

THE WHALE-FISHES:

FAMILIES CETOMIMIDAE, BARBOURISIIDAE AND RONDELETIIDAE (ORDER CETUNCULI)

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INTRODUCTION

The "Galathea" Deep-Sea Expedition Round the World 1950-1952 collected in the Indian Ocean noteworthy examples of the rare "whale-fishes", an order of primitive bony fishes of which less than 50 specimens have been previously recorded.

The "Galathea" Expedition obtained six specimens, representing all three known families of the order Cetunculi, including the Barbourisiidae which was known only from the unique type. Also included are two new species of the genera *Gyrinomimus* and *Cetomimus* of the family Cetomimidae.

The method of investigation followed in this report is that of Harry (1952), whose paper summarized the literature to date on the whale-fishes. Subsequent to that paper Koefoed (1955) and Rass (1955) have recorded additional material and added new species in the family Cetomimidae.

The author wishes to express his gratitude to Dr. Anton F. Bruun, leader of the "Galathea" Expedition, for allowing him to examine and report upon these remarkable fishes, and to the George Vanderbilt Foundation at Stanford University for its support of the studies. The illustrations are by Mrs. Janet (Roemhild) Canning, scientific illustrator of the George Vanderbilt Foundation. The fishes are of the collections of the Universitetets Zoologiske Museum, Copenhagen.

FAMILY CETOMIMIDAE

Cetomimus indagator n. sp.

(Fig. 1, pl. 1)

Holotype: 120.2 mm. in standard length; from off the east coast of South Africa, 32°33'S. Lat., 32°01'E. Long., "Galathea"-Expedition 1950-52 station 186; 31 Jan. 1951, time 1645. Bottom Globigerina ooze. Depth 3620 meters; 7000 meters wire out.

Description of Galathea type: The only known specimen is in moderately good condition except that the skin is lacerated in many places and the lateral-line is greatly torn; however, the tips of the fin rays are all present and all characters utilized in cetomimid descriptions are present, except for parts of the lateral-line.

Body oval in cross-section behind head. Greatest depth at nape. Caudal peduncle much longer than deep. Anus well before anal fin by a distance equal to pectoral fin length. No distinct cavernous luminous tissue present on head, body or fins (see discussion of glandular tissue about anal fin origin under section on that fin).

Head very large, strongly compressed; head width slightly greater than body width, approximately 1.5 in head depth. Profile of snout to nape rounded at snout and relatively straight posteriorly. Nostrils similar to head pores, close together on each side, situated approximately an eye diameter above the upper jaw. Nasal organ a thin straight membrane, more prominently developed in anterior nostril, slightly ridged, without development of olfactory laminae. A line between tip of snout and eye touches lower border of anterior nostril. Eyes small, slightly nearer upper jaw than profile of head. Interorbital very broad, strongly convex, with one lateral projection forward on each side.

Mouth enormous, moderately oblique. Dentigerous margins of jaws slightly concave. Rictus approximately two eye diameters before posterior tip of premaxillary. Posterior end of jaws well before edge of gill cover. Mandible without lateral processes. Tip of angular rounded, without spines. Distance between ricti 2.5 into upper jaw length. Teeth on jaws granular, in many irregular series on both jaws. The individual teeth are tiny, always pointed, and either conical or incisiform. Dentition on jaws as in text-fig. 1A and B of Harry (1952, p.

60). Teeth on lower jaw extend posteriorly to rictus, but not beyond. Teeth on vomer and palatines similar in shape to those on jaws, depressible. Vomer very small, diamond-shaped, with about four rows of teeth, seven in longest central row. A single small slender palatine bone situated laterally under eye; palatine with two longitudinal rows of teeth, 15 teeth in longest (inner) row. Copula on tongue small, long and slender, club-shaped, posterior end largest, rounded; anterior end pointed. Length of copula about 2.2 in snout length; narrowest width of copula about one-tenth its length. Teeth on copula similar to those in jaws, covering entire bone, without separate rows of teeth; approximately 30 irregular rows of depressible teeth along its length.

Four gill arches present, a slit present behind last arch. Holobranchs very poorly developed, shorter in length than width of gill arches. Normal gill rakers absent; their function performed by small round bony plates covered with gill-teeth which are minute, granular, fixed, similar to dentition in jaws. Each gill-plate with approximately 15-40 teeth. First gill arch with 3+10 round dentigerous plates, of which 3 plates are on the hypobranchial. Pharyngobranchial teeth in two small, oval, high-crowned patches of tiny depressible teeth. Anterior pharyngobranchial teeth in five rows, approximately seven teeth in longest rows. Posterior pharyngobranchial teeth in four rows, approximately 10 teeth in longest row.

Lateral-line a broad tube, pierced by 12 pores on body from upper posterior edge of gill opening to base of caudal fin. Original structure of pores, tubes and flaps on lateral-line not preserved. Apparently the pores along the lateral-line are all large, with no flaps or only small flaps. Numerous large pores on head.

Skin delicate, smooth, lacking scales and spicules, but not loose and flabby.

Dorsal and anal fins far back on body. Dorsal fin origin in advance of a vertical from anal fin origin, but behind anus. Dorsal fin with 14 rays, all simple. Anal fin with 13 rays, all simple. In both the dorsal and anal fins the last two rays are split to the base and counted separately. The anal fin has a superficial appearance in profile of being abnormally constricted at the base, but it is completely normal, providing this species with a unique form in this fin. The anal fin of this species is also unique in the whale-fishes in the form of its luminous organ. About the base of the anterior rays are small hollow streaks along the surface that appear to correspond

to the cavernous tissue in more advanced species. These streaks are connected to a reticulate pattern of minute granule-filled canals over the surrounding region. Pectoral fin situated low, somewhat more elongate than usually found in cetomimids, middle rays prolonged. Pectoral rays 18 on each side. Pelvic fins absent. Caudal fin large, slightly emarginate. Principal caudal fin rays 5+6.

Coloration: Uniformly solid dark brown in alcohol. Tips of fins light. Interior of mouth almost completely unpigmented. Inside of operculum lightly pigmented.

Measurements in percent of standard length: Body depth measured at a vertical from region of pectoral fins 22.9. Caudal peduncle length, which is the oblique distance between the end of the anal base and mid-base of caudal fin 24.5. Least depth of caudal peduncle 08.5. Head length measured from the anterior tip of the snout (upper jaw) to the most distant point on the opercular margin including membranous flaps, 32.9. Snouth length measured from the anterior tip of the snout (upper jaw) to the anterior margin of the fleshy orbit 11.5. Upper jaw length, which is the distance between the tip of the snout and posteriormost point of the premaxillary 22.8. Eye diameter, which is the greatest visible distance, without dissection, across the orbit, and corresponding to the diameter of the opaque cornea 01.5. Interorbital width, which is the least fleshy width 13.1. Greatest head width measured between the sides of the premaxillaries 15.6. Distance between tip of snout and visible base without dissection of first dorsal fin ray 69.7. Dorsal fin base length from origin of first ray to base of last ray 11.8. Distance between tip of snout and anus 61.6. Length of anal fin base from origin of first ray to base of last ray 71.6. Length of pectoral fin measured from base of longest middle ray to its tip 08.7. Length of caudal fin from mid-base (measured from the fold when the fin is flexed from side to side) to a vertical from tip of longest ray 19.0.

Relationships: The species *indagator* clearly belongs in the genus *Cetomimus*, agreeing with the characters used by Harry (1952), Parr and others to distinguish this genus. It reveals in general form closest affinities to *Cetomimus kerdops* Parr in the previously monotypic subgenus *Psapharocetus* and keys out to this group in Harry's key (1952, pp. 59-60). Therefore, this new species further sub-

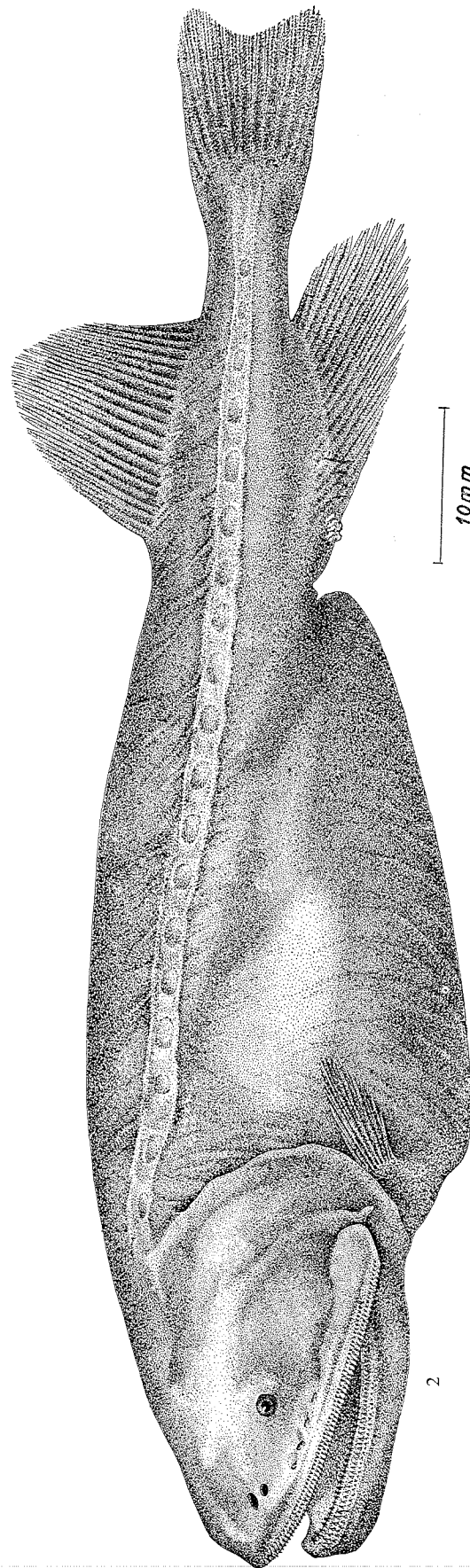
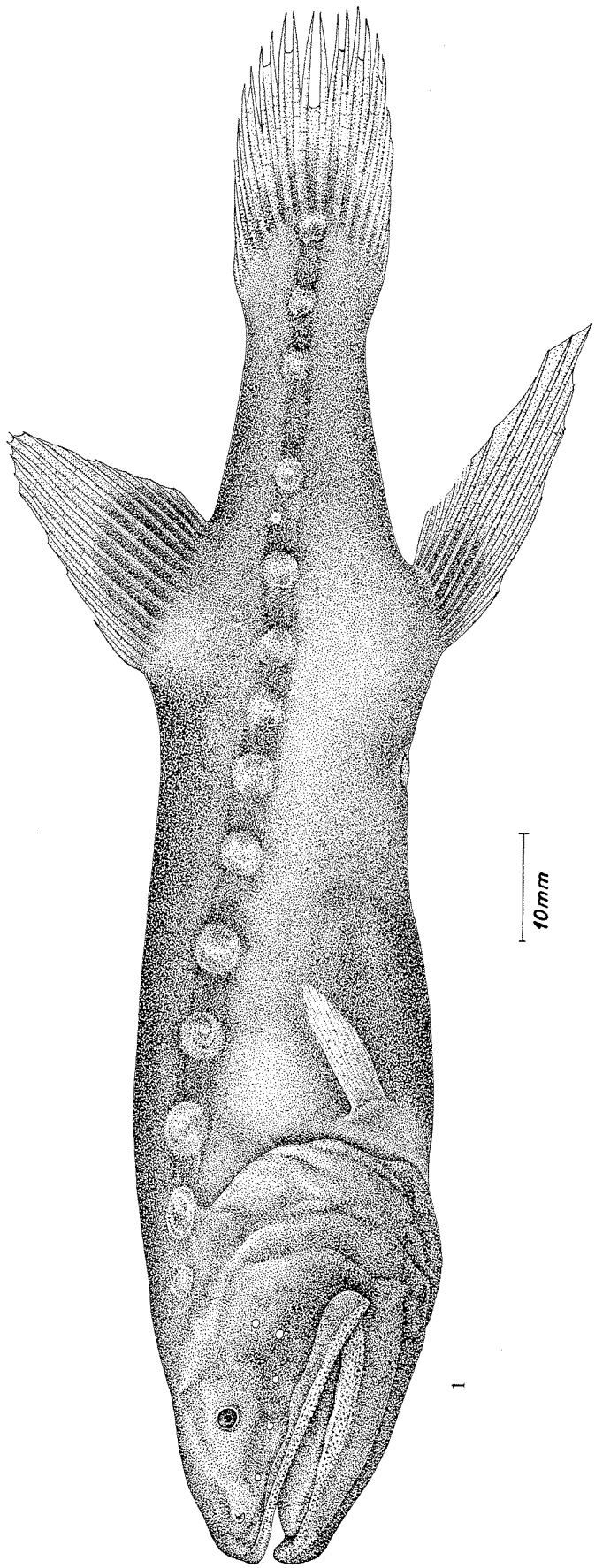


Fig. 1. Holotype of *Cetomimus indagator*, new species, from station 186 of the "Galathea"-Expedition 1950-1952 off the east coast of South Africa.
Fig. 2. Holotype of *Gyrinomimus bruuni*, new species, from station 234 of the "Galathea"-Expedition 1950-1952 from off Kenya.

width of copula about one-third its length. None of copular teeth rows separated from remainder.

Four gill arches present, no slit behind the last. Holobranchs well developed, their length approximately thrice the width of the gill arch. Normal gill-rakers absent; their function performed by flat bony plates covered with gill teeth which are minute, granular, fixed, arranged in five series across the plates. Teeth on hypobranchial of first arch on two elongate bony patches with 9-13 teeth each in the longest row. Teeth on ceratobranchial of first arch in a single long patch preceded by and followed by a tiny patch; approximately 70 teeth in a longitudinal row on long patch. Teeth above angle on epibranchial on first arch in a single long slender patch, with about 30 teeth in a longitudinal row; preceded by a small circular patch at angle. Pharyngobranchial teeth in two elongate high-crowned patches on each side; individual teeth similar to those on jaws. Anterior pharyngobranchial teeth in three rows; inner row longest, about 18 teeth in length. Posterior pharyngobranchial teeth in four rows, about 24 teeth in longest row.

Lateral-line a broad tube, pierced by 19 pores on body from upper posterior edge of gill opening to base of caudal fin, the last two pores with moderately developed flaps on their anterior margins; flaps shorter than pores; posterior pores small, much narrower than lateral-line tube. Lateral-line membrane between pores generally has one or two median mucus-tubes anteriorly and two mucus-tubes (one above the other) posteriorly. Longitudinal keel on membranes between pores only slightly developed, anteriorly not evident. Scattered mucus-tubes present on the caudal fin behind the last pore. No scattered mucus tubes noticed on back. Numerous large pores and a few mucus-tubes scattered over head.

Skin loose and flabby over head and body; skin smooth, completely lacking scales and spicules. No cavernous luminous tissue present about dorsal fin. Anal luminous tissue primarily associated with anus, as previously described. Otherwise no luminous organs evident. Four small lappets present anteriorly along base of anal fin.

Dorsal and anal fins far back on body. Dorsal fin origin well in advance of a vertical from anal fin and anus. Dorsal fin with 20 rays, at least the first five and last two rays simple. End of dorsal fin base opposite end of anal fin base. Anal fin with 18 rays, at least the first five and last two rays are simple. Both the anal and dorsal fins have the tips of the

middle rays broken, and the branched rays cannot be counted; the last two rays are split to the base and counted separately. Pectoral fin short, low, directed obliquely upward, outline evenly rounded; pectoral rays 18 on each side. Pelvic fins absent. Caudal fin short, tips of rays broken off in type.

Coloration: Uniform solid dark brown in alcohol. Tips of fins light. Roof of mouth dark brown to black. Inside of operculum lightly pigmented brown.

Measurements in percent of standard length: Body depth measured at a vertical from region of pectoral fins 27.5. Caudal peduncle length, which is the oblique distance between the end of the anal base and mid-base of caudal fin 10.5. Least depth of caudal peduncle 05.9. Head length measured from the anterior tip of the snout (upper jaw) to the most distant point on the opercular margin including membranous flaps 31.5. Snout length measured from the anterior tip of the snout to the anterior margin of the fleshy orbit 11.9. Upper jaw length, which is the distance between the tip of the snout and posteriormost point of the premaxillary 25.8. Eye diameter, which is the greatest visible distance, without dissection, across the orbit, and corresponding to the diameter of the opaque cornea 01.6. Interorbital width, which is the least fleshy width 14.3. Greatest head width measured between the sides of the premaxillaries 19.6. Distance between tip of snout and visible base without dissection of first dorsal fin ray 74.0. Dorsal fin base length from origin of first ray to base of last ray 17.1. Distance between tip of snout and anus 71.0. Length of anal fin base from origin of first ray to base of last ray 15.5. Length of pectoral fin measured from base of longest middle ray to its tip 09.8.

Relationships: The new species *bruuni* clearly belongs in the genus *Gyrinomimus*, agreeing well with the genus as delimited by Parr (1934, 1946) and Harry (1952). Three specimens of two species of *Gyrinomimus* are known, *G. simplex* Parr and *G. myersi* Parr. All three specimens have been compared to the new species *G. bruuni*.

Bruuni is significantly differentiated from the previous known species of *Gyrinomimus* by gill structure and other characters as shown in the following key. It is most closely related to *G. simplex*, as evidenced by lateral-line form, dentition and general body and head form.

Name: *bruuni* is named after Dr. Anton F. Bruun, leader of the "Galathea" Deep-Sea Expedition Round the World 1950-1952, and foremost investigator of the marine life of the greatest depths.

Key to the species of the genus *Gyrinomimus*

- 1a. Four distinct gill arches present, bearing holobranchs. Distinct cavernous luminous tissue present about anal fin origin. 20 dorsal rays. 19 lateral-line pores between gill opening and caudal fin. *Gyrinomimus bruuni*, n. sp.
- 1b. Three distinct gill arches present, bearing holobranchs. No distinct cavernous luminous tissue. 17 dorsal rays. 15 lateral-line pores.
- 2a. Long pointed flaps covering lateral-line pores. Three rows of teeth on vomer.
. *Gyrinomimus myersi* Parr
- 2b. Lateral-line pores lacking flaps. Two rows of teeth on vomer. . . . *Gyrinomimus simplex* Parr

FAMILY BARBOURISIIDAE

Barbourisia rufa Parr (Fig. 3, pl. 2)

Specimen taken by the "Galathea"-Expedition: One 211 mm. in standard length; from off Cape Amber, Madagascar, 11°43'S. Lat., 49°09'E. Long., "Galathea"-Expedition 1950-52 station 220; 1. March 1951, time 1930. Depth 1070-1360 meters; Triangular pelagic Trawl, 2000 meters wire out. Estimated fishing depth 450-700 meters.

This specimen agrees well in all characters with the holotype of *Barbourisia rufa* Parr as described and figured by Parr (1945). Since the species previously was only known from the holotype, this second specimen of a very rare family is quite important. In the first place it settles an argument about the validity of the family and possible teratological nature of the unique type, see Myers (1946) and Parr (1945, 1946b). Also, the "Galathea" specimen reveals very close similarities to the type, which is interesting because the two specimens were taken in different oceans, the type having been collected in the Gulf of Mexico. It appears likely that the family and species occurs worldwide at mid-depths and over this range has little variability. A comparison of the two specimens known can be made from fig. 3 and pl. 1 of the holotype (Parr, 1945), both of which were drawn by the same illustrator.

Description of "Galathea" specimen: Skin of head and body covered with minute imbedded spines. No luminous organs evident. Jaws covered with tiny granular teeth as in figs. 1A and B of Harry (1952). Vomer very small, oval, with approximately 15 minute teeth. No palatine teeth present. Four gill arches present, a small slit behind last arch. Normal gillrakers present, 4+15 on first arch.

Dorsal fin rays 22; 11 simple rays followed by 10 branched rays and a simple ray. Anal fin rays 18; 4 simple rays followed by 13 branched rays and a simple ray. Last two rays of dorsal and anal fins separated to base and counted separately. Pectoral fin rays 14. Pelvic fin rays 6. Lateral-line pores 32 between upper posterior margin of head and caudal fin.

Coloration: Externally, head, body and fins completely unpigmented in formalin. Epidermis diaphanous. Inside of mouth unpigmented. Inside of operculum dark brown. When alive the fish was of a beautiful red color with a tint of orange in it.

FAMILY RONDELETIIDAE

Rondeletia bicolor Goode and Bean (Fig. 4, pl. 2)

Specimens taken by the "Galathea" Expedition: Three specimens 65.4-84.8 mm. in standard length.

65.4 mm. S.L.; from off Ceylon-Calcutta, 17°10' N. Lat., 84°30'E. Long., "Galathea"-Expedition 1950-52 station 299; 24. April 1951, time 1725. Bottom mud. Depth 2820 m.; 5300 meters wire out.

84.7 mm. S.L.; from off Ceylon-Calcutta, 19°30' N. Lat., 86°32'E. Long., "Galathea"-Expedition 1950-52 station 301; 25. April 1951, time 1810. Depth 1110 meters; triangular pelagic trawl, 2100 meters wire out. Estimated fishing depth 700-800 meters.

84.8 mm. S.L.; from the Sunda Trench, 10°21'S. Lat., 11°12'E. Long., "Galathea"-Expedition station 466; 6. Sept. 1951, time 0835-1035. Bottom bluish clay. Depth 7160 meters. 10,600 meters wire out.

The three "Galathea" examples agree closely with the previous accounts of the species, establishing the family outside of the Atlantic Ocean for the first time. This material and other collections to be reported upon elsewhere establishes the family and species as round-the-world in distribution.

Description of "Galathea" specimens: These rondeletiids are in excellent, complete condition. Jaws covered with tiny granular teeth as in text-figs. 1A and B of Harry (1952). Vomer and palatine teeth absent. Four gill arches present with a small slit behind last arch. Normal gillrakers present, 6+14 on first arch.

Dorsal fin rays 14. Anal fin rays 13. Counts for dorsal and anal fins were determined by detailed dissection of the fin bases; the last two rays are separate to the base and counted separately. Pectoral fin rays 9. Pelvic fin rays 5. Principal caudal fin rays 9+10. All the counts have been prepared from the largest example from the Java Deep.

Coloration: Uniformly solid dark brown in alcohol. Tips of fins light. Inside of mouth and operculum lightly pigmented.

CONCLUSIONS

This report on cetunculous fishes collected by the "Galathea" Expedition 1950-52 establishes the first substantial collections of whale-fishes from the Indian Ocean; previously, all but two examples of the order had been recorded from the Atlantic Ocean. Undoubtedly, as this bizarre fish group becomes better known, it will be shown to be circum-orbital in distribution and as abundant in the Pacific and Indian Oceans as in the Atlantic.

Present studies of the Galathea example of *Barbourisia rufa* Parr, the monotypic member of the Barbourisiidae, further confirms the conclusions (Harry, 1952) about the close relationship of this family to the Cetomimidae and Rondeletiidae. The

characteristics of *Barbourisia*, such as in dentition, gill arch structure, lateral-line form, and fins, are distinctly intermediate between the Cetomimidae and Rondeletiidae.

The "Galathea" Expedition 1950-52 resulted in the addition of two new species to the whale-fish group, which now totals 13 species recognized in the Cetomimidae, and one each in the Barbourisiidae and Rondeletiidae. Continuing studies clearly indicate that the number of valid species of Cetunculi will be more than doubled before all the forms are known.

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