

SCIENTIFIC RESULTS OF EXPLORATIONS BY THE U. S. FISH COMMISSION STEAMER ALBATROSS.

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NO. XXIX.—A REVISION OF THE ORDER HETEROMI, DEEP-SEA FISHES,
WITH A DESCRIPTION OF THE NEW GENERIC TYPES MACDONALDIA
AND LIPOGENYS.

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[Abridged from advance sheets of *Oceanic Ichthyology*.]

THE collection of heteromous fishes obtained by the U. S. Fish Commission includes representatives of three of the five known genera of the order. The first species was taken in 1880 by a New England fishing vessel from the stomach of a ground shark on the Grand Bank of Newfoundland. The *Albatross* secured its first specimen (a *Macdonaldia*) in 1884 off the coast of New Jersey, and again, in 1887, dredged a second specimen of the same species in nearly the same locality.

In 1886 this vessel collected several examples of *Notacanthus analis* west of the Bermudas, and in 1887 *Lipogenys* was dredged off the Maryland coast.

Heteromi have been recorded from the Arctic, the Mediterranean, north and south Atlantic, and north and south Pacific, in depths ranging from 100 to upward of 1,800 fathoms.

Order HETEROMI.

Notacanthi, BLEEKER, Tentamen, 1859, XXIII. (In part.)

Heteromi, GILL, American Naturalist, November, 1889, p. 1016.

Teleosts with the scapular arch formed by the proscapula and post temporal (or posterotemporal), the latter detached from the sides of the cranium, and impinging on the supraoccipital; the hypercoracoid and hypocoracoid coalesced into a single lamellar imperforate plate; the actinosts normal; the cranium with the condyle confined to the basioccipital (ill defined); the exoccipitals coalesced with the epiotics and opisthotics; the vomer obsolete; the opercular apparatus complete, but the preoperculum slightly connected with or discrete from the suspensorium; the suborbitals suppressed; the jaw bones complete and little aberrant; the palatines, entopterygoids, and ectopterygoids well developed; the anterior vertebræ separate, and the ventrals abdominal. (Gill.)

All the heteromous teleosts have a subfusiform, moderately compressed body, with head and snout protruding, and sometimes produced and proboscis-like as in *Polyacanthonotus*.

Family NOTACANTHIDÆ.

Notacantini, RAFINESQUE, Indice d'Ittiologia Siciliana, 1810, p. 34.

Notacanthini, BONAPARTE, Cat. Metodico, 1846, p. 72.

Notacanthoidei, BLEEKER, l. c.

Notacanthi, GÜNTHER, Cat. Fish. Brit. Mus., III, 1861, p. 544.

Notacanthidæ, GILL, Arr. Fam. Fish., 1872, p. 21; Johnson's Cyclopædia, III, 1883, Century Dictionary, IV, 4022.—JORDAN and GILBERT, Bull., U. S. Nat. Mus., XVI, p. 370.

Heteromous teleosts, with elongate, subfusiform, moderately compressed body. Head short and snout protruding, sometimes produced, proboscis-like (as in *Polyacanthonotus*). Mouth moderate, horizontal, or inferior, suctorial (as in *Macdonaldia*). Scales small on body and head; lateral line present. Teeth slender, closely set, in a single series in each jaw. Gill-openings wide, the membranes separate and free from the isthmus.

Dorsal fin median, with short and free dorsal spines, and with soft rays very few or absent. Anal fin long, rather high, extending from the middle of the body to the caudal, with which it unites, and with numerous spinous rays. Ventrals abdominal, often confluent, with 1-5 spines and 4-8 soft rays. Pectorals short and high. Pseudobranchiæ, none.

The elaborate anatomical description of *Notacanthus sexspinis* given by Günther* with numerous excellent figures, applies in its general features to all the members of this family.

In the discussion of the genera and species below, little attention has been given to the degree of connection of the ventral fins. In every instance these are connate or confluent, but the degree of connection depends not so much upon their proximity to each other as upon the extent of the connecting membrane in the several forms, and we question whether the character can be so defined as to serve even for specific distinctions.

All the species examined by us have the peculiar modification of the posterior extremities of the maxillary, and the sharp spine more or less hidden by the fleshy fold of the lips at the angle of the mouth on either side.

KEY TO THE GENERA OF NOTACANTHIDÆ AND LIPOGENYIDÆ.

I. Jaws normal. Dorsal spines separated. Teeth in both jaws.

A. Dorsal spines 6-12. Teeth in upper jaw compressed, and obliquely triangular. Ventrals connate or confluent.....NOTACANTHIDÆ.

1. Origin of spinous dorsal far in advance of vent. Mouth lateral. Ventral fins connate or confluent.....NOTACANTHUS.

2. Origin of spinous dorsal in vertical from vent. Mouth subinferior, crescentic. Jaws each with 22 teeth. Ventral fins united....GIGLIOLIA.

* Challenger Report, XXII, p. 243-8.

- B. Dorsal spines 27-38. Teeth in jaws erect, fine. Ventrals separated. POLYACANTHONOTINÆ.
 1. Snout proboscis-like. Dorsal and anal spines long, flexible, the latter not exceeding 30 in number. Lateral line strongly arched. POLYACANTHONOTUS.
 2. Snout not very elongate. Dorsal and anal spines low and strong, the latter 50 or more in number. Lateral line straight. MACDONALDIA.
 II. Jaws modified to form a suctorial mouth. Dorsal spines close together, united by membrane to form a high triangular fin. LIPOGENYIDÆ.
 A. Dorsal spines 5, with 5 soft rays.
 1. Lateral line obsolete. LIPOGENYS.

Genus NOTACANTHUS, Bloch.

Notacanthus, BLOCH, Abhandl. Böhm. Gesellsch., 1787.—LACÉPÈDE, Hist. Nat. Poiss., 1804.—Goode, Proc. U. S. Nat. Mus., III, 1880, p. 555.

Acanthonotus, BLOCH, Ichthyologia, XII, 1797, p. 113, pl. CCCXXXI. (No description separate from that of species *A. nasus*.)—SCHNEIDER, Bloch, Syst. Ichth., 1801, p. 390, pl. XLVII.

Campylodon, FABRICIUS (*vide* GÜNTHER).

KEY TO THE SPECIES OF NOTACANTHUS AND GIGLIOLIA.

- I. Origin of dorsal considerably in advance of that of anal. Lip normal, continuous. NOTACANTHUS.
 A. Body much higher over ventrals than over pectorals, and comparatively short.
 1. Lateral line in front of dorsal spines, following profile of back, then sinking to median line of body. D. X-XI.
 a. First dorsal spine behind vertical from axil of ventral. A. XIII-XIV. (XVII?) N. NASUS.
 b. First dorsal spine in front of vertical from insertion of ventral. A. XVII. N. ANALIS.
 B. Body little higher over ventrals than over pectorals, and comparatively elongate.
 1. Lateral line inconspicuous, nearer to dorsal than to ventral outline throughout, not arched anteriorly. D. VI-VIII.
 a. Last dorsal spines over anterior part of soft anal. A. XII. N. BONAPARTII.
 b. Dorsal and soft anal not passing same vertical. A. XIII-XIV. N. SEXSPINIS.
 2. Lateral line slightly arched above pectoral, sinking to median line of body in advance of first dorsal spines. D. X.
 a. Last dorsal spine over fifth from last anal spine. Fins low. A. XIX. N. PHASGANORUS.
 II. Origin of dorsal over the vent. Lip absent in middle portion. GIGLIOLIA.
 A. Body much higher over ventrals than over pectorals; comparatively short.
 1. Lateral line arched over ventrals and pectorals. D. VIII.
 a. Snout thick, swollen. A. XV-XVIII. G. MOSELEYI.

NOTACANTHUS NASUS (Bloch), Jordan and Gilbert.

Acanthonotus nasus, BLOCH, Ausl. Fische, XII, p. 114.—SCHNEIDER, Bloch's Systema Ichthyologiae, 1801, p. 390.

Notacanthus nasus, BLOCH, Fische, VII, p. 113, pl. 431.—CUVIER and VALENCIENNES, Hist. Nat. Poiss., VIII, p. 467, pl. CCXXI.—LÜTKEN, Vid. Med., 1878, p. 145.—GÜNTHER, Cat. Fish. Brit. Mus., III, p. 54; *Challenger* Report, XXII, p. 248.—GIGLIOLI, Elenco, 94.—VAILLANT, Voy. Travailleur and Talisman, p. 317.

Campylodon fabricii, REINHARDT, Vidensk. Selsk. Afhandl., 1838, p. 120.

Notacanthus chemnitzii, BLOCH, (Abh. Bohm. Gesellsch., 1787).—JORDAN and GILBERT, Bull. U. S. Nat. Mus., XVI, p. 370.

A *Notacanthus* with elongate body, whose greatest height lies between the pectoral and ventral fins and is contained about four and one-half times in the distance from the vent to the tip of the snout. Head short, compressed, its length not quite three and one-half times in the distance from vent to snout. Mouth large, extending backward to a point nearly under the eye; the maxillary nearly to the vertical from the anterior margin of the pupil. The mouth does not lie entirely on the under portion of the head, but is sublateral. There are thirty-five teeth in the intermaxillaries on each side. The distance between the upper profile of the head and the eye is about equal to the diameter of the eye, which is slightly greater than one-third the length of the snout (certainly not more than one-half the length of the snout) and about one-eighth the length of the head. [In this connection it is taken for granted that the hole in the skin of the head represents the size of the eye. If, however, we assume that the entire portion free of scales is the eye, the diameter is greater and equal to one-sixth the length of the head. It is, at any rate, considerably less than the width of the inter-orbital space.] The gill-cover appears to be divided to below the symphysis of the operculum (with hyomandibular), and is free from the isthmus.

Scales are lacking only about the mouth and eyes; about forty rows of small scales (2 mm. broad, 4 mm. long) between the ventral outline and the lateral line; smooth and imbricated.

Of the eleven dorsal spines, the first (overlooked by Bloch and Valenciennes) is very small and only visible as a point; placed close to this (1 mm.) is the second, which is also very short and feeble. The third, though also short, is thicker. The vent lies behind the fifth spine. Of the fifteen anal spines, which have their origin immediately behind the vent, the first (overlooked by Bloch and Valenciennes) is very small; it does not extend beyond the profile; the second and third but slightly. The spines which are longest and placed farthest back still bear traces of a connecting membrane, and are probably only worn-off rays. The pectorals are inserted somewhat farther back from the gill-covers than shown by Bloch; the end is surely broken off, but yet it can hardly be doubted that this fin is too long in Bloch's figure; its base is less than one-sixth the length of the head. The ventral fins, connected together behind the median line by a membrane, terminate considerably in advance of the vent (they are apparently worn off a little behind).

Radial formula: D. 11; A. 15 + 118. C?; P. 19; V. 3 + 7 (l), 8 (r); Branchiostegals VIII. (r)—IX. (l).

Total length (restored), 85 cm. Length of head, about 10.7 cm. Height of body, about 8 cm. Length of caudal, about 47.5 cm.

The full diagnosis given above was furnished by our friend Dr. Franz Hildgendorf, custos of the zoological collections in the Royal Museum of Natural History, Berlin, who also gives the following notes on the present condition of the type:

The original Bloch specimen (Cat. gen. No. 1409) is still in existence (our museum possesses in addition to this only a single specimen of *Notacanthus*, *Notac. sexspinis*), but it is in a very unsatisfactory condition. It was perhaps injured in transportation from Paris. The jar has not been opened for more than thirty years. Very likely Bloch received it in a poor state of preservation—a large cavity in the belly between the pectorals and ventrals, a dilapidated left cheek, injured eyeballs, intestines wanting, etc. In addition to this, there are other defects of a later date, such as the loss of the caudal, the tip of the snout, the maceration of the frontal bones. The gill arch is almost entirely gone; the intestines altogether. The frontal bone is crushed and the first vertebra is disconnected. There is a long gap in the dorsal fin.

The actual length is now 82 cm.; in addition to this should be added at the most 1 cm. for the snout and $\frac{2}{3}$ cm. for the caudal fin. This makes its former length about 85 cm. (Bloch says 2½ feet. This would be according to the Rhenish, i. e., Prussian, measure only 78½ cm. Perhaps Bloch had a longer foot, or he gave only an approximate measurement.) As we have no other specimen which we might have confounded with that of Bloch, and ours still bears the label (apparently in Troschel's handwriting), "*Notacanthus nasus*, Iceland, Bloch," I have no doubt that No. 1409 is the type specimen. Nor can there have been another in Paris.

How much of the end of the caudal is missing is difficult to say. The point of the fracture is hard and the fin bones are soft. If Valenciennes's account is accurate, the caudal fin only is missing, and one or two rays of this are still attached. If Bloch's description is correct, there were 149—(13, 8, or 10? spines for the caudal), =126–128 rays in the anal; consequently a caudal end, with at least 10 rays, in addition to the caudal fin, was lost, and the fish would have been somewhat longer than 85 cm. I presume there was an oversight on Bloch's part.

The material now classed by authors under the name of *N. nasus* is the following: (1) A specimen described by Fabricius in 1798 under the generic name of *Campylodon*, obtained in 1794 from Greenland; (2) Bloch's type in the Berlin Museum, believed by him to come from the West Indies, described under the names *N. chemnitzii* (?), *N. nasus*, and *Acanthonotus nasus*; (3) a specimen, obtained off Iceland by *La Recherche* and brought by Gaimard to the Paris Museum, figured in the *Règne Animal*, and said to have been figured also in the *Voyage in Scandinavia*; this, as has already been stated, is possibly a typical *N. nasus*; (4) a specimen, 3 feet long, obtained in South Greenland, and brought in 1877 to the Copenhagen Museum. This also is possibly not a characteristic representative of the species.

Both Canestrini and Giglioli enumerate *Notacanthus nasus* among Mediterranean fishes, but entirely without warrant.

NOTACANTHUS ANALIS, Gill.

Notacanthus analis, GILL, Proc. U. S. Nat. Mus., VI, 1838, p. 255.—GÜNTHER, *Challenger Report*, XXII, p. 248, note.—VAILLANT, *Voy.*, Travailleur and Talisman, p. 318, *et seq.*—JORDAN and GILBERT, Cat. Fish. N. Amer., 1885, p. 58.

A *Notacanthus*, with its body much higher over ventrals than over pectorals, and comparatively short. Its height equal to one-third of the distance from the vent to the tip of the snout, and nearly equal to

the length of the head. The lateral line arcuate in front of the dorsal spines, following profile of the back, and then sinking to the median line of the body. First dorsal spine in front of vertical from insertion of ventral.

The snout is compressed, pointed, much produced beyond the moderate mouth. The cleft extends nearly to the vertical through the middle of eye. The length of the snout is one and one-half times the diameter of the eye. The width of the interorbital area is slightly less than the diameter of the eye. The projection of the snout beyond the mouth equal to the diameter of the eye, or nearly so. The snout is compressed, not swollen. Mouth narrow, transverse, its width about one-fourth the length of the head. The eye is placed some distance below the upper profile and in the line of the lateral line continued to the nostrils. Gill-opening wide; the membranes confluent and slightly in advance of the vertical from the upper end of the gill-opening; not attached to the isthmus. Scales very minute, imbricated, adherent.

All the dorsal spines are short, the anterior very short; the second and first nearly over the origin of the ventrals, the fifth above the vent, and the sixth slightly behind the origin of the anal. The longest about one-half as long as the eye. The last (eleventh), which is followed by a single ray attached to it by membrane, is over the fifteenth spine of the anal. The dorsal spines are distant from each other, and behind each is a narrow angular membrane. The anal begins immediately behind the vent and in its middle portion is considerably elevated; the length of its longest rays are about equal to that of the snout, from which point it slopes rapidly to the tip of the tail. The pectoral, placed high up in the middle axis of the body, is inserted at some distance behind the gill-opening and is broad and nearly oval in shape. Ventrals confluent, some distance in advance of the vent, stout, broad, ovate in form, not extending to the vent but separated from it by a distance equal to half their own length. Color uniform light brown.

Radial formula: D. XI; A. XVIII+.

This description is prepared from the types of Gill, (No. 37856, U.S. N.M.) from *Albatross* station 2677, N. Lat. $32^{\circ} 39'$ W. Lon., $76^{\circ} 50' 30''$, in 478 fathoms. The types, two in number, measure $11\frac{1}{2}$ and $12\frac{1}{2}$ inches, respectively. Another specimen (No. 44246, U.S.N.M.) was obtained by the *Albatross* from station 2676, in $32^{\circ} 39'$ N. Lat., $70^{\circ} 01'$ W. Lon., at a depth of 407 fathoms.

NOTACANTHUS BONAPARTII, RISSO.

- Notacanthus bonaparti*, RISSO, Wieg. Archiv f. Naturgesch., 1840, p. 376, pl. x.
Notacanthus bonapartii, FILIPPI and VERANY, Mem. Acc. Sci. Torino, XVIII, 1857, p. 190, Notad 6.—CANESTRINI, Pesci d'Italia, p. 118.—MOREAU, Hist. Nat. Poiss. France, 1881, p. 161.—GIGLIOLI, Elenco, 33.
Notacanthus mediterraneus, FILIPPI and VERANY, Mem. Acc. Sci. Torino, 2d series, XVIII, 1859, p. 190 (*nota supra*); Alcuni Pesci del Mediterraneo, 1857, p. 3.—GÜNTHER, Cat. Fish. Brit. Mus., III, p. 545.—CANESTRINI, Pesci d'Italia, 1872, p. 118.—MOREAU, Hist. Nat. Poiss. France, 1881, III, p. 158 (woodcut).—VAILLANT, Voy. Travailleur and Talisman, p. 317; p. 325, pl. XXVII.

A *Notacanthus*, with body slender, comparatively elongate, little higher over ventrals than over pectorals; with its lateral line inconspicuous, nearer to the dorsal than to the ventral outline, not arched anteriorly. Snout produced and compressed. Palatine teeth in a single series. Ventrals joined by a membrane of considerable width between the internal rays. The height of the body is about one-thirteenth of its length; its thickness, about one-twentieth. The tail does not appear to be in the least truncated, though so described by certain authors, one of whom in his figure shows a tail carried to an acute point, making the length of the body considerably greater in proportion to its height than is indicated in his own description. Color yellowish, with silvery reflections; the limb of the operculum, the margin of the orbit, and the mouth darker.

Radial formula: D. VI-VII; A. XII-100+; V. II, III-6 (IV-8 according to Filippi and Verany).

This form was carefully figured and described by Risso in 1840. He had a single specimen 148 millimeters long, which he recognized as an inhabitant of abyssal depths (*Sejour abymes marines vaseux*). By some error his description and figure, otherwise perfectly consistent, disagreed in respect to the number of spines in the dorsal fin, the figure showing 7, the description 9. Misled by this, Filippi and Verany redescribed the same fish in 1859, and to justify their course proposed the theory that Risso's descriptions and figures were based on different specimens—a theory accepted without criticism by later writers, but which we can not believe a true one.

Risso was a careful and experienced worker, and it would be unjust to the memory of one of the best Italian ichthyologists to admit that he could be guilty of such an error. Then, too, he states positively that he had only a single specimen. It is much more probable that the German typesetter in the office of Wiegmann's Archiv mistook a "7" for a "9" in Risso's manuscript.

Risso's figure is a good one of a young *N. mediterraneus* and his description agrees with it perfectly with the exception of this one figure in type.

The specimen described and figured by Günther under the name *N. mediterraneus* is not a Mediterranean form, but one from the Southern Pacific, and has been referred by us to a new genus and species.

Moreau is in error in referring the figures of Bloch and Cuvier and Valenciennes to this species. (See discussion under *Notacanthus nasus*.)

N. bonapartii was described under the name *N. mediterraneus* by Filippi and Verany in 1857 from a specimen obtained at Nice, and preserved in the Zoological Museum at Turin. Two others from the same locality, referred by Moreau to this species, are in the museum in Paris. The *Travailleur* and *Talisman* obtained four additional individuals, one from the coast of Soudan, at a depth of 1,232 meters, and another

from the same region at 932 meters; two from the Banc D'Arguin at 1,495 meters. These last have been made the subject of an elaborate description by Vaillant, who also publishes a good figure.

This species is distinguished from *N. sexspinis*, (fig. 192A-B), described by Richardson from Australian Seas* and subsequently described by Günther, who also gives an excellent figure† by the various characters, most striking of which is the difference in the relationships of the position of the dorsal spines and the soft anal fin. In *N. sexspinis* the dorsal and soft anal do not pass the same vertical, whereas in *N. mediterraneus* the last three dorsal spines are placed over the anterior part of the soft anal. The National Museum is indebted to Dr. Günther for a specimen of *Notacanthus sexspinus* from New Zealand (No. 12625, U.S.N.M.). It is a small specimen, and does not exhibit any inflation of the cheeks, such as is shown in the plate in the *Challenger* report. It has eight dorsal spines.

The type of *N. mediterraneus* from Nice was examined by Giglioli at the Turin Museum in 1882. Its total length is 203 mm., and its radial formula D. 6 / 1; A. 12 / 132?; V. 3-4 / 8; C. 5?.

Prof. Giglioli informs us that in his "Central Collection of Italian Vertebrates" at Florence he has four specimens of *N. bonapartii*, as follows:

- a. Nice, August 11, 1882. Total length, 153 mm. D. 8 / 1; A. 6-7 / 120; V. 3 / 6-7; P. 9-10; C. 3-4 ?. A large curved spine in upper corner of mouth on either side.
- b. Nice, March 7, 1891. Total length, 205 mm. D. 7 / 1; A. 14 / 120; V. 3 / 7. P. 12. C. 4?. Buccal spines hidden in skin.
- c. Nice, June 15, 1892. Total length, 203 mm. D. 7 / 1. A. 8 ? / 140. V. 3 / 5-7. P. 10 / 12. Buccal spines large and prominent.
- d. Syracuse, 1855-'60?. D. 7 / 1. A. 11 / 25. P. 9-10. V. 3 / 5. Tail broken off. Buccal spines conspicuous.

Another specimen, collected by Bellotti at Messina, December 12, 1882, and now in the Museo Civico at Milan, was examined by Giglioli, who states that it was 104 mm. long, and had D. 7 / 1. A. 7 / ?. V. 3 / 6. P. 10-12. C. 5 ?.

NOTACANTHUS PHASGANORUS, Goode.

Notacanthus phasganorus, GOODE, Proc. U. S. Nat. Mus., III, p. 535, Apr. 18, 1881.—GÜNTHER, *Challenger* Report, XXII, p. 249.—JORDAN and GILBERT, Bull. U. S. Nat. Mus., XVI, p. 900.—VAILLANT, Voy. Travailleur and Talisman, p. 318 *et seq.*

A *Notacanthus*, with its body a little higher over the ventrals than over pectorals, and comparatively elongate; with its lateral line slightly arched above the pectorals, sinking to median line of body in advance of first dorsal spines, and its last dorsal spine over the fifth from the last anal spine.

*Voyage Erebus and Terror, Fishes, p. 54, pl. XXXII, figs. 4-11.

†Voyage of the Challenger, XXII, p. 243, pl. LXI, fig. a.

Its body is much compressed, its greatest width slightly more than one-third height of the body at vent.

Scales round, thin, flexible, very small upon the head (not wider than the diameter of one of the dorsal spines), but upon the anterior half of the body about three times as large, decreasing in size upon posterior half, until upon tail they are smaller than upon head. Number of scales in lateral line not far from 400. (In the partially digested specimen before me it is impossible to make an exact enumeration.) Number between lateral line and dorsal fin, about 20; between lateral line and anal fin, about 36. Head covered in every part, even the lips, with small scales, of which there are about 40 between eye and end of opercular flap. Scales deeply embedded (in life are probably hidden beneath a slimy epidermis).

Length of the head about $7\frac{1}{3}$ in that of body. Bones are all flexible, and their outlines are invisible without dissection, the whole being covered with a leathery skin. Width of interorbital space appears to be (in the mutilated head) somewhat greater than length of snout and about one-fourth length of the head. Diameter of orbit appears to be about one-half width of interorbital space. Length of postorbital portion of head nearly three times that of snout. Length of mandibular bone slightly exceeds twice diameter of eye; that of upper jaw considerably greater. Teeth in upper jaw blunt, acicular, set side by side like the teeth of a comb, about 32 on each side. In lower jaw shorter, slenderer, and in double rows. Villiform teeth upon palatines.

Dorsal fin begins at a distance from snout not far from two and three-fourth times length of the head, and nearly over the one hundred and tenth scale of lateral line; it consists of ten low, widely separated spines, unconnected by any membrane. Distance between first and tenth spine nearly double length of head.

Spines from fourth to ninth about equidistant, while the other interspaces are shorter.

Distance from snout to anal fin equal to about four times length of head. Anterior spinous portion of anal resembles dorsal and is devoid of connecting membrane. (The membrane is also absent from the posterior half of the fin, but may possibly have been destroyed.) Anal rays extend to tip of tail and number about 130, the number of spines being 19. Anal begins immediately behind vent, and its length of base is slightly less than half that of body (less by a length about equal to the distance from the angle of the mouth to the gill-opening).

Pectoral fin placed at a distance behind the gill-opening about equal to width of its own base (its length is at least double this distance—how much more can not be determined, but the fin is evidently short and rounded in contour, the upper rays longest). Its base is stout-peduncular, and thickly covered with scales.

Distance of the ventrals from snout equal to that of the dorsal,

though its insertion is slightly in advance of that of dorsal. Ventrals closely adjacent, separated by narrow groove, broad, with peduncle-like bases, thickly covered with scales, and are provided with two spines and eight or nine (as nearly as the specimen will permit determination) rays.

Radial formula: D. x; A. XIX (130); C. 0; P. (17); V. II, 8-9.

The U. S. Fish Commission received the type from the schooner *Gath-erer*, of Gloucester (Capt. Briggs Gilpatrick), which had been taken from the stomach of a Ground-shark (*Somniosus brevipinnis*), on the Grand Bank of Newfoundland.

GIGLIOLIA, new genus.

A genus of *Notacanthidae*, distinguished from *Notacanthus* by the less advanced position of the dorsal, the first dorsal spine being placed in the vertical over the vent and close to the vertical from the first anal spine. Dorsal spines 6-9; anal spines 15-18, these being longer and more slender than in *Notacanthus*, enveloped nearly to their tips in a membrane, and grading imperceptibly in length and size into those of the anal, which is comparatively high. The greatest height of the body is in the region of the ventral fins, and the lateral line, which is conspicuous, is arched over the pectorals and ventrals, but follows closely the dorsal outline until it passes beyond the dorsal spines, after which it is directed in a straight line to the tip of the pointed tail. Head comparatively broad, mouth inferior, almost suctorial; teeth in each intermaxillary 20-22; snout thick, swollen, much produced, nostrils large, conspicuous, covered by a membranous flap. Pectoral short, broad, rounded. Ventrals placed low down and completely united, extending to the vent.

In general appearance and proportions this form resembles the high-backed division of the genus *Notacanthus*, to which belong *N. nasus* and *N. chemnitzii*. Its mouth, however, is placed more on the under surface of the head than even in *N. sexspinis*, and resembles in some respects that of our new genus *Macdonaldia*.

This genus is named in honor of Commendatore Enrico Hillier Giglioli, professor in the University of Florence and founder of the Central Museum of Italian Vertebrates, who has been identified with all the efforts of the Italian Government in deep-sea research, and whose thorough works upon the geographical distribution of Italian vertebrates, both terrestrial and aquatic, are of an importance which can not be overstated.

The only species assigned to this genus is that obtained by the *Challenger* off the southwest coast of South America, and referred by Günther to *Notacanthus bonapartii*. For this form, represented by a single individual 11½ inches long, from a depth of 400 fathoms at station 1310, we propose the specific name *moseleyi*, in memory of the lamented Henry

Nottidge Moseley, F. R. S., naturalist of the *Challenger*, and later Linacre professor in the University of Oxford.

GIGLIOLIA MOSELEYI, new species.

Plate XVIII, fig. 1.

Notacanthus bonapartii, GÜNTHER, *Challenger* Report, XXII, 249, pl. lxi, fig. c.

The following excellent description is by Dr. Günther:

Body moderately elongate, its greatest depth opposite to the ventral fin, and contained twice and two-thirds in distance of the vent from the end of the snout; the length of the compressed oblong head is contained twice and one-third in the same length. The snout is thick, swollen, much produced beyond the narrow transverse mouth, which is opposite to the front margin of the orbit, and quite at the lower side of the head. Twenty teeth on each side of the upper jaw. The eye is close to the upper profile, two-thirds of the length of the snout, one-fifth of that of the head, and less than the width of the interorbital space. Gill openings of moderate width, the gill membranes being confluent in the vertical from the upper end of the gill opening, and not attached to the isthmus.

The whole body and head are covered with minute, smooth, imbricate, and adherent scales.

All the dorsal spines are short, the anterior very short, the second opposite to the vent. The anal spines commence immediately behind the vent and increase in length posteriorly, passing into the flexible rays, which are of varying and indefinite number. The pectoral is inserted at the usual distance from the gill opening and has a base of moderate width. Ventrals united and extending to the vent (Günther).

Radial formula: D. VIII-IX; A. XV-XVIII, 150; C. 3; P. 9; V. I, 7; Cæc. pyl. 5.

Genus POLYACANTHONOTUS, Bleeker.

Polyacanthonotus, BLEEKER, GÜNTHER, *Challenger* Report, XXII, 1875, p. 243 (as subgenus).

Zanotacanthus, GILL, Johnson's *Cyclopædia*, III, 1876, p. 883.

Paradoxichthys, GIGLIOLI, *Nature*, XXV, p. 535, 1882.

Teratichthys, GIGLIOLI, *l. c.*

Notacanthids, with very slender, elongate body, and inferior mouth, and the snout prolonged into a proboscis-like tip, resembling that of *Mastacembelus*, its length at least one-third that of the head. Dorsal fin represented by numerous slender, curved, flexible, disjoined spines, the first of which is placed some distance behind the vertical from the origin of the pectoral. Anal composed of a smaller number of longer, slender, flexible spines, passing at a point some distance behind the last of the dorsal spines into a low, short, anal fin. Pectorals moderate, slender, placed above the median line of the body, and close to the lateral line. Ventrals slender, entirely separate, not reaching to the vent. Scales inconspicuous or probably absent. Lateral line conspicuous, descending from the angle of the operculum in a strong, broad curve, to below the middle region of the body at a point not far from the vent. Teeth very fine, in rows upon each jaw; stronger teeth upon

the palate, arranged in the form of a horseshoe. The ventral with one spine. Type, *Notacanthus rissoanus* (Filippi and Verany.)

POLYACANTHONOTUS RISSOANUS (De Filippi and Verany), Günther.

Notacanthus rissoanus, DE FILIPPI and VERANY, Mem. Acc. Sci. Torino, 2d ser., XVIII, 1859, p. 6; Nota Sopra alcuni Pesci del Mediterraneo, 1857, p. 3.—GÜNTHER, Cat. Fish. Brit. Mus., III, p. 545.—CANESTRINI, Pesci d'Italia, p. 118.—GIGLIOLI, Elenco, 34; Nature, XXV, p. 535.—MOREAU, Hist. Nat. Poiss. France, p. 162.—VAILLANT, Voy. Travailleur and Talisman, 335, pl. xxvii, fig 1.

[*Notacanthus* (*Polyacanthonotus*) *rissoanus*, GÜNTHER Challenger Report, XXII, p. 250 (description and figure relate to another species).]

Paradoxichthys garibaldianus, GIGLIOLI, Nature, XXV, p. 535.

A Notacanthid fish, slender and elongate in form, its greatest height above the anus and near the middle of the body, one-fifteenth of the length of the body; its height at the shoulders about one-twentieth. The length of the head is about one-eighth of that of the body. Snout very elongate, one-third of the length of the head; as long as the height of the body at the shoulders and three times the diameter of the eye. In form resembling that of *Mastacembelus*. "The condition of the type," remarks Vaillant, "does not allow us to estimate the size of the mouth, but its connature does not reach the anterior edge of the orbit. Its form is analogous to that in other species of the genus, that is to say, its inferior teeth are exceedingly fine and closely set in the jaws, while there are stronger teeth upon the palate, where they are arranged in the form of a horseshoe."

Eye moderate in size, its diameter one-eighth the length of the head; interorbital space very narrow, not one-half the diameter of the eye. Branchial opening large. Operculum truncated posteriorly.

Vent in front of the middle of the body.

No traces of scales. The lateral line, however, is conspicuous, and it descends from the upper angle of the operculum to the middle of the body, or a little below it, in the vicinity of the region of the vent. The first dorsal spine is placed two-thirds times its own length back of the vertical from the axil of the pectoral, and its length is less than the diameter of the eye. The highest dorsal spines, those in the posterior third of the fin, are twice as long as the diameter of the eye. The spines are all slightly curved backward, and there is a soft, supplementary ray behind the last. The anal spines are longer than the dorsal spines, the longest two and one-half times the diameter of the eye. The first, which is somewhat longer than the first dorsal spine, situated immediately behind the vent under the eighteenth dorsal spine.

In the specimen figured and described by Vaillant there is a semblance of a minute, separate caudal fin, but it is by no means certain that this exists. The pectoral is placed a considerable distance from the operculum, nearly equal to the length of the snout, and its lower axil is in the median line of the body, or nearly so. Its length is about equal to that of the snout. The ventrals, situated at a distance

from the snout equal to about one-third of the length of the body, do not reach the anus, and are the same size as the pectorals. In Vailant's specimen they appear to be separate, and he was able to observe but a single spine. The color, in fresh condition, was milky white; the head and iris being black.

Radial formula: D. 29-37; A. 34-41.

This species was known to Risso, who had in his collection the specimen which afterwards served De Filippi as a type and which is now in the Turin Museum. A sketch by Risso of this fish, to which he never gave a name, is given in "Oceanic Ichthyology." The Turin specimen was examined by Prof. Giglioli in 1882; it is 160 mm. long and has the following radial formula: D. 29/1; A. 35.

Prof. Giglioli has three specimens in his collection at Florence. We are indebted to him for the following details concerning them:

- a. Nice, August 5, 1881 (type of *Paradoxichthys Garibaldianus*): Total length, 199 mm. D. 32/0; A. 38/100; P. 9-10; V. 1-10; C. 4?. This specimen has a long, straight spine, pointed backwards, above the maxillary bone on either side.
- b. Nice, March 1, 1891: Total length, 186 mm; D. 30/1; A. 41/150; P. 10; V. 1/10; C. 4?. Found dead and partly decomposed. The peculiar maxillary spine is small in this and in the following specimen.
- c. Nice, January 27, 1892: Total length, 160 mm. D. 30/0; A. 34/? Found partially digested in the stomach of *Galeus canis*.

In addition to these specimens one other was taken by the French expedition off the coast of Morocco, station 40, at a depth of 2,212 meters. Its radial formula was D. 37/1; A. 27/?.

MACDONALDIA, new genus.

Notacanthids, with elongate body and inferior mouth. Body and head covered with minute, imbricated scales. Dorsal fin represented by numerous short, straight, robust, and disjoined spines, 27 to 34 in number, the first in advance of the insertion of the pectoral. Anal as in *Notacanthus* but lower, and with a longer portion of low, short, slightly curved, disjoined spines, from 35 to 55 in number, which under the final dorsal spines pass into flexible rays. Lateral line straight, conspicuous. Pectorals moderate, placed far back, below the middle line of the body and remote from the lateral line. Teeth in jaws erect, small; and also in series on the vomer and palate. A line of pores on the inner edge of the mandible. Ventrals moderate, entirely separate. Type, *Notacanthus rostratus*, Collett.

This genus is named in honor of Col. Marshall McDonald, U. S. Commissioner of Fisheries, in commemoration of his liberal policy in furthering ichthyological research.

MACDONALDIA ROSTRATA (Collett) Goode and Bean.

Plate XVIII, fig. 2.

Notacanthus rostratus, Collet, Bull. Soc. Zool. France, 1889, p. 307.

The body is greatly compressed, its outlines tapering rapidly in both directions from the origin of the vent. Its greatest height is con-

tained $3\frac{1}{2}$ times in the distance of the vent from the tip of the snout, or about four-fifths the length of the head, which is contained $9\frac{1}{2}$ times in the total. The snout is compressed, pointed, snake-like, produced beyond the mouth a distance less than the diameter of the eye, and contained three times in the length of the head. The mouth is small; its cleft scarcely reaches to the anterior nostril. Each jaw is armed with a series of minute teeth and a similar series on vomer and palate. The eye is moderate in size, placed not far from the dorsal profile, distant about $2\frac{1}{2}$ diameters from the end of the snout, more than three times from the end of the opercle. Gill opening wide. The body and head covered by minute, imbricated scales. A line of mucous pores extends from the anterior end of the lateral line forward under the eye and thence to the end of the maxilla.

The dorsal spines are short, distant from one another, the first being over the end of the opercle, the fifth slightly behind the vertical through the origin of the pectoral, the twelfth slightly in advance of the origin of the pectoral, the fifteenth almost over the origin of the anal, and the last (twenty-eighth) a little behind the middle of the length of the tail. In another individual the fourth spine is immediately over the pectoral insertion, the thirteenth over the ventral origin, and the whole number of spines is 30, but there is behind the thirtieth a minute spine almost united by membrane. The anal begins immediately behind the vent, and after the fifth spine the height of the fin remains uniform until the length of the rays gradually decreases near the tip of the tail. The pectoral is inserted at a distance from the gill opening nearly twice its own length. The ventrals have a broad base, are not confluent and reach to the vent or slightly beyond it.

D. XXVIII-XXXI; A. XLII-LIII.

The types are No. 35601, U.S.N.M., and were obtained by the steamer *Albatross* at station 2216, latitude $39^{\circ} 47' N.$, longitude $70^{\circ} 30' 30'' W.$, in a depth of 963 fathoms. They measure $16\frac{1}{2}$ and 16 inches, respectively. Another specimen, 17 inches long, was obtained by the same steamer at station 2553, latitude $39^{\circ} 48' N.$, longitude $70^{\circ} 36' W.$, in a depth of 551 fathoms.

Closely allied to *M. rostrata* is *Notacanthus challenger* (Vaillant) (*Notacanthus rissoanus*, Günther, *Challenger Report*, XXII, 250, pl. LXI, Fig. B: not Filippi and Verany), renamed by Vaillant in the report of the *Travailleur* and *Talisman*, page 387. This is distinguished by the larger number of its dorsal rays, the less anterior position of the origin of the dorsal, the lesser height of the body in comparison with the distance from the vent to the snout, comparatively longer snout and larger eye, and the absence of the suborbital row of mucous pores.

Dr. Günther states that although the species is a matter of some certainty, the diagnosis of *N. rissoanus* "applies sufficiently well to his specimen;" further remarking that "since a number of Mediterranean fishes are identical with Japanese, and at least one other species

of *Notacanthus*, *N. bonapartii*, shows a wide geographical range, he should not feel justified in giving a distinct name to the fish described." We can not help feeling that Dr. Günther has departed from his customary cautious and scientific method in this case, and are satisfied that he would not have done so had he seen the specimen obtained by the French Exploring Expedition on the coast of Morocco, and described and figured by Vaillant. Coming as it does from the Mediterranean region, and having a proboscis-like character of the snout, much more emphasized than in the Japanese form, the presumptions in favor of its identity with *N. rissoanus* are very strong. We therefore not only adopt the identification of Vaillant, in preference to that of Günther, but accept the new name which Vaillant has proposed for the Japanese form.

Family LIPOGENYIDÆ.

Lipogenyidæ, Gill, MS.

Heteromes with a roundish, inferior, suctorial mouth; imperfect lower jaw with its rami separated at middle, connected with the corresponding sides of the upper jaw, and invested in a thick, transversely plicated horseshoe-shaped lip, reflected upward behind on the cheeks; no teeth; short row of four or five partially connected graduated dorsal spines, and five to seven branched rays, forming a regular fin. (Gill.)

The anomalous and unexampled modification of the lower jaw and mouth deserves a detailed anatomical examination; but the existence of only one specimen for the present, at least, is deemed to render such an investigation inadvisable.

LIPOGENYS, new genus.

Head and body compressed, the body elongate as in *Notacanthus*. Snout produced, compressed, obtuse at tip. Cleft of the mouth inferior, suctorial, circular in front, surrounded by rugose, contractile lip, with cleft posteriorly flanked by wing-like flaps, containing the modified mandibular bones which articulate with the end of the maxilla, and are free behind. A concealed spine at the end of the maxilla. No teeth. Anterior nostril in short tube, the posterior oblong, under a short flap. Dorsal fin short, but normal and well developed, with a distinct soft portion. Anal fin normal in position, high, with many spines, and with some of the rays spine-like, though forked. A distinct though very small caudal fin. Ventrals normal, well developed, with several spines. Scales minute, very numerous. Lateral line conspicuous.

LIPOGENYS GILLII, new species.

Plate XVIII, fig. 3.

Body compressed, its greatest width one-half its height, which is about one-tenth of the length. The length of the head is contained $8\frac{2}{3}$ times in that of the body and twice in the distance from the origin

of the pectoral to the vent. The width of the interorbital space is about equal to the diameter of the eye, which is one-fifth the length of the head. The length of the snout is about one-fourth that of the head. The postorbital portion of the head is twice as long as the snout. The peculiar form of the jaws and mouth has been described under the head of the genus. The diameter of the circular opening is about one half the diameter of the eye. The dorsal fin begins at a distance from the snout equal to about three times the length of the head. It consists of five graduated spines, of which the first is minute and the longest as long as the snout, and five rays, of which the second is longest, nearly one-half as long as the head. The spines and rays are all compactly arranged in a strong triangular fin. The length of the dorsal base equals one-half that of the head. The anal begins under the fourth spine of the dorsal; it contains 41 spines and 88 rays, of which the anterior 10 are stiff, though articulated, and divided at the tip. The longest ray is longer than the longest spine, about as long as the snout. The ventral consists of seven spines and seven rays. The two fins almost meet in the median line, but are disconnected. The fin reaches to the vent. Its distance from the tip of the snout is about $2\frac{1}{2}$ times the length of the head. The pectoral is placed below the median line of the body, at a distance from the head about equal to the diameter of the eye; its length is a little greater than the postorbital part of the head. The lateral line is well developed anteriorly, becoming obsolete at a distance from the end of the dorsal about equal to $2\frac{1}{2}$ times the length of the head.

The color is uniform light brown. The under side of the gill covers dark, showing dark at the edges of the opercular bone.

The type measures 17 inches in length. It is No. 39212, U.S.N.M., and was taken by the steamer *Albatross* at station 2742, in N. lat. $37^{\circ} 46' 30''$; W. lon. $73^{\circ} 56' 30''$, from a depth of 865 fathoms.



Goode, G. Brown and Bean, Tarleton H. 1895. "A revision of the order Heteromi, deep-sea fishes, with a description of the new generic types *Macdonaldia* and *Lipogenys*." *Proceedings of the United States National Museum* 17, 455–470.

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