Gill opening narrow, little wider than the eye, entirely above the base of the pectoral. The nape and the lower portions of the cheeks are somewhat swollen. Skin thin and but slightly attached, though close fitting; on the male in breeding season it is roughened with numerous small papillæ, each bearing a minute styloform spine (Plate VII. Fig. 19); on the females and young it is more smooth. The dorsal and the anal are distinct, but connected with the caudal by a low membrane; they are rounded posteriorly, and rise gradually from the foremost rays. The greatest height of the dorsal is not quite half that of the body. In the breeding season the outer ends of the rays are prolonged beyond the membrane more than at other times. This is especially the case with five or six of the anterior, in front of the shallow notch separating the fin into two portions. Six or eight of these rays are apparently unsegmented; on these the nuptial growth is long and flexible. The first ray of this fin is about opposite the hinder edge of the disk. The first ray of the anal is opposite the eighth or ninth of the dorsal; the fin extends back a trifle farther under the caudal. Caudal not quite as long as the head, subtruncate or rounded posteriorly, median rays entirely behind the end of the anal. Disk subround, two thirds of the length of the head, equalling the distance from the first ray of the anal or three fourths of its distance from the chin. The vent is nearer to the disk than to the first anal ray, and the distance from the latter to the base of the caudal is one and one half times its distance from the end of the snout.

Pectorals broad, rounded posteriorly in the upper portion, with the rays prolonged beyond the margin in a short fringe (more pronounced in the nuptial season); lower fringe longer, several of the rays at the side of the disk longest, producing the appearance of a notch in the fin. A low fold of the skin connects the pectorals in front of the disk. The nuptial extension of the rays is to be seen on all the fins of some specimens; it is less on

the female than on the male. On the former the skin is nearly or quite smooth, and the growth peculiar to the reproductive season is most marked on the anterior portions of dorsal and anal, and on the lower pectoral.

Olivaceous to brown, punctulate and clouded with darker, tinted with reddish to yellowish; in cases with cloudings, or nearly regular transverse bands, on the vertical fins; in others with markings reduced to mere freckles. Frequently the outer borders of all the fins have darker blotches.

Specimens of two and three fourths inches in length have the eggs fully developed. The largest at hand is a female of four and one half inches.

Two specimens in the Museum collections bear the label, "Triest, C. L. Salmin"; their formula is D. 29-30; A. 24; P. 30; C. 14-17; Vert. 38. Their colors are so faded nothing can be determined of the original appearance.

In the collection there are also specimens from various parts of the coast of England and Scotland, from Grand Menan, from Eastport, and from Portland Harbor, Maine, from Massachusetts Bay, and, south of Cape Cod, from the shores of Connecticut. Numerous individuals were taken off Portland; they are somewhat abundant in March and April, when they venture into shoal water to deposit their eggs. They are found among the weeds or under stones, where they lie with the tail turned forward, as in Figure 22 of Plate VII. Young ones are frequently met with inside of the shells of pectens.

#### ANATOMY.

As in all the species of this family, the bones are very light; they are perhaps a trifle less firm than those of *L. mucosus*, which are the best ossified of those that have come to our attention. Viewed from above, the skull of *L. Montagu* is broader than long. The width of the crown at the occiput is nearly equal to its length from the ethmoid, which is at the apex of its triangular area. Across the interorbital space the frontal ridge is prominent. In front of it near each eye another ridge extends forward to one of the turbinals. The occipital crest is not especially prominent; it has not so much of an upward curve posteriorly as that of *L. mucosus*. The slender prolongation from the suborbital to the hinder border of the moderately expanded upper limb of the preoperculum is less than half as long as the forward section of the chain; its position is nearly horizontal. There is but little curvature in the posterior extremity of the

operculum. Both suboperculum and interoperculum are wider and more robust in the anterior half. Pleurapophyses are present. This is one of the species of *Liparis* proper, all of which, so far as examined, have thirty-eight or thirty-nine vertebræ. The hindmost segment of the column, as in the family at large, sends backward and obliquely upward a spine connected with the lower edge of which there are two broad compressed plates, widening backward and bearing the caudal rays on their hind border. The lower of the plates reaches the lower edge of the centrum. Compared with *L. Agassizii*, Plate III. Figs. 2, 3, the top of the head is more triangular and more strongly ridged, the orbital spine is shorter, and the dorsal and anal fins are not so perfectly continuous with the caudal.

The gill rakers are more numerous on the second and third gills; they are provided with small teeth. The esophagus is short; the stomach is U-shaped, as broad as long; the pyloric cæca vary in number from twenty-two, on a female, to twenty-eight, on a male; the length of the intestine equals about half that of the specimen; the kidneys are elongate, slender, and fused about three fourths of their extent; the bladder is simple and rather large; the ovaries are broad and thick, connecting posteriorly and discharging through a common duct; the liver is large, composed of a left upper lobe, shorter and narrower, a left median lobe, longer, broader, and thicker, and a right lobe shorter than the left upper; the gall bladder is small and elongate.

The mass of the brain is larger as compared with the entire bulk of the fish than in *Cyclopterus*. In that genus the brain cavity is much too large for the brain; in *L. Montagu* the chamber is almost entirely filled. A closer approach to the Cottoid brain is made in this species than in either of its congeners. As will be seen in Plate VIII. Fig. 9, the width across the optic lobes is greater in proportion to the length. Each hemisphere is somewhat smaller than either of the optic lobes, or than the cerebellum. The latter extends back to cover the sinus; at each side of it the restiformia are rather prominent; behind it the *lobi posteriores* are very distinct; and behind them, again, there is an opening into the ventricle.

**Liparis mucosus.**

**Plate V. Figs. 1-5; Plate IX. Fig. 1; Plate X. Fig. A.**

*Liparis mucosus* Ayres, 1855, Pr. Cal. Acad., I. 21, — 1873, Pr. Cal. Acad., I. (reprint) 22; Gth., 1861, Cat., III. 165, 559; J. & G., 1881, Pr. U. S. Mus., IV. 62, — 1882, Bull. 16 U. S. Mus., 741.

*Liparis (Neoliparis) mucosus* St., 1875, Ichth. Beitr., III. 51, — 1876, S. B. Ak. Wien, LXXII. 82; Jor., 1887, Rep. U. S. F. Comm., 1885, 903.

*Neoliparis mucosus* J. & G., 1880, Pr. U. S. Mus., III. 454.

B. 6; D. 34-36; A. 25-27; P. 30-32; C. 14-17; Vert. 39.

One of the more elongate species. Slightly depressed and broader forward of the dorsal, stout and compressed behind the abdominal cavity. The upper and the lower outlines form long curves in the posterior half of the body, and approach each other gradually in the anterior. Greatest height, behind the middle of the total length, one fourth of the length, without the caudal. Snout to anal fin not quite as far as from first anal ray to base of caudal. Head short, about one fifth of the entire length, depressed, convex on the occiput, less so between the eyes, swollen on cheeks and internasal region (much less on young), snout blunt, broadly rounded, opercular spine long. Mouth-cleft moderate, little wider than the interorbital space, maxillary not reaching a vertical from the eye. Teeth tricuspid, losing the cusps and becoming chisel-shaped or blunt with use, bases strong, rounded, apices compressed. Eyes small, one sixth to one seventh as long as the head, half as long as the snout. Posterior nostril smaller, above the eye, half the ocular diameter from the anterior, which is larger and has a short tube. Vent nearly one third of the distance from the snout to the base of the caudal. Ventral disk small, half as long as the head, nearer to the vent than to the end of the snout, its middle on a vertical from the gill opening. Gill opening moderate, half as wide as the mouth, one third of its length descending in front of the base of the pectoral. Skin thin, loose, covered with slime. Pectoral rather short, reaching as far back as the vent, broadly rounded in the upper portion, with the fourth to the eighth rays, at each side of the disk, prolonged into a sort of fringed lobe. Dorsal beginning over the middle of the length of the pectoral, with six or seven of the anterior rays separated from the posterior by a space in which the rays are shorter, having the appearance of two nearly distinct fins. Anal with its first ray opposite the dorsal notch, about two fifths of the distance from the snout to the end of the caudal, the base of which is hardly reached by the last ray. Caudal nearly as long as the head, subtruncate.

Color light olivaceous, punctulate and clouded with brown to darker or chocolate brown, snout and borders of fins darker; caudal, and sometimes dorsal and anal, with brown in irregular narrow transverse streaks. Largest specimen five and three quarters inches in length.

*Hab.*—San Francisco; Monterey; Coast of California; St. Paul's, Alaska; Kamtchatka; Plover Bay, Siberia; Unalashka.

Small specimens from St. Paul's differ from the above description in having the median caudal rays somewhat more prolonged, the nasal region less prominent and convex, and nebulous patches of brownish on the fins and body; all of which are no doubt modified with age. Some are much darker than others. The fore part of the head appears narrower, and the body in front of the vent much stouter, than in the larger specimens.

#### ANATOMY.

The skeleton in specimens of about six inches is nearly as firm as that of the average teleostean. Due allowance must be made in all comparisons on account of age. By comparing equal sizes, we find no great amount of difference in the amount of ossification between the species of the subgenus *Liparis*. On the larger individuals of *L. mucosus* the suborbital spine, about three fifths of the length of the chain, is longer than on the young. The comparative width of the expanded upper limb of the preoperculum also is greater. Both the anterior and the posterior borders of the operculum are curved; the posterior extremity is elongate. The limbs of the interoperculum differ less in size and flexibility than in the preceding species. Near the mid-length of the interoperculum there is a slight irregularity; otherwise the curvatures are almost regular in the two halves. Parietals, frontals, paroccipitals, and exoccipitals are broad. The occipital crest is short, but prominent. From the crest, in aged individuals, there is a low ridge passing forward and bifurcating behind the frontal transverse ridge. One of the more evident of the distinguishing features of this species appears in the teeth, which are larger, with cusps less distinct and sharp, and frequently so much worn as to look like blunted or rounded simple crowns. Figure 5 of Plate V. represents the common form of tooth; the outlines on Plate IX. are from irregular and unusual ones. While the teeth of *L. mucosus* are larger than those of *L. calliodon*, those of the latter are really more harsh to the touch because of their sharpness. The plates behind the last vertebra are short and broad; the lateral ridges from the

lower edge of the centrum to the upper hinder angle of the upper plate are strongly indicated. The anterior of the ventral rays is cultriform, more curved than those shown on Plate VIII. Figs. 12-14, and the angle in the other five, passing backward, varies from a right angle to a more acute.

The liver is large; the left lobes are about equal in size and scarcely distinct, the incision being short; the right lobe is shorter and not so broad. The pyloric portion of the stomach is not as long as the cardiac. There seem to be quite as many cæca as in *L. Montagu*, if not more; thirty-three were counted in a badly preserved example. Within the stomach there were a number of crustacea of various species, and amongst them a dozen small stones, probably taken unintentionally with the crustaceans. This fact suggests that other species habitually feeding amongst the weeds and grasses would take in more or less of them while in pursuit of their animal food, and in this way some of the Discoboles may have been led on to depend eventually in some degree on vegetation for subsistence.

### ***Liparis calliodon*.**

Plate VI. Fig. 1-5.

*Cyclopterus calliodon* Pallas, 1831, Zoog. Ross.-Asiat., III. 75.

*Liparis calliodon* Gthr., 1861, Cat., III. 162; *L. calliodon*, Bean, 1881, Pr. U. S. Mus., IV. 247, 271; J. & G., 1882, Bull. 16 U. S. Mus., 743; Jor., 1887, Rep. U. S. F. Comm., 1885, 903.

*Liparis cyclopus* Gthr., 1861, Cat., III. 163; Put., 1874, Pr. A. A. A. Sci., 338; J. & G., 1880, Pr. U. S. Mus., 454, — 1881, Pr. U. S. Mus., IV. 62, — 1882, Bull. 16 U. S. Mus., 743; Bean, 1881, Pr. U. S. Mus., IV. 247, 271; Jor., 1887, Rep. U. S. F. Comm., 1885, 903.

B. 6; D. 33-34; A. 28-29; P. 41-43; C. 20; Vert. 10 + 29.

Moderately elongate and stout, compressed posteriorly, rather thick behind the abdomen, tapering, and with upper and lower outlines slightly convex, between dorsal and anal; depth four and two thirds times in the length, excluding the caudal. The body cavity in the female is more than half of the total length, excluding the caudal. Head short, about four times in the length, without the caudal, not quite as wide as long, cheeks and occiput swollen, descent into the interorbital space abrupt, internasal region prominent, snout broad, blunt, rounded, nearly one and one fourth times the length of the orbit. Mouth anterior, opening slightly upward, angle very little in front of a vertical from the anterior margin of the orbit. Teeth small, tricuspid, lightly compressed at the apex, harsh to the touch. Eye medium, more than one fifth of the length of the head, one half of the interorbital space, four fifths of the preorbital



length, lateral. Posterior nostril pore-like, on the interorbital space near the eye; anterior larger, tubular, nearly three fourths of the ocular diameter farther forward. Disk subcircular, half as long as the head, distant a trifle more than its own length from the lower lip, or almost twice as far from the vent. Vent more than half-way from disk to anal, its distance from the snout about four fifths of that from the base of the caudal. From the snout to the first ray of the dorsal is more than one third of the distance to the base of the caudal. Anterior rays of the dorsal feeble, short, and unsegmented, fifth and sixth little if any shorter. Dorsal and anal broadening backward, not at all or but slightly connected with the caudal, rounded posteriorly. The specimens in hand show no unions with the tail fin, but it is possible a narrow membrane has been carried away. The anal extends a little farther back than the dorsal; its first ray is less than half-way from the snout to the forward extremity of the caudal rays. Pectoral short, not reaching as far back as to a vertical from the vent; upper portion broadly rounded; an excavation at the side of the disk; lower portion with long protruding rays. The fourth and fifth rays of the lower pectoral are the longest in the fin. Caudal subtruncate, length of rays nearly equal to height of body. In a female measuring four and a half inches the spawn is nearly ready for extrusion.

Color light olivaceous, in alcohol, punctulate with darker. The punctulations form cloudings and blotches on the back and flanks. Fins darker, with irregular blotches or, posteriorly, transverse streaks or bands.

The specimens described are said to have been taken near San Francisco. They agree well with those described by Pallas, from Kamtchatka, except in regard to the number of rays in the anal and the streak from the upper jaw through the eye. The markings or life colors cannot be made out accurately from our examples. On one which apparently had no more than twenty-five anal rays, twenty-eight were discovered after removing the skin. As was remarked of *L. cyclopus* by Dr. Günther, this species agrees well with *L. liparis*; it is distinguished by shorter fins and larger number of rays in pectorals and caudal, and by the shape of the head from the eyes forward.

The following is the description given by Pallas:—

“*Cyclopterus oblongus compressus, capite depresso majusculo, dentibus apice trilobis.*

“*Dodrantal minor, gracilis, caput corpore crassius, depressiusculum, rostro valde depresso, rotundato; maxilla inferior in superiorem incidens utraque margine scaberrima et*

intra marginem serie denticulorum minimorum, basi cylindraceorum, apice trilobo terminatorum, quales in nullo pisci observavi. Oculorum irides angusto circulo pupillari fulvo. A maxilla superiore utrinque processus sub cute tenuis osseus, quasi zygoma, per discum operculorum. Opercula mollia rotundata, una cum membranis branchiostegis sexradiatis undique pelle adnata, relicto tantum spiraculo lunato utrinque ad dorsum. Corpus alepidotum, albo teretiusculum inde compressum, cauda cathetoplatea. Cutis ubique fusco-punctata, mollis. Color in dorso lutescente fuscus, subtus fulvescens; lituræ rotundatæ fuscae secundum lineam lateralem. Striga argentea a maxilla superiore per oculum et opercula. Pinnae pectorales fere ad jugulum positæ, longiusculæ, radiis mollibus, tenuissimis. Côtula jugularis inter membranas branchiostegas sita, parva, carnosæ, ruga medii disci pinnatæ. Pinna dorsalis unice fere ad caudam continuatæ, prior radiorum 33. paulo pone spiracula incipiens, altera ab ano, circa medium longitudinis, radiorum 24. Caudæ pinna fusco-nebulosa, longiuscula, subæqualis, rad. 15.

“Ad Camtschatcæ pariter et insularem littora frequenter a fluctibus eiecitur.

“Camtschadalis *Cmaïs*. Aleutis *Tomdogduk*.”

#### ANATOMY.

In the solidity of its skeleton this species approaches closely to *L. mucosus*; its bones are nearly as firm as those of most ordinary bony fishes. On the top of the skull the frontal ridges spread more rapidly, and make a much more open curve, than those of the species mentioned. These ridges, and those behind the turbinals, are moderately prominent. As in *L. mucosus*, there is a strong ridge from the lower limb of the preoperculum to the articulation of the operculum with the hyomandibular. The operculum has less of the boot-shape; it is nearly represented by that of *L. Agassizii* in Plate III. Figure 2. In the suboperculum the anterior limb is the longer, stronger, and more curved. Half of the greatest length of the suborbital chain is comprised in the spine-like extension. The upper limb of the preoperculum is moderately broad. By the forms of their teeth the larger specimens of *L. mucosus* and *L. calliodon* are readily distinguished from the other species. The shape of the teeth of *L. calliodon* is shown by Figure 5 of Plate VI.; they are smaller and more harsh than those of *L. mucosus*. In both of these species the cusps are broadened, rounded, and compressed, instead of being conical and pointed, as in most other cases. The plates on the hindmost vertebra are of equal length; the lateral ridges on the upper are sufficiently distinct.

The brain is elongate; the olfactory nerves are short; the hemispheres and optic lobes are about equal in size; and the cerebellum is slightly larger, extends back to the posterior lobes, and exposes a margin of con-

siderable width at each side when viewed from above. In most respects this brain agrees well with that of *L. mucosus* or of *L. liparis*.

The number of cæca approaches that of *L. Montagu*. A similar shape obtains in the stomach, which was filled with crustaceans resembling shrimps.

### *Liparis liparis*.

Plate VII. Figs. 1-5, 21, 22.

*Liparis* Artedi, 1738, Descr. Spec. Pisc. 117.

*Cyclopterus liparis* Linn., 1760, Systema, ed. 12, I. 414, — 1767, ed. 13, I. 414; Phipps, 1773, Voy. North Pole, 189; Müll., 1774, Linn. Natursyst., III. 333; Höslin, 1781, Lehr-Buch, I. 578; Bonn., 1788, Ichth., 27 (descr. only); Gmel., 1789, Syst. Linn., I. 1477; Walb., 1792, Art. Gen. Pisc., 489, in part; Donnd., 1798, Beitr., III. 817; Wilh., 1799, Unterh. Naturg., IX. 130, pl. 16, fig. 49; Georgi, 1801, Geog.-Phys. Nat. Besch., VII. 1967; Schn., 1801, Bl. Ichth., 569; Oken, 1816, Lehrbuch, III. 135; Ross, App. Parry's Voy., 199; Pall., 1831, Zoogr., III. 76; Jen., 1835, Brit. Vert., 472; Reinb., 1838, Ichth. Bidr., 109, 116; Schill., 1839, Naturg. Fische, III. 91; Gmel., 1839, Gemein. Naturg. Fische, 74; Nilss., 1855, Skand. Fauna, IV. 237; Schleg., 1862, Nederl. Visschen, 60, pl. 6, fig. 2; Buckl., 1881, Brit. Fish, 96; *Cyclogaster liparis* Gron., 1854, Cat., ed. Gray, 40.

*Liparis liparis* Cuv., 1817, R. An., II. 227, — 1829, R. An., II. 316, — 1836, R. An., I. 573; Griff., 1834, An. King., 502; Val., 1840, Cuv. R. An., ed. ill., 511; Gthr., 1882, Pr. Soc. Edinb., XI. 679; Jor., 1887, Rep. U. S. F. Comm., 1885, 103; Gill, 1891, Pr. U. S. Mus., XIII., pl. xxx, figs. 2-5, skull.

*Cyclopterus lineatus* Lepech., 1774, Nov. Comm. Ac. Petrop., XVIII. 522, pl. 5, figs. 2, 3; Bonn., 1788, Ichth., 28, pl. 86, fig. 354; Gmel., 1789, Linn. Syst., I. 1478; Walb., 1792, Art. Gen. Pisc., 490; Donnd., 1798, Beitr., III. 818; Schn., 1801, Bl. Syst. Ichth., 198; Georgi, 1801, Geogr. Besch., VII. 1968; Sonn., 1803, Hist. Poiss., V. 273; Shaw, 1804, Gen. Zool., V. 295; Turt., 1806, Syst. Linn., I. 907.

*Liparis lineatus* Kröy., 1847, Nat. Tidsskr. (2), II. 284, — Voy. en Scand., pl. 13, fig. 2, a-g, — 1862, Nat. Tidsskr. (3), I. 244, 539; Lütck., 1860, Nat. For. Vid. Medd., 173, — 1862, Vid. Medd. 1861, 243, varieties *paucistriata* and *multistriata*, pl. 7, fig. 1, — 1887, Dijnph. Zool., Kara-Havets Fiske, 139, 505; Gill, 1873, Cat. Fish E. C. N. A., 21; Coll., 1875, Norges Fiske, 65, — 1879, Vid. Selsk. Forh. Chr'a, No. 1, p. 41 (varieties *assimilis*, *stellatus*, *subfuscus*, *scorpioides*, *mixtus*, *decorus*, *scriptus*, *lineatus*, *arcticus*, and *fuscus*), — 1880, Norsk. Nord. Exp., Fiske, 50; Jor. & Gil., 1882, Bull. 16 U. S. Mus., 742; Stein., 1886, Jan. Mayen Exp., III. 106.

*Liparis vulgaris* Flem., 1822, Phil. Zool., 387, — 1828, Brit. An., 190; Yarr., 1836, Brit. Fish., II. 274; Wilson, 1838, Ichth. in Encycl. Brit.; Parn., 1838, Fish Firth of Forth, 383; Ham., 1854, Brit. Fish., II. 252, 404, pl. 14, fig. 1; Gth., 1861, Cat., III. 159, — 1874, Ann. Mag. (4), XII. 139; Fortin, 1863, Rep. Com. Cr. Lands, 161; Malmg., 1865, Spetsb. Fisk., 510; McInt., 1866, Fish N. Uist, Pr. R. Soc. Edinb., V. 614, — 1875, Fish St. And., 175; Put., 1873, Pr. B. N. H. Soc., 114, — 1874, Pr. A. A. S., 335; Bean, 1879, Pr. U. S. Mus., II. 20; Goode & B., 1879, Bull. Essex Inst., XI. extr. p. 12; Winth., 1879, Prodr. Ichth. Dan., 20, Nat. Tidsskr., 3 R, 12<sup>e</sup> Bd.; Mor., 1881, Poiss. Fr., III. 353; Mob. & Hke., 1884, Viert. Ber. Unt. Deutsch. Meere, 204, 225, fig.; Day, 1884, Fish. Brit. & Irel., I. 184, pl. 56, fig. 1; Hans., 1885, Zool. Dan., Fiske, 41, pl. 7, fig. 2; Smith, 1888, Pr. R. Soc. Edinb., 144.

*Liparis barbatus* Ekst., 1832, Vet. Ak. Handl., 168, pl. 5, — 1835, Fische Mörkö, 113, pl. 5; Kröy., 1845, Dan. Fiske, II. 534; Nilss., 1855, Skand. Fauna, IV. 237; Lütck., 1860, Vid. Medd., 169, — 1862, Nat. För. Vid. Medd., 219, 261; Malmg., 1864, Spetsb. Fisk., 24, — 1865, Öf. Vet. Ak. Förh., 510; Stuck., 1884, Bull. Soc. Belg. (3), VIII. 74, fig.

*Liparis stellatus* Malm, 1865, Förh. Skand. Naturf. 1863, 9 Möte, 412, — 1877, Göf. och Boh. Fauna, 103, 457, pl. 7, fig. 5; Winth., 1879, Nat. Tidsskr., 3 R, 12<sup>e</sup> Bd.; Hans., 1885, Zool. Dan., Fiske, 42, pl. 7, fig. 4.

*Liparis Ekstromi* Malm, 1865, För. Sk. Nat., 9 Möte, 412, — 1877, Göf. & Boh. Fauna, 103, 451.

*Gobius smyrnensis* Bonn., 1788, Ichth., 66, pl. 36, fig. 144; LaC., 1800, Hist. Poiss., II. 579, — *Le Cycloptère liparis*, p. 69, — *Cyclopterus musculus*, 1802, Poiss., IV. 683. *Le Cycloptère barbu* Sonn.,

1803, Hist. Poiss., V. 272. *Gobio* K lreuter, 1764, Nov. Comm. Ac. Petrop., IX. 439, pl. 9, figs. 5, 6. *Gobius* M ll., 1806, Zool. Dan., IV. 16, pl. 131. *Liparis communis* Sab., 1824, App. Parry's Voy., cexii; Ross, 1835, Ross's Sec. Voy., xlvii; Rich., 1835, F. B. Am., III. 263.

*Liparis nostras* Johnson, 1686, App. Willugh. Hist. Pisc., p. 17. *Liparis ophidoides*, Swains., 1838, Nat. Hist. Fish., II. 339. *Unctuous Sucker* Penn., 1776, Brit. Zool., III. 135, pl. 21, fig. 3.—1812, Brit. Zool., III. 179, pl. 24. *Unctuous Lump-Sucker* Don., 1803, Brit. Fish., II. pl. 47. *Sea Snail*, Willugh., 1686, Hist. Pisc., App., 17; Petiver, 1711, Gazoph., pl. 51, fig. 5; Couch, 1863, Brit. Fish., II. 190, pl. 105.

B. 6; D. 33–35; A. 27–29; P. 34–37; C. 12–14; Vert. 38–39; C ca 10–13.

Body moderately stout, somewhat high on the shoulders, compressed behind the body cavity in the caudal portion, which is deep and rather thick anteriorly, tapering rapidly. Body proper about half of the entire length to the base of the tail. Length of the head little less than its width, a little more than its depth, about the same as the greatest depth of the body, and contained about three and one half times in the total length, without the caudal. Snout short, broad, blunt, nearly three and one half times in the head, very convex in the internasal region. Mouth moderate, maxillary reaching a vertical from the eye, lower jaw shorter. Teeth small, in pavement, alternating in the different rows, tricuspid. Lower lip interrupted in the middle, one third or more of its length. The fold above the upper lip with six to eight notches, below the openings of the pores. A series of six pores, on each side, from the middle of the fold above the upper lip, passes backward and curves up behind the eye; another series, of seven on each side, passes from the middle of the chin back and upward toward the upper edge of the gill opening. Eye small, nearly as long as the snout, contained four and one half times in the length of the head, or less than twice in the convex interorbital space. Nasal tubules short; posterior smaller, between the eyes; anterior farther forward, larger. A large pore is situated a short distance in front of the nostril toward the tip of the snout. Gill openings narrow, not as wide as the eye, above the base of the pectoral. Nape and shoulders high. Cheeks swollen. Skin smooth, thin, easily detached.

Dorsal and anal fins rising gradually, the rays attaining their greatest height in the hinder third of the length, united with the caudal by membrane. The separation of the three fins is less marked than in *L. Montagu*, so much so that it is difficult in some cases to determine whether certain rays belong to the caudal. Dorsal notch shallow or absent, most noticeable in the breeding season. First ray little farther back than the opercular angle, or the hinder edge of the disk, five or six of the anterior rays crooked

and twisted, as in *L. Montagui*, and without apparent segmentation. Evidently these rays are affected by a nuptial growth, which is not so patent above the skin, on the ends of rays, as in other species. In the anal the first ray is about opposite the seventh or eighth ray of the dorsal; the fin extends farther back than the latter, reaching under nearly one third of the caudal. Caudal slightly rounded posteriorly; the longest rays are one half to two thirds of the length of the head. Disk subcircular, half as long as the head, equal the distance from the chin, less than the distance to the anal. Vent nearly half-way from disk to first anal ray, which latter is half-way between the snout and the base of the caudal. The position varies in the sexes. The body cavity is longer in the females, and the vent is farther back; this applies to all the species.

Pectorals broad, deeply notched below the middle of the hind border; rays of the lower portion extending beyond the membrane, a couple of the longer sometimes reaching almost as far back as to the vent. A slight fold of the skin unites the fins in front of the disk.

Olive to brown, light to dark, punctulate and clouded, blotched, banded, vermiculate, or longitudinally striped with darker and with lighter. In life the tints vary from lilac to reddish or yellowish, with spaces on certain individuals often nearly white, and every variety of coloration may be taken in a single locality. This being the case, it is thought best to treat the striping, freckling, banding etc., merely as marks of individual variation, and not as characters indicating established varieties. On the striped specimens the number of lines varies greatly, of the spotted ones no two are alike, and the same is true of every other pattern. Most often there are blotches on the posterior portions of the anal and the dorsal; frequently they take on the appearance of transverse bands, as is still more often the case on the caudal.

The specimens in the Museum were secured from the Cheshire coast and other points in Great Britain, from Ostend, and from various localities off the coast of Massachusetts, Connecticut, and Maine. A small specimen, with the locality "Off Block Island, from a pecten," that may not be positively identified, bears peculiar markings: from the tip of the snout a white line passes above each eye to meet its fellow of the opposite side at the beginning of the dorsal, which is white; and a white spot as large as the orbit extends downward, and slightly backward from the eye. These marks are very distinct, and they give the specimen quite a different appearance from that of another of the same size and origin, uniform in coloration.

## ANATOMY.

No very marked differences from others of the same section of the genus occur in the skeleton of this species. The skull at hand bears a moderate occipital crest, and a pronounced ridge across the interorbital space, with others nearly as prominent from the latter toward the ethmoid. The forehead is rather broad, and behind the eyes the crown is nearly quadrate. In the frontal ridge the curve is intermediate between that of *L. calliodon* and *L. mucosus*. About half of the greatest length of the suborbital chain equals that of the suborbital spine. A moderate amount of expansion obtains in the upper limb of the preoperculum. On the operculum the outlines are comparatively straight. The posterior limb of the suboperculum is the shorter, thinner, and more flexible. The interoperculum is rather short, and somewhat forward in position; it is stouter in the middle and more slender backward. Posteriorly the maxilla curves downward; a little more of it is behind its suborbital angle than in other species. The fan-like plates behind the hindmost vertebra are short and broad, the lower a trifle the shorter; the lateral ridges indicative of the so called embryonic spine are prominent. In the disk all of the rays are more bent than those figured in Plate VIII. Figs. 12-14; though nearly straight in most of its extent, the anterior ray is sharply turned backward near its inward extremity. It is to be remembered, in making comparisons from these data, that they are taken from an individual of three and a quarter inches.

The brain is not so much like that of the Cottoid as that of *L. Montagui*; it is more elongate, and the difference in size between the hemispheres and the optic lobes is not apparent, while the cerebellum is larger than either. Backward, the last reaches to the prominent posterior lobes; at its sides, a considerable margin is exposed. Behind the posterior lobes an opening into the ventricle is seen, much as in Plate VIII. Fig. 9. The olfactory nerves are short. The most patent difference between this brain and that of *L. Montagui* lies in the slightly greater width of the hemispheres as compared with the optic lobes, which, with the wider bones of the forward portion of the skull, is what might be expected in contrasting with a species having a more pointed head.

The liver is large; the median, or lower left, is the largest and longest of the lobes; the upper lobe of the left side is narrower, and appears as if divided into two lobes; the right lobe is shortest, and nearly as broad as the

median. As in the other species, this organ is much affected by individual variation. The stomach closely resembles that of *L. Montagui*, but in the examples dissected has only ten to thirteen cæca, whereas that species has more than twenty. Each of a number of the cæca contained a small lump of a dark-colored substance. The food in the stomach was composed entirely of small crustacea. The bladder is of moderate size; the kidneys are elongate, slender, more massive anteriorly, and confluent backward; and the intestine is as long as the distance from the vent to the tip of the tail.

In the earlier synonymy allowance must be made for the inclusion of two or more species, which may not be separated with any degree of confidence by means of the data given by the authors responsible for the mixture. Thus Cuvier evidently included *L. Agassizii*, from Bloch, with this species, and he was followed by a number of others.

### ***Liparis antarctica.***

Plate VI. Fig. 6-10.

*Liparis antarctica* Putnam, 1874, Pr. A. A. S., 339.

*Enantioliparis antarctica* Gill, 1891, Pr. U. S. Mus., XIII. 365.

D. 28; A. 24; P. 30; C. 14.

A rather stout species, in which the body cavity ends, and the anal fin begins, at the middle of the length without the caudal. The length of the head equals its width, and is contained three and two thirds times in the length of the body to the base of the caudal. Above the bases of the pectorals the dorsal outline is greatly arched; the height is three elevenths of the length, if the caudal is excluded. Below the sixth ray of the dorsal is the first ray of the ventral; from this point backward the body is much compressed and tapers rapidly. Forehead flattened; snout thick, blunt; mouth anterior, horizontal, not reaching a vertical from the front of the eye. Anterior nostril tubular, near the eye; posterior above the eye, on the interorbital space. Eye small, equal to length of snout, half of interorbital space, or little less than one fourth of head. Teeth numerous, in alternating series, small, short, tricuspid, with broadly spreading cusps.

Dorsal and anal low anteriorly, widest near the middle of their lengths, continuous with the caudal. The last not distinct from dorsal and anal,

tapering to a long sharp point. Pectoral reaching far behind vent, not reaching the anal, broadly rounded on the hinder margin, notched at the sides of the disk, some anterior rays long and projecting as a fringe. Disk subround, papillary portion broader than long, and about two thirds as long as the head. Vent close to the posterior border of the disk, the width of the latter equalling its distance from the anal fin. The specimen described is one and one half inches in entire length.

Color light brownish, probably yellowish or reddish in life.

No. 12,972 in the Museum of Comparative Zoölogy; collected by the Hassler Expedition at Eden Harbor, in the southern part of South America.

#### CARELIPARIS.

### Liparis Agassizii.

#### Plates I.-III.

*Cyclopterus liparis* Bloch, 1785, *Ausländ. Fische*, I. 48, pl. cxxiii. figs. 3, 4; Bonnat., 1788, *Tabl. Encycl. et Method., Ichthyol.*, pl. 20, fig. 67 (not text); Walb., 1792, *Art. Gen. Pisc.*, 489; Castel, 1801, *Hist. Nat. Poiss. Bloch*, VIII. 128, pl. 11, fig. 2; Sonnini, 1803, *Hist. Poiss.*, V. 272; Shaw, 1804, *Gen. Zool.*, V. 394, pl. 166, fig. 2; Turton, 1806, *Syst. Nat. Linné*, I. 906; Ansljin, 1828, *Syst. Besch.*, IV. 68, pl. 65 (cop. Bl.).

*Liparis liparis* Cuv., 1817, *R. An.*, II. 227, — 1829, *R. An.*, II. 346, — 1836, *R. An.*, I. 573; Val., 1836-50, *R. An.*, ed. illustr., *Poiss.*, 310. (Bloch's example led to the inclusion of *L. Agassizii* with *L. liparis* in these cases.)

*Liparis vulgaris* Schinz, 1836, *Naturg. u. Abbild. der Fische*, 258, pl. 86, fig. 1.

*Liparis Agassizii* Putnam, 1874, *Pr. A. A. A. S.*, 339.

*Liparis gibbus* Bean, 1881, *Pr. U. S. Mus.*, IV. 148, 247, 271; *L. gibba* J. & G., 1882, *Bull. 16 U. S. Mus.* 741; *Jor.*, 1887, *Rep. U. S. F. Comm.*, 1885, 903.

B. 6; D. 41 (41-44); A. 33 (32-35); P. 38 (35-38); C. 12; Vert. 46.

Body elongate, rather less inflated anteriorly than the other *Liparids*, greatly compressed posteriorly. With the exception of the disk the appearance is very much the same as that of a *Cottoid*. Total length two and three fourths times the distance from snout to vent. The greatest width, or the height, is contained about four and one half times, and the length of the head more than four times, in the total length. Head moderately broad, depressed anteriorly, slightly convex in transverse section through the frontal region; snout broad, blunt, rounded, convex, nearly four times the diameter of the eye, one third of the length of the head. Mouth wide, maxilla extending behind a vertical from the anterior border of the eye; upper lip complete, lower separated for only about half the distance from the angle of the mouth to the middle. Teeth small, tricuspid, with slender



somewhat compressed bases, cusps compressed to sharp edges, outer cusp turned outward so as to give an inflated appearance at the top, arranged in about seventy-two rows, counting lengthwise on each jaw, or ten rows transversely, from outer to inner. Pharyngeal teeth simple, in two bunches of eight or ten rows at the esophagus on the roof of the mouth, and below these on the floor in two smaller elongate groups. Nostrils small, tubes short or absent, posterior between the anterior halves of the eyes, anterior in front of these about one diameter of the orbit, and twice the same distance from each other. Eye small, less than one eighth of head. Gills three and a half. Gill openings a vertical slit, extending downward a short distance on the base of the pectoral. Skin thin, loose. Backward from the vent the form is much compressed, the thickness being nearly one half of the height, and both lateral and dorsal outlines taper regularly to the caudal. Dorsal, anal, and caudal fins confluent, anal extending farther on the caudal, i. e. more than half the length of the latter. Dorsal commencing above the gill opening, at a distance from the snout that is contained in the total length without the caudal three and two fifths times. The anal begins a trifle in advance of the mid-length, excluding the caudal. Pectoral broad, not reaching the anal, upper portion rounded, lower fringed, a shallow indentation between the two portions. Caudal subtruncate, rounded, with rays more than half as long as the head. Ventral disk small, one fourth longer than broad, situated its length from the lips, occupying nearly one third of the distance from the snout to the first ray of the anal, or about one eighth of the total length. Entire length ten inches.

Color dark brown, irregularly marked with whitish or grayish. A series of five or six spots, each as large as the eye, along the middle of the flank. Below these, near the lower edge, there are indications of four or five whitish blotches, resembling transverse bands. Dorsal, anal, and caudal with irregular cloudings and blotches of darker and of lighter. Base of pectoral with a couple of large blotches of light grayish, balance of the fin freckled with light color. Head dark, somewhat reddened.

Collected by Messrs. Pierce and Smith at Saghalien, Channel of Tartary. Dr. Bean's specimens came from Plover Bay, Siberia; Unalashka; St. Paul's Island; off Indian Point; Cape Tchaplín; E. Siberia; and Bering Strait.

## ANATOMY.

Details of the internal structure are given on Plate III. In Figure 1 the muscles and the lateral line system are shown as they appeared after the removal of the skin. The tubes of the lateral system are almost entirely cephalic, not extending behind the shoulder, as is the case throughout the family, of which this species may be taken as a typical example. It is evident from the limited extent of the tubes, and from the amount of mucus over the entire body, that their function is not the production of the slime. Considering them in connection with the presence of the disk, the position of the eyes, the strength and expanse of the fins on the hinder portion of the body, the kinds of crustaceans and fishes in the stomachs of this and others of the species, and the habit of some to rest with the caudal extremity turned forward, it seems as if it might be within bounds to say that the majority of these fishes are accustomed to lie in wait, anchored by the disk upon rocks or other supports, to capture their swiftly moving prey by sudden darts and rushes, and that, as in the Selachians, the lateral system subserves the purpose of a very delicate tactile organ. With the reduction of the gill openings there has been a corresponding diminution in the size of the operculum, the movable cover of the branchial aperture. The skeleton, shown in Figures 3 and 4, though moderately firm, is comparatively light. In most features, the skull compares well with that of *L. pulchellus*. The crown is flattened; behind the orbits it appears subquadrate; it has inconspicuous frontal ridges, with an interspace in the middle and a low supplemental ridge a short distance farther back. The suborbital spine is slender, and more than equals the length of the balance of the chain. When Figure 3 was drawn, the slender postorbitals, connecting with the postfrontals, would seem to have been overlooked. The operculum is shaped less like a boot than in most of the species; in outline it resembles that of *L. liparis*. The angle in the middle of the suboperculum is very blunt, and the expansion of the upper limb of the preoperculum is less than that of *L. mucosus*.

From the condition of the specimens it is possible to determine but little about the viscera. The stomach appears as in the allied species; the cæca are numerous, but may not be counted satisfactorily.

**Liparis tunicatus.**

*Cyclopterus liparis* var. *minor* Fabr., 1780, Fauna Groenl., 135; Walb., 1792, Art. Gen. Pisc., 489; var. *a*, *Abapokitsok*, Bonnat., 1788, Tabl. Encycl., 28.

*Liparis tunicata* Reinh., 1836, Overs. k. Dansk. Vid. Selsk. Förh., VI. p. cxi (tr. Arch. f. Naturg. Jahrg. 3, I. 267), — 1844, Isis, 819, — 1857, Nat. Bidr. Beskr. Groenl., part; Lütke., 1860, Nat. Vid. Medd., 173 (sep. p. 5), — 1857, Kara-Havets Fiske, 139, 504; Coll., 1880, Norsk. Nordhavs-Exp., Fiske, 59.

*Liparis arctica* Gill, 1864, Pr. Phil. Ac., 191, — 1873, Cat. Fish. E. C. N. A., 21; J. & G., 1882, Bull. 16 U. S. Mus., 742.

*Liparis Fabricii* Kröy., 1847, Nat. Tidskr., III. 274, — Voy. en Skand., pl. 8, fig. 2, a-1, — 1862, Nat. Tidskr. (3), I. 235; Gthr., 1861, Cat., III. 161, — 1877, Pr. Zool. Soc., 294, 476; Gill, 1861, Cat. Fish. E. C. N. A., 47, — 1864, Pr. Phil. Ac., 192, — 1873, Cat. Fish. E. C. N. A., 21; Malng., 1864, Spets. Fisk-fauna, 27; Bean, 1879, Bull. 15 U. S. Mus., 116.

*Liparis lineatus* Coll., 1880, Norsk. Nordhavs-Exp., Fiske, 50 (part).

*Liparis liparis arctica* Jor., 1887, Rep. U. S. F. Comm., 1885, 903.

“B. 7 [6]; D. 39; A. 33; P. 30; V. 7; C. 14.

“Corpus habet elongatum teretiusculum, abdomine ventricoso, blennium referens, et plerumque digito medio non longius. Caput corporis crassitie, obtusum, postice depressiusculum, antice convexius. Os angustum, maxillis æqualibus labiatis et arcte dentatis. Maxillæ extus, regio inferior oculorum, et opercula branchialia, puncta alba minuta impressa, non tamen profunda, habent. Oculi distantes latera spectant, parvi, nigri, iride fulva, quam cingit argentea. Lingua brevis cartilaginea, alba, obtusa. Nares quatuor tubulatæ. Apertura branchialis minuta fere linearis. Pinnæ pectorales a branchiarum apertura sub gula protendunt, ventrales fere cingentes, antice tamen non coeuntes; radii priores membrana longiore, apice albi. Pinnæ ventrales connatæ in orbiculum planiusculum, margine molli eminentiore, radios 14 vel 16 minus notabiles habent in circuitu. Anus pone caput situs. Pinna dorsalis pone cervicem, et analis pone anum incipientes, sibi oppositæ ad caudalem usque excurrentes, illique unitæ sunt. Omnes cute gelatinosa corporis tectæ, ut radii illarum difficulter numerentur. Cauda fere cuneata. Totus piscis nudus, lubricus, et colore fusco, carne rubicunda perlucens. Ovaria duo minuta linearia ova crocea continent.”

The above is the original description from Fabricius. Kröyer's description, 1847, under the name *Liparis Fabricii*, will add a number of details:—

“D. 13 + 27; A. 2 + 30; P. 34; C. 9; Vert. 46.

“Color supra cinereo-cœrulescens vel aurantiacus maculis punctivæ nigricantibus variegatus, infra albicans. Caput quartam longitudinis animalis

partem fere æquans, maximam piscis altitudinem superans, subcompressum, altius quam latius, rostro exaltato, truncato. Nares anteriores, simplices, posteriores margine cutaceo cinctæ (vel brevissime tubulosæ). Maxilla inferior superiori subbrevis. Diameter oculi longitudinalis tertiam ferme longitudinalis capitis partem æquat. Dentes graciles, seriebus transversis dispositi, trilaciniati, lacinia intermedia lateralibus multo majore. Discus ventralis ellipticus, vix nonam longitudinalis piscis partem explens. Pinna caudalis acuminata maxima parte cum pinnis dorsali et anali connata, sextam usque ad octavam longitudinalis animalis partem explens."

*Hab.* — Arctic seas, from Greenland.

### Liparis Steineni.

*Liparis Steineni* Fischer, 1885, Jahrb. der wissenschaft. Anstalten zu Hamburg, II. 63.

*Enantioliparis Steineni* Gill, 1891, Pr. U. S. Mus., XIII. 365.

"B. 5 [? 6]; D. 44-45; A. 36; P. 32; C. 10.

"*Charaktere.* — Die vertikalen Flossen stossen zusammen. Die Anal-flosse beginnt unter dem zehnten Stral der Rückenflosse; Bauchscheibe oval, halb so lang wie der Kopf. Die Brustflosse reicht nicht ganz bis zum Anfang der Afterflosse; sie hat keine eigentliche Einbuchtung; ihre vier untersten Stralen reichen mit den Enden über die Flossenhaut hinaus, der erste derselben so weit, dass dadurch der Anschein eines Einschnittes entsteht. Interorbitalraum breiter als die Schnauzenlänge. — Gelbbraun, Oberseite des Rumpfes und vertikale Flossen dunkler.

"Hinteres Nasloch in einer weiten ziemlich kurzen Röhre, die ebenso weit vom Auge, wie vom Lippenrande entfernt ist; vorderes ziemlich nahe vor jenem, einer Schleimpore ähnlich."

Greatest height of body, a little less than the length of the head, about one fifth of the total length. Eye four fifths of the length of the snout, and one half the width of the interorbital space. Snout broad. Jaws equal. Mouth-cleft not reaching a vertical from the front edge of the eye. Gills three doubled and one single; no pseudobranchiæ (?). Teeth small, tricuspidate. Ventral disk oval, one and one fourth times as long as wide.

Concerning the pseudobranchiæ Dr. Fischer says: "Das an der Stelle der letzteren liegende Organ erweist sich als ein Kiemendeckenmuskel mit quergestreiften Fasern."

*Hab.* — Royal Bay, South Georgia.

**Liparis pulchellus.**

**Plate IV.; Plate V. Figs. 6-8; Plate VIII. Figs. 4-7, 12-14.**

*Liparis pulchellus* Ayres, 1855, Pr. Cal. Acad., I. 23; Gth., 1861, Cat., III. 164, 559; Ayres, 1873, Pr. Cal. Acad., I. (reprint) 22; St., 1875, Ichth. Beitr., III. 53, — 1876, S. B. Ak. Wien, LXXII. 81; J. & G., 1880, Pr. U. S. Mus., III. 451, — 1881, Pr. U. S. Mus., IV. 5, 62, — *L. pulchella*, 1882, Bull. 16 U. S. Mus., 741; Bean, 1881, Pr. U. S. Mus., IV. 247, 271, — 1883, Pr. U. S. Mus., VI. 355; Jor., 1887, Rep. U. S. F. Comm., 1885, 903.

*Cyclogaster pulchellus* Gir., 1859, Pacif. R. R. Rep., X., Fishes, 132.

B. 6; D. 47-49; A. 39-40; P. 35-36; C. 12; Vert. 52.

In this species the body is elongate, somewhat depressed anteriorly, compressed posteriorly, tapering gradually to the caudal fin, and the body cavity occupies less than two fifths of the total length. The head is less than one fifth of the total; it is broader than high, and one sixth longer than broad. The short, subquadrangular appearance of the head, and the blunt angles on the snout and above the eyes, serve to distinguish this species from the others. From the side the snout overhangs the mouth, as if the latter were inferior and the former slightly bent upward. The crown is flattened; the interorbital space, in alcoholic specimens, is a trifle concave, both longitudinally and transversely; the cheeks are swollen. The snout is broad, thick, subtruncate, very blunt, and less than twice as long as the eye. The mouth is comparatively narrow, its width being less than half the length of the head. Upper lip complete, lower interrupted more than half the width of the cleft. Teeth very small, slender, tricuspid, with rounded bases which taper toward the summit, where there is a slight degree of compression; median cusp longest. Pharyngeal teeth simple, in a pair of rounded bunches above, and another pair of more elongate groups below. Eye moderate, about one fifth as long as the head, half as wide as the interorbital space. Anterior nostril larger, in front of the eye; posterior, so small as to appear obsolete, on the interorbital space near the eye. Gill opening narrow, not as wide as the eye; less than half of it in front of the base of the pectoral. Three double gills and one single. Pseudo-branchs present. Skin loose, thin, and covered with mucus in life. Dorsal, anal, and caudal confluent; the first two do not quite extend to the end of the last, and their anterior rays are buried in the loose tissues. Caudal extending but little beyond the other fins, subtruncate. Pectoral moderately broad, rounded in the upper portion, indented in the margin near the disk, and fringed by four or five of the rays at the

throat. Ventral disk small, little longer than broad, twice as long as the orbit, with a broad membranous border, nearer the chin than the vent, the hinder margin not much nearer to the base of the anal than to the end of the snout.

Ayres gives the "color light olive-brown, with numerous narrow, wavy lines of darker brown running longitudinally, and forming in some instances rings and irregular figures; abdomen and throat white; some small brown spots and others of white on the sides, one series faintly indicating a *lateral line* with a slight downward curve." Excepting the lateral line, this answers well for some specimens, such as that figured on Plate V. Fig. 6; others, as drawn on Plate IV., may be described as light brownish, punctulate and freckled with darker, with obliquely transverse clouded bands of darker on the fins, with darker color near the edges of the fins, with scattered small, rounded, dark-edged spots of white (openings of pores), and without traces of longitudinal stripes; and on others the brown color forms vermiculations or marmorations. These various markings are found on the specimens from a single locality; they indicate the extent of individual variation, rather than the existence of more or less firmly established varieties in the species. Our largest specimen is six and three fourths inches in length.

*Hab.* — San Francisco; Monterey. Others are identified by Bean from Tongass, Alaska; St. Paul's, Kodiak; and Unalashka.

#### ANATOMY.

This is one of the more elongate species of the genus. The coloration is adapted to a life among the weeds, and the snout is shaped as if it might be utilized in shovelling or rooting out the prey from its hiding places. In the vertebral column there are a greater number of segments than in any of the preceding; the column tapers more, consequently there is more difference in size between the posterior vertebræ and the anterior. *L. caliodon* shows little difference between these vertebræ; in *L. Agassizii* the difference is somewhat greater; but in *L. pulchellus* the column tapers so much, and becomes so slender toward the extremity, that the caudal centra are scarcely half as large as those in the anterior portion of the series. Because of this the plates to which the caudal rays articulate are small; their hinder borders form an angle, placing the median rays farther back, an approach toward an acuminate condition of the tail. Twenty-one or

twenty-two of the anterior rays of the dorsal are segmented. All of the bones are less solid than those of *L. mucosus*. Seen from above, the sides of the skull are nearly parallel, the snout being about as wide as the occiput. The crown is flattened; the occipital crest is moderately prominent; the ridges are low and not very conspicuous; the frontal ridge apparently is interrupted in the middle of the interorbital space, to be supplemented by a short transverse ridge a little distance farther back; and the ridges behind the turbinals are approximately parallel. In the formation of the overhanging snout, the intermaxillary has been modified very little; it retains the shape and position of the superior process, toward the ethmoid, of the other species; but the more important elements of the bony foundation appear to be secured by the forward projection and greater development of the suborbitals, the turbinals, the palatines, and the maxillæ, accompanied by a slight retraction of the mouth through the assumption by the lower end of the suspensorium of a more backward position. As the snout has been widened, the forward ends of the maxillæ have been considerably extended toward the median line of the skull. A tough spongy tissue upon the rostral bones seems to confirm the idea of utilization in pushing, scraping, or digging. The suborbital spine is nearly half of the greatest length of the chain. The amount of expansion in the upper limb of the preoperculum is hardly as great as in that of *L. calliodon*. The lower end of the hyomandibular being so far backward, the bend in the preoperculum has become almost right-angled. Very slender postorbitals connect the suborbital spines with the postfrontals. In the operculum a close resemblance is seen to that of *L. Agassizii*, Plate III. Fig. 2. The anterior section of the suboperculum is slender and spine-like; the posterior is membranous. Posteriorly, about two fifths of the interoperculum is slender and bent upward; anteriorly, it is stouter. Compared with those of *L. mucosus* the teeth are small; the cusps are acute subconical.

The entire brain, Plate VIII. Figs. 4-6, is rather elongate; owing to the narrowness of the optic lobes, the Cottoid resemblance is not so manifest. Hemispheres, optic lobes, and cerebellum are nearly equal in size. The posterior lobes are decidedly prominent, and are not quite reached by the cerebellum. The olfactory lobes are well developed; the olfactory nerves are short and widely divergent forward, as in *L. Montagu*, Plate VIII. Fig. 9.

The liver is peculiar in having a long narrow upper lobe on the left,

separated from a lower lobe on the same side by a wide indentation of the posterior margin, and in having a right lobe that is very small and short. There is a small elongate gall bladder. As in Liparids generally, the kidneys are larger forward and fused posteriorly. The bladder has the appearance of being slightly constricted, under the median line of the body, into a right and a left section. In the main, the stomach resembles that of the average species of this genus. The pyloric portion is short; twenty-seven cæca are present in the specimen under notice. The intestine is of more than the average length. One of the stomachs examined contained a large shrimp-like crustacean; another had some sand fleas, some worms, and a couple of seeds, resembling oats in size and shape; and two others were filled with worms apparently such as burrow in the mud. In the intestine of each there was a quantity of earthy or sandy matter.

### **Liparis pallidus.**

*Enantioliparis pallidus* Vaill., 1888, Miss. Sci. Cap Horn, Poiss., 22, pl. 4, figs. 3-3 b; Gill, 1891, Pr. U. S. Mus., XIII. 365.

Professor Vaillant founds his genus *Enantioliparis* on a small specimen from Orange Bay, Tierra del Fuego. By the characters published we are unable to separate the species from *Liparis*. In the original publication there is no mention of one of the most essential characters in the classification adopted here, the dentition. The Professor, however, kindly informs me the teeth are tricuspid. The prolongation of certain rays of the pectorals or other fins, very marked in the breeding season, is too variable to be accorded much value in distinguishing the genera unless accompanied by other characters of more importance.

All that is known of the species is contained in the original description, from which the following portions are reproduced: "Liparidibus persimiles, nisi impares pinnae continuæ sunt et radii inferiores liberi pectoralibus haud reperiuntur. . . . Ces poissons doivent être distingués des vrais *Liparis* Art. Chez ceux-ci les nageoires verticales peuvent être contiguës, mais ne sont pas réellement continues et ils présentent des rayons pectoraux inférieurs libres et prolongés. Ce dernier caractère se rencontre également chez les *Careproctus* Kr., lesquels ont les nageoires verticales continues comme les *Enantioliparis*. . . . Les nageoires impaires sont complètement unies, sans qu'il y ait de caudale distincte; leur état ne permet pas d'apprécier exactement



le nombre des rayons; la dorsale commence un peu avant l'extrémité de la pectorale, mais en tous cas, en arrière de sa base, l'origine de l'anale est encore plus reculée. Les pectorales, qui ne comptent pas plus de vingt rayons, se prolongent fort en avant sous la gorge, arrivant au contact l'une de l'autre; il n'y a pas de rayons inférieurs isolés et prolongés; l'extrémité de cette nageoire est loin d'atteindre l'anale. Le disque ventral paraît très peu plus large que long, 5 mm, 7 sur 5 mm, 3, encore faut-il tenir compte de la mollesse de cet organe, dont le liquide conservateur a pu altérer la forme. La couleur était sur le frais d'un gris rosé ou blanchâtre, lavé d'une teinte légère sépia sur la tête et à la base des pectorales."

Two specimens were secured from a depth of 28 meters. The measurements given show the total length to be 42 mm., the height or thickness 13, the length of head 10, of snout 3.5, of eye 2, and the width of interorbital space 6 mm.

#### CAREPROCTUS.

This genus and *Liparis* are brought very close together by *Careproctus major*. The simple form of tooth in the one case and the tricuspid form in the other were formerly considered sufficiently distinctive for separating these genera. Lütken, 1887, pointed out that the young of the mentioned species has the tricuspid teeth of *Liparis*, and that with age it acquires the simple teeth of *Careproctus*. It is possible that a similar change takes place in the other species we have brought together in the latter. Indeed, assuming derivation from species of *Liparis* of the shoal waters, it is just what we should expect in all these *Careprocti* of the deep sea.

Besides the dentition, other features may be selected that in comparisons may serve to distinguish this genus from the preceding: the head is higher at the back; the body is deeper in front of the dorsal fin; the caudal region is longer, more slender and tapering; the vertebræ are more numerous; the dorsal and anal fins have more rays, and are more completely fused with the caudal; the disk is reduced in size; the suborbital process is less developed; and apparently the intestine is shorter. Among these differences there is none that may not be a consequence of the modifying influences of great depths upon species of *Liparis* such as now exist along the coasts.

While we have no direct evidence of distribution of *Careproctus* south

of the equator, its nature and habits are such that it may be expected from all of the ocean bottoms.

*Careproctus Reinhardi* is the type on which the genus was founded, by Kröyer, in 1862.

### **Careproctus micropus.**

Günther, 1887, Challenger Report, XXII., Deep-Sea Fishes, p. 66, pl. xii. fig. B.

D. 35-37; A. 35-36.

"This species approaches in some respects the genus *Careproctus*, having the tail particularly attenuated, and the ventral disk of unusually small size. The head is large and thick, about one fourth of the total length, the caudal included. The interorbital space equals in length the postorbital portion of the head. Eye entirely in the anterior half of the head, and one fifth of its length. Nostrils not tubulated. Cleft of the mouth not extending to the front margin of the eye. Teeth simple, unicuspid.

"Vertical fins continuous, caudal very narrow and pointed. The origin of the anal is opposite to the eighth dorsal ray. Form of the pectoral typical, the foremost rays being opposite to the anterior margin of the ventral disk. Ventral disk circular, small, one fourth of the length of the head, situated immediately behind the level of the eye. Vent very close to ventral disk. Color light grayish or purplish.

"*Hab.*—'Knight Errant,' 1882, Station 9; depth, 608 fathoms. Two specimens, 2 and  $3\frac{1}{2}$  inches long. 'Knight Errant,' 1880, Station 8; depth, 540 fathoms. One specimen,  $3\frac{1}{2}$  inches long."

*Gymnolycodes Edwardsi* Vaillant, 1888, Exp. Travailleur et Talisman, Poissons, p. 313, Plate XXVI. Fig. 3, is said to be very closely allied to this species, if not identical.

### **Careproctus major.**

*Cyclopterus liparis* var. *major* Fabricius, 1780, Fauna Groenlandica, 136; Walb., 1792, Art. Gen. Pisc., 489; var. *b*, *Amersulak*, Bonnat, 1788, Tabl. Encycl., 28.

*Liparis tunicata* Kröy., 1862, Nat. Tidsskr. (3), I. pt. 2, 236; Gill, 1861, Pr. Phil. Ac., 190; Coll., 1880, Norsk. Nord-Havs. Exp., Fiske, 59; J. & G., 1882, Bull. 16 U. S. Mus., 742.

*Liparis major* Gill, 1861, Pr. Phil. Ac., 193; J. & G., 1882, Bull. 16 U. S. Mus., 741.

*Actinochir tunicata* Gill, 1861, Pr. Phil. Ac., 190.

*Actinochir major* Gill, 1873, Cat. Fish. E. C. N. A., 21.

*Liparis Fabricii* Lütken, 1887, Kara-Havets Fisk, 146, pl. 15, figs. 4-6; Gill, 1891, Pr. U. S. Mus. XIII. pl. xxix. (from Lütken).

*Liparis (Actinochir) major* Jor., 1887, Rep. U. S. F. Comm., 1885, 903.

B. 6; D. 45-48; A. 38-40; P. 34-37; C. 12-14; Vert. 52 (10 + 42); Cæca 26.

Elongate, much compressed and tapering posteriorly, rather thin behind the abdomen, slender at the base of the caudal, broad and high between the pectorals. Head high and broad, prominent at the nape, length a little more than the depth, nearly one fourth of the total without the caudal, forehead depressed. Snout broad, blunt, rounded, rather deep, as long as the eye. Mouth anterior, broad, maxillary subtending the eye, jaws about equal. A broad interruption in the lower lip in the middle of the chin. Teeth small, in pavement, tricuspid in younger specimens, simple in old. Some of those from which this description is drawn show the three-pronged teeth in the outer rows, and an approach to the simple in the inner. A series of five or six pores on each side, just above the upper lip from the snout to the postorbital region; another of six or seven pores from the chin toward the upper angle of the gill opening. Posterior nostril reduced, pore-like<sup>9</sup>, on the interorbital space; anterior in front of the eye, tubular. Between and a little in front of the tubes are a couple of large pores. Eye moderately large, in the anterior half of the head, lateral, about the length of the snout, once in the interorbital space, one and one fourth times in the disk, and three and one half times in the length of the head. Disk small, little longer than wide, one and one fourth times as long as the eye, distant from the mouth one and one third times the length, which is equal to half the distance to the anal fin. Vent about midway from disk to first ray of the anal. Gill opening little wider than the eye, one third of its extent in front of the base of the pectoral. One single and three double gills. Pseudobranchs small. Opercular spine rather broad. Skin thin, loose, easily carried away, that of the males in breeding season roughened with small spine-bearing papillæ. Dorsal and anal continuous with the caudal, the union occupying nearly half the length of the last, the anal extending a little farther back than the dorsal. Caudal rays less than two thirds as long as the head, hinder margin of the fin slightly rounded, narrow. Pectorals broad and rounded in the upper portion, reaching the anal fin; in the lower portion fringed; several of the rays at the sides of the disk, much longer than those immediately above them, form a notch in the margin, a fold uniting the fins in front of the disk. There is no apparent notch in the dorsal; like the anal, it rises gradually, and attains its greatest extent in the posterior third of its length.

Professor Lütken gives the following as the formula: D. 43-49; A. 36-40; P. 32-38; C. 9-11. The specimens described here, and from which the numbers placed at the head of this description were taken, were furnished this Museum by him. From his large series he finds a greater range of variation in all cases except that of the caudal, where 12-14 rays appear on these examples. Our largest is five inches in length.

Color olivaceous to dark brown, darkest about the head and body. On close examination the skin is seen to be thickly punctulate with brown, in cases forming cloudings, blotches, or transverse bands on the fins and hinder part of the body. In life there is no doubt of the presence of tints of lilac, reddish, or yellowish. One of these specimens has six bands of brownish on the dorsal, and four on the anal.

Krüyer's description, 1862, of this species, as his *Liparis tunicata*, is necessary for comparison with the foregoing and with *L. tunicata* of Reinhardt. It furnishes the following particulars as copied from his work.

"D. 50-45; A. 33-38; P. 42; C. 10; Vert. 48.

"Color fuscus vel cinereo-olivaceus, infra parum modo dilutior, nullis maculis punctisque nigro-marmoratus; rarissime longitudinaliter lineatus vel undulatus lineis dilutioribus. Caput quartam longitudinis piscis partem æquans, altitudinem superans, depressum, latius quam altius, rostro humiliori obtuso. Nares anteriores tubulosæ, posteriores modo margine cutaneo prominente cinctæ. Maxilla inferior superiori brevior, ferme horizontalis. Dentes maxillarum numerosi, multiseriati, trilaciniati, lacinia intermedia lateralibus angulariter protensis multo majore. Diameter oculi longitudinalis vix sextam longitudinis capitis partem explet, tertiam vero latitudinis frontis inter oculos partem æquat aut superat. Spatium a margine oculi posteriori ad aperturam branchialem latitudine frontis inter oculos aliquanto longius. Discus ventralis suborbicularis, decimam fere longitudinis piscis partem explens. Pinna caudalis haud acuminata, eum pinna dorsali et anali connata sed ad basin modo, octavam ferme explens longitudinis partem."

#### ANATOMY.

*Skeleton.* — The amount of ossification in this species is less than in such as *L. Agassizii* or *L. mucosus*. The skull is more nearly quadrate in trans-section; it is higher at the occiput and descends more to the ethmoid. The forehead is broader and the frontal ridge less crooked. There is also a marked difference in the suborbitals; the posterior process in *L. major* is

nearly straight, and is so short that its length is only about one third of the distance from its anterior extremity to the forward end of the chain, and it rises backward to meet the preoperculum. The latter is less expanded in the upper limb than in the other species; the hinder prolongation of the operculum is more turned upward; the suboperculum is more slender, and its branches form a more acute angle between them; and the interoperculum is more bent upward posteriorly. As on the other species, in the base of the pectoral, scapula, carpals, and coracoid form a series of six bones, each of which is in contact with the clavícula. With the close attachment existing between the inside of the base of the pectoral and the side of the body the motion of the fin is almost entirely confined to the rays, which have sufficient freedom of movement on the edges of the basalia. The post-clavícula is very long and slender. In the base of the caudal of the specimen under examination a peculiar feature is to be observed: viewed from the side, the posterior vertebral segment bears some likeness to the end of the column as shown in Figure 4 of Plate XII., except that, instead of rays passing from the lower edge of the strong backward and upward directed spine-like termination, there are two thin plates which widen backward toward their subtruncate hinder margins, on which the caudal rays are joined. Both of the plates pass from the lower edge of the so called spine, which ends in the superior hinder angle of the upper plate. An embryonic simulation is brought about by this spine and the greater length of the upper plate.

*Viscera.*—There is a partial division of the liver into three lobes. The greater portion lies to the left side, and has the appearance of being two lobes, the lower longer, broader, and rounded posteriorly, the upper shorter, narrower, and more pointed. A third portion lies toward the right; it is the shortest, and is sinuate on the hind border. The gall bladder is small, elongate, and empties into the intestine a short distance below the cæca. The stomach is shaped a little like a "Dutchman's pipe"; the cardiac portion (bowl) is larger and twice as long as the pyloric. Half of the cardiac portion, thin-walled and darker colored, is a mere receptacle for the food; in the posterior half, in which the digestive function resides, the walls suddenly thicken and change in color, becoming white, like the pyloric region. There is no constriction, as if the anterior part were a continuation of the esophagus, as might be expected between two sections so different in thickness of wall and in color. The pyloric portion is only about half as long

as the other. There are twenty-six stout and pointed cæca. The length of the intestine is about two thirds of the entire length of the specimen; the rectum is the wider fourth of the intestine. A worm and some crustacea were found in the stomach, but nothing could be seen that resembled vegetable matter. The ovaries lie behind the middle of the chamber; they unite posteriorly. Forward the kidneys are larger, near the middle of the cavity they coalesce. The bladder is small and simple.

*Brain.*—The brain is narrow and long. Compared with that of *L. pulchellus*, Plate VIII. Fig. 4, the olfactory nerves are longer and the hemispheres smaller. In *C. major* the optic lobes are small; they are equal in size to the cerebellum, and larger than the hemispheres. At each side of the cerebellum a rather wide margin of the brain is exposed, and a very little of the sinus is covered; behind the sinus are two prominent lobes, very much as in *L. pulchellus*.

### Careproctus gelatinosus.

*Cyclopterus gelatinosus* Pall., 1769, Spicil. Zool., VII. 19, tab. iii. fig. 1, Anat. fig. 2-6,—1831, Zoogr. Ross.-Asiat., III. 74; Bonnat., 1788, Ichthyol., 28; Walb., 1792, Art. Gen. Pisc., 488; LaC., 1800, Hist. Poiss., II. 62; Bl. Schn., 1801, Syst., 199; Sonn., 1803, Hist. Poiss., V. 262; Shaw, 1804, Gen. Zool., V. 293; Turton, 1806, Syst. Nat. Linn., I. 906.

*Liparis gelatinosus* Cuv., 1817, R. An., II. 227,—1829, R. An., II. 346,—1836, R. An., I. 573,—1836-50, R. An., ed. ill., 311; Wilson, 1838, Ichth. in Encycl. Brit.; Stor., 1846, Synops. Fish. N. Amer., 483; Gthr., 1861, Cat., III. 163; Gill, 1861, Cat. Fish. E. Coast U. S., 47; Coll., 1880, Norsk. Nord.-Exp., Fiske.

*Careproctus gelatinosus* Kröy., 1862, Nat. Tidsskr., 3 R, 1 B, 1861-63, 254; J. & G., 1882, Bull. 16 U. S. Mus., 740; Jor. 1887, Rep. U. S. F. Comm., 1885, 903.

*Careproctus spectrum* Bean, 1890, Pr. U. S. Mus., XIII. 40.

D. 50+; 45 (Pallas). D. 57; A. 47 (Bean).

“Magnitudo sesquipedalis; forma gracillima inter congeneres. Corpus oblongum, compressum, versus caput crassiusculum, postice sensim adtenuatum, compressius et planilaterum. Cutis mollissima, alepidota, glabra. Substantia totius piscis subdiaphana, mollissima, fluxa, iners, levissimo tactu, vel concussione, tota gelatinæ instar contremiscens. Caput crassum, subquadratum, depressius, vertice planiusculo, ad orbitas convexo; versus nares sensim declivi. Orbitæ oculique cute communi, sed adtenuatiore obducta. Irides livido-virescentes, circulo cœrulescente cinctæ. Pupillæ axis sursum directa. Nares inter oris marginem et oculos mediæ, simplices, tubulo cutaceo, arrecto, 1 lin. longitudine, prominentes, limboque rubentes. Inter nares et labiorum marginem utrinque pori duo, per quos immissus

flatus ad labia superiora pertingit, quæ poris similibus, denis cribrata sunt. Decem alii habentur ab angulo oris versus valvam branchialem. Flatus per nares immissus cutem capitis instar utris extendit. Labia duplicata, crassa, carnosa; interiora retractilia, ad angulos subappendiculata. Maxillæ utriusque limbus interius scaber. Os sursum dehiscens, fere ut in *Cycl. ventricosus* vel *Uranoscopto*, sed inferiore maxilla minus producta. Linguæ vix vestigium distinctum in scapo branchiarum comparet. Arcus palati asper ad labium; tubercula aspera in fauce quaterna, nempe duo palati, totidemque in branchiarum trunco; quorum priora mobilia, majora et ovalia, inferiora oblonga. Branchiæ pro mole piscis parvæ, utrinque quaternæ: arcu cartilagineo, interne tuberculis transversim compressis, scaberrimis, stridentibus dentato. Opercula branchiarum subrhomboidea, cutacea, mollia, cartilaginibus fulta. Membrana branchialis tota connata, radiis, ut in sicco specimine videbatur, septenis. Apertura branchiarum supra ortum pinnarum pectoralium, ovalis. Pinnæ pectorales magnæ, latissimæ, jugulares, aliquot linearum distantia ab oris margine, in ipsa gula incipientes, primo subparallelae, dehinc operculorum adhesionem usque ad aperturam branchialem cingentes; flaccidæ radiis mollibus, cartilagineis suffultæ, circumscriptione, si expandas, rotundatæ. Radii anteriores sensim breviores et exiliores, tresque vel quatuor primi exillissimi, soluti, cirrhorum vel digitorum instar ante pinnam propendent. In universum radii circiter 30. Pinna dorsalis et ani paulo pone medium corporis incipiunt carnosæ mollibus radiis infirmæ, atroviolaceæ, longitudinaliter decurrentes usque ad pinnam caudæ sexradiatam. Dorsalis radii plus quam 50. P. ani circiter 45. quantum in siccato pisce video. Acetabulum jugulare, inter pinnas pectorales, sub gula, ante anum positum, minutum, papilliforme, totumque molle, intus cartilagine bilamellata, a gula descendente suffultum. Anus in ima ventris carina, prope acetabulum, in medio pariter inter pinnas pectorales spatio, prominens, orificio antrorsum spectante. Linea lateralis, ut congeneribus omnibus, nulla. Color exalbidus, rosea rubedine suffusus; in pinnis longitudinalibus violascens. Membrana branchiales cameras intus vestiens atro-purpurascit.

“Longitudo tota, ab apice labii superioris ad extremam caudam 1' 6." 4." Ab apice labii, usque ad initium pinnæ dorsi 10.", usque ad anum 1." 8."”

*Hab.* — Peter and Paul's Harbor.

The above is from the original description.

In the *Zoographia*, Pallas gives the following additional particulars:—

“In alto Oceani orientalis, nec non in sinibus et recessibus maris vivit,

nec raro procellis egeritur. Iners et molle corpus, fere Medusarum consistentia, ut mirum sit adeo tenerum et satis magnum (sæpe ulnare) corpus in adeo tempestuoso salo resistere posse. Virosi aliquid videtur in se habere, nam non solum homines hunc piscem nauseant; sed ipsi familiae Camtschadorum canes, quibus terrima quæque in cibum cedunt, objectam hanc offam aversantur. Hunc piscem etiam in mari albo et Oceano boreo interdum observari a fide dignis hominibus accepi."

### Careproctus Reinhardi.

*Liparis glutinosus* Reinh., 1843, Overs. Kgl. Danske Vid. Selsk. Forh., 1842, p. 82.

*Liparis gelatinosus* Reinh., 1843, Overs. K. D. Vid. Selsk. Forh., p. lxxvii, pl. x., — 1844, Isis von Oken, p. 819; Pet., 1874, Die zweite Deutsche Nordpolfahrt, II. 171 (a mixture of several species), pl. 1, fig. 2.

*Liparis Reinhardi* Krøy., 1862, Nat. Tidsskr. (3), I. pt. 2, p. 252 (sep. p. 20); Lütke, 1857, Dijnphna-Togtets zool.-botan. Udbytte, Kara-Havets Fiske, 139, 505.

*Careproctus Reinhardi* Krøy., 1862, Nat. Tidsskr. (3), I. 257 (sep. p. 25); Gill, 1864, Pr. Phil. Ac., 194, — 1873, Cat. Fish. E. C. N. Amer., 21, — 1891, Pr. U. S. Mus., XIII. 373; Coll., 1880, Norsk. Nord.-Exp., Fiske, 57, pl. ii. fig. 15, 16, — 1880, Vid.-Selsk. Forh. Chr'a, No. 8; J. & G., 1882, Bull. 16 U. S. Mus., 957, Bean, 1884, Rep. U. S. F. Comm., 1882, 341, St., 1886, Jan Meyen Exp., III. 107; Jor., 1887, Rep. U. S. F. Comm., 1885, 903.

*Liparis ranula* Goode & Bean, 1880, Pr. U. S. Mus., II. 46; J. & G., 1882, Bull. 16 U. S. Mus., 742; Jor., 1887, Rep. U. S. F. Comm., 1885, 903.

B. 6; D. 54; A. 46; P. 32; C. 11; Vert. 60.

"Color supra fuscus, infra albus, argentatus. Caput quartam longitudinis piscis partem haud prorsus æquans, compressum, duplo altius quam latius, rostro obtuso. Maxilla inferior adscendens, sublongior. Diameter oculi longitudinalis sextam fere explens longitudinis capitis partem dimidiamque frontis inter oculos latitudinem. Longitudo rostri ad oculos, latitudo frontis inter oculos et distantia a margine oculi posteriori ad aperturam branchialem invicem ferme æquales. Dentes simplices, hamati. Discus ventralis minutus, fere rudimentarius (20ies et plus longitudine corporis superatus), sub anteriorem oculi partem positus, minimoque intervallo ab ano diremptus, qui vero a pinna anali remotissimus est (tertia fere longitudinis piscis parte). Cauda elongata, valde acuminata. Pinna dorsalis, analis et caudalis in acumen connatæ." (Krøyer.)

The more important items in the description of *Liparis ranula* are given below; they do not appear to be of sufficient importance to warrant separation as a distinct species from *L. Reinhardi*.



D.  $48\pm$ ; A.  $48\pm$ ; P.  $15 + 12$  or  $13$ .

Body thick, subcylindrical anteriorly, rapidly tapering to the tail; depth or length of head one fourth of total, without caudal. Skin thick, lax. Head swollen at the nape; depth one sixth of body length; width little greater, twice that of disk; length two and a half times the interorbital distance. Snout broad, about one fourth as long as head. Mouth-cleft not reaching a vertical from orbit; upper jaw the longer. Eye lateral, not interfering with upper profile, about one fourth of head. Nostril near the eye. From snout to first dorsal ray one third, and from snout to first anal ray about two fifths of the length of the body. Origin of anal below eighth ray of dorsal. Disk slightly longer than its distance from the snout, or than its width. Color uniform, whitish.

*Hab.*— Off Halifax Harbor, in 52 fathoms. Known from the description of Goode and Bean.

From particulars given by Professor Collett we take the following.

Body translucent, jelly-like; skin lax, viscid; teeth simple; ventral disk very small, situated far forward, almost hidden by the anterior portions of the pectorals; vent near the disk, about midway from snout to anal; tail long, slender, tapering to a point, caudal continuous with dorsal and anal; fin-rays soft, slender; pectorals semicircular, below the head, beginning far in front and close together near the symphysis of the lower jaw, first eight or ten rays projecting, larger median portion with short ones, upper elongate; eyes comparatively large, more than one fourth as long as the head, which latter is one fourth to one fifth of the total length. Only one pair of nostrils was detected, and they were not prolonged in tubes.

Color pale reddish gray, or whitish; no bands or marks.

An Arctic and deep-sea form, descending to seven hundred fathoms.

The localities given are Greenland, Jan Mayen, and Beeren Eiland.

If we are correct in supposing the Liparididæ to have originated in the North, and thence to have been distributed through the depths to the far South, it is *Careproctus* rather than *Liparis* we should have expected to meet with in the Antarctic regions. There is, however, a possibility that one or more of what have been taken for species of *Liparis* from the southern localities may yet prove to be founded on young individuals of species of *Careproctus*.

*AMITRINÆ.*

## PARALIPARIS.

In shape of head and body, in the posterior process of the infraorbital bone, in the arrangement of the teeth, and in the structure of the vertical fins, this genus is much like *Liparis*. The teeth, so far as described, are simple, as in the older individuals of the *Careprocti*. The body is long, slender in the caudal portion, and is covered with a loose, thin skin. The vent is remote from the anal. There are no ventrals. The pectorals are deeply notched or divided. Dorsal and anal are long, and confluent with the caudal. Gills three and a half. Pseudobranchiæ are said to be present in one of the species.

Paraliparis first was ranked as a subgenus of *Liparis* by Collett, 1878, who described the type species, *P. bathybius*. In his work on the Fishes of the Norwegian North-Atlantic Expedition, 1880, he discarded the subgenus, placing the species in *Liparis*. Günther, 1887, in his work on the Deep-Sea Fishes of the Challenger Expeditions, raised *Paraliparis* to generic rank, and included, with *P. bathybius* and *P. membranaceus*, *P. liparinus*, the type of a genus founded by Goode, 1881, under the name *Amitra*, which, being preoccupied, had been changed to *Monomitra* in 1884 by its founder.

Species of this genus have been found in both the Atlantic and the Pacific north of the equator; but, being deep-sea forms, there is no reason we should not expect them at great depths in all the connected waters. In some respects the structure of the *Amitrinæ* is such as to entitle them to rank as a distinct family, *Amitridæ*.

**Paraliparis rosaceus.**

*Paraliparis rosaceus* Gilb., 1890, Pr. U. S. Mus., XIII. 93.

D. 58; A. 53.

“Body slender, covered with lax skin, which invests also the fins. Head small,  $5\frac{2}{3}$  in length; depth,  $4\frac{3}{4}$ . Mouth transverse, nearly horizontal, the maxillary scarcely vertical from front of pupil, equaling length of snout,  $3\frac{1}{2}$  in head; eye half interorbital width, 5 in head.

“Teeth in lower jaw pointed, in a single close-set series, their even tips forming an almost uniform cutting edge. Teeth in upper jaw apparently

paved, the jaw presenting a smooth, rounded surface, on which the teeth are little evident, but occasionally present sharp projecting points. Lower jaw included.

"A series of conspicuous mucous pores on snout, mandible, and on preopercle. Gill opening a narrow slit above base of pectorals.

"Pectoral fin divided into two wholly distinct lobes not connected by intervening rays, a space without rays present, equaling diameter of pupil. The lower lobe consists of four rays, the longest three-fifths head, inserted under preopercular margin. The main portion of the fin consists of about fifteen rays and is but slightly longer than the lower lobe; dorsal beginning behind middle of pectorals, its distance from tip of snout  $4\frac{1}{8}$  in length; distance of origin of anal from tip of snout equaling one third standard length.

"Vent under base of upper pectoral rays, but wholly behind base of lower lobe of pectorals, its distance from tip of snout equaling length of head, and equaling also its distance from origin of anal. No trace of ventral disk or fins. D. 58; A. 53.

"*Color*: Light rose-red, the fins and head largely jet black. Abdomen behind vent blackish. Peritoneum and lining membranes of mouth and gill-cavity jet black. A single specimen,  $5\frac{1}{8}$  inches long, from Station 2919, in 984 fathoms."

*Hab.* — Off Pacific coast of the United States.

### **Paraliparis bathybius.**

*Liparis (Paraliparis) bathybi* Collett, 1878, Vid.-Selsk. Forh. Chr'a, No. 14, p. 32.

*Liparis bathybi* Coll., 1880, Norske Nord.-Exp., p. 52, pl. ii. fig. 14.

*Paraliparis bathybius* Gthr., 1887, Challenger Deep-Sea Fishes, p. 68, pl. xii. fig. C; Gill, 1891, Pr. U. S. Mus., XIII. 373.

B. 7 (? 6); D. 59; A. 51; P. 13 + 3 (4) + 3; C. 8.

Head short and globular; equal in length to the depth of the body, or to two elevenths of the total length. Orbits large, two sevenths of the length of the head, or three fifths of the interorbital space. Dorsal and anal fins covering two thirds of the caudal. Snout short, little longer than the orbit. In the pectoral the upper portion is separated from the lower by a space occupied by three or four rudimentary rays. Concerning the eyes, the ventral disk, and the position of the vent, nothing is known. Specimen described a female of 208 mm. Color brownish black. (Collett.)

The Challenger specimen was also a female with ova, and measured seven and a half inches in length; it had D. 60, A. 50, P. 12 + 3. Dr. Günther says of it: "Fortunately those parts about which Collett's description leaves us in doubt are well enough preserved to confirm his supposition that this fish is the type of a distinct genus. The ventral disk, or indeed any external trace of ventral fins, is absent, and the lower portion of the pectoral fin is separated from the upper by a smooth space, without any of those intermediate filaments which are shown in Collett's figure. The three lower rays are connected by membrane to their tips, and form a fin by themselves. The posterior part of the vertical fins is also less elevated, the rays being directed more backwards. The vent occupies a similarly advanced position as in *Liparis*."

Collett's type was taken in the open sea west of Beeren Eiland, at a depth of 658 fathoms. The habitat given by Günther is "Knight Errant, Station 8, 1882; depth 640 fathoms."

There are several points in which the figures given by the authors cited do not agree, but their significance can only be determined by comparison of the types, or by more examples. On the Bear Island specimen as figured, the caudal is subtruncate and covered by dorsal and anal for two thirds of its length, the space between the two portions of the pectoral has filamentary rays, the gill opening extends down a little in front of the base of the pectoral, and the distance from the mouth-cleft is greater to the orbit than to the nostril. On the Challenger drawing, the fish has a long pointed tail less than half of which is covered by dorsal and anal, the pectoral filaments are entirely absent, the gill opening does not extend down in front of the pectoral, and the distance from the mouth-cleft to the orbit is much less than to the nostril.

### **Paraliparis liparinus.**

*Amitra liparina* Goode, 1881, Pr. U. S. Mus., III. 478; J. & G., 1882, Bull. 16 U. S. Mus., 739.

*Monomitra liparina* Goode, 1881, Pr. U. S. Mus., VI. 109; Bean, 1884, Rep. U. S. F. Comm., 1882, 311; Jor., 1887, Rep. U. S. F. Comm., 1885, 903.

*Paraliparis liparinus* Günther, 1857, Challenger Reports, XII., Deep-Sea Fishes, p. 68.

D. 67; A. 54; P. 23; C. 6.

Body elongate, compressed posteriorly, very thin at the tail, covered by a thick, lax, slimy skin. Head small, thick, convex between the eyes, length four and one third times its width, three twentieths of the total

length, without caudal. Stout convex, protruding. Mouth under the snout and far back from its tip. Eyes lateral, half as wide as the interorbital area. Nostril in front of the eye. Operculum very small, strap-shaped. Gills three and one half. Pseudobranchiæ present. Teeth weak, paved. The dorsal begins over the end of the pectoral, and the rays and outline, as of the anal, are hardly visible through the skin. The anal begins below the eighth to the tenth dorsal rays. The dorsal and anal rays lie closely connected with those of the caudal, which are larger and extend in a pencil-like point. Ventrals absent. Pectoral broad, lower base almost below posterior margin of orbit, lowest six rays prolonged. The jugular disk cannot be found.

Color yellowish white, dusky toward the tail and blackish upon the anterior part of the head. Abdominal cavity showing black through the skin.

The above is from Goode's description.

*Hab.*—Atlantic, off Rhode Island, in 487 fathoms.

Attention has been directed by Dr. Günther to the fact that in the species of this genus described by himself and Professor Collett there are no pseudobranchiæ, while in the species characterized above they are said to be present, but that, on account of the close agreement in the majority of essentials, this difference and minor ones cannot be considered sufficient for generic separation.

### **Paraliparis membranaceus.**

*Paraliparis membranaceus* Günther, 1857, Challenger Reports, XXII., Deep-Sea Fishes, p. 69, pl. xxii. fig. D.

D. ca. 70; A. ca. 70.

This species is known from Dr. Günther's description of a specimen, only 60 mm. in length, of which he says he could not be certain whether it represented a species in which embryonic characters are persistent, or merely an early stage of development.

Head large, compressed, about as high as long. Abdominal cavity very short, black, visible through the integuments. Tail compressed and gradually tapering to a fine point. Integuments colorless, with minute scattered points of pigment. A broad median dorsal fold rises from the top of the snout, and is continued to the extremity of the tail, gradually disappearing as it approaches the caudal fin, which is represented by two or three

extremely fine and rather long terminal filaments. Fin rays begin to be developed in the dorsal above the posterior part of the abdomen, where the fold is highest; the anterior rays are more distinct, the hinder ones crowded and almost indistinguishable. The anal is similar; the fold starts from the vent, opposite the hind margin of the orbit, and the rays from the hinder end of the abdominal cavity, whence the fin continues in the same manner as the dorsal. Pectoral very large, with a very broad base, extending from the upper end of the gill opening forward nearly to the hyoid bone; its principal portion consists of an extremely delicate membrane, in which the rays are visible like fine striæ, and which on its hinder margin is provided with long fringes. The eight lower or anterior rays are quite free, but are not separated by an interspace from the remaining part of the fin. The bones of the head are very thin, forming cavities on the top and the snout. The eye is of moderate size, about two sevenths of the length of the head, a little shorter than the snout, and much less than the width of the interorbital space, which is very convex. Jaws even in front, the maxillary extending nearly to the margin of the orbit. Gill openings closed below, restricted to small slits. Specimen, two and one fourth inches long, obtained off Cape St. Vincent in 400 fathoms. (Günther.)

## LITERATURE.

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NOTE. — IN making up the synonymy and the bibliographical lists dependence has been entirely placed on the Museum libraries. With few or no exceptions, all of the more important works are included. It is true that extensive additions to these lists might have been made from numerous manuals and other unnoticed publications, but the time and labor thus expended would have been without adequate compensation, since such works ordinarily make no contributions to the literature of the subject beyond the historical item of a mere mention, a notice of which is more often worse than valueless on account of the waste of energy it entails upon the student in his search for information through sending him to a barren source. Viewed in this light, it is a question whether our lists are not already too long.

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## EXPLANATION OF THE PLATES.

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NOTE. — Slight differences may be noted in places between the text and some of the figures on the earlier plates. The specimens from which these drawings were made are no longer accessible, and the descriptions are taken from others, which results in bringing individual variations into prominence.

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### PLATE I.

*Liparis Agassizii* Putnam.

- Fig. 1. A full length view of the side.  
Fig. 2. The same specimen as seen in front, with expanded pectorals.  
Fig. 3. The left side of the body proper, exposing the tubes of the face, the liver, pyloric cæca, stomach, ovary, and bladder.

### PLATE II.

*Liparis Agassizii* Put.

- Fig. 1. Representation of the upper surface, full length.  
Fig. 2. Appearance from beneath, showing the disk.

### PLATE III.

*Liparis Agassizii* Put.

- Fig. 1. The entire side after the removal of the skin, showing the muscles and the tubes leading to the pores.  
Fig. 2. A lateral view of the skeleton.  
Fig. 3. The skull as it appears from above.  
Fig. 4. The anterior upper portion of the head, exposing the nasal cavity and nostrils.  
Fig. 5. One of the teeth.

### PLATE IV.

*Liparis pulchellus* Ayres.

- Fig. 1. A complete view of the side.  
Fig. 2. Upper surface of the same specimen.  
Fig. 3. A drawing of the ventral surface, indicating the disk and pectoral fins.  
Fig. 4. A front view.  
Fig. 5. A single tooth.

## PLATE V.

*Liparis mucosus* Ayr. Figs. 1 to 5.

- Fig. 1. A representation of the entire lateral surface.  
 Fig. 2. The same individual as seen from above.  
 Fig. 3. The ventral surface of the same.  
 Fig. 4. The same, as viewed directly in front.  
 Fig. 5. A tooth.

*Liparis pulchellus* Ayr. Figs. 6 to 8.

- Fig. 6. The side of a striped specimen.  
 Fig. 7. A caudal fin, abnormal.  
 Fig. 8. The gill arches and pharyngeals.

## PLATE VI.

*Liparis calliodon* Pallas. Figs. 1 to 5.

- Fig. 1. Lateral aspect.  
 Fig. 2. A dorsal representation.  
 Fig. 3. The ventral appearance.  
 Fig. 4. An anterior view.  
 Fig. 5. One of the teeth.

*Liparis antarctica* Put. Figs. 6 to 10.

- Fig. 6. As seen from the side.  
 Fig. 7. The same enlarged.  
 Fig. 8. The back of the same example.  
 Fig. 9. The lower aspect.  
 Fig. 10. A front view of the same individual.

## PLATE VII.

*Liparis liparis* Linné. Figs. 1-5, 21, 22.

- Figs. 1-4. Side, back, belly, and front views of the lineated forms.  
 Fig. 5. One of the teeth.  
 Figs. 21, 22. Side and back views of a young one of the blotched forms.

*Liparis Montaguï* Donovan. Figs. 6-20.

- Fig. 6. A young specimen, natural size.  
 Figs. 7-10. The same specimen enlarged, from the side, the back, the belly, and the front.  
 Figs. 11, 12. Side and front views of male.  
 Figs. 13-15. Side, back, and lower views of female.  
 Fig. 16. Enlarged view of side of anterior half of female.  
 Fig. 17. Left side of anterior half of female, showing liver and ovaries.  
 Fig. 18. Stomach of same, right side.  
 Fig. 19. Skin of male, showing the papillæ and spines in breeding season.  
 Fig. 20. One of the teeth.



## PLATE VIII.

*Cyclopterus lumpus* Linné. Figs. 1-3, 15-17.

- Figs. 1-3. Brain: Fig. 1, the upper surface; Fig. 2, the side; and Fig. 3, the appearance from beneath.  
 Figs. 15-17. Pelvis and ventrals, right half; Fig. 15 as seen from above, Fig. 16 from the outer side, and Fig. 17 from beneath.

*Liparis pulchellus* Ayr. Figs. 4-7, 12-14.

- Figs. 4-6. Brain. Fig. 4 a dorsal, Fig. 5 a lateral, and Fig. 6 a ventral view.  
 Fig. 7. Otoliths.  
 Figs. 12-14. Pelvis and ventrals; Fig. 12 the dorsal, Fig. 13 the lateral (right side), and Fig. 14 the ventral aspect.

*Liparis Montagu* Don. Figs. 8-11.

- Fig. 8. Otoliths.  
 Figs. 9-11. Brain; Fig. 9 upper, Fig. 10 lateral, and Fig. 11 lower surface.

## PLATE IX.

- Figs. 1, 4-8. *Liparis mucosus* Ayr. Fig. 1, a side view of the skull; Figs. 4 and 5, irregular teeth; Fig. 6, operculum; Fig. 7, suboperculum; Fig. 8, interoperculum.  
 Fig. 2. *Cyclopterus lumpus*. Side of the skull.  
 Fig. 3. *Cottus octodecimspinosus* Mitch. Skull from the side.

## PLATE X.

- Fig. A. *Liparis mucosus*. Skull with bones in outline.  
 Fig. B. *Cyclopterus lumpus*. Skull with bones in outline.  
 Fig. C. *Cottus groenlandicus* C. & V. Skull with bones in outline.

The numbers on the different bones are those used by Cuvier and Günther. 1, Frontal; 2, Prefrontal; 3, Ethmoid; 8, Supraoccipital; 17, Intermaxillary; 18, Maxillary; 19, Suborbitals; 20, Turbinal; 22, Palatine; 23, Hyomandibular; 24, Pterygoid; 25, Entopterygoid; 26, Quadrate; 27, Pretympanic; 28, Operculum; 29, Stylohyal; 30, Preoperculum; 31, Symplectic; 32, Suboperculum; 33, Interoperculum; 34, Dentary; 35, Articular; 36, Angular; 37, Epiphyal; 38, Ceratohyal; 39, Basihyal; 42, Urohyal; 43, Branchiostegal rays; 46, Posttemporal; 47, Supraclavicular.

## PLATE XI.

*Cyclopterus spinosus* Müller.

- Figs. 1-3. Side, ventral, and front views.

*Cyclopteroideus gyrynops* Garman. Figs. 4-9.

- Figs. 4-6. Surfaces: Fig. 4, lateral; Fig. 5, inferior; Fig. 6, anterior.  
 Figs. 7-9. Viscera: Fig. 7, from below; Fig. 8, from above; Fig. 9, from the right side, with the esophagus toward the right hand.

## PLATE XI. (continued.)

*Cyclopterus lumpus* Linné.

Fig. 10. Viscera seen from the left side.

The lettering is the same for each of the figures: *a*, anus; *c*, cæca; *e*, esophagus; *i*, intestine; *k*, kidney; *l*, liver; *o*, ovary; *p*, pylorus; *r*, rectum; *s*, stomach; *sp.*, spleen; *u*, end of the ureters in the anal papilla.

## PLATE XII.

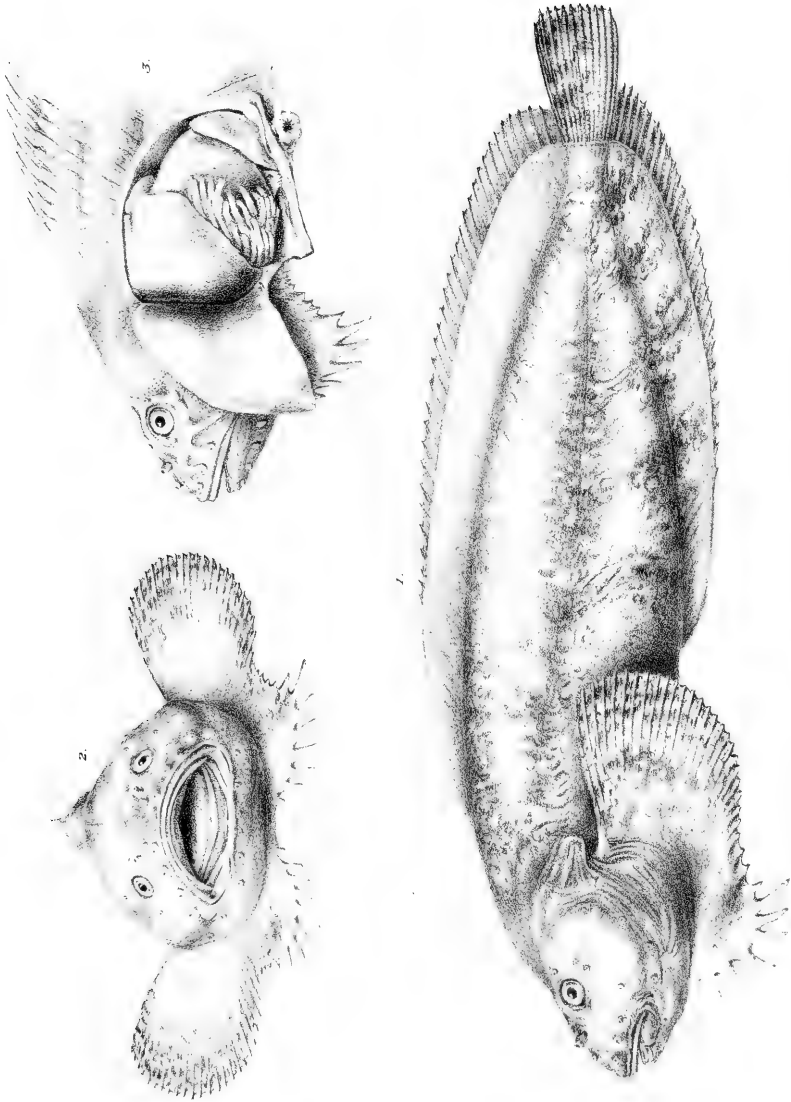
*Cyclopterus lumpus* Linn.

The Figures in this and the following Plate are from the original drawings prepared by Prof. Alexander Agassiz for his young stages of Osseous Fishes. Figures 1 and 2 represent the side and back of the youngest specimen. Figures 3, 4, and 5 are lateral views of older ones, up to the time of complete separation of the fins and the appearance of the tubercles.

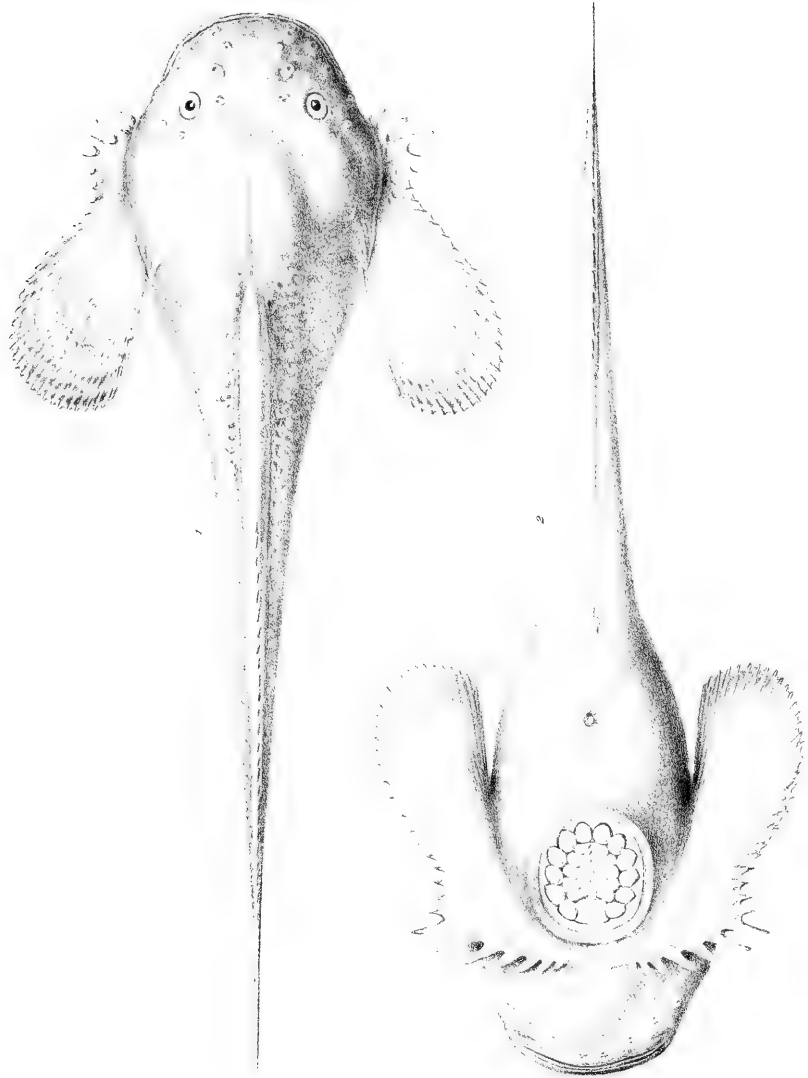
## PLATE XIII.

*Cyclopterus lumpus* Linn.

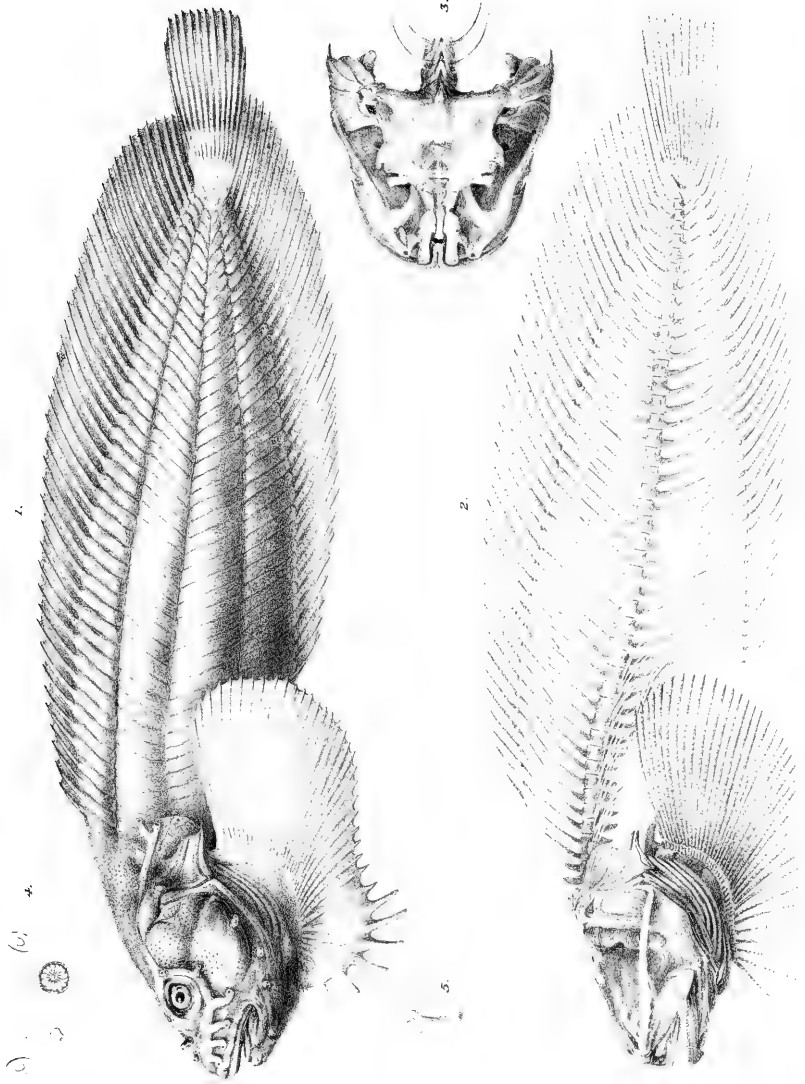
Young stages: Figs. 1 and 3, lateral views; Figs. 2 and 4, superior aspects; Fig. 3<sup>a</sup>, the spiny protuberances along the vertebral line and upper margin of the anterior dorsal; Fig. 3<sup>b</sup>, the largest spiny protuberances of the lateral line; and Fig. 3<sup>c</sup> shows the pectorals and ventrals as they appear from beneath.











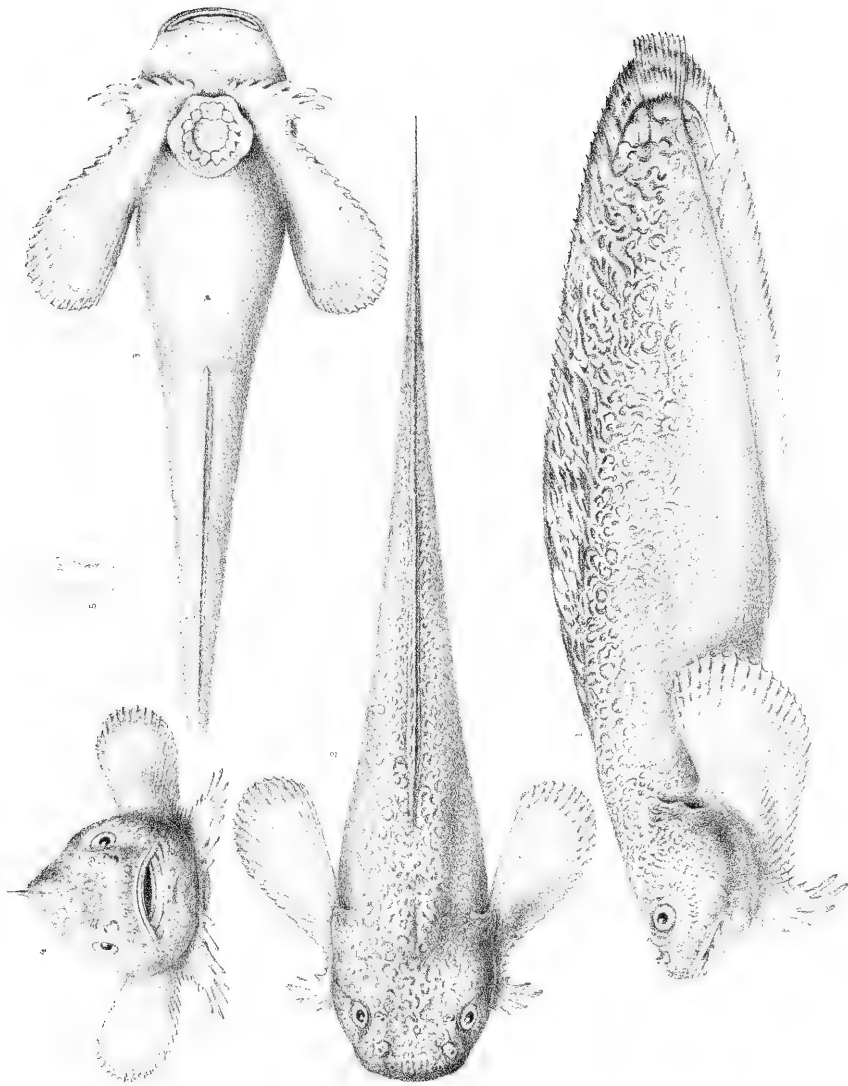
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LIPARIS AGASSIZII

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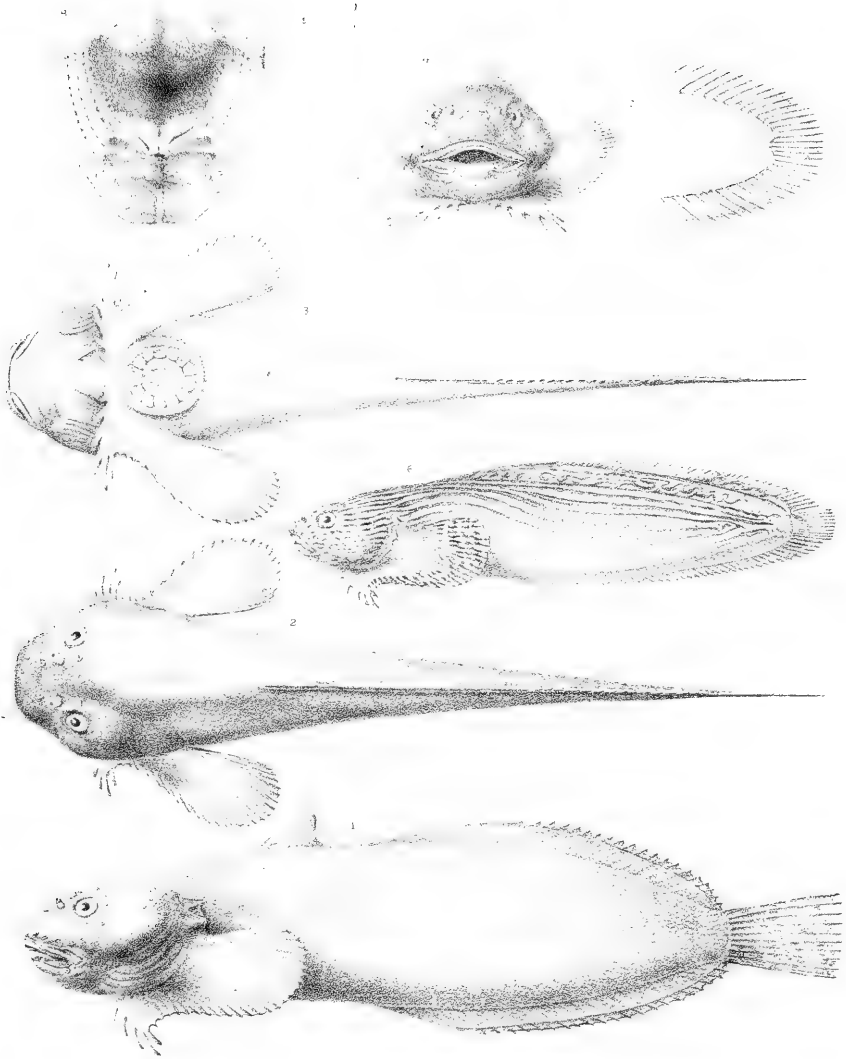


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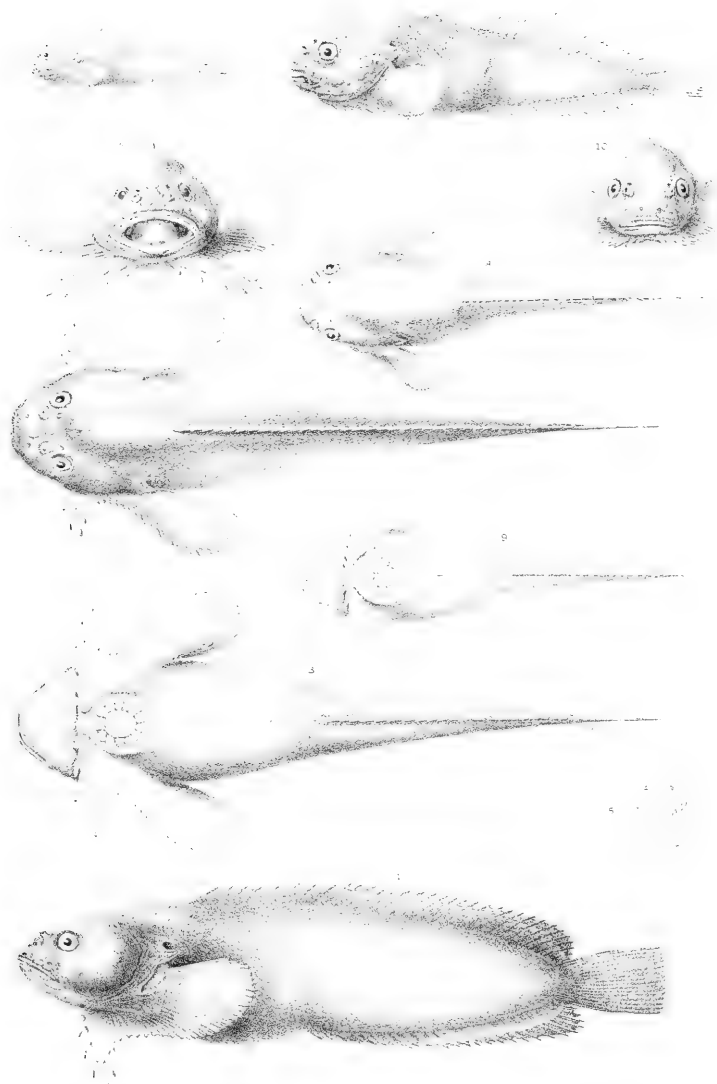
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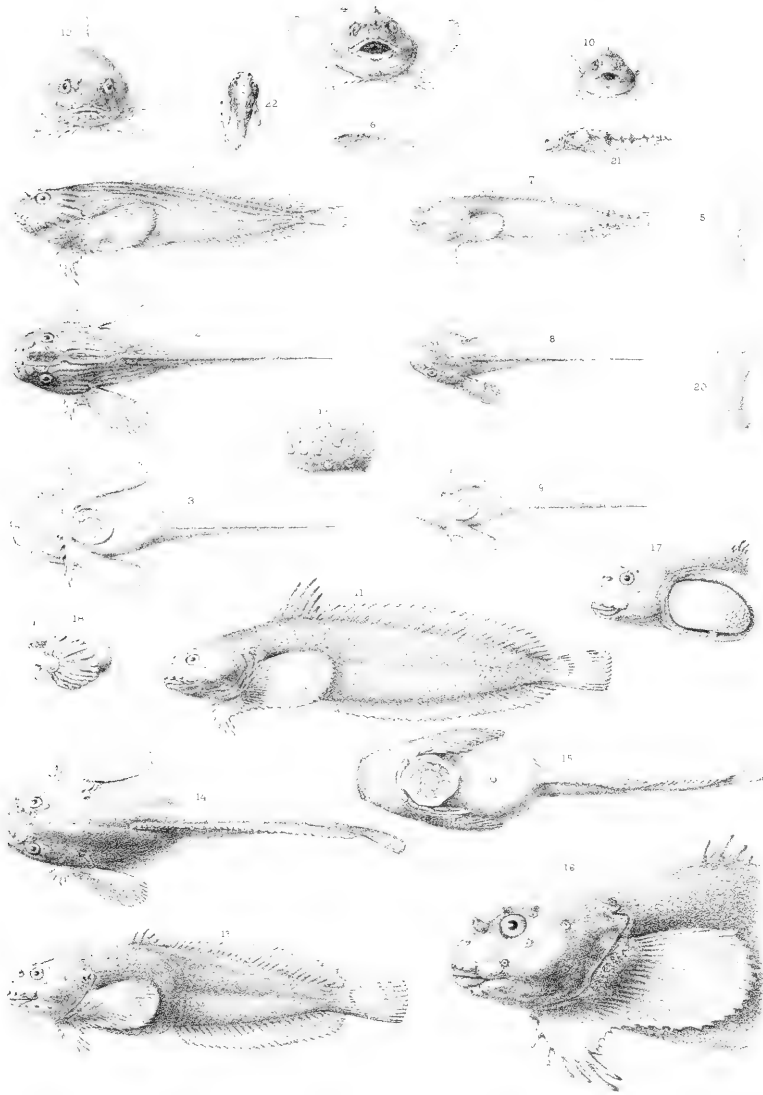






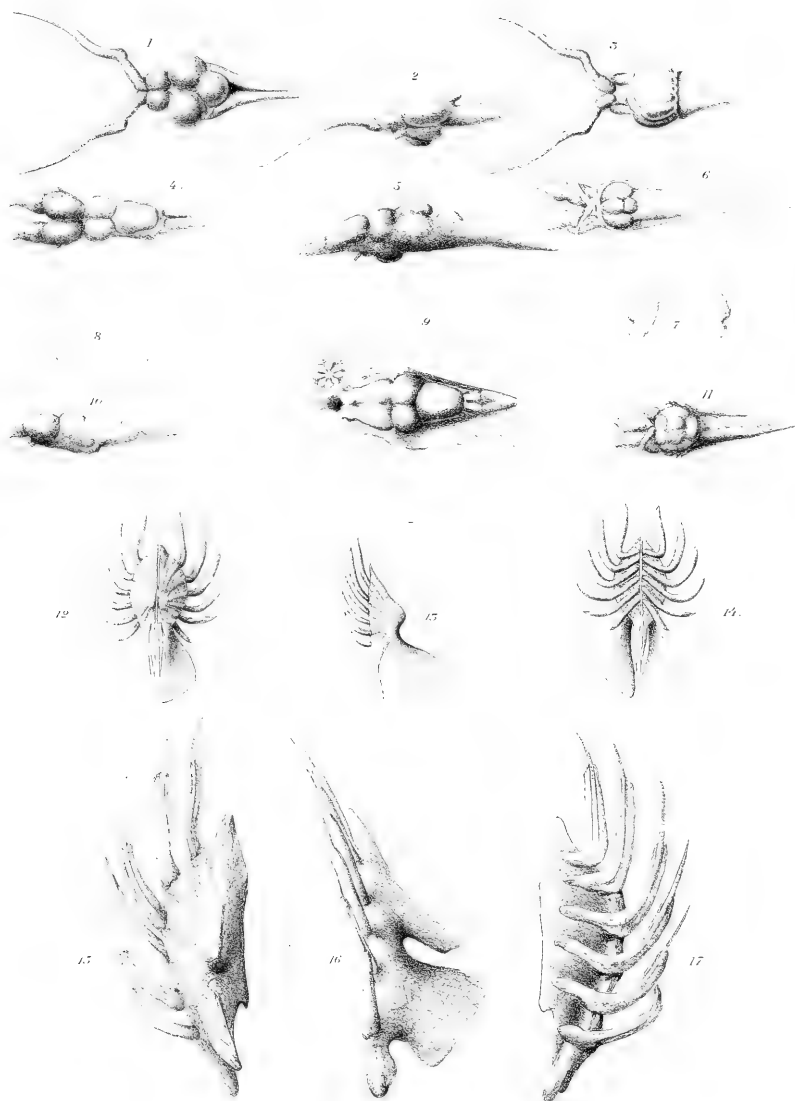




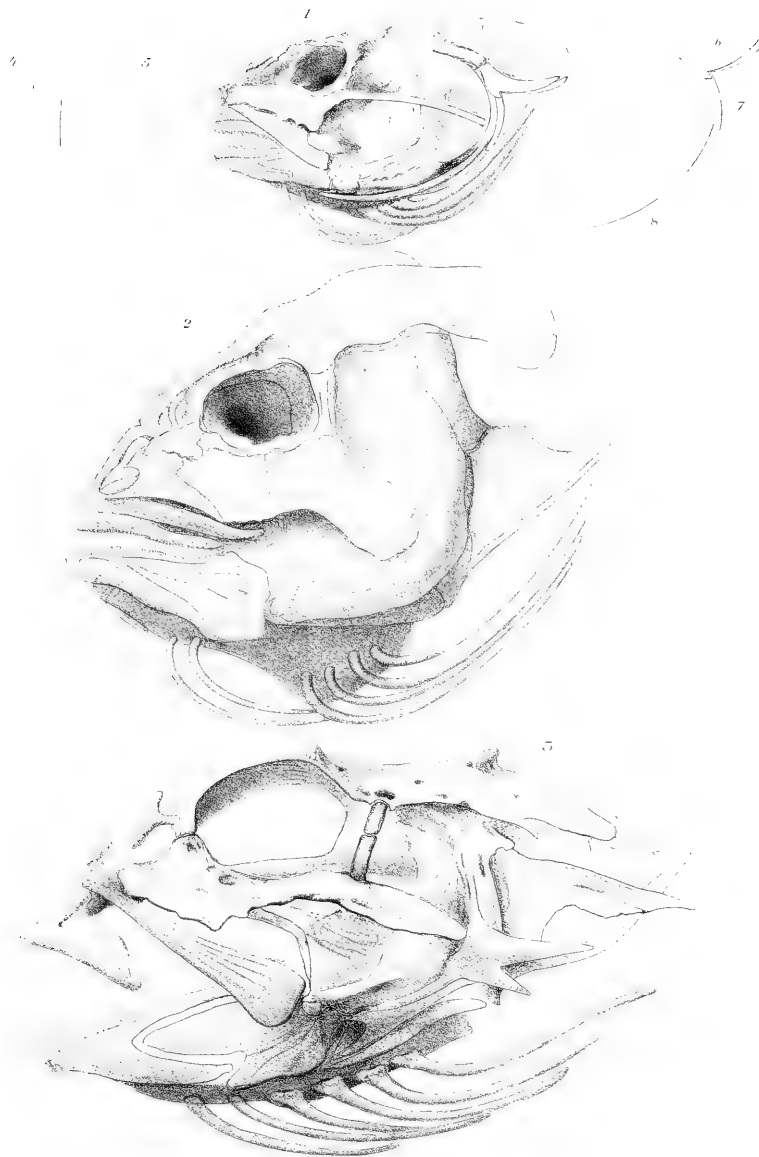




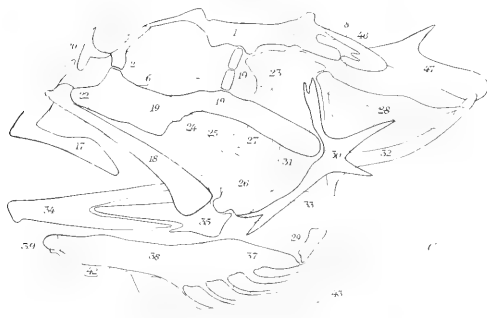
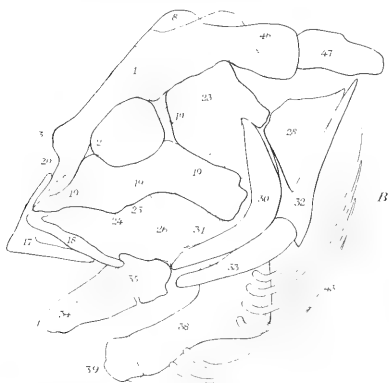
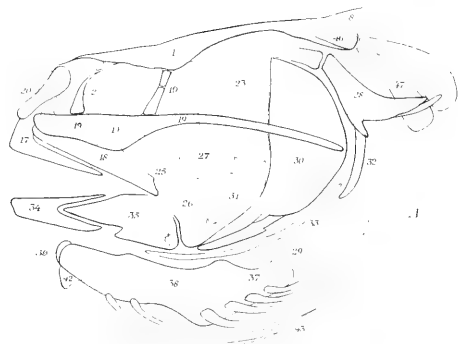




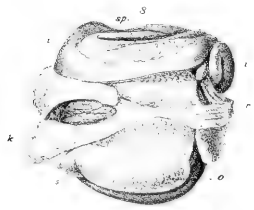
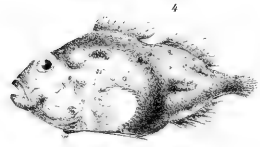
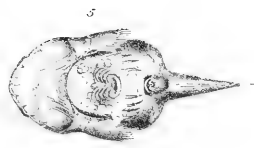
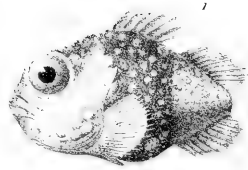
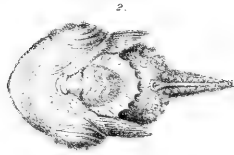








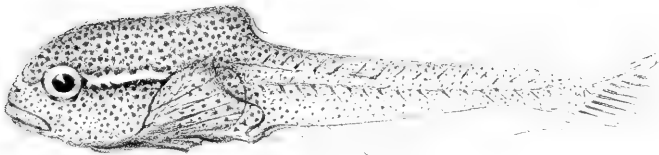




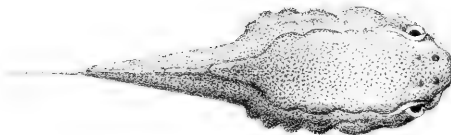
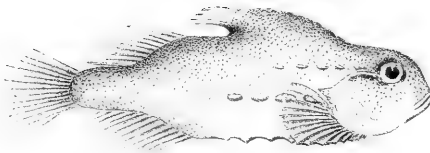
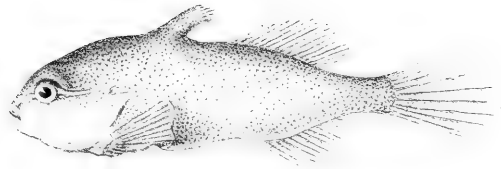




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