

A REVIEW OF THE APODAL FISHES OR EELS OF JAPAN,
WITH DESCRIPTIONS OF NINETEEN NEW SPECIES.

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In the following paper is given an account of the species of apodal or eel-like fishes known from the waters of Japan. The paper is based on the collection made by the authors in the waters of Japan during the summer of 1900, under the auspices of the Hopkins Seaside Laboratory, the series of Japanese fishes belonging to the United States National Museum, and specimens collected by the United States Fish Commission steamer *Albatross*. The collection made by the authors is in the museum of Leland Stanford Junior University, a series having been also deposited in the United States National Museum. The accompanying drawings are the work of Miss Lydia M. Hart.

The apodal fishes agree in the eel-like form of the body, the degradation of the skeleton, and the deterioration of the fins and their basal segments.

Among the apodal fishes of Japan two orders are recognized; one, *Symbranchia*, has the structure of the mouth characteristic of ordinary fishes; the other, *Apodes*, has the premaxillaries atrophied or lost.

Order SYMBRANCHIA.

Body eel-shaped; premaxillary, maxillary, and palatine bones well developed and distinct from each other, as in ordinary fishes. Shoulder girdle joined to the skull in typical species (in one family, *Amphipnoidae*, distinct from the skull as in the eels). No mesocoracoid; symplectic present or absent; scales minute or wanting; no paired fins; vertical fins rudimentary, reduced to folds of the skin; vent at a great distance from the head; gill openings confluent in a single slit; no air bladder; stomach without blind sac or pyloric caeca; ovaries with oviducts; skull solid, the bones firmly united; vertebrae numerous, the

anterior unmodified. Eel-like fishes, widely distributed in warm seas and in fresh waters. The species are few, but highly diversified in structure, constituting two suborders and four families. They are probably related to the *Apodes*, but this is not certain, and in the structure of the head they approach more nearly to the true fishes. They represent degraded rather than primitive types, and the line of their descent is as yet unknown. It is not even certain that the forms grouped in this order are closely related. (*σύν* together; *βράγχια*, gills.)

Family I. MONOPTERIDÆ.

RICE-FIELD EELS.

Body elongate, naked; tail short, tapering to a point; no barbels; margin of the upper jaw formed by the premaxillaries, the maxillaries well developed, lying behind them and parallel with them; lips thick; palatine teeth small, in a narrow band; gill openings confluent into a ventral slit, the membranes united to the isthmus; gill arches three, with the gill-fringes rudimentary, and with moderate slits between them; no accessory breathing sac; lateral line present; no pectoral or ventral fins; dorsal and anal reduced to low folds; ribs present; no air bladder; stomach without caecal sac or pyloric appendages. Ovaries with oviducts. Vertebrae $100 + 88 = 188$.

Eel-like fishes of the rivers of eastern Asia, everywhere abundant, probably all reducible to one single species.

1. MONOPTERUS Lacépède.

Monopterus LACÉPÈDE, Hist. Nat. Poiss., II, 1798, p. 139 (*javanicensis*).

Pluta SCHNEIDER, Syst. Ichth., 1801, p. 565 (*javanicensis*).

Ophicardia McCLELLAND, Calcutta Journ. Nat. Hist., V, p. 191 (*phayriana*).

Apterigia BASILEWSKY, Nouv. Mém. Soc. Nat. Mosc., X, 1855, p. 247 (*saccogularis*).

Characters of the genus included above. (*μόνος*, one; *πτερόν*, fin.)

1. MONOPTERUS ALBUS (Zuiew).

Muraena alba ZUIEW, Nov. Act. Ac. Sci. Petropol, 1793, p. 299, pl. VII, fig. 2.

Monopterus javanicus LACÉPÈDE, Hist. Nat. Poiss., II, 1798, p. 139, Java.

Monopterus javanicus SCHNEIDER, Syst. Ichth., 1801, p. 565, after Lacépède.—CANTOR, Malayan Fish, 1850, p. 339, pl. v, figs. 6-8.—BLEEKER, Atlas Ichth. Mur. 1864, p. 118, pl. XLVII, fig. 1, Java, Sumatra, Banka, Bintang, Borneo, Celebes.—GÜNTHER, Cat. Fish., VIII, 1870, p. 14, Batavia, Borneo, Sarawak, Siam, Formosa, Chusan, Hongkong, Ningpo, North China, Japan, and of authors generally.

Unibranchapertura levis LACÉPÈDE, Hist. Nat. Poiss., V, 1803, p. 658, pl. XVII, fig. 3.

Monopterus levis RICHARDSON, Voy. Sulphur, Ichth., p. 116, Hongkong.

Symbranchus eurychasma BLEEKER, Verh. Bat. Gen. Muren, XXV, p. 60.

Ophicardia phayriana McCLELLAND, Calcutta Journ. Nat. Hist., V, pp. 191, 218, pl. XII, fig. 1, River Ganges.

- Monopterus cinereus* RICHARDSON, Voyage Sulphur, p. 117, pl. LII, figs. 1-6 (Excl. syn.), Chusan, Woosung.
- Monopterus (?) xanthognathus* RICHARDSON, Voy. Sulphur, p. 118, pl. LII, fig. 7, Canton.
- Monopterus marmoratus* TEMMINCK and SCHLEGEL, Richardson, Ichth. China, 1846, p. 315, Chusan.
- Monopterus helvolus* RICHARDSON, Ichth. China, p. 316, Canton.
- Apterigia saccoangularis* BASILEWSKY, Nouv. Mém. Soc. Nat. Moscow, X, 1855, p. 247, pl. VIII, fig. 2, Tschili.
- Apterigia nigromaculata* BASILEWSKY, Nouv. Mém. Soc. Nat. Moscow, X, p. 248, pl. II, fig. 2, Peking.
- Apterigia immaculata* BASILEWSKY, Nouv. Mém. Soc. Nat. Moscow, X, p. 248, Peking.

Head 13 in length, its depth greater than that of body, $1\frac{2}{3}$ in its length; depth 22 (17 to 26) in length. Jaws heavy, the lower shorter; maxillary 2 in head; teeth small, mostly uniserial. Eye very small, over middle of maxillary. Gill openings inferior, confluent in a semicircular slit. Tail very short, pointed, $2\frac{3}{4}$ in rest of body. Dorsal fin very low, beginning close behind vent. Anal very indistinct, about half length of dorsal; no pectorals. Color in spirits blackish olive, with traces of darker and paler streaks and mottlings; a dark cross-band behind head; in life with yellowish streaks and dashes and dark dots above.

Length 1 to 2 feet.

Fresh waters and rice ditches of China, Korea, and southward to Java, Borneo, and Siam, north to the Riu Kiu Islands; our specimens, four in number, were collected by Mr. Tashiro on the island of Okinawa, where it is known as Ta-unagi or rice-field eel. The present description is taken from specimen No. 69, in the Imperial Museum at Tokyo, from the island of Amami-Oshima in the northern Riu Kiu group. It is a foot in length. The specimen is recorded as "*Moringua javanica*" in Dr. Ishikawa's list. (*albus*, white.)

Order APODES.

EELS.

Teleost fishes with the premaxillaries atrophied or lost, the maxillaries lateral, and the body anguilliform and destitute of ventral fins. The most striking feature is the absence of the premaxillaries, taken in connection with the elongate form and the little development of the scapular arch, which is not attached to the cranium. Other characters not confined to the Apodes are the following: The absence of the symplectic bone, the reduction of the opercular apparatus and of the palatopterygoid arch, the absence of ventral fins, the absence of the mesocoracoid or præcoracoid arch, and the reduction or total absence of the scales. There are no spines in the fins, the gill openings are comparatively small, and there are no pseudobranchiæ. The vertebrae are in large number and none of them are specially modified. The tail

is isocercal—that is, with the caudal vertebrae remaining in a straight line to its extremity, as in the embryos of most fish, and in the *Anacanthini*.

We begin our discussion of the eels with the forms which seem nearest to the primitive stock from which the members of the group have descended. It is evident that among the eels the forms of simplest structure, *Sphagebranchus*, etc., are not in any sense primitive forms, but the results of long-continued and progressive degeneration, so far as the fins and mouth parts are concerned. The *Apodes* are probably descended from soft-rayed fishes, and their divergence from typical forms is, in most respects, a retrogression. (α^2 -without: $\pi\acute{o}\upsilon\varsigma$, foot, from the absence of ventral fins.)

FAMILIES OF APODES.

- a. *Euchelycephali*: Gill openings well developed, leading to large interbranchial slits; tongue present; opercles and branchial bones well developed; scapular arch present.
- b. Skin covered with rudimentary embedded scales, usually linear in form, arranged in small groups, and placed obliquely at right angles to those of neighboring groups; pectorals and vertical fins well developed, the latter confluent about the tail; lateral line present; posterior nostril in front of eyes; tongue with its margins free.
- c. Gill openings well separated; branchiostegals long, bent upwards behind.
- d. Gill openings lateral and vertical; snout conic, the jaws not very heavy; gape longitudinal; lips thick; lower jaw projecting; teeth in cardiform bands on jaws and vomer; eggs minute.....ANGUILLID.E. II.
- cc. Gill openings inferior, very close together, apparently confluent; branchiostegal rays abbreviated behind; head conical; tongue small; posterior nostrils in front of eye.....SYNAPHOBRANCHID.E. III.
- bb. Scales wholly wanting; eggs, so far as known, of moderate size, much as in ordinary fishes.
- e. Tail not much if any shorter than rest of body; heart placed close behind the gills.
- f. Tip of tail with a more or less distinct fin, the dorsal and anal fins confluent around it; the tail sometimes ending in a long filament. Coloration almost always plain, brownish, blackish, or silvery, the fins often black-margined.
- g. Posterior nostril without tube, situated entirely above the upper lip.
- h. Tongue broad, largely free anteriorly and on sides; vomerine teeth moderate.
- i. Pectoral fins well developed; body not excessively elongate; lower jaw not projecting; anterior nostril remote from eye.
LEPTOCEPHALID.E. IV.
- hh. Tongue narrow, adnate to the floor of the mouth or only the tip slightly free; vomerine teeth well developed, sometimes enlarged.
- j. Jaws not attenuate and recurved at tip; gill openings well separated; anterior nostril remote from eye.
- k. Pectoral fins well developed; skin thick; skeleton firm; snout moderate; tail not ending in a filiform tip.

MURENESOCID.E. V.

kk. Pectoral fins wholly wanting; snout and jaws much produced, the upper longer; jaw straight; skin thin, the skeleton weak; tail ending in a filiform tip; gill openings small, subinferior; teeth sharp, subequal, recurved; a long series on the vomer; deep-sea eels, soft in body.

NETTASTOMIDÆ. VI.

gg. Posterior nostril close to the edge of the upper lip; tongue more or less fully adnate to the floor of the mouth; teeth subequal.

MYRIDÆ. VII.

ff. Tip of tail without rays, projecting beyond the dorsal and anal fins, (not filiform); posterior nostril on the edge of the upper lip; anterior nostril near tip of snout, usually in a small tube; tongue usually adnate to the floor of the mouth. Coloration frequently variegated.

OPHICHTHYIDÆ. VIII.

ee. Tail much shorter than the trunk; heart situated at a great distance behind the gills; pectorals small or wanting; vertical fins little developed; body slender, cylindrical; gill openings narrow, inferior.

MORINGUIDÆ. IX.

aa. Colocephali: Gill openings small, roundish, leading to restricted interbranchial slits; tongue wanting; pectoral fins (typically) wanting; opercles feebly developed; fourth gill arch modified, strengthened, and supporting pharyngeal jaws.

l. Scapular arch obsolete or represented by cartilage; heart not far back; pectorals wanting; skin thick; coloration often variegatedMUREXIDÆ. X.

Family II. ANGUILLIDÆ.

TRUE EELS.

The true eels, or *Anguillidæ*, are characterized by their scaly skin in association with a conical head and a general resemblance to the *Congers*. The group is thus diagnosed by Dr. Gill: "Enchelycephalous Apodals with conical head, well-developed opercular apparatus, lateral maxillines, cardiform teeth, distinct tongue, vertical lateral branchial apertures, continuous vertical fins, with the dorsal far from the head, pectorals well developed, scaly skin, and nearly perfect branchial skeleton."

The *Anguillidæ* approach more nearly than most of the other eels to the type of the true fishes. In one respect, that of the minute ova and concealed generation, however, they differ widely from these. The single genus of living *Anguillidæ* is widely diffused in temperate and tropical waters. Unlike the other eels the *Anguillidæ* freely ascend the rivers, descending to the sea for purposes of reproduction. One genus, with five or more valid species.

a. Dorsal fin inserted well behind base of pectorals; shoulder girdle well developed; lower jaw projecting.....*Anguilla*. 2.

2. ANGUILLA Shaw.

EELS.

Anguilla SHAW, General Zoölogy, IV, 1804, p. 15 (*anguilla*).

Muraena BLEEKER, Pocy, etc. (taking as type *Muraena anguilla*, the first species mentioned by Artedi under *Muraena*).

Body elongate, compressed behind, covered with embedded scales which are linear in form and placed obliquely, some of them at right angles to others. Lateral line well developed. Head long, conical, moderately pointed, the rather small eye well forward and over the angle of the mouth. Teeth small, subequal, in bands on each jaw and a long patch on the vomer. Tongue free at tip. Lips rather full, with a free margin behind, attached by a frenum in front. Lower jaw projecting. Gill openings rather small, slit-like, about as wide as base of pectorals and partly below them. Nostrils superior, well separated, the anterior with a slight tube. Vent close in front of anal. Dorsal inserted at some distance from the head, confluent with the anal around the tail. Pectorals well developed. Species found in most warm seas (the eastern Pacific excepted), ascending streams, but mostly spawning in the sea. The eels often move for a considerable distance on land in damp grass. Waterfalls, dams, and other obstructions are often passed in this way. It is thought that the eel spawns only in the sea, the female dying after having once produced ova. The females are larger than the males, paler in color, with smaller eyes and higher fins. Eels are among the most voracious of fishes. "On their hunting excursions they overturn alike huge and small stones, beneath which they find species of shrimp and crayfish, of which they are excessively fond. Their noses are poked into every imaginable hole in their search for food, to the terror of innumerable small fishes." The single Japanese species differs very slightly, if at all, from the American eel *Anguilla chryssypa*. (*Anguilla*, the eel.)

2. ANGUILLA JAPONICA Schlegel.

UNAGI (EEL); O-UNAGI (GREAT EEL); GOMA-UNAGI (CARAWAY-SEED OR SPECKLED EEL).

Anguilla japonica SCHLEGEL, Fauna Japonica, 1847, p. 258, pl. cxiii, fig. 2, Nagasaki.—BLEEKER, Verh. Bot. Gen., XXV, Japan, p. 51.—KNER, Novara Fische, p. 370.—JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 348, Yokohama.

Muraena pekinensis BASILEWSKY, Nouv. Mém. Soc. Nat. Mosc., X, 1855, p. 246, pl. iii, fig. 2, Pekin.

Anguilla vulgaris, bengalensis, and mauritiana ISHIKAWA, Prel. Cat. Fish, p. 7, 1897, Hitaka, Tokyo, Hashigo, Zensho, Sagami, Awa, Kadzusa.

Head about $2\frac{1}{4}$ in trunk, upper jaw $3\frac{1}{2}$ in head, distance from front of dorsal to vent a little less than head; pectoral, 3 in head; distance

from snout to dorsal, $3\frac{1}{4}$ in length. Dark brown or yellowish brown above, rarely marbled; abruptly paler below; pectoral pale; dorsal, anal, and caudal edged behind with black. Length, 2 to 5 feet. Streams, lakes, and estuaries of Japan, almost everywhere very common; our specimens from Hakodate, Aomori, Same, Matsushima, Sendai, Tokyo, Misaki, Wakanoura, Omura Bay, Kurume, and Nagasaki.

In southern Japan very large examples 4 or 5 feet long are sometimes taken. The species is very similar to the American eel (*Anguilla chryssypa* Rafinesque), differing in a very slightly more anterior dorsal and more blackish edging to the fins behind, matters of very slight importance. This species is known to fishermen as "unagi," the very large ones as "ounagi," or great eel. The name "goma-unagi," or caraway-seed eel, is given to speckled individuals.

Family III. SYNAPHOBRANCHIDÆ.

This group consists of deep-sea eels, differing from the *Anguillidæ* in having the gill openings externally confluent into a single slit. The following diagnosis is given by Dr. Gill:

Enchelycephalous apodals, with conic, pointed head; moderate opercular apparatus, lateral maxillines, cardiform teeth, distinct tongue, inferior branchial apertures discharging by a common aperture, continuous vertical fins, pectorals well developed, scaly skin, and nearly perfect branchial skeleton.

Body eel-shaped, covered with linear, embedded scales placed at right angles, as in *Anguilla*. Lateral line present. Head long and pointed, the snout produced. Mouth very long, the eye being over the middle of its cleft. Jaws about equal; teeth small, sharp, in a broad band in each jaw, becoming a single series anteriorly; those of inner series in upper jaw and of outer series in mandible somewhat enlarged; vomerine teeth in a narrow band anteriorly. Gill openings inferior, horizontal, close together, convergent forward, somewhat confluent at the surface, but separated by a considerable isthmus within. Brauchiostegals peculiarly formed, in moderate number (about 15), attached to the sides of the compressed ceratohyal and epihyal, slender, abbreviated, and moderately bowed, not being curved up above the operculum. Tongue long, free only at the sides. Nostrils large, the anterior with a short tube, the posterior before the lower part of the eye. Pectoral well developed; dorsal low, beginning behind vent; anal longer than dorsal, rather high, its rays slender, branched, not embedded in the skin; vertical fins confluent around the tail. Vent near the anterior fourth of the body. Muscular and osseous system well developed. Stomach very distensible. Deep-sea fishes; two genera, with 6 or 8 species known.

- a. Dorsal fin low, beginning behind vent; vomerine teeth in a single patch; pectorals long, longer than the rather slender snout *Synaphobranchus*. 3.
 aa. Dorsal fin beginning close behind base of pectorals; vomerine teeth in two patches, one behind the other; pectorals short, not longer than the short snout *Histiobranchus*. 4.

3. SYNAPHOBRANCHUS Johnson.

Synaphobranchus JOHNSON, Proc. Zool. Soc. London, 1862, p. 169, (*kaupii*).

Dorsal beginning behind vent. This genus contains two or three species, deep-sea fishes from the Atlantic and Pacific. (*συναφής*, united; *βράγχια*, gills.)

- a. Dorsal inserted directly over or very slightly behind vent..... *affinis*. 3.
 aa. Dorsal inserted behind vent at a distance equal to three-fifths length of head
iracanis. 4.
 aaa. Dorsal inserted behind vent at a distance equal to length of head.... *jenkinsi*. 5.

3. SYNAPHOBRANCHUS AFFINIS (Günther).

Synaphobranchus affinis GÜNTHER, Ann. and Mag. Nat. Hist., XX, 1877, p. 445, Enoshima (misprinted Inosima), Japan.—JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 348 (off Tokyo; *Albatross* Coll.).

Dorsal fin beginning very close behind vent; head and trunk, $2\frac{2}{3}$ in tail; maxillary, $1\frac{2}{3}$ in head, not nearly reaching gill opening; head, $2\frac{1}{2}$ in distance from tip of snout to dorsal, $1\frac{1}{3}$ in trunk; snout, 3 in head; eye, 2 in snout; cleft of mouth, $1\frac{3}{5}$ in head; pectoral, $2\frac{1}{2}$ in head; its insertion nearer snout than anus. Uniform bluish brown, with fine dots; pores of lateral line pale, about 20 before vent; pectorals pale; vertical fins darker behind, light-edged anteriorly; inside of mouth blue-black; gill openings dark. Coasts of Japan and southward to the Philippines, in 400 to 600 fathoms; not rare: our numerous specimens from Totomi Bay (off Hamamatsu), station 2730, *Albatross*; off Tokyo, collection of U. S. Fish Commission steamer *Albatross*, and off Misaki (collection of Alan Owston). The species is very close to *S. pinnatus* of the Atlantic, which Dr. Günther regards in the Challenger Report as the same species. He gives a good figure of a specimen from south of Tokyo,¹ under the name of *Synaphobranchus pinnatus*. The species described and figured by Jordan and Evermann, following Goode and Bean, under the name of *Synaphobranchus pinnatus* is evidently different, having the dorsal much farther back. (*S. affinis*, related to *S. pinnatus*.)

4. SYNAPHOBRANCHUS IRACANIS Jordan and Snyder, new species.

Dorsal fin beginning far behind vent at a distance equal to $\frac{3}{5}$ the head's length; maxillary, $1\frac{1}{2}$ in head; head, $1\frac{2}{5}$ in trunk; head and trunk, $2\frac{3}{5}$ in tail; snout, $3\frac{1}{5}$ in head; eye, $2\frac{1}{5}$ in snout; pectoral, long,

¹ Challenger Report, p. 253, pl. LXII, fig. A.

$1\frac{2}{3}$ in head, its insertion nearer tip of snout than vent. Uniform dull brown. One specimen taken in 200 fathoms depth off the coast of Myiako, in Rikuchu (north of Sendai), by Mitonubu Irako, director of the Museum of Morioka, and by him presented to the museum of Stanford University. The species is related to *Synaphobranchus brevi-*

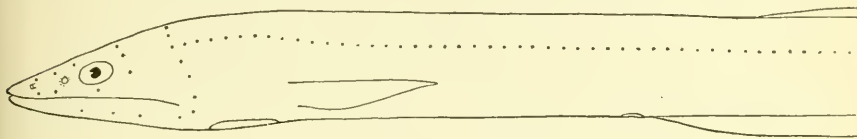


FIG. 1.—SYNAPHOBRANCHUS IRACONIS.

dorsalis, figured by Günther from the coast of New Guinea. The greater length of the tail, the larger mouth, larger pectoral, and especially the anterior insertion of the dorsal should separate the present species.

Type.—No. 6465, Leland Stanford Junior University Museum.
Named for Mitonubu Irako.

5. SYNAPHOBRANCHUS JENKINSI Jordan and Snyder, new species.

Head, $1\frac{2}{3}$ in trunk; head and trunk, $2\frac{3}{5}$ in tail; distance from snout to front of dorsal, $2\frac{2}{3}$ in total length; distance from vent to front of dorsal equal to head; snout, 3 in head; cleft of mouth, $1\frac{2}{3}$ in head; teeth very small, subequal; eye, 2 in snout; pectoral, $2\frac{1}{2}$ in head.

Color brown above, purplish black below, and on head and lining membranes.

This species is allied to *Synaphobranchus brevidorsalis* Günther, from the Philippines, but the insertion of the dorsal is much in front of the middle of the body, while in the latter species it is much behind.

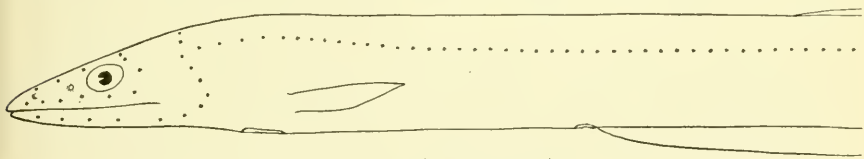


FIG. 2.—SYNAPHOBRANCHUS JENKINSI.

One specimen, $16\frac{1}{2}$ inches long (Type No. 49727, U.S.N.M.), from Station 3696, in Sagami Bay, off Enoshima, taken by the U. S. Fish Commission steamer *Albatross* in 1901. Doubtless the specimen referred to *Synaphobranchus brevidorsalis* from the Hyalonema ground, off Enoshima, belongs to this species.

Named for Dr. Oliver Peebles Jenkins, in recognition of his work on the fishes of Hawaii.

4. HISTIOBRANCHUS Gill.

Histiobranchus GILL, Proc. U. S. Nat. Mus., 1883, p. 255 (*infernalis*).

This genus is close to the preceding, from which it is distinguished by the more anterior insertion of its dorsal. Two species have been described, perhaps identical with each other. (*ἰστίον*, sail, i. e., dorsal fin; *βράγχια*, gills; from the insertion of the dorsal.)

6. HISTIOBRANCHUS BATHYBIUS (Günther.)

Synaphobranchus bathybius GÜNTHER, Ann. and Mag. Nat. Hist., XX, 1877, p. 445; and in Voy. Challenger, 1887, p. 254, pl. LXII, fig. b, off Tokyo, North Pacific, Kerguelen Island.

Histiobranchus bathybius JORDAN and EVERMANN, Fish. N. M. America, I, 1896, p. 352, Bering Sea.

Pectoral fin longer than snout; eye one-half or two-thirds of the length of snout; head and trunk $1\frac{1}{4}$ in tail; dorsal beginning above or immediately behind the pectoral, which is only one-third length of head; scales quite rudimentary, lanceolate, imbedded in the skin; cheeks naked; dorsal and anal fins low, especially the former. Uniformly black. (Günther.) Northern and western Pacific in deep water off Tokyo, not obtained by us; one specimen taken in Bering Sea in 1890. (*βαθύς*, deep; *βίος*, life.)

Family IV. LEPTOCEPHALIDÆ.

CONGER EELS.

This family includes those eels which are scaleless, and have the tongue largely free in front, the body moderately elongate, the end of the tail surrounded by a fin, the posterior nostril remote from the upper lip and near front of eye, and the pectoral fins well developed. Lower jaw more or less included; teeth on sides forming a cutting edge; lateral line well developed. All the species are plainly colored, grayish or dusky above, silvery below. Species found in most warm seas, usually at moderate depths. Most of the species undergo a metamorphosis, the young being loosely organized and transparent, band-shaped, and with very small head. The body grows smaller with increased age, owing to the compacting of the tissues. The two genera found in Japan are not well separated and should perhaps be reunited.

a. Insertion of dorsal over or behind middle of pectoral; tail notably longer than rest of body; muciferous cavities of skull small *Leptocephalus*. 5.

aa. Insertion of dorsal before middle of pectoral; snout and mouth smaller; skull more cavernous.

b. Teeth mostly pointed;¹ tail not half longer than rest of body..... *Congrellus*. 6.

¹Teeth blunt or molar in *Congermorena* (type *habenata*).

5. LEPTOCEPHALUS Scopoli.

CONGER EELS.

(a) Larval forms.

Leptocephalus SCOPOLI, Int. Hist. Nat., 1777, p. 453 (*morrissi*).

Ocyurus RAFINESQUE, Caratteri, 1810, p. 19 (*vermiformis*).

Helmetis RAFINESQUE, Indice d'Ittiologia Siciliana, 1810, p. 62 (*punctatus*).

Helmichthys COSTA, Fauna Napoli, Pesci, 1854 (*diaphanus*).

? *Leptocephalichthys* BLEEKER, Act. Soc. Sci. Ind. Nederl., I, Manado, p. 69 (*hyp-solosoma*).

? *Diaphanichthys* PETERS, Monatsber. Ak. Wiss. Berl., 1864, p. 399 (*brevicaudus*).

(b) Adult forms.

Echelus RAFINESQUE, Caratteri, etc., 1810, p. 63 (in part, includes species of *Conger*, *Ophisoma*, and *Myrus*; restricted by Bleeker to *Myrus*).

Conger CUVIER Règne Animal, 2d ed., 1829, p. 350 (*conger*).

Ariosoma SWAINSON, Nat. Hist. Class'n Fishes, I, 1838, p. 220 (no type mentioned; diagnosis worthless).

Ophisoma SWAINSON, Nat. Hist. Class'n Fishes, II, 1839, p. 334 (*acuta*). Substitute for *Ariosoma*; not *Ophisomus*, Swainson, Nat. Hist., Class'n Fishes, II, 1839, p. 227 = *Muraenoides*, Lacépède.

Congrus RICHARDSON, Voyage Erebus and Terror, p. 107, 1844 (*conger*).

? *Gnathophis* KAUP, Aale Hamburg. Mus., 1859, p. 7 (*heterognathus*).

Body formed as in *Anguilla*, the skin scaleless. Head depressed above, anteriorly pointed. Lateral line present. Mouth wide, its cleft extending at least to below middle of eye. Teeth in outer series in each jaw equal and close-set, forming a cutting edge; no canines; band of vomerine teeth short. Tongue anteriorly free. Vertical fins well developed, confluent around the tail; pectoral fins well developed; dorsal beginning close behind pectorals. Gill openings rather large, low. Eyes well developed. Posterior nostril near eye; anterior near tip of snout, with a short tube. Lower jaw not projecting. Skeleton differing in numerous respects from that of *Anguilla*. Vertebrae about 56 + 100. In most warm seas. This genus contains the well-known and widely distributed Conger eel and three or four closely related species. The earliest generic name used for members of the group is *Leptocephalus*, based on a curious, elongate, transparent, band-like creature with minute head and very small mouth, found in the waters of Europe, and known as *Leptocephalus morrissi*. This has been shown by Gill, Günther, and Facciola to be the young and larval form of *Leptocephalus conger*. A number of the genera and species of the supposed family of Leptocephalidae have been described, but there is no doubt that all of them are larvæ—some of eels, as *Conger*, *Conger-murana*, *Nettastoma*, and *Oryzomus*; others of Isospondylous fishes, as *Albula*, *Elops*, *Alepocephalus*, *Stomias*, etc.¹ It is thought by Dr.

¹Günther, Cat., VIII, p. 136.

Günther that the Leptocephalid forms are probably "individuals arrested in the development at a very early period of their life, yet continuing to grow to a certain size, without corresponding development of their internal organs, and perishing without having attained the characters of the perfect animal." The recent observations of Dr. Gilbert on the larvæ of *Albula*, *Elops*, and *Conger*, however, seem to point to the conclusion that these curious forms are normal young, and that the individuals grow smaller in size for a time with increased age, owing to the increasing compactness of the tissues.

Inasmuch as the name *Leptocephalus* has been associated for more than a century with larval forms, it is a decided inconvenience to accord to it precedence as a generic name over *Conger*. The strict law of priority, however, demands its retention, and the tendency among systematic zoologists is to recognize as few exceptions as may be to this rule. The unfamiliar names *Oxyurus* and *Helmictis* are both earlier than *Conger*. (*λεπτός*, slender; *κεφαλή*, head.)

The species of this genus are very difficult to determine. Among those found in Japan four are unquestionably valid *myriaster*, *japonicus*, *nystromi*, and *retroinctus*, but the other three may be forms of *japonicus*.

- a. Lateral line with each pore in the center of a whitish spot, these close set, as wide as the interspaces; about 38 before vent; head above with cross-series of many white pores, obscure in the young; adult with a series of round, wide-set whitish spots on each side of back; lower jaw included; pectoral more or less dusky, the dorsal inserted nearly above its tip; dorsal and anal with broad black margin..... *myriaster*. 7.
- aa. Lateral line without pale dots or with them very inconspicuous, not so broad as the interspaces; head with cross-series of conspicuous pores, the pores uncolored, like pin pricks; no pale spots on sides of back.
- b. Dorsal fin beginning over or behind tip of pectoral; pores before vent about 40; maxillary reaching posterior border of pupil; pectorals chiefly black; dorsal and anal with broad black margin.
- c. Head, $1\frac{3}{5}$ in trunk; head and trunk, $1\frac{3}{5}$ in tail..... *creberrimus*. 8.
- cc. Head, $1\frac{1}{5}$ in trunk; head and trunk, $1\frac{1}{2}$ in tail..... *kinsuanus*. 9.
- d. Pectorals pale; dorsal and anal with very little black margin or none; head and trunk, $1\frac{3}{5}$ in tail..... *japonicus*. 10.
- bb. Dorsal fin beginning nearly over middle of pectoral; dorsal and anal with broad black margins.
- e. Dorsal and anal each with a broad margin for their whole length. Mouth large, the maxillary extending to posterior margin of eye; eye, $6\frac{1}{2}$ in head; jaws subequal; tail twice length of rest of body; 36 whitish pores in advance of vent; no white spots on sides of back; dorsal and anal broadly edged with black; tail not white-edged; pectoral pale, the dorsal beginning above its middle..... *riukiuanus*. 11.
- cc. Mouth moderate, the maxillary not extending beyond pupil; pores before vent about 40; trunk very short, containing head $1\frac{1}{5}$ times; lower jaw short; mouth small, the maxillary to below middle of eye, 3 in head. *nystromi*. 12.
- cc. Dorsal and anal pale, the posterior portion for about the length of the head, jet black; pores of lateral line, wide set, about 30 before vent; pores minute; mouth small; pectorals pale..... *retroinctus*. 13.

7. LEPTOCEPHALUS MYRIASTER (Brevoort).

MAANAGO, TRUE CONGER.

Anguilla myriaster BREVOORT, U. S. Expl. Japan, 1856, p. 282, pl. XI, fig. 2, from a rough but characteristic drawing made at Hakodate.

Leptocephalus myriaster JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, XXIII, p. 347, Tokyo, Hakodate.

Conger vulgaris ISHIKAWA, Prel. Cat. Fish., 1897, p. 7, Hakodate, Tokyo.

Head, $1\frac{9}{10}$ in trunk ($1\frac{3}{5}$ in young); head and trunk, $1\frac{2}{3}$ in tail ($1\frac{3}{5}$ in young); lower jaw included; snout blunt, 4 in head; eye, 2 in snout, rather small; mouth moderate, the maxillary $2\frac{4}{5}$ in head, reaching posterior part of pupil; pectoral rounded, $2\frac{2}{5}$ in head, the dorsal inserted over its last third or fourth, dorsal and anal rather high.

Color dusky brown, paler below; a row of round whitish spots along side of back, regularly placed, beginning with a median spot at the nape, these spots found in no other species; lateral line very distinct, of a row of close-set white pores, just below the lateral line itself, about 38 of these before the vent; a cross series of 16 to 24 whitish pores on nape, just before the median spot; four series of small pores running forward from this; numerous stellate pores, regularly arranged about eye, on snout and on opercle; dorsal and anal each with a broad black median band meeting around the tail; pectoral more or less dusky in adult, pale in the young.

Description from a specimen 23 inches long from Hakodate. Others from Hiroshima, Tokyo, Onomichi, Nagasaki, and elsewhere agree in essential respects, the pores on the head indistinct in those under 6 inches in length.

Coasts of Japan, very abundant; obtained by us at Mororan, Matsushima, Same, Hakodate, Tokyo, Misaki, Hiroshima, Wakanoura, Kobe, Onomichi, Hakata, and Nagasaki. It reaches a length of 2 to 4 feet and is much used as food: (*μυρία*, myriad; *ἀστὴρ*, star, from the stellate spots, which at once separate this species from other congers).

8. LEPTOCEPHALUS EREBENNUS Jordan and Snyder, new species.

DAINANANAGO (FORMOSA CONGER); KANAKIUIANAGO (CRAB-EATING CONGER).

? *Conger vulgaris* SCHLEGEL, Fauna Japonica, 1847, p. 259, Nagasaki; not of European waters.

Head, $1\frac{1}{2}$ in trunk; head and trunk, $1\frac{1}{2}$ in tail; lower jaw not very short; snout moderate, 4 in head; eye, $1\frac{3}{4}$ in snout; mouth rather large, the maxillary $2\frac{3}{4}$ in head, extending to opposite posterior border of pupil; pectoral rounded, 3 in head; dorsal inserted over its tip; distance from gill opening to front of dorsal, $2\frac{3}{5}$ in head, dorsal and anal high.

Color almost black, the sides marbled, the belly mottled dusky;

dorsal and anal blackish, with a jet-black margin; lateral line blackish, with a row of whitish dots, like pin pricks, its whole length; about 38 before vent; cross-series of pores on nape not evident; pectoral dusky with a whitish edge behind and below; no white spots on back; no white on tail.

Described from a specimen $19\frac{1}{2}$ inches long, obtained at Misaki. Type No. 6466, Leland Stanford Junior University Museum.

We refer to this species a large specimen also from Misaki, having the dorsal inserted farther backward. Head, $1\frac{1}{3}$ in trunk; head and trunk, $1\frac{3}{4}$ in tail; cleft of mouth extending to just beyond pupil, $2\frac{1}{5}$ in head; snout, $3\frac{2}{5}$ in head; eye, $1\frac{3}{4}$ in snout; pectoral, 3 in head, the dorsal beginning well behind its tip; distance from front of dorsal to gill opening, $1\frac{2}{3}$ in head.

Color black; fins all blackish, the dorsal and anal broadly edged with black.

Another specimen 2 feet 7 inches long, from Misaki.

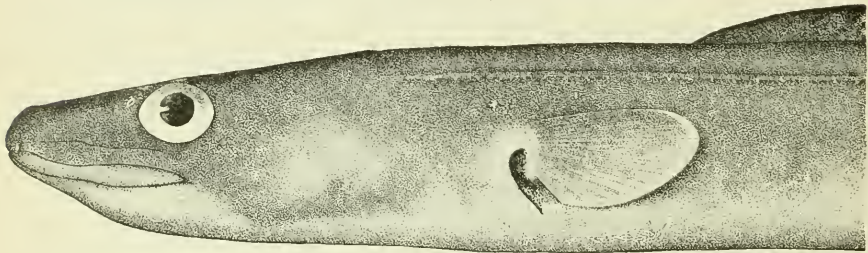


FIG. 3.—LEPTOCEPHALUS EREBENNUS.

Still another specimen, doubtless of the same species, differs equally in measurements:

Head $1\frac{2}{3}$ in trunk; head and trunk $1\frac{3}{4}$ in tail; lower jaw not much shortened; snout rather sharp, $4\frac{1}{4}$ in head; eye $1\frac{2}{3}$ in snout; mouth rather large, the maxillary $2\frac{1}{2}$ in head, extending nearly to opposite posterior border of eye; pectoral pointed, $3\frac{1}{2}$ in head; dorsal inserted very slightly behind its tip; distance from gill opening to front of dorsal $1\frac{2}{3}$ in head; dorsal and anal moderate.

Color very dark, almost black; lateral line, a continuous streak, with minute, whitish, wide-set pores, like pin pricks, about 45 before vent; no pale spots; cross series of pores on back of head very minute; pectorals black, with a pale edge below; dorsal and anal dusky, with a broad black margin; no white on tail.

This specimen, taken at Misaki, is 14 inches long. This species is known to fishermen as *Kanakinainago* or *Dainananago*. It is nearest *Leptocephalus conger*, the common Conger eel of the Atlantic, but differs in some regards. In *Leptocephalus conger* (specimen 1880, Stanford Museum, from Beaufort, North Carolina) there is a distinct cross streak of fine pale pores across occiput; there are 42 pores before vent;

the maxillary is 3 in head; head and trunk $1\frac{2}{3}$ in tail; dorsal and anal pale at base, with broad black margin; lateral line with the pores pale, the line itself a pale streak; dorsal inserted over tip of pectoral. We have found in Japan no Conger corresponding to the Atlantic species, though this one comes nearest it. (*ἔρεβενρός*, very black—as Erebus.)

We refer with some doubt to this species, a small eel, 5 inches long, from Wakanoura. Head $1\frac{2}{3}$ in trunk; head and trunk $1\frac{3}{5}$ in tail; maxillary extending to posterior border of eye, $2\frac{1}{2}$ in head; snout $3\frac{2}{3}$ in head; lower jaw not much shorter; pectoral $2\frac{1}{2}$ in head; dorsal inserted over posterior third of pectoral; 42 pores before vent; lateral line forming a continuous streak. Color light olive; pores of lateral line large, pale, but without white dots; sides with some black dots; dorsal with the black margin obsolete except posteriorly where it is narrow; anal showing traces of a dark edge posteriorly; tip of tail white; pectorals pale; pores on top of head not evident.

9. *LEPTOCEPHALUS KIUSIUANUS* Jordan and Snyder, new species.

KUROANAGO (BLACK CONGER).

Head $1\frac{1}{2}$ in trunk; head and trunk $1\frac{1}{2}$ in tail; lower jaw rather short; snout shortish, $4\frac{1}{4}$ in head; eye $1\frac{3}{4}$ in snout; cleft of mouth moderate, the maxillary 3 in head, extending to posterior margin of eye; pectoral pointed, $3\frac{1}{4}$ in head; dorsal inserted over end of second third of pectoral; insertion of dorsal to gill opening, $4\frac{1}{4}$ in head; dorsal and anal rather high.

Color dark brown, the dorsal and anal broadly edged with black; tip of tail with a slight white margin. Pectoral dusky, with a pale edge. Lateral line conspicuous, with small pale pores, 38 before vent; no white spots anywhere. Pores on head inconspicuous.

One specimen, type No. 6467, Leland Stanford Junior University Museum, $2\frac{1}{2}$ feet long, from Hakata, province of Chikuzen, in Kiusiu. It differs strongly from any other species we have seen in the relative shortness of the trunk. The dorsal is inserted anteriorly, but not so far forward as in *L. nystromi*, which has also the trunk short. *Leptocephalus marginatus* (= *noordzieki*, Bleeker) from Polynesia, has higher fins and slenderer body.

10. *LEPTOCEPHALUS JAPONICUS*¹ Bleeker.

Conger japonicus BLEEKER, Enum. Espèce Ic. Poiss. Japon, 1874, p. 32, Japan.

This species, according to Bleeker, is characterized by its dentition, its convex anterior profile, by the relative length of its head and trunk.

¹ *LEPTOCEPHALUS HETEROGNATHUS* (Bleeker.)

Closely allied to this genus is a young Conger in very bad condition received by Dr. Bleeker from Nagasaki. According to Günther, the typical example belongs to *Conger murana* and is very closely allied to the New Zealand species, *C. habenata*, having a similar dentition (like that of *Congrellus*, except that the teeth are blunt).

by the length of its pectorals, and the size of its gill openings. Maxillary reaching to opposite posterior part of pupil; head $2\frac{2}{5}$ in trunk; 8 in total length; head and trunk $1\frac{3}{5}$ in tail (from figure); pectorals $2\frac{1}{5}$ in head, reaching past front of dorsal; gill openings broader than base of pectoral.

Color mottled dusky above, paler below; fins yellowish, the black margin of dorsal obsolete (on the figure); pectorals pale. (Bleeker.)

One specimen 336mm. long, said to be from Japan, apparently distinguished by its pale dorsal fins and anal. Not seen by us.

This species is also very close to the one figured by Bleeker from East Indian examples as the true Conger (*Leptocephalus conger* = *Conger vulgaris*), but the young examples have the tail shorter than in Bleeker's figure, doubtless a matter of age. The European Conger seems, however, to be different from any Japanese Conger we have seen. It is possible that further research will show that *japonicus* is the young and *erebennus* the adult of the same species.

11. LEPTOCEPHALUS RIUKIUANUS Jordan and Snyder, new species.

Head 2 in trunk; head and trunk together half length of tail; mouth larger than in related species, the jaws subequal, the maxillary $2\frac{1}{2}$ in head, extending to opposite posterior margin of eye; snout rather pointed, $4\frac{1}{4}$ in head; eye large, $1\frac{1}{2}$ in snout, about $6\frac{1}{2}$ in head; pectorals $3\frac{1}{4}$ in head; dorsal inserted about over middle of pectoral.

Color dusky above, paler below; a series of small faint white pores along the lateral line, these smaller, farther apart, and less distant than



FIG. 4.—LEPTOCEPHALUS RIUKIUANUS.

in *Leptocephalus myriaster*, and becoming obsolete behind; about 36 of these before the vent; dorsal and anal each with a broad black margin which surrounds the tip of the tail, pectoral pale; a dark streak through snout, extending obliquely downward and backward below eye; nuchal pores small, few in a cross series.

It may, perhaps, "be recognized by the great length of its tail; body = 2 inches; tail, $3\frac{1}{2}$ inches," which is about the usual relation in *Leptocephalus*.

The species was not seen by us. There is nothing in the published account to separate it from a young *Leptocephalus*, for example, *L. japonicus*, which has little dark edging to its dorsal. (*ἕτερος*, different; *γνάθος*, jaw.)

Myrophis heterognathus BLEEKER, Act. Soc. Sci. Indo-Nedrl. V, Japan, p. 9, pl. 11, fig. 1, Nagasaki.

Gnathophis heterognathus KARP, Aale Hambarg. Mus., 1859, p. 7 (after Bleeker).

(*Congernurwa*) *heterognathus* GÜNTHER, Cat. Fish., VIII, 1870, p. 42, same specimen.

One specimen $13\frac{1}{2}$ inches long. Type No. 6468, Leland Stanford Junior University Museum, obtained by Capt. Alan Owston at Yaeyama, Ishigaki Islands, in the southern Riukiu group. This species is near to *L. erbenus*, but has the backward insertion of the dorsal characteristic of *L. nystromi*. It is, however, clearly distinct from *L. nystromi*, and equally different from *L. myriaster*.

12. *LEPTOCEPHALUS NYSTROMI* Jordan and Snyder, new species.

Conger marginatus GÜNTHER, Shore Fishes, Challenger, 1880, p. 73, Inland Sea of Japan.—NYSTROM, Kong. Sven. Vet. Ak., XIII, 1887, p. 47, Nagasaki; not of Valenciennes.—ISHIKAWA, Prel. Cat. 1897, p. 7, Riukiu Islands.

Head $1\frac{1}{3}$ in trunk; head and trunk $1\frac{2}{3}$ in tail; mouth small, the maxillary extending about to middle of eye, 3 in head; lower jaw much shorter than upper; snout blunt, somewhat cavernous, $3\frac{1}{2}$ in head; eye $1\frac{1}{2}$ in snout, smaller in adult; pectorals 3 in head; dorsal inserted over middle of pectoral or a little before; distance from gill opening to dorsal, 8 in head; dorsal and anal not especially elevated.

Color very pale, brownish above, whitish below; dorsal and anal

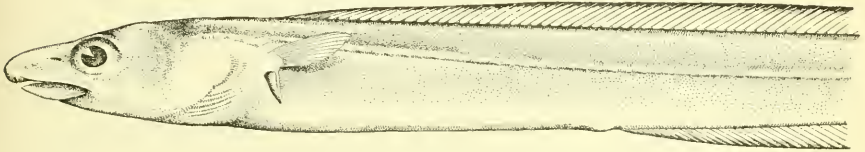


FIG. 5.—*LEPTOCEPHALUS NYSTROMI*.

with a broad black margin surrounding the tail; pectoral pale or slightly dusky at base; lateral line a conspicuous ridge with about 35 pores before vent; these a little paler than body; nuchal pores not evident.

Southern Japan, north to Kobe, here described from the type, No. 6469, Leland Stanford Junior University Museum, taken at Nagasaki. The species has been confounded with *L. marginatus* of Polynesia, with which it agrees in the insertion of the dorsal. *L. marginatus* has the pectoral black at tip and the dorsal fin higher. (Named for Edward Nystrom, of the University of Upsala, in recognition of his excellent work on the fishes of Nagasaki.)

13. *LEPTOCEPHALUS RETROTINCTUS* Jordan and Snyder, new species.

Head $1\frac{3}{4}$ in trunk; head and trunk $1\frac{1}{3}$ in tail; lower jaw short; snout rather blunt, 4 in head; eye $1\frac{1}{2}$ in snout; mouth small, the maxillary extending to opposite posterior part of eye, $2\frac{2}{3}$ in head; pectoral pointed, $3\frac{1}{5}$ in head; the dorsal inserted rather in front of its middle; distance from gill opening to dorsal about 8 in head; dorsal and anal

rather low. Lateral line a broad furrow with a ridge, no conspicuous pale pores or pin pricks, the pores wide set and indistinct, about 30 before vent; cross series of pores at nape, very minute, scarcely visible. Color very pale brown, somewhat silvery, the sides abruptly paler; pectoral pale; dorsal and anal pale except for a distance from tip of tail about equal to length of head, in which both fins are entirely black; tip of tail black, edged with pale in one specimen.



FIG. 6.—LEPTOCEPHALUS RETROTINCTUS.

Two specimens, each 11 to 12 inches long, found in the market at Tokyo. Type No. 6470, Leland Stanford Junior University museum. The peculiar coloration of the dorsal and anal furnishes a distinctive character, as also the character of the lateral line. (*Retro-*, behind; *tinctus*, dyed.)

6. CONGRELLUS Ogilby.

Congrellus OGILBY, in Jordan and Evermann, Fishes N. M. America, III, 1898, p. 2801 (*balearica*).

Dorsal fin inserted more anteriorly than in *Leptocephalus*, over the gill opening or anterior part of pectoral; head with muciferous cavities, more or less conspicuous; mouth rather small; teeth all pointed; body more robust than in *Leptocephalus*, the tail not much if any longer than rest of body, its tip white in Japanese species; dorsal and anal edged with black. The genus is not very different from *Leptocephalus*, the species *megastomus* being almost exactly intermediate. (Diminutive of *Conger*, the Conger eel.

- a.* Mouth large, the maxillary extending much beyond pupil; $2\frac{1}{8}$ in head; pectorals $3\frac{1}{3}$ in head; nape with a distinct cross series of about 4 pores; dorsal and anal without dark margin; end of tail black, with a broad pale border; pectorals dusky.....*megastomus*. 14.
- aa.* Mouth moderate, the maxillary extending to opposite posterior part of pupil; about $3\frac{1}{2}$ in head; dorsal and anal each with a broad black margin; tip of tail white; pectorals pale (*anago*) or dark (*meeki*).....*anago*. 15.

14. CONGRELLUS MEGASTOMUS (Günther).

OKIANAGO; OFF SHORE CONGER.

Congromuræna megastoma GÜNTHER, Shore Fishes Challenger, 1880, p. 73, Enoshima, from Japanese fishing boats, specimens 11 to 19 inches long.

Head 2 in trunk; head and trunk $2\frac{2}{5}$ in total; $1\frac{2}{5}$ in tail; snout rather short and blunt, $3\frac{3}{4}$ in head; lower jaw shorter than upper; eye $1\frac{1}{2}$ in snout; mouth small, the maxillary $2\frac{1}{4}$ in head, extending to opposite posterior part of eye; pectoral, short, rounded, $3\frac{1}{3}$ in head; dorsal

inserted a little before middle of pectoral; dorsal and anal moderate. Color pale olivaceous; a series of minute whitish pores along lateral line, much smaller and less distinct than in *Leptocephalus myriaster*, 47 of them in front of vent; a few similar but larger pores on head, about 4 arranged in cross-series on the nape, these less numerous than in *L. myriaster*; snout with large pores; no pale dots above lateral line; pectoral largely blackish; dorsal and anal without black margin; tip of tail with dorsal and anal fins for a space about two-fifths length of head abruptly black, with a broad white margin.

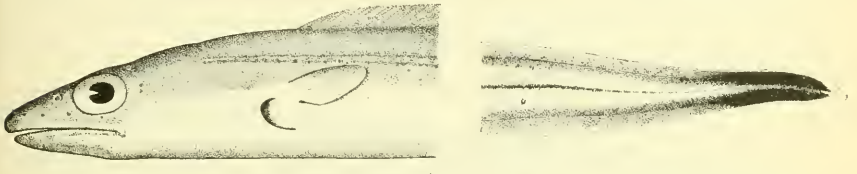


FIG. 7.—*CONGRELLUS MEGASTOMUS*.

Shores of Japan in rather deep water. Known from Sagami and Totomi bays. Here described from two examples, each about a foot long; the one, dredged by the U. S. Fish Commission Steamer *Albatross* off Hamamatsu (Totomi) in 34 fathoms, station 3730; the other, taken with a long line (dabonawa) off Misaki, by Kumakichi Aoki, and presented to us by Professor Mitsukuri. The peculiar coloration of the tail at once separates it from the other Congers. In its technical characters it is almost as near *Leptocephalus* as *Congrellus*. (μέγας large; στόμα, mouth.)

15. *CONGRELLUS ANAGO* (Schlegel).

ANAGO.

Conger anago SCHLEGEL, Fauna Japonica, 1846, p. 259, pl. cviii, fig. 1, Nagasaki.—BLEEKER, Verh. Bat. Gen. Japan, p. 52.

Congromurana anago GÜNTHER, Cat. Fish., VIII, 1870, p. 42, Japan, Amboyna.—GÜNTHER, Shore Fish. Challenger, 1880, p. 73, Yokohama.—ISHIKAWA, Prel. Cat., 1897, p. 6, Tokyo.

? ? *Ophisoma anagoides* BLEEKER, Atl. Mur., p. 27, Singapore, Celebes, Batjan, Amboyna, Banda (distinguished from *C. anago* by the smaller eye, stouter form, smaller head, and narrower border of the fins, the anal and tip of tail without black; probably a different species).

Congrellus meeki, JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXIII, 1900, p. 347, pl. xi, Tokyo, based on a large example with black pectoral; several such examples were taken by us in Tokyo Bay and at Wakanoura. Except for the dark color of the pectorals no difference can be detected. The insertion of the dorsal is subject to considerable variation.

Head $1\frac{1}{2}$ in trunk; head and trunk $1\frac{1}{10}$ to $1\frac{1}{2}$ in total; form robust; snout short, bluntish, 5 in head; eye very large, about as long as snout; cleft of mouth reaching about to posterior part of pupil, $3\frac{3}{5}$ in head. Teeth less closely set than in *Leptocephalus*, all pointed.

Pectoral $2\frac{1}{2}$ in head, the dorsal beginning variously from above its base to nearly over its middle. Sixty pores before the vent, the pores smaller than in *Leptocephalus*.

Body light or dark brownish, the head sometimes dotted; usually two dark shades behind eyes; pores of lateral line inconspicuous; cross-series of pores on nape not evident; pectoral fin pale or variously blackish (*meeki*), sometimes entirely black, usually pale, especially in the young; tip of tail always white; vertical fins with a broad black margin. Length 1 to 2 feet.

Coasts of Japan and southward, very common and much used as food. It varies somewhat in color. Our specimens from Tokyo, Misaki, Kobe, Wakanoura, and Nagasaki. Several large specimens

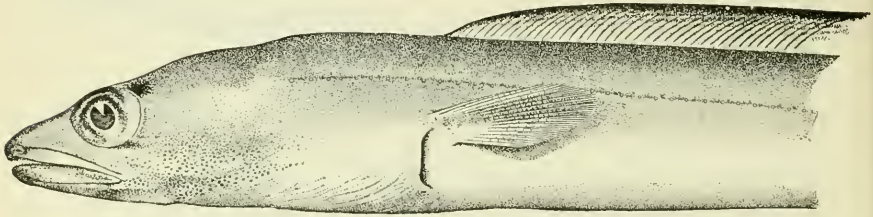


FIG. 8.—CONGRELLUS ANAGO.

from Tokio and Wakanoura have the pectorals black and correspond to *Congrellus meeki*, but no other distinctive characters can be made out. *Congrellus meeki* is probably only a highly colored adult. (*Anago*, the Japanese name; possibly from *ana*, hole; *go*, child or creature.)

Family V. MURENESOCIDÆ.

Scaleless anguilloid eels, with the posterior nostril not labial, the tongue largely adnate, the jaws not excessively elongate, the tail of moderate length, the end of the tail surrounded by the caudal fin, and the pectoral fins well developed; gill openings rather wide; jaws of moderate length; vomer well armed. None of these characters appear to have in themselves great importance, but, according to Dr. Gill, in the genus *Mureneseox*, the only genus in which the osteology is well known, the characters are such as fully to justify family distinction. Dr. Gill gives the following diagnosis of Mureneseoidæ:

Enchelycephalous Apodals with the tongue not free, the branchiostegal membrane connecting the opposite sides below, the epipharyngeals reduced to one pair, and the hypopharyngeals linguiform and encroaching on the fourth branchial arch.

The species of this family are not very numerous, and a large proportion are American. In general appearance and habits they approach the Congers. All are plainly colored and some descend to rather deep water.

a. Teeth in jaws in several series, those of one series enlarged and compressed, long canines in front; vomer with several long series of teeth, the middle one of very large canines; snout moderate; dorsal beginning above gill opening.

Murænesox. 7.

aa. Teeth in the jaws in three series, those of the median series containing long, wide-set canines; vomer with very small teeth; pectoral and vertical fins well developed, the dorsal inserted over the gill opening; snout very long, pointed; tail shorter than rest of body *Oxyconger*. 8.

7. MURÆNESOX McClelland.

Murænesox McCLELLAND, Calcutta Journ. Nat. Hist., IV, 1843, p. 408 (*tricuspidata*).

Cynoponticus COSTA, Fauna Napoli, Pesci., 1850, pl. xxviii (*ferox* = *saranna*).

Brachyconger BLEEKER, Nederl. Tijdskr., Dierkunde, II, 1865, p. 236 (*saranna*).

Congresox GILL, Proc. U. S. Nat. Mus., 1890, p. 234 (*tabalon*).

Body robust. Dorsal and anal fins well developed, the dorsal beginning nearly above gill opening. Mouth large; teeth in jaws in several series, those of one series enlarged and depressed, forming long canines in front; vomer with several long series of teeth, the middle one of strong canines. This genus contains numerous species of large, conger-like eels, some of which are found in all warm seas. They are remarkable for the strong armature of the vomer. (*Muræna*; *Esor*, pike.)

16. MURÆNESOX CINEREUS (Forskål).

HAMO.

Muræna cinerea or *tota cinerea* FORSKÅL, Descr. Anim., 1775, pp. X, 22, Red Sea.

Murænesox cinereus GÜNTHER, Cat. Fish., VIII, 1870, p. 46, Vizagapatam, Calcutta, Philippines, Singapore, Amoy, Formosa, Japan, Australia.—NYSTROM, K. Svensk. Vet. Akad. Handl., 1877, p. 46, Nagasaki.

Muræna arabica SCHNEIDER, Syst. Ichth., 1801, p. 488, after Forskål.

Muræna bagio HAMILTON-BUCHANAN, Fish Ganges, XXIV, 1822, p. 364; Ganges River.

Murænesox bagio PETERS, Wiegml. Archiv., 1855, p. 270.—KAUP, Apodes, 1856, p. 116, pl. XIV, fig. 73.—BLEEKER, Atlas. Ichth. Muræn., p. 24, pl. xxvi, fig. 2, Java, Pinang, Bintang, Singapore, Sumatra, Borneo, Celebes, Philippines.

Ophisurus rostratus QUOY and GAIMARD, Voy. Uranie, 1846, p. 242, pl. LI, fig. 1.

Conger longirostris BENNETT, Life of Raffles, 1830, p. 692.

Conger oxyrhynchus EYDOUX and SOULEYET, Voyage Bonite, I, p. 203, pl. IX, fig. 2. *Murænesox tricuspidata* McCLELLAND, Journ. Nat. Hist., IV, 1844, p. 409, pl. XIV, fig. 1, 1844, River Ganges.

Congrus tricuspidatus RICHARDSON, Voy. Sulphur, Fish., 1846, p. 105, pl. LI, fig. 2, and elsewhere.

Murænesox hamiltoni McCLELLAND, Journ. Nat. Hist., V, 1844, pp. 182, 210, pl. VIII, fig. 3, River Ganges.

Murænesox bengalensis McCLELLAND, Journ. Nat. Hist., V, 1844, pp. 182, 210.

Conger hamo SCHLEGEL, Fauna Japonica, Poiss, 1846, p. 262, pl. cxiv, fig. 2, Nagasaki.—BREVOORT, Exped. Japan, p. 282, 1856, Shimoda.

Congrus protereus RICHARDSON, Voy. Erebus and Terror, Fish., 1846, p. 110.

Congrus angustidens RICHARDSON, Voy. Erebus and Terror, Fish., 1846, p. 110; China.

Congrus brevicuspis RICHARDSON, Voy. Erebus and Terror, Fish., 1846, p. 110; locality unknown.

Congrus singapurensis BLEEKER, Verh. Bat. Gen. Mur., XXV, p. 21, Singapore.

Murænesox singapurensis BLEEKER, Atlas Ichth. Mur., p. 25, pl. VII, fig. 2.

Snout long, rather pointed; vomerine teeth compressed, with a basal lobe in front and behind; teeth in the inner series of mandible similar to those on the vomer, but smaller and rarely with basal lobes; teeth of the outer series rudimentary; not bent outward. Dorsal inserted close behind base of pectoral. Ashy-gray, sides silvery; dorsal and anal with a broad black margin; pectorals pale, or suffused with dusky on the under side.

Length 4 to 6 feet. A very large eel, with very strong teeth, widely distributed in the East Indies and north to Japan. We follow Dr. Günther in identifying the Japanese *hamo*, with *M. cinereus*, of the Red Sea, finding no grounds on which to suspect difference. Our numerous specimens are from Tokyo, Misaki, Tsuruga, Wakanoura, Onomichi, Hiroshima, and Nagasaki. It is much used as food and known by the name of *hamo* (*Cinereus*, ashy).

8. OXYCONGER Bleeker.

Oxyconger BLEEKER, Atlas, Ichth. Murèn. 1867, p. 19 (*leptognathus*).

Body compressed; snout much produced; teeth in each jaw in about three series; the median series containing long, slender canines, wide-set, some of them straight, some of them curved; vomer with series of very small teeth. Pectorals slender, well developed. Dorsal inserted over gill opening. Nostrils without tubes, the posterior in front of the eye, at some distance from it. Japan. ($\sigma^7 \vartheta^5$, sharp; *Conger*.)

17. OXYCONGER LEPTOGNATHUS Bleeker.

Conger leptognathus BLEEKER, Act. Soc. Indo-Nedrl., III; Japan, IV, p. 27, Nagasaki.

Oxyconger leptognathus GÜNTHER, Cat. Fishes, VIII, p. 49, 1870; same specimen.

Head $2\frac{1}{10}$ in trunk; tail shorter than rest of body, about one-fifth longer than trunk; cleft of mouth $1\frac{2}{3}$ in head; about 12 canines on

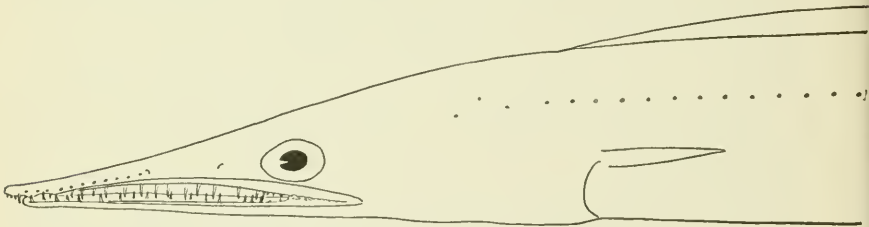


FIG. 9.—OXYCONGER LEPTOGNATHUS.

each side in each jaw; snout very sharp, $2\frac{1}{5}$ in head; eye $3\frac{2}{3}$ in snout; pectoral $4\frac{1}{2}$ in head. Olivaceous, sides silvery, dorsal and anal each with a broad black margin; pectoral pale; tip of tail white with a black edging. Coasts of Japan, two specimens known, the original

type from Nagasaki; the second, here described, about 14 inches long, from the market of Tokyo, taken outside of Tokyo Bay, off Awa or Misaki. (λεπτός, slender; γνάθος, jaw.)

Family VI. NETTASTOMIDÆ.

Eels without pectoral fins, the tongue not free, the posterior nostril before the eye, the gill openings small, separate, subinferior, the vent remote from the head, the tail ending in a slender tip, the vertical fins moderately developed; and the jaws produced, slender and straight, the upper the longer, both as well as the vomer armed with bands of close-set slender teeth. The species are allied to the *Muraenesocidæ*, but are weaker fishes, of the deep sea, with fragile bodies, the skin sometimes charged with black pigment.

a. Nostrils valvular on the upper surface of the head; the posterior above anterior angle of eye; tail tapering to a point; snout without fleshy projection at tip.

Nettastoma. 9

aa. Nostrils lateral, the posterior slit-like, in front of eye.....*Chlopsis*. 10

9. NETTASTOMA Rafinesque.

Nettastoma RAFINESQUE, Caratteri, etc., 1810 (*melanurum*).

Characters of the genus included above. (νήττα, duck; στόμα, mouth.)

18. NETTASTOMA PARVICEPS Günther.

Nettastoma parviceps GÜNTHER, Ann. Mag. Nat. Hist., XX, 1887, p. 446, south of Yedo (Tokyo); Rept. Challenger Fishes, 1887, p. 253, pl. LXIII, fig. A, same specimen.

Head small, its length $2\frac{1}{2}$ in distance from gill-opening to vent. Dorsal fin inserted in advance of gill-opening. In other respects similar to *Nettastoma melanurum* of the Mediterranean. (Günther.) The figure shows a row of 5 or 6 large pores across occiput; snout $2\frac{2}{5}$ in head; head and trunk shorter than tail, which ends in a slender point; 45 pores in lateral line before vent; cleft of mouth a little more than half head, extending to just beyond eye; eye 4 in head. Color not very dark, apparently some edging to the fins behind.

One specimen known, taken by the *Challenger* south of Tokyo at station 232, in 345 fathoms; length, $26\frac{1}{2}$ inches; not seen by us. (*Parrus*, small; *ceps*, head.)

10. CHLOPSIS Rafinesque.

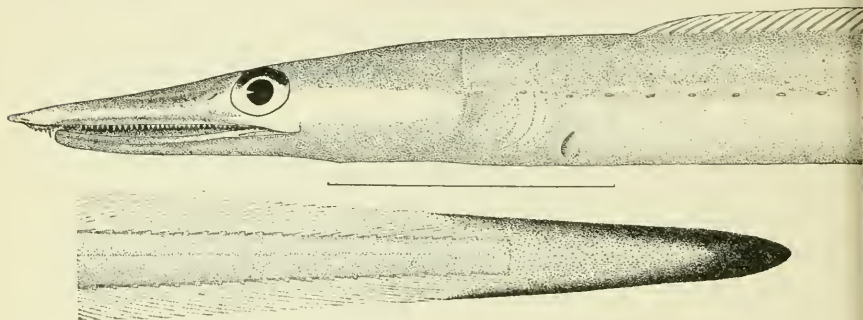
Chlopsis RAFINESQUE, Indice Ittiol. Sicil., 1810, p. 58 (*bicolor*.)

Saurenhelys PETERS, Berliner Monatsber., 1864, p. 397 (*caucasicora-bicolor*.)

This genus sufficiently characterized above differs from *Nettastoma* in the position of the nostrils, the posterior being in front of the eye, as usual in congroid fishes. Deep water. (χλόη, twig; ὄψις, appearance.)

19. *CHLOPSIS FIERASFER* Jordan and Snyder, new species.

Head $1\frac{1}{5}$ in trunk; head and trunk $2\frac{9}{10}$ in tail; snout produced, with a slight fleshy tip, $2\frac{1}{2}$ in head; eye $3\frac{3}{8}$ in snout; cleft of mouth extending to posterior edge of pupil; teeth sharp, slender, rather close-set; dorsal inserted behind gill-opening at a distance a little greater than length of eye; a mucous tube, behind occiput across neck, without distinct pores; lateral line a continuous tube, with 29 large slit-like pores before vent. Depth of body $4\frac{1}{3}$ in head, tail tapering to a moderate point, without filament at tip. Color light olivaceous, with silvery sheen on sides of head; posterior part of dorsal and anal in the type for a distance about two-thirds length of head jet black as

FIG. 10.—*CHLOPSIS FIERASFER*.

though dipped in ink; rest of fins pale; another specimen without black on tail; a black dot at base of each dorsal and anal ray, that on anal sending a narrow streak up each ray.

Two specimens, the type $18\frac{1}{2}$ inches long, No. 6471, Stanford University Museum, taken at Wakanoura, in Kii, Japan; a female with ripe eggs; the other $14\frac{1}{2}$ inches long (No. 49728, U. S. Nat. Mus.), taken also at Wakanoura. The two specimens differ a little, especially in the color of the tail, but are evidently not of distinct species. The snout of the smaller one measures $2\frac{2}{3}$ in head. (*Fierasfer*, a fish of similar color; from *φιερρός*, sleek.)

Family VII. MYRIDÆ.

End of tail surrounded by the confluent vertical fins; the posterior nostril is in, or very near, the upper lip; the teeth small, and the tongue is more or less fully adnate to the floor of the mouth. The species are usually of small size and plain colors, more or less worm-like in form, and inhabit sandy coasts in tropical seas. They are intermediate in character between the *Ophichthyidae* and the *Muraenesocidae*. The osteology has not yet been carefully studied, but they will probably be found to be most nearly related to the latter family. Indeed, the

Muraenesocidae, *Nettastomidae*, and *Myridae* are all very close to the *Leptocephalidae* and might be reunited with the latter, as in Bleeker's arrangement.

- a. Pectorals present; dorsal beginning near the gill opening.....*Myrus*. 11.
- aa. Pectorals wanting; dorsal low, beginning well behind gill opening.
Muraenichthys. 12.

11. MYRUS Kaup.

Myrus KAUP, Apodes, 1856, p. 31 (*myrus*).

Body slender; nostrils close to margin of upper lip, the anterior tubular, the posterior lobed. Pectoral well developed; dorsal beginning behind gill opening; caudal rays very short. Teeth subequal in bands. Species few, of the Mediterranean Sea and Japan. (*μύρος*, an ancient name in Aristotle of some eel.)

20. MYRUS UROPTERUS (Schlegel).

Conger uropterus SCHLEGEL, Fauna Japonica, Poiss., 1847, p. 261, Nagasaki.

Ophisurus uropterus BLEEKER, Act. Soc. Nederl., III; Japan, IV, p. 28; V, pl. 1, fig. 1, Nagasaki.

Myrus uropterus GÜNTHER, Cat. Fish., VIII, 1870, p. 50, from a specimen sent by Dr. Bleeker.—NYSTROM, K. Svensk. Vet. Akad. Handl., 1887, p. 46. Nagasaki.

Tail twice as long as trunk without head; cleft of mouth to hind margin of eye; dorsal fin beginning over end of pectoral; front margin of eye much nearer end of maxillary than tip of snout. Coloration plain brownish. (Günther.) Nagasaki; not seen by us; probably rare. (*φυρά*, tail; *πτερόν*, fin.)

12. MURÆNICHTHYS Bleeker.

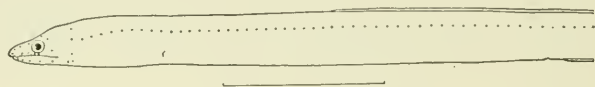
Muraenichthys BLEEKER, Verhand. Batavia, Gen. Muræn., XXV, 1853, p. 71 (*gymnopterus*).

Slender worm-shaped eels, without pectoral fins, and with both nostrils on the margin of the upper lip. Dorsal and anal very low, beginning far behind gill opening and meeting around the tail; gill opening small; teeth small. East Indies and Japan. (*μύραινα*, moray; *ιχθύς*; fish.)

- a. Dorsal fin inserted before vent.
- b. Dorsal fin inserted more than a head's length before vent, at a point nearer gill opening than vent; form robust, snout blunt, flattish; top of head with large pores, fins well developed on tail.....*owstoni*. 21.
- bb. Dorsal fin inserted less than a head's length in advance of vent; form slender.
- c. Snout short, blunt, 10 in head, not longer than eye; insertion of dorsal three-tenths of the head's length before vent; head $2\frac{3}{4}$ in trunk.....*hatta*. 22.
- aa. Dorsal fin inserted behind vent; snout long, sharp, $5\frac{1}{2}$ in head, much longer than eye; insertion of dorsal three-fourths head's length before vent; head $3\frac{3}{4}$ in trunk.....*aoki*. 23.

21. *MURAENICHTHYS OWSTONI* Jordan and Snyder, new species.

Body moderately robust, cylindrical, the depth 3 in head; head $2\frac{2}{3}$ in trunk; head and trunk $1\frac{3}{5}$ in tail; eye 2 in snout; snout rather obtuse, flattish above, $5\frac{1}{3}$ in head; cleft of mouth 3 in head, extending well beyond eye; teeth mostly biserial; gill opening smaller than eye. Dorsal inserted nearer gill opening than vent at a distance equal to $1\frac{2}{3}$ times length of head in front of vent; dorsal and anal well developed on tail, the highest rays two-thirds length of snout, much higher than

FIG. 11.—*MURAENICHTHYS OWSTONI*.

those on back. Lateral line running high, continuous, about 45 pores before vent, little curved above throat; top of head with about 9 pores regularly arranged.

Color uniform chestnut brown, darker above and scarcely dotted; belly and fins paler, but of similar shade.

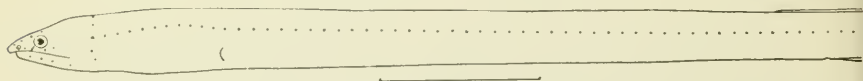
Here described from a specimen, 9 inches long, obtained by Mr. Alan Owston, at Yaeyama Island, one of the Ishigaki group in the southern part of the Riukiu Archipelago in Japan. Type No. 6472, Leland Stanford Junior University Museum; a smaller specimen was taken at the same time.

This species is close to *Muraenichthys macropterus* from Amboyna and Solor, but has stouter body, larger fins, and the dorsal inserted a little farther forward.

Named for Mr. Alan Owston, of Yokohama, a well-known English naturalist and collector, discoverer of the species.

22. *MURAENICHTHYS HATTÆ* Jordan and Snyder, new species.

Body elongate, subcylindrical, the depth 4 in head; head $2\frac{4}{5}$ in trunk; head and trunk $1\frac{1}{2}$ in tail; eye 2 in snout; snout short, blunt, $7\frac{1}{3}$ in head;

FIG. 12.—*MURAENICHTHYS HATTÆ*.

cleft of mouth 4 in head, extending far behind eye; dorsal inserted in front of vent at a distance equal to three-tenths length of head. Lateral line little curved at throat, with 54 pores before vent. Color brownish, with fine dots above; vertical fins dusky behind.

One specimen 13 inches long, from a rock pool at Wakanoura, No. 6473, Leland Stanford Junior Museum.

Named for Dr. S. Hatta, of the Imperial University, of Tokyo, in recognition of his excellent paper on the Lampreys of Japan.

23. MURÆNICHTHYS AOKI Jordan and Snyder, new species.

Body elongate, worm-shaped, the depth 4 in head; head $3\frac{3}{4}$ in trunk; head and trunk $1\frac{1}{5}$ in tail; eye $2\frac{1}{3}$ in snout; snout rather long and sharp, $5\frac{1}{2}$ in head; cleft of mouth $3\frac{1}{5}$ in head, extending somewhat behind eye; dorsal fin rudimentary, inserted behind vent at a distance equal to about 2 times length of snout. Lateral line curved upward over the throat. Color brownish, with dark dots; sides silvery; fins plain.

This species is close to *Murænichthys hatta*, but has a shorter

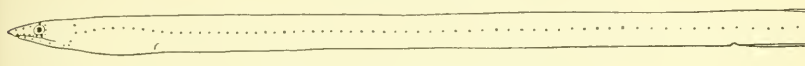


FIG. 13.—MURÆNICHTHYS AOKI.

head, longer, sharper snout, and the dorsal beginning farther forward. The type specimen No. 6474, Stanford University Museum, $7\frac{1}{2}$ inches long, is from a rock-pool at Misaki. It may prove indistinguishable from *M. hatta*, but the differences seem far too great for the limits of one species.

Named for Kumakichi Aoki, fisherman, assistant to Dr. Mitsukuri in the Marine Laboratory at Misaki, and one of the best collectors in Japan.

Family VIII. OPHICHTHYIDÆ.

SNAKE EELS.

This family includes those true eels which are scaleless, and have the end of the tail projecting beyond the dorsal and anal fins, and without the rudiment of a caudal fin. Anterior nostrils placed in the upper lip, opening downward; gill openings not confluent; tongue more or less fully adnate to the floor of the mouth. The species are, for the most part, moderate or small in size, and they are very abundant in the tropical seas, especially about the coral reefs. The eggs are numerous, of moderate size, similar to those of ordinary fishes. Species numerous, especially in the Tropics. Many of the species are singularly colored, the bands or spots heightening the analogy between them and the serpents.

a. Body without evident fins anywhere except a slight ridge along back; teeth all small, conical; gill openings close together, subinferior, converging forward; anterior nostril tubular; tongue scarcely free in front; mouth small.

Sphagebranchus, 13.

- aa. Body with distinct dorsal and anal fins.
- b. Pectoral wanting; dorsal high, beginning on nape.....*Callochelys*. 14.
- bb. Pectoral present.
- c. Vomerine teeth none; teeth pointed.....*Leiorhamus*. 15.
- cc. Vomerine teeth present.
- d. Teeth blunt, mostly granular or molar; pectoral fins present, small.
- e. Dorsal rather high, inserted on the head before gill opening; anal not nearly reaching tip of tail.....*Chlerastes*. 16.
- ee. Dorsal beginning behind gill opening.....*Pisoodonophis*. 17.
- dd. Teeth all pointed, none of them molar; pectoral fins well developed, much longer than eye; gill openings usually lateral, sometimes subinferior.
- f. Snout moderate or short, less than one-fourth head, the jaws not produced into a slender beak.
- g. Lips not fringed with conspicuous barbels.
- h. Teeth subequal, with no elongate canines on jaws or vomer.
- i. Teeth in sides of upper jaw in several series forming broad bands; jaws long; lips without papilla.....*Xyrius*. 18.
- ii. Teeth in sides of upper jaw in one or two series.
- j. Dorsal fin inserted over gill opening or nearly so; trunk very long.....*Microdonophis*. 19.
- jj. Dorsal fin inserted well behind base of pectoral.....*Ophichthys*. 20.
- hh. Teeth unequal, some of them long canines, either on vomer or on sides of one or both jaws; mouth large, the snout short, and the eyes more or less superior.....*Mystriophis*. 21.
- gg. Lips with a conspicuous fringe of barbels; canines present on jaws and vomer; jaws rather long, the lower projecting; head depressed; eyes superior; tail shorter than rest of body.....*Brachysomophis*. 22.
- ff. Snout long, the jaws produced in a slender beak; canine teeth strong; dorsal fin inserted well behind pectorals.....*Oxystomus*. 23.

13. SPHAGEBRANCHUS Bloch.

Sphagebranchus BLOCH, Ichthyologia, LX, 1795, p. 88 (*rostratus*).

Cæcilia Lacépède, Hist. Nat. Poiss., II, 1800, p. 135 (*branderiana* = *cæcus*) (not of Linneus, a genus of Batrachia).

Aptericthys DE LA ROCHE, Ann. Mus., XIII, 1809, p. 325 (*cæcus*).

Branderius RAFINESQUE, Analyse de la Natur, 1815, p. 93 (substitute for *Cæcilia*).

Very small eels without fins, a slight fold, apparently rayless, representing the dorsal; snout much projecting; teeth small, mostly uniserial; gill openings inferior, converging. Smallest and simplest in structure of the *Ophichthyidae*, the species little known and scantily represented in collections. (σφάξ, throat; βράγχια, gills.)

24. SPHAGEBRANCHUS MOSERI Jordan and Snyder, new species.

Eyes well developed; head $5\frac{5}{8}$ in trunk; head and trunk $1\frac{1}{5}$ in tail; snout sharp, much projecting, its length 5 in head; eye 2 in snout; cleft of mouth $3\frac{1}{2}$ in head; gill slits about as long as eye, converging forward; lateral line distinct from vent backward. A very slight fold

along back, indicating the place of the dorsal fin; no evident fin rays. Color, light olive, finely dotted; body with broad, very faint dark shades, scarcely visible, alternate with paler areas; head mottled with darker.

One specimen, 6 inches long, type No. 49728, United States National Museum, dredged by the U. S. Fish Commission steamer *Albatross* at station 3700, in Suruga Bay, off Namazu, in 100 fathoms.

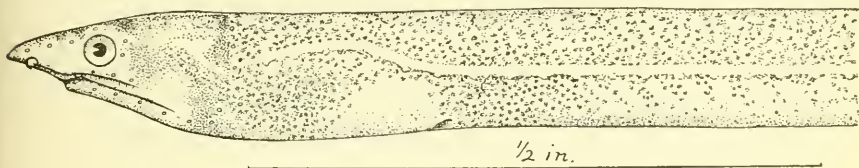


FIG. 14.—SPHAGEBRANCHUS MOSERI.

Named for Jefferson Franklin Moser, lieutenant-commander, U. S. N., in honor of the valued services to ichthyology rendered by him as commander of the U. S. Fish Commission steamer *Albatross*.

14. CALLECHELYS Kaup.

Callechelys KAUP, Apodes, 1856, p. 28 (*guichenoti*).

Pectoral fins wanting; body elongate, compressed; dorsal fin inserted on the head, in advance of the gill opening; tail much shorter than rest of body. Otherwise close to *Ophichthus*. (κάλλος, beauty; ἔγχελος, eel.)

25. CALLECHELYS MELANOTÆNIA Bleeker.

Callechelys melanotania BLEEKER, Atlas, Ichthyol. Muræen., 1864, p. 66, pl. XLIX, fig. 2, Amboyna.

Ophichthys melanotania GÜNTHER, Cat. Fish., VIII, p. 87, Amboyna, same specimen.

Head $11\frac{2}{3}$ in trunk; head and trunk $2\frac{1}{3}$ times length of tail; body very slender, the depth $2\frac{3}{4}$ in head; snout pointed, much produced; cleft of mouth narrow, extending behind eye; teeth pointed, uniserial; those in front above, strong, recurved, in two rows; gill openings inferior, slightly convergent. No pectoral fin. Dorsal rather high, beginning above angle of mouth. Color whitish with a broad, well-defined, jet black band along upper part of side, forming about half of depth of body; head whitish, marbled with dusky; dorsal fin white with a broad black edge; anal white.

A very handsome eel, recorded by Dr. Bleeker from Amboyna; a single specimen $19\frac{1}{2}$ inches long collected by Capt. Alan Owston at Yaeyama, Ishigaki Island, Southern Riu Kiu group, and presented to Stanford University. (μέλας, black; ταινία, ribbon.)

15. LEIURANUS Bleeker.

Leiuranus BLEEKER, Verh. Bat. Gen. Muren., XXV, p. 36 (*lacepedii* = *semicinctus*).

Stethopterus BLEEKER, Verh. Bat. Gen. Muren., XXV, p. 36 (*rimineus* = *semicinctus*).

Body cylindrical, mouth small; below the sharp projecting snout; teeth pointed, of moderate size, biserial above, uniserial below; no teeth on vomer; eye small; pectoral small; dorsal and anal low, the former beginning nearly above gill opening.

Small eels, having the bright colors of *Chlervastes*, but in technical respects nearer *Ophichthus*, distinguished by the absence of vomerine teeth. ($\lambda\epsilon\iota\omicron\varsigma$. smooth; $\omicron\upsilon\acute{\rho}\alpha\nu\acute{\omicron}\varsigma$, sky, the roof of the mouth.)

26. LEIURANUS SEMICINCTUS (Lay and Bennett).

Ophisurus semicinctus LAY and BENNETT, Beechey's Voyage, Blossom, 1839, p. 66 pl. xx, fig. 4. Collected by Mr. Lay, on Oahu; 24 dark cross bands.

Liuranus semicinctus GÜNTHER, Cat. Fish., VIII, 1870, p. 54, Fiji, China.

Ophisurus (or *Sphagebranchius*) *rimineus* RICHARDSON, Voy. Sulphur, p. 107, pl. LII, fig. 16-20, China. Coll. Edw. Belcher (young, with 33 dark bands).

Ophisurus rimineus RICHARDSON, Ichth. China, 1846, p. 314.

Stethopterus rimineus BLEEKER, Verh. Bat. Gen. Muren., XXV, p. 36.

Leiuranus lacepedii BLEEKER, Verh. Bat. Gen. Muren., XXV, p. 36.

Leiuranus colubrinus KAUP, Apodes, 1856, p. 2.—BLEEKER, Atlas, Ichth. Muren., p. 42, pl. ix, fig. 1, and of authors (by confusion with *Chlervastes colubrinus*).

Head $6\frac{2}{3}$ in trunk; head and trunk one-seventh longer than tail; depth $3\frac{1}{2}$ in head; cleft of mouth short, extending a little beyond eye; dorsal inserted a little posterior to base of pectoral, which is nearly three times the length of the small eye; dorsal and anal extending to near tip of tail. Whitish brown with 24 (24 to 35) broad blackish or dark brown bands, much wider than the interspaces, but growing narrower below, most of them not meeting on the belly anteriorly, those on the tail meeting below more or less perfectly in the large specimen, but not in the two smaller ones. In this regard and in the width of the bands there is considerable variation; first two bands on head, narrow; tip of snout and tip of tail white.

East Indies, not very common. Our three specimens, the largest $17\frac{1}{2}$ inches long, collected at Yaeyama, Ishigaki Islands, in the southern Riu Kiu Archipelago. It was found in company with *Chlervastes colubrinus*, a species to which it bears a remarkable resemblance, the chief difference in color being that the dark cross-bands in *Leiuranus* mostly fail to meet across the belly. If any advantage could be supposed to accrue to either of these harlequins, this would be regarded as a striking case of mimicry. (*Semi-half; cinctus*-banded.)

16. CHLEVASTES Jordan and Snyder, new genus.

Chlevastes JORDAN and SNYDER, new genus (*colubrinus*).

Anal fin ending far before end of dorsal on the tail. Teeth mostly blunt, granular or molar; pectoral fins rudimentary; dorsal beginning before gill opening, on the nape. Colors variegated.

One species in the tropical seas. This genus is very close to *Myrichthys* (= *Ophisurus* Bleeker, not of Lacépède), differing in the disappearance of the anal fin far before the tip of the tail. (*χλεραστίης*, a harlequin.)

27. CHLEVASTES COLUBRINUS (Boddært).

Muraena colubrina BODDÆRT, Pallas, Neue Nord. Beytr., II, 1781, p. 56, pl. 11, fig. 3, Amboyna.

Gymnothorax colubrinus SCHNEIDER, Syst. Ichth., 1801, p. 529, copied.

Ophisurus colubrinus RICHARDSON, Voy. Erebus and Terror, Fishes, p. 100.

Ophichthys colubrinus GÜNTHER, Cat. Fish., VIII, 1870, p. 81, Borneo, Fiji.

Muraena annulata AHL, De Muraena et Ophichtho, 1789, p. 8, pl. 1, fig. 1, East Indies.

Muraena fasciata AHL, De Muraena et Ophichtho, 1789, p. 9.

Ophisurus fasciatus LACÉPÈDE, Hist. Nat. Poiss., IV, 1803, p. 686.—RICHARDSON, Voy. Erebus and Terror, Fishes, p. 100.—BLEEKER, Atlas Ichth., Muraen., p. 64, pl. XXI, fig. 1.—KNER, Novara Fische, p. 379.

Pisoodonophis fasciatus KAUP, Apodes, 1856, p. 23.

Ophisurus alternans QUAY and GAIMARD, Voy. Uranie, I, p. 243, pl. XLV, fig. 2.

Ophisurus fasciatus var. *latifasciatus*, *oculatus*, and *semicinctus* BLEEKER, Atlas Ichth., Muraen., p. 64.

Head $7\frac{1}{2}$ in length of trunk; head and trunk $1\frac{1}{2}$ in tail; depth $2\frac{2}{3}$ in head; snout short, pointed, much projecting; cleft of mouth $\frac{1}{2}$ in head, slightly extending beyond eye. Eye very small. Pectoral fin reduced to a slight rudiment; dorsal inserted on top of head, at a point nearer snout than gill opening; dorsal ending not far from tip of tail; end of anal two heads' lengths before tip of tail; teeth small, mostly biserial. Body brownish white, paler below, with 29 jet black rings, about as wide as the interspaces extending on the fins; tip of snout and tip of tail white; rings just as distinct on belly as on back, but with occasional irregularities.

According to Bleeker and Günther, there is also a variety (*fasciatus*) with the interspaces ornamented with ocellate spots, and other varieties are said to differ in the relative length of light and dark rings, the latter occasionally not covering the belly.

East Indies. Our three specimens typical in color, collected by Capt. Alan Owston, at Yaeyama, Ishigaki Islands, southern Rin Kiu. The largest is $16\frac{1}{2}$ inches long.

The close resemblance of this species to *Leirurannus semicinctus* of the same waters has been often noted. (*Coluber*, a spotted snake.)

17. PISOODONOPHIS Kaup.

Pisoodonophis KAUP, Apodal Fishes, 1856, p. 17 (*boro*).

Pisodontophis, amended spelling.

Eels with the blunt teeth of *myrichthys* and the backward dorsal and well-developed pectoral of *Ophichthus*. Species slender, plainly colored, mostly of the East Indies. (*πίσος*, pea; *ὄδους*, tooth; *ὄφις*, snake.)

28. PISOODONOPHIS ZOPHISTIUS Jordan and Snyder, new species,

Head 3 in trunk; head and body $1\frac{2}{3}$ in tail. Body slender cylindrical; its depth $3\frac{1}{2}$ in head. Mouth moderate; its cleft $3\frac{1}{3}$ in head; snout sharp 5 in head; eye 9 in head; teeth small, all rounded or granular in narrow bands; pectoral sharp $3\frac{1}{3}$ in head; dorsal inserted just before its middle; dorsal fin rather high, distinctly elevated on the black patch in front, low on the tail, which is sharp at tip.

Color blackish above, paler below, with vague pale blotches on side; head with dark lengthwise wrinkles; lower jaw with six black pores on each side and three behind rictus; sides and top of head also with

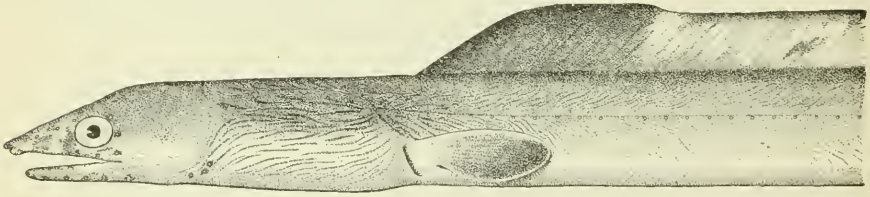


FIG. 15.—PISOODONOPHIS ZOPHISTIUS.

black pores regularly arranged; snout with dark markings; dorsal with a large jet-black blotch in front; the fin posteriorly dusky, with a broad black edge; anal pale, with a blackish edge; pectoral black, narrowly edged with pale.

One specimen received from Asakusa Aquarium in Tokyo, taken outside the Bay of Tokyo, near Misaki. Type No. 6475, Leland Stanford Junior University Museum. Its length is 21 inches.

This species is evidently very close to *Pisoodonophis canerivorus*, as described by Günther, Bleeker, and Richardson. In all the numerous figures of the latter species the pores behind the rictus characteristic of *P. zophistius* are not represented, and none of Bleeker's figures show the black blotch and peculiar form of the anterior part of the dorsal. (*ζόφος*, dusky; *ίστίον*, dorsal.)

18. XYRIAS Jordan and Snyder, new genus.

Xyrius JORDAN and SNYDER, new genus (*revulsus*).

This genus differs from *Ophichthus* in having the lateral teeth in the upper jaw in a broad band of about four series; lower teeth larger,

mostly in one row; front teeth somewhat enlarged. From *Cirrhimuraena*, with which it agrees in this regard, it differs in lacking altogether the fringe of fine cirri or barbels along the edge of the upper lip characteristic of the latter genus. The teeth are all pointed, subequal, the pectoral is well developed, and the dorsal fin begins well behind its tip. (*Ξυρίας*, a shaveling, from the unfringed lips.)

29. XYRIAS REVULSUS Jordan and Snyder, new species.

Head $3\frac{3}{4}$ in trunk; head and trunk a little longer than tail; depth 4 in head; snout short, $6\frac{2}{3}$ in head; eye $2\frac{1}{2}$ in snout; cleft of mouth very long, extending far behind eye, $2\frac{1}{10}$ in head; teeth in upper jaw in about four rows on each side, equal in size; lower teeth larger, close set, mostly in one row; vomerine teeth moderate; front teeth of upper jaw enlarged; pectoral small, 6 in head; dorsal inserted behind gill opening at a distance $2\frac{2}{3}$ in head.

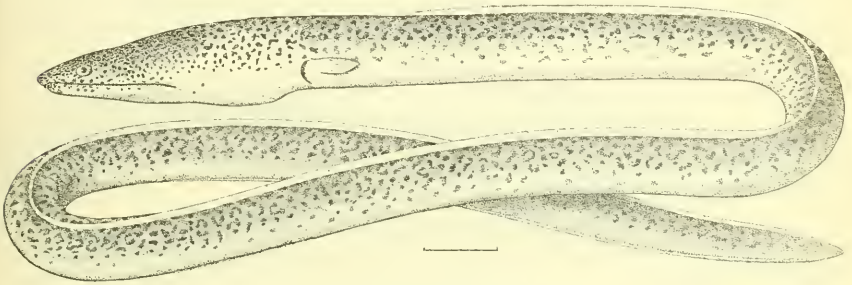


FIG. 16.—XYRIAS REVULSUS.

Color light brown, bluish-white below, upper parts everywhere closely freckled with fine irregular brown spots, rarely confluent and of various forms, rather narrower than the interspaces; these spots darker on head and much more closely set; similar spots on chin; fins all whitish; pectoral a little spotted.

One very fine specimen 35 inches long (No. 6476 Leland Stanford Junior Museum) was obtained at the Asakusa Aquarium, having been taken near Misaki. The species is very distinct from anything else known to us. (*Revulsus*, smooth-shaven, twice plucked; from the smooth lips.)

19. MICRODONOPHIS Kaup.

Microdonophis KAUP, Apodal Fishes, 1856, p. 6, (*allipinnis*).

This genus is distinguished from *Ophichthus* by the anterior insertion of the dorsal, which is placed over the gill opening; pectoral small; trunk very long; teeth pointed, subequal, all uniserial. East Indies. (*μικρός*, small; *ὀδούς*, tooth; *ὄφις*, snake.)

30. MICRODONOPHIS ERABO Jordan and Snyder, new species.

MONGAROCHI.

Head $4\frac{5}{8}$ to 5 in trunk; head and trunk a little shorter than tail; body rather slender, the depth $2\frac{3}{4}$ in head; snout blunt, triangular, depressed, $4\frac{3}{4}$ in head; eye small, $2\frac{1}{2}$ in snout, the front of the eye slightly nearer tip of snout than angle of mouth, the cleft of the mouth extending well beyond eye, $2\frac{1}{2}$ in head; gill opening small; pectoral small, $4\frac{1}{4}$ in head; teeth subequal, not very sharp, in a single row above and below, the row sometimes somewhat irregular or partly divided into two; vomerine teeth in one row; nasal teeth 3 on each side; no conspicuous pores on head. Dorsal moderate, inserted just a little before gill opening; lateral line conspicuous.

Color brownish olive, white below; body with large, round, brown spots of varying sizes, one large one often alternating with two small ones, the uppermost on the median line; largest spots about one-fifth head; spots on head much smaller, crowded, reducing the pale color to

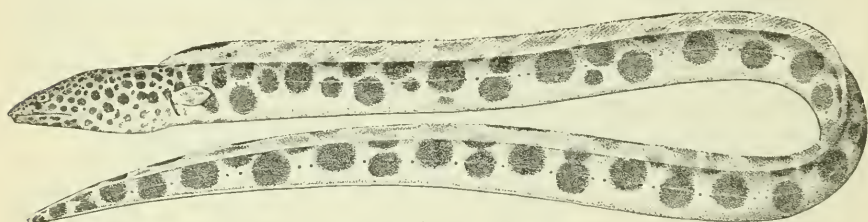


FIG. 17.—MICRODONOPHIS ERABO.

reticulations; lower jaw and throat spotted; pectoral with five or six small spots, these faint in the smaller specimens; dorsal with oblong spots and markings, like those on body; anal plain white.

The species is allied to *Ophichthus polyophthalmus* and with it belongs to Kaup's genus or subgenus *Microdonophis*, characterized by the anterior portion of the dorsal and the uniserial teeth.

Three specimens from Misaki, the longest 24 inches in length, type No. 6477, Leland Stanford Junior University Museum, the others $22\frac{1}{2}$ and 21, received from the Asakusa Aquarium in Tokyo, through the courtesy of Professor Kishinouye, of the Imperial Fisheries Bureau. It is known as *Mongarochi* to the fishermen.

Still another specimen (No. 81, Imperial Museum) was presented to us by Professor Ishikawa. It is from an unknown locality, but we noted its identity with No. 79, in the same list, known to be from Boshu (Awa), at the mouth of Tokyo Bay. Two others, also from an unknown locality, supposably Misaki and No. 4733, Imperial University Museum, were presented by Professor Mitsukuri. Still another, said to be from Okinawa, was received from Yonekichi Komeyama, a dealer in natural history specimens. The spotting of the body and pectoral fins differs considerably in these examples, but

all agree in the general coloration, the very long trunk, the forward insertion of the pectorals, and the uniserial teeth. (*Eryabo* or *Eryabo unagi*, the name of the venomous sea snake, *Platurus fasciatus*, of the bays of South Japan.)

20. OPHICHTHUS Ahl.

Ophichthus AHL, De Murena et Ophichtho, 1789 (*ophis*).

Ophisurus LACÉPÈDE, Hist. Nat. Poiss., II, 1800, p. 98 (*ophis*).

Congrus RAFINESQUE, Caratteri, etc., 1810, p. 62 (*maculatus*).

Ophisurus SWAINSON, Nat. Hist. Classn. Anim., II, 1839, p. 334 (*pictus-maculatus*).

(Not of Lacépède.)

Centrurophis КАУР, Apodes, 1856, p. 2 (*spadiceus*).

Pecilocephalus КАУР, Apodes, p. 5 (*bouapartei*).

Cyclophis КАУР, Apodes, p. 6 (*compar*).

Herpetoichthys КАУР, Apodes, p. 7 (*ornatissimus*).

Elapsopsis КАУР, Apodes, p. 9 (*versicolor*).

Muraenopsis КАУР, Apodes, p. 11 (*ocellatus*). (The name wrongly accredited to Le Sueur.)

Scyrtalophis КАУР, Apodes, p. 13 (*magnioculis*).

Leptorhinophis КАУР, Apodes, p. 14 (*gomesii*).

Cryptopterus КАУР, Aale Hamburg, 1859 (*pineticeps*).

Uranichthys POEY, Repertorio, II, 1867, p. 256 (*havannensis*).

Oxyodontichthys POEY, Anales Soc. Nat. Hist. Esp., 1880, p. 254 (*macrurus*).

Ophichthys BLEEKER, Günther, and of recent authors generally (corrected spelling).

This genus contains all the Ophichthyoid eels which have sharp teeth, no marked canines, well-developed pectoral fins, and the dorsal inserted behind the head. The species are very numerous in tropical seas, and many attempts have been made to split the group into smaller genera. Notwithstanding the great differences when extremes are compared, these small genera can not be well defined. The generic name, *Ophisurus*, often used for other groups, was an exact synonym of *Ophichthus*. (ὄφις, snake; ἰχθύς, fish; hence more correctly written *Ophichthys*.)

- a. *Centrurophis* КАУР. Teeth above in a single, sometimes irregular series; lower teeth uniserial.
 - b. Color not uniform light brown; nape with a broad blackish bar, edged before and behind with pale; dorsal and anal with a median dusky stripe; dorsal inserted above end of pectoral *cephalozona*. 31.
 - bb. Color uniform light brown; no bands on head; dorsal and anal pale, edged with white.
 - c. Dorsal fin inserted behind pectoral at a distance from gill opening nearly half head; dorsal and anal elevated on tail *urolophus*. 32.
 - cc. Dorsal fin inserted over middle of pectoral at a distance from gill opening less than one-fifth head; fins not elevated on the tail. *asakusa*. 33.
- aa. *Herpetoichthys* КАУР. Teeth above distinctly biserial; coloration uniform light brown, the fins pale.
 - d. Body rather stout, the depth $2\frac{1}{3}$ in head; lower teeth uniserial; dorsal inserted over tip of pectoral. *tsuchidai*. 34.
 - dd. Body very slender, the depth rarely one-fourth the head; lower teeth biserial; dorsal inserted well behind pectoral *stenopterus*. 35.

31. OPHICHTHUS CEPHALOZONA Bleeker.

Centropomus spadiceus KAUP, Apodes, 1856 fig. 1, (not description; not of Richardson).

Muraenopsis marginata BLEEKER, Ned. Tydskr. Dierk., I, p. 179 (not of Peters).

Ophichthys cephalozona BLEEKER, Atlas Ichth. Muraen., 1864, p. 49, pl. XII, fig. 2 (Singapore, Amboyna).—KNER, Novara-Fische, p. 377.—GÜNTHER, Cat. Fish., VIII, p. 69, Amboyna, Cape York, Australia, Cebu, Philippine Islands, Japan.

Head 4 in trunk; head and trunk about as long as tail; mouth moderate, extending slightly beyond eye; snout pointed, the upper jaw much projecting; eye moderate, 2 in snout, situated in anterior third of head; posterior nostril in advance of eye; anterior with a broad tube. Premaxillary teeth stout, in an irregular group; these together with a pair in front of lower jaw stronger than the others, which are pointed, fixed, uniserial. Pectoral a little more than one-fourth of head. Dorsal inserted above end of pectoral.

Body purplish brown; nape with a very broad cross band of deep black, broadly edged with white in front and behind. Dorsal and anal tricolor, brownish at base, black and white along the margin. (Günther.) Pectoral dark. Three distinct pores behind rictus; snout and lower jaw with large pores.

East Indies, widely distributed, a specimen in the British Museum collected by Mr. Jamrach in "Japan." This belongs to a variety or perhaps distinct species, having the nuchal band less distinct, the body and fins marked with irregular dark-brown blotches and the dorsal fin without pale edge. (*κεφαλή*, head; *ζώνη*, band.)

32 OPHICHTHUS UROLOPHUS (Schlegel).

Conger urolophus SCHLEGEL, Fauna Japonica, Poiss., 1847, p. 260, pl. cxiv, fig. 1 (Nagasaki.)

Ophichthys urolophus GÜNTHER, Cat. Fish., VIII, p. 73, after Schlegel.—NYSSTRÖM, K. Svensk, Vet. Akad. Handl. 1887, p. 46, Nagasaki.

Head 3 in trunk; cleft of mouth 3 in head; eye $1\frac{2}{3}$ in snout; teeth uniserial in both jaws, those above in front somewhat irregular. Pectoral well developed, the dorsal beginning behind its tip, its distance from the gill opening about $2\frac{1}{5}$ in head; vertical fins somewhat elevated at the tail.

Color uniform light brown; oblong brownish spots on head and nape above; fins pale, with a white margin. (Schlegel.)

Nagasaki, described from a large specimen, figured by Schlegel; not seen by subsequent writers unless our *O. asakusæ* is the same, which seems very unlikely. (*οὐρά*, tail; *λόφος*, crest.)

33. OPHICHTHUS ASAKUSÆ Jordan and Snyder, new species.

Head $2\frac{2}{3}$ in trunk; head and trunk $1\frac{1}{5}$ in tail; body very robust, the depth at gill opening $2\frac{1}{2}$ in head; mouth rather small, its cleft $2\frac{2}{3}$ in head; extending well beyond eye; snout short, blunt, depressed above,

$5\frac{1}{3}$ in head; eye moderate $1\frac{1}{2}$ in snout; front of eye about equidistant between tip of snout and angle of mouth; teeth stout, short and rather sharp, subequal, in one irregular row above, the lower apparently uniserial; pectoral roundish, $4\frac{1}{5}$ in head; dorsal inserted over middle of pectoral; distance from insertion of dorsal forward to gill opening 6 in head; the fin rather high, not elevated at the tail, the fin there lower than anteriorly; tail bluntish; pores in lateral line very small; head with longitudinal wrinkles.

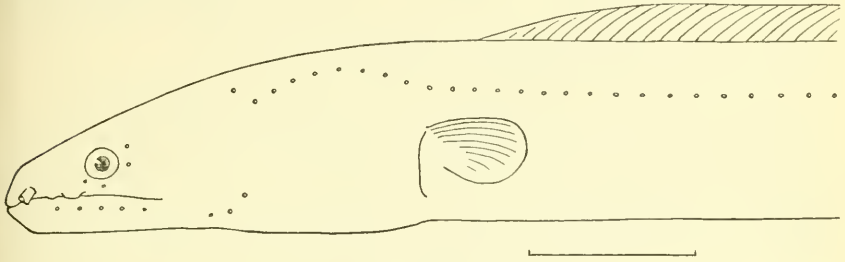


FIG. 18.—OPHICHTHUS ASAKUSÆ.

Color uniform olive brown, the belly paler, no dark streaks or points on head; dorsal and anal fins pale, the edge whitish.

One specimen $22\frac{3}{4}$ inches long, type No. 6478, Leland Stanford Junior University Museum, obtained from the Asakusa Aquarium in Tokyo, taken outside the Bay of Tokyo, near Misaki. The pale edge of the dorsal and anal are characteristic of the species. It is closely related to the species called *urolophus* by Schlegel, but in that species the dorsal is inserted well behind the pectoral at a distance behind the gill opening $2\frac{1}{5}$ in head according to Schlegel's figure. Our specimen moreover shows no sign of the elevation of the dorsal and anal on the tail, which suggested the name *urolophus*.

34. OPHICHTHUS TSUCHIDÆ Jordan and Snyder, new species.

Head $2\frac{2}{3}$ in trunk; head and trunk $1\frac{1}{5}$ in tail. Body robust, the depth at gill opening $2\frac{1}{2}$ in head. Mouth rather large, its cleft $2\frac{1}{2}$ in

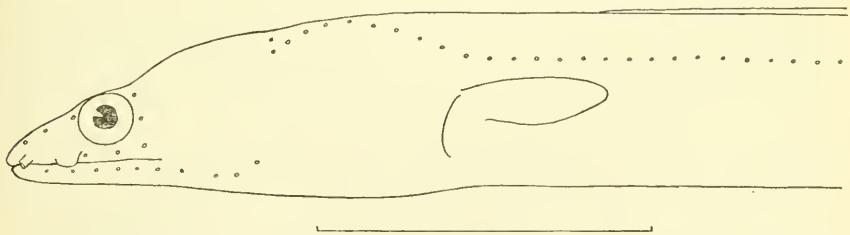


FIG. 19.—OPHICHTHUS TSUCHIDÆ.

head, the front of eye midway between tip of snout and angle of mouth; maxillary extending well beyond eye. Snout short, blunt, depressed above, $5\frac{2}{3}$ in head; eye large, $1\frac{1}{2}$ in snout. Teeth all sharp, subequal, those in upper jaw in two distinct series, those below

uniserial. Pectorial rather pointed, 3 in head. Dorsal inserted over tip of pectoral, the fin rather low, not elevated at the tail, distance from gill opening to front of dorsal, $2\frac{1}{2}$ in head; tail bluntnish; pores in lateral line evident; skin of head wrinkled. Color uniform olive brown, made darker by dark points, belly paler; dorsal and anal pale, each with whitish border.

One specimen, a foot long, from Misaki, No. 6479, Leland Stanford Junior University Museum, named for Mr. Tsuchida, assistant to Dr. Mitsukuri in the seaside laboratory of the Imperial University at Misaki.

35. OPHICHTHUS STENOPTERUS Cope.

Ophichthus stenopterus COPE, Trans. Am. Phil. Soc., 1871, p. 482, Japan.

Tail nearly twice length of head and trunk. Teeth in two rows in each jaw; vomerine teeth mostly in two series; eye 2 in snout, pectoral 5 in head; dorsal beginning behind it at a point $1\frac{1}{2}$ times length of fin. Dorsal and anal very low, each a mere fold in front. Brown above, white below; anal and dorsal white. Body very slender, much as in *O. lumbricoides* Bleeker. The depth in *lumbricoides* is less than one-fourth the head, but its fins are much higher than in *O. stenopterus*. (*στενός*, narrow; *πτερόν*, fin.) Two specimen said to be from Japan.

21. MYSTRIOPHIS Kaup.¹

Mystriophis Kaup, Apodes, 1856, p. 10 (*rostellatus*).

Large eels, allied to *Ophichthus*, but distinguished by the presence of large canines on the jaws and vomer. Snout short, expanded at tip, suggesting the muzzle of a crocodile. Coloration plain. (*μυστρίον*, a spoon, from the form of the snout in *M. rostellatus*; *ὄφις*, snake.)

36. MYSTRIOPHIS PORPHYREUS (Schlegel.)

Ophisurus porphyreus SCHLEGEL, Fauna Japonica, Poiss., 1847, p. 265, pl. cxvi, fig. 1, Nagasaki.

Mystriophis porphyreus KAUP, Apodes, 1856, p. 10, after Schlegel.

Ophichthys rostellatus GÜNTHER, in part, not of Richardson. (Specimen from Japan, purchased from Herr Frank.)

Head 3 in trunk; head and trunk a very little shorter than tail. Cleft of mouth $2\frac{1}{5}$ in head; snout short, broad, flattened, slightly contracted behind its tip, like the snout of the crocodile. $9\frac{1}{2}$ in head; eye 2 in snout. Teeth pointed, fixed, very unequal; those in front canine. Vomerine teeth very large, in one row, 4 or 5 in number; teeth in upper jaws in two very distinct rows, those of the outer row far apart and larger; lower jaw with a single row of large canines. Vertical fins moderate; pectoral rounded, 6 in head. Gill openings wide, close together. Dorsal beginning far behind pectoral, the distance behind gill opening two-thirds of length of head.

¹The American species hitherto referred to this genus have the vomerine teeth small and the snout narrowed. To these the name *Crotalopsis* Kaup (*Echiopsis* Kaup) should be applied. The species are spotted with black.

Purplish brown, streaky, paler below; head with some dark dots and wrinkles; pores on head not conspicuous. Pectoral pale; dorsal brownish, with the edge black; anal a little paler.

Coast of southern Japan, rather rare, here described from two specimens $3\frac{1}{2}$ to 4 feet in length, taken at Wakanoura. Dr. Günther identifies the species with *Mystriophis rostellatus* from Senegal, but in the Japanese species the head is shorter, and the lower teeth are uniserial. This species is one of the largest of the Ophichthyoid eels. (*πορφύρεος*, purplish.)

22. BRACHYSOMOPHIS Kaup.

Brachysomophis KAUP, Apodes, 1856, p. 9 (*horridus*.)

? *Achirophichthys* BLEEKER, Poissons Inéd. Murènes, Ned. Tijdschr. Dierk., II, p. 42 (*typus=crocodilinus* young).

This genus differs from *Mystriophis* chiefly in the presence of a conspicuous fringe of papillae on the lips. The vomerine teeth are canine. Species East Indian, doubtfully recorded from Japan. (*βραχύς*, short; *σῶμα*, body; *ὄφις*, snake.)

37. BRACHYSOMOPHIS CROCODILINUS (Bennett).

Ophisurus crocodilinus BENNETT, Proc. Zool. Soc. Lond., 1833, p. 32, Mauritius.

Brachysomophis horridus KAUP, Apodes, 1856, p. 9, fig. 6, Otaheite.—BLEEKER, Verh. Med. Ak. Amst., 1868, II, p. 303.

? *Achirophichthys typus* BLEEKER, Ned. Tijdschr. Dierk., p. 42, Celebes.

Ophichthys crocodilinus GÜNTHER, Cat., VII, 1870, p. 64, Galapagos, Japan.

Brachysomophis crocodilinus JORDAN and DAVIS, Apodal Fishes, 1892, p. 636.—JORDAN and EVERMANN, Fish. N. M. America, after Günther.

Teeth unequal in size; maxillary teeth in a double row, those of the inner row stronger and less numerous than the outer; vomer and mandibular teeth uniserial, large canine teeth; head 3 in trunk; snout extremely short and rather flattened, scarcely twice as long as eye, which is small and situated in the anterior ninth of the length of the head; vertical fins moderately well developed; distance between the origin of dorsal fin and gill opening $2\frac{1}{2}$ in head; pectoral small; body longer than tail. Upper parts brownish, minutely dotted with darker; a series of black pores along the lateral line, sometimes a whitish line across the occiput (Günther). East Indies, a specimen recorded by Günther from the Galapagos, and also recorded by Günther, with equal doubt, from Japan. (*Crocodilinus*, like a crocodile.)

23. OXYSTOMUS Rafinesque.

Oxy stomus RAFINESQUE, Caratteri di Alcuni Generi, 1810, p. 62 (*hydulinus=serpens*; young).

Ophisurus RISSO, Europe Merid., 1826, pp. 111, 206 (*serpens*, not of Rafinesque).

Leptognathus SWAINSON, Natur. Hist. Classn. Fish., II, 1839, p. 234 (*ocyrrhynchus=serpens*).

Leptorhynchus SMITH, Illustr. Fishes S. Afr., 1840 (*carpensis*).

This genus is allied to *Ophichthus*, differing in the long and slender jaws, similar to those of *Oeyconger*, *Chlopsis*, and *Nettastomat*. The

canine teeth are strong, as in *Mystrophis*, and the tail is much longer than the rest of the body. Pectorals well developed, the dorsal inserted well behind them. Teeth sharp. (ὄξύς, sharp; στόμα, mouth.)

38. OXYSTOMUS MACRORHYNCHUS Bleeker.

UMIHEBI (SEA SNAKE); DAINANHEBI (FORMOSA SNAKE).

Ophisurus serpens SCHLEGEL, Fauna Japonica, Poiss., 1847, p. 264, Nagasaki (not *Muraena serpens* Linnaeus).

Ophichthys serpens GÜNTHER, Cat. Fish., VIII, 1870, p. 65, specimen from Japan.—ISHIKAWA, Prel. Cat., 1897, p. 6, Tokyo.

Ophisurus macrorhynchus BLEEKER, Verh. Bat. Gen. Muraen., XXV, 1852, p. 28, Japan.—BREVOORT, Exped. Japan, 1856, p. 283, Shimoda.

Head 4 in trunk; head and trunk $1\frac{2}{3}$ in tail; depth of body $3\frac{1}{2}$ in head; snout sharp $3\frac{3}{4}$ in head (4 in large example); eye large, 3 in snout, nearer angle of mouth than tip of snout; cleft of mouth $1\frac{5}{8}$ in head; teeth pointed, fixed, unequal, those above biserial on posterior part of jaw, those below uniserial; teeth of front of jaw and on vomer canine; upper jaw with a row of large pores; gill openings wide; pectoral 5 in head (6 in large example); the dorsal beginning behind tip of pectoral a distance about equal to length of pectoral.

Color brownish, sides and below silvery; pectoral brownish.

Coasts of Japan, not rare; two specimens received by us, the longest from Onasagawa, through Yonekiebi Komeyama, 32 inches long; the other from Tokyo Bay, presented by Dr. Ishikawa; still another, over 4 feet long, is from Misaki. It is known as *Umihebi* or *Dainanhebi*.

The species is very close to *Oxyptomus serpens* (Linnaeus) of Europe, with which Dr. Günther identifies it. It seems to differ somewhat in measurements. The pectoral fin is a little larger, and the head shorter in relation to the trunk. At least, the two species should not be united without full comparison of specimens, though the published accounts of *O. serpens* indicate no difference of importance. (μακρός, long; ῥύγχος, snout.)

Family IX. MORINGUIDÆ.

Body cylindrical, more or less slender, the tail much shorter than rest of body, usually bluntish, with a fin at the top. Posterior nostrils in front of the small eye; mouth small; teeth small, uniserial; gill openings rather narrow, inferior. Heart placed far behind the gills. Pectorals small or wanting; dorsal fin low, mostly confined to the tail. Small eels of the tropical seas, often very slender or worm-like, and noted for the extreme shortness of the tail. The genera are closely related and two of them (*Moringua* = *Raitaboura* = *Stilbiscus* and *Aphthalmichthys*) are found in the West Indies as well as in the East.

a. Pectoral fin wanting or reduced to a slight scale-like appendage; vertical fins distinct only on the tail, not interrupted in the middle. *Aphthalmichthys*. 24.

24. APHTHALMICHTHYS Kaup.

Aphthalmichthys KAUP, Apodes, 1856, p. 105 (*javanicus*).

This genus differs from *Moringua* in the little development of the fins. The pectorals are wanting or very nearly so, and the dorsal and anal form low ridges developed as fin only at the end of the tail. Eye very small; lower jaw projecting. (*a.*, privative; ὀφθαλμός, eye; ἰχθύς, fish.)

a. Body moderately slender, the depth 3 to 4 in head, 40 to 45 in entire length.

abbreviatus. 39.

aa. Body excessively slender, the depth $3\frac{1}{2}$ to 4 in head, 75 to 100 in entire length.

javanicus. 40.

39. APHTHALMICHTHYS ABBREVIATUS Bleeker.

Aphthalmichthys abbreviatus BLEEKER, Ned. Tyds. Dierks. I, about 1860, p. 163, Java, etc.; Atlas Ichth. Muraen., 1864, p. 17, pl. 1, fig. 1, Java, Batu, Celebes, Ternate, Amboyna, Timor.

Moringua abbreviata GÜNTHER, Cat. Fish., VIII, 1870, p. 92.

Head 7 in trunk, $11\frac{1}{3}$ in total; tail $3\frac{2}{3}$ in total length; depth of body $4\frac{1}{4}$ in head, about 45 in total length; cleft of mouth 5 in head; dorsal fin beginning three heads' lengths from tip of tail; the anal a little farther forward; fin rays on tip of tail as long as eye and snout. Pectoral visible, but scarcely larger than eye. Color light brown.

East Indies, generally common, here described from a specimen $11\frac{1}{2}$ inches long, taken by Capt. Alan Owston at Yaeyama, in the southern Riukiu Islands. It agrees in the main with Bleeker's figure, but has rather better developed fins. (*Abbreviatus*, shortened.)

40. APHTHALMICHTHYS JAVANICUS Kaup.

Aphthalmichthys javanicus KAUP, Apodes, 1856, p. 105, Java.—BLEEKER, Ned. Tydsskr. Dierk., I, p. 164; Atlas Ichth. Muraen., 1864, p. 16, pl. II, fig. 2, Java, Celebes, Ceram, Timor.

Moringua javanica GÜNTHER, Cat. Fish., VIII, 1870, p. 92, Moluccas, Fiji, Japan.

Depth of body 75 to 100 times in length; head 15 to 22 times in body; vertical fins reduced to a fringe at end of tail. No pectorals. Brownish, paler below. (Bleeker.)

East Indies, recorded by Günther from Japan, doubtless the Riukiu Islands. Size larger than in *A. abbreviatus*, the body much more slender.

Family X. MURÆNIDÆ.

MORAYS.

The *Muraenidæ* represent the most degenerate type of eels so far as the skeleton is concerned, and they are doubtless the farthest removed from the more typical fishes from which the eels have descended. The essential characters of the family are thus stated by Dr. Gill:

Colocephalous Apodals with conic head, fully developed opercular apparatus, long and wide ethmoid, posterior maxillines, pauciserial teeth, roundish, lateral branchial

apertures, diversiform vertical fins, pectoral fins (typically) suppressed, scaleless skin, restricted interbranchial slits, and very imperfect branchial skeleton, with the fourth branchial arch modified, strengthened, and supporting pharyngeal jaws.

The Morays may be readily distinguished from the other eels by their small round gill openings and by the absence of pectorals. The body and fins are covered by a thick, leathery skin, the occipital region is elevated through the development of the strong muscles which move the lower jaw, and the jaws are usually narrow and armed with knife-like or else molar teeth. The Morays inhabit tropical and subtropical waters, being especially abundant in crevices about coral reefs. Many of the species reach a large size, and all are voracious and pugnacious. The coloration is usually strongly marked, the color cells being highly specialized. The genera 10 or 12; species 120. The *Muraenidae* without fins are the simplest in structure, but their characters are those of degradation, and they are further removed from the primitive stock than such genera as *Muraena*.

- a. Vertical fins well developed, the dorsal beginning on the head.
- b. Posterior nostrils as well as the anterior with a long tube *Muraena*. 25.
- bb. Posterior nostrils circular, without tube.
- c. Teeth all or nearly all sharp, the longer ones depressible canines.
- d. Body stout, the depth more than one-third length of head, the tail about as long as rest of body; vomerine teeth, if present, canine-like.
- e. Depressible canine teeth few (1 to 10 in number, all told).
- *Gymnothorax*. 26.
- cc. Depressible canines very numerous, about 30 in number, all told; teeth biserial; mouth large, not closing completely *Amasia*. 27.
- dd. Body very slender, the depth less than one-third of head; tail longer than rest of body; mouth small *Strophidon*. 28.
- cc. Teeth mostly obtuse, molar-like; posterior nostrils without tube; mouth small; dorsal beginning before gill opening *Echidna*. 29.
- aa. Vertical fins reduced to a rudiment on end of tail; teeth pointed; posterior nostril without tube; cleft of mouth not half head; snout moderate, about half length of gape *Cropterygins*. 30.

25. MURÆNA (Artedi) Linnæus.

MORAYS.

Muraena ARTEDI, Gen. Pisc., 1738, p. 23 (in part; includes all eels).

Muraena LINNÆUS, X, 1758, p. 243 (*helena*, etc.; includes all eels).

Muranophis LACÉPÈDE, Hist. Nat. Poiss., V, 1803, p. 630 (*helena*, etc.).

Limnamuraena KAUP, Apodes, 1856, p. 95 (*guttata*).

This genus as now restricted contains numerous species found in the tropical seas, distinguished from all the rest of the family having developed fins by the presence of barbels on the posterior as well as the anterior nostrils. The teeth are all sharp and the dorsal fin begins on the head. (*μόραινα* (Moray), ancient name of *Muraena helena* of Europe.)

41. *MURÆNA PARDALIS* Schlegel.

Muræna pardalis SCHLEGEL, Fauna Japonica, Poiss., 1847, p. 268, pl. 119, Nagasaki.—BLEEKER, Act. Soc. Indo-Nederl., Japan, VI, p. 230, Japan; Nat. Tydschr. Ned. Ind., XVI, p. 206.—GÜNTHER, Cat. Fish., VIII, 1870, p. 99, Mauritius.

Gymnothorax pardalis BLEEKER, Atlas Ichth. Muræn., 1864, p. 86, pl. xxv, fig. 1; pl. xxvi, fig. 2, Japan, Cocos, Java.

Head $2\frac{3}{8}$ in trunk; tail a little longer than rest of body; body very robust, the depth $1\frac{2}{5}$ in head; snout pointed, narrow, $3\frac{3}{8}$ in head; posterior nostrils with very long tubes, 2 in snout, twice as long as anterior, which are shorter than eye; eye moderate, $2\frac{1}{3}$ in snout, a little nearer angle of mouth than tip of snout; mouth very large, not closing completely, its cleft $2\frac{1}{2}$ in head; canines strong; teeth in each jaw biserial in the young, becoming uniserial in the adult; about 10 canines on each side in lower jaw, besides smaller teeth; 2 depressible fangs on vomer.

Dark brown, clouded or vaguely barred with darker, the dark forming reticulations around pale areas; everywhere covered with numerous small round yellowish or whitish ocelli ringed with darker, these largest on the lower parts, and on head and belly; in the young white with dark cross bands, the white breaking up into spots with age, sometimes partly confluent; lower jaw with light and dark crossbars; no pale edgings to the fins.

East Indies, north to Japan, not rare. Our specimens, three in number, are from Wakanoura, the largest 25 inches long.

This species may be at once known from all other Japanese Morays by the four barbels on the snout. The spots on the body, white with black rings, are also different from any other. (*παρόδαλις*, leopard.)

26. *GYMNOTHORAX* Bloch.

Gymnothorax BLOCH, Ichthyol., IX, 1795, p. 85 (*reticularis*).

Lycodontis McCLELLAND, Calcutta Journ. Nat. Hist., V, 1844, p. 173 (*literata* = *tile*).

Therodontis McCLELLAND, Calcutta Journ. Nat. Hist., V, 1844, p. 174 (*reticulata* = *tesselata*).

? *Sidera* КАУР, Apodes, 1856, p. 70 (*pfifferi*) (vomerine teeth globular).

Eurymyxetera КАУР, Apodes, 1856, p. 72 (*crudelis*).

Polyuranodon КАУР, Apodes, 1856, p. 96 (*kuhli* = *polyuranodon*).

Taniophis КАУР, Aale Hamburg Mus., Nachtrage, 1859, p. 10 (*westphali* = *funebri*).

Priodonophis КАУР, Aalenähnliche Fische Hamburg. Museum, 1859, p. 22 (*ocellatus*).

Neomuræna GIRARD, U. S. Mex. Bound. Surv., Fishes, 1859, p. 76 (*nigromarginata-ocellatus*).

Pseudomuræna JOHNSON, Proc. Zool. Soc. London, 1860, p. 167 (*madoirensis*).

This genus, as here understood, comprises the great bulk of the *Murænidæ*, including all the species with sharp teeth, the vomer with a few depressible canines, the number of depressible teeth in the mouth less than ten; the body stout and not greatly elongate; the anterior

nostrils only tubular, and the dorsal fin beginning on the head. The large canines, varying much in number, are usually depressible. The Morays of this genus are everywhere abundant in the tropical seas, where some of them reach a great size. They are the most active and voracious of the eels, often showing much pugnacity. Most of them live in shallow water about rocks or reefs. (*γυμνός*, naked; *θώραξ*, chest, from the absence of pectoral fins. The name *Gymnothorax*, based on a Japanese Moray of this genus, must take the place of *Lycodontis*.)

- a. *Gymnothorax*: Teeth of jaws uniserial; mouth closing completely.
- b. General color uniform purplish; dorsal and anal each with a broad white margin; dorsal fin high; jaws with large pores *albomarginata*. 42.
- bb. General color not uniform, the body much spotted or banded.
- c. Body mottled or spotted, without distinct dark cross bands.
- d. Body with spots or blotches, of varying forms, some or all of them paler than the ground color.
- c. Anal fin with a distinct white margin; light and dark markings arranged to form irregular diffuse cross bands; head 2 to 2½ in trunk. *kidako*. 43.
- cc. Anal fin without distinct white margin; head 2½ in trunk; body with dark lines and many whitish spots, some of them ring like.
- microszewskii*. 44.
- dd. Body with roundish black spots darker than the ground color, the spots on head similar; head 2½ in trunk; tail longer than rest of body.
- revesii*. 45.
- ce. Body pale brown with about 20 broad dark bands, most distinct on belly; head and back finely spotted; mouth small *reticularis*. 46.

42. GYMNOTHORAX ALBIMARGINATUS (Schlegel).

?? *Muraena hepatica* RÜPPELL, Atlas Fische, p. 120, Red Sea.—GÜNTHER, Cat. Fish., 1870, p. 122, Amboyna.

Muraena albimarginata SCHLEGEL, Fauna Japonica, 1847, p. 267, pl. cxviii, Nagasaki.

Gymnothorax albimarginatus BLEEKER, Atlas Ichth. Muren., p. 107, pl. xxxvii, fig. 2; pl. xl, fig. 3, Amboyna.

Head 3⅔ in trunk; tail nearly or quite as long as rest of body; teeth uniserial, the canines scarcely enlarged; mouth closing completely; snout thick, of moderate length; eye small, 2½ in snout, nearer to angle of mouth than tip of snout; cleft of mouth about 2⅔ in head; gill opening scarcely wider than eye; length of anterior nasal tubes less than vertical diameter of eye. Dorsal fin very high, beginning in advance of gill opening, the posterior rays higher than body below; jaws with large whitish pores, about 3 above and 5 below on each side.

Color uniform purplish brown, paler below; dorsal and anal each with a broad whitish margin. (Schlegel; Günther.)

East Indies, north to Kiusiu, not seen by us. Dr Günther identifies the species with *Gymnothorax hepaticus* (Rüppell), an earlier named species from the Red Sea. But as Bleeker observes, this identity is not yet proved, and Dr. Day records neither of them from India. (*Albus*, white; *marginatus*, edged.)

43. GYMNOTHORAX KIDAKO (Schlegel).

KIDAKO; KICHIGAIUNAGI; UTSUBO.

Murena kidako SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 266, pl. cxvii, Nagasaki.—BREVOORT, Exped. Japan, 1856, p. 283, Shimoda.—NYSTROM, K. Svensk. Vet. Akad. Handl., 1887, p. 46, Nagasaki.

Murena similis RICHARDSON, Voy. Erebus and Terror, 1847, p. 83, Japan.—КАПР, Apodes, 1856, p. 63.

Murena nubilus GÜNTHER, Cat. Fish., VIII, 1870, p. 117, Japan (not of Richardson).—ISHIKAWA, Prel. Cat., 1897, p. 5, Sagami.

Head 2 to $2\frac{1}{2}$ in trunk; $6\frac{1}{5}$ in total length; head and trunk a little shorter than tail. Skin smooth; cleft of mouth large, $2\frac{1}{3}$ in head; mouth closing completely; teeth rather broad, all in single series, without basal lobes; mandible with about 16 teeth on each side; vomer with one row of depressible teeth; nasal tube rather shorter than eye, which is nearly 2 in snout; snout 5 in head, compressed and somewhat produced; eye a little nearer tip of snout than angle of mouth; gill opening not so wide as eye.

Color dark brown or black, everywhere blotched or spotted with white or yellowish, the white or yellowish closely mixed with the dark ground color, both light and dark colors confluent in irregular transverse bands. In some specimens light colors prevail, in others the dark; gill opening dark; angle of mouth black without white spot before it; no white pores on lower jaw; belly colored like sides, but the white markings more conspicuous; dorsal beginning well in front of gill opening, colored like the body with dark brown and white mottlings; no marginal stripe; anal black, with a very distinct white margin, chin and throat with traces of dark streaks.

Coasts of Japan, generally common, varying much in shade and degree of mottling from almost gray to almost black. It may be, however, always distinguished by the white stripe along the black anal. Our specimens, ten in number, are from Tokyo, Misaki, and Wakanoura. This species is placed by Dr. Günther in the synonymy of *Murena nubilus*, from the East Indies, but that species has a black margin to the dorsal, as well as the anal. The specimen described above (Misaki) is $24\frac{1}{2}$ inches long.

As Richardson, in his account of the eels of the "Voyage of the *Erebus and Terror*" acknowledges the receipt of Schlegel's account of the eels of the "Fauna Japonica," we must consider that Schlegel's name *kidako* has priority over Richardson's name *similis* for the common Japanese Moray. (*Kidako*, the common Japanese name.)

44. GYMNOTHORAX MIEROSZEWSKII (Steindachner).

Muraena mieraszevskii STEINDACHNER, Reise Sr. Maj. Schiff Aurora, 1898, p. 222, Kobe.

Head $2\frac{2}{5}$ in trunk; head and trunk as long as tail; snout $4\frac{2}{3}$ in head; cleft of mouth $2\frac{1}{3}$; greatest depth of body $1\frac{1}{3}$ in head; eye $2\frac{1}{2}$ in snout; mouth not closing; the cleft long, the teeth pointed, with the points turned backward, all one-rowed, about 13 on each side in each jaw; no teeth on vomer; anterior nasal tube half eye; posterior nostril without tube; gill opening as large as eye.

Body with the skin wrinkled, color light and dark brownish violet, covered with innumerable crossing lines of violet brown and close-set, diffuse, roundish spots of brownish white, occasionally ring-like; black furrows between angle of mouth and gill opening; region of gill opening, angle of mouth, and lower margin of eye diffusely blackish; front of head above and below dark grayish-violet; tail darker than rest of body; spots on tail smaller, closer-set and better defined, the reticulate lines less distinct. (Steindachner.)

Described from a specimen 85 cm. long, obtained at Kobe by Dr. C. Ritter von Mieraszewski, surgeon of the Austrian frigate *Aurora*, for whom the species was named.

45. GYMNOTHORAX REEVESI (Richardson).

Muraena reevesi RICHARDSON, Voyage Sulphur, 1848, p. 109, pl. XLIX, fig. 2, on a Chinese drawing made for John Reeves, of Canton.—GÜNTHER, Cat. Fish., VIII, 1870, p. 107, "Japan."

Head $2\frac{1}{3}$ in trunk; tail longer than rest of body; cleft of mouth wide, $2\frac{1}{5}$ to $2\frac{1}{3}$ in head; snout compressed, rather short; eye moderate, more than half snout, nearer tip of snout than angle of mouth. Anterior nasal tubes short; gill opening not wider than eye; mouth closing completely; canines moderate, few in number; teeth uniserial, without basal lobes, about 17 on each side of mandible.

Color dark brown, with several series of indistinct black round spots, longitudinally arranged and about as large as eye; head with spots similar in size and form to those of body; fins without pale margin. (Günther.)

Coasts of China, not seen by us, recorded by Günther from Japan, (collection Jamrach), probably from the Riukiu Islands. (Named for John Reeves, of Canton.)

46. GYMNOTHORAX RETICULARIS Bloch.

Gymnothorax reticularis BLOCH, Ausländische Fische, IX, 1795, p. 85, pl. ccccxvi, Indian Ocean.—SCHNEIDER, Syst. Ichth., 1801, p. 528 (copied).

Muraenophis reticularis LACÉPÈDE, Hist. Nat. Poiss., V, 1803, p. 628 (copied).

Muraena reticularis GÜNTHER, Cat. Fish., VIII, 1870, p. 105, China Sea, Japan.—ISHIKAWA, Prel. Cat., 1897, p. 5, Tokio.

Muraena reticulata RICHARDSON, Voyage Erebus and Terror, 1847, p. 82, Sea of Borneo.—КАУП, Apodes, 1856, p. 60, fig. XLIX.

Muraena minor SCHLEGEL, Fauna Japonica, Poiss., 1846, p. 269, pl. cxv, fig. 2, Nagasaki.

Priodonophis minor BLEEKER, Verh. Bat. Gen., XXVI, p. 123.—KNER, Novara Fische, p. 382.

Head $2\frac{1}{8}$ in trunk; $7\frac{1}{8}$ in total length; head and trunk a little shorter than tail; snout short, blunt, 8 in head; nasal tube very short, about half eye, which is $1\frac{1}{3}$ in snout; mouth closing completely; cleft of mouth $3\frac{1}{4}$ in head; teeth one-rowed, their points turned backward, the edges of some slightly serrated, about 14 on each side of mandible; a large depressible canine on vomer; the other teeth all or nearly all fixed; gill opening scarcely as large as eye, the dorsal beginning well before it; dorsal rather high.

Yellowish or whitish brown, with 15 to 22 dark cross bands made up of different brown spots, these mostly turning into black on the belly, where they are very distinct; they are also more distinct on the dorsal fin; upper parts everywhere on bands and between them closely covered with dark-brown spots of different sizes; lower jaw with cross bands of spots. There is considerable variation in the ground color and in the clearness of the bands and spots. The bands are very distinct on the ventral line. In life the pale markings have a pinkish shade.

Of this small moray, we have five specimens, the largest $22\frac{1}{2}$ inches long, from Wakanoura, and one from Misaki.

It can be confounded with no other species in Japanese waters, as no other has dark bands distinct on the belly. (*Reticularis*, netted.)

27. ÆMASIA Jordan and Snyder, new genus.

Æmasia JORDAN and SNYDER, new genus (*lichenosa*).

This genus differs from *Gymnothorax* in the large mouth and very numerous depressible fang-like canines, there being about 30 of these in all on jaws and vomer. Teeth in both jaws biserial, mouth not closing completely. Doubtless some of the species hitherto referred to *Gymnothorax* belong to this genus, but none of them known to us have such an array of bristling teeth as the type of *Æmasia*. (*αίμασιά*, a hedge, from the bristling teeth.)

47. ÆMASIA LICHENOSA Jordan and Snyder, new species.

Head $2\frac{1}{5}$ in trunk, 7 in total length; head and trunk a little shorter than tail; body robust, the depth about half head; mouth very large, the jaws not closing completely; cleft of mouth $2\frac{1}{5}$ in head; teeth very sharp, mostly set vertically, the long slender canines in inner series of both jaws and on vomer depressible; teeth on both jaws and vomer biserial, the teeth on vomer largest; about 18 large teeth on each side of lower jaw; about 30 depressible canines in all within the mouth;

nasal tubes much shorter than eye; snout sharp, $4\frac{1}{2}$ in head; eye $2\frac{1}{2}$ in snout, nearer to angle of mouth than to its tip; gill opening about as large as eye, dorsal beginning somewhat before it.

Color very dark brown, almost black, everywhere blotched with light gray, like spots of lichen; three rows of larger spots on each side, besides many smaller ones, all very irregular in form; smaller spots of similar character on head; spots of body larger toward head; on belly the ground color is reduced to irregular reticulations; dorsal and anal fins colored like the body without light or dark edgings; no black at angle of mouth or around gill opening. This species is strongly distinguished by its dentition, there being about 30 large

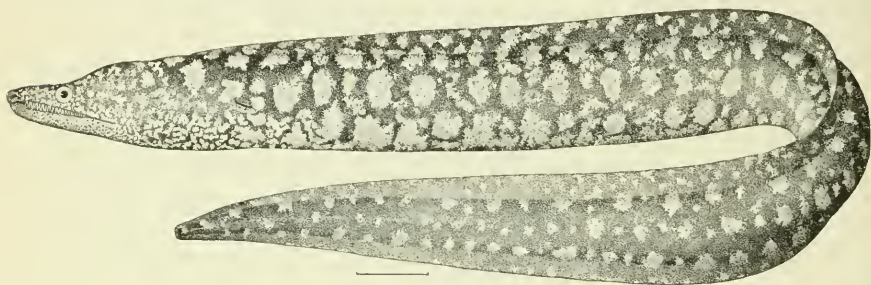


FIG. 20.—EMASIA LICHENOSA.

depressible teeth or fangs in its mouth. The absence of pale edge to the anal separates it at sight from *Gymnothorax kidako*, which it resembles in color, although its pale markings take the form of lichen-like blotches rather than irregular crossbars.

Of this interesting species two specimens, each about 22 inches long, were obtained, the one at Wakanoura, the other at Misaki. On the specimen from Wakanoura, the pale spots are smaller and less conspicuous than on the other.

Type No. 6480, Leland Stanford Junior University Museum. Locality, Wakanoura. (*Lichenosus*, covered with lichens.)

28. STROPHIDON McClelland.

Strophidon McCLELLAND, Calcutta Journ. Nat. Hist., V, 1844, p. 187 (*longicaudata* = *sathete*).

Pseudochidna BLEEKER, Atlas Ichth., Muren., 1864, p. 109, pl. VIII (no description; changed to *Strophidon* in text).

This genus contains morays distinguished by the extreme length and slenderness of the body and the great number of the fin rays (D. 628, A. 355 in *S. brummeri*). The species of *Gymnothorax* have D. 250 to 400, A. 150 to 280. The tail is not twice as long as rest of body. The snout is small, and the dorsal begins well forward of the gill opening on the head. Species few. (*στροφή*, twist; *ὀδόν*, tooth.)

48. STROPHIDON BRUMMERI Bleeker.

Muræna brummeri BLEEKER, Nat. Tyds. Ned. Ind., XVII, p. 137, Timor.

Strophidon or *Pseudechidna brummeri* BLEEKER, Atlas Ichth., Muran., p. 109, pl. XVIII, fig. 1, Timor, Ceram.

Muræna brummeri GÜNTHER, Cat. Fish., VIII, 1870, p. 128, Timor.

Body and tail very slender, the head $5\frac{2}{3}$ in trunk, the tail one-third longer than rest of body. Cleft of mouth $3\frac{1}{3}$ in head; teeth in single rows; mouth closing completely. Dorsal rather high, inserted at end of second third of length of head, more than half as high as body.

Uniform rather light brown; the head with numerous dark dots, especially on the jaws; the fins with white margin.

East Indies, here described from a specimen $23\frac{1}{2}$ inches long, taken by Capt. Alan Owston, at low tide, at Yaeyama, Ishigaki Islands, Southern Riukiu. (A personal name.)

29. ECHIDNA Foster.

Echidna FOSTER, Enchiridion, 1778, p. 31 (*variegata*).

Gymnomuræna LACÉPÈDE, Hist. Nat. Poiss., V, 1803, p. 648 (*doliata*).

Gymnopsis RAFINESQUE, Analyse de la Natur, 1815, p. 93 (*doliata*).

Megadere RAFINESQUE, Analyse de la Natur, 1815, p. 93 (*variegata*).

Molari RICHARDSON, Voy. Erebus and Terror, 1846, p. 79 (*ophis=uchulosa*).

Pecilophis КАУР, Apodes, 1856, p. 98 (*catenatus*).

This genus is distinguished from *Gymnothorax* by its blunt teeth. The mouth is small and the body little elongate. The name *Echidna* was applied to this group of morays long before its use by Cuvier for a genus of Australian Monotremes. (ἔχιδνα, ἔχις, viper.)

49. ECHIDNA KISHINOUEI Jordan and Snyder, new species.

Head $3\frac{1}{4}$ in trunk; head and trunk $1\frac{1}{2}$ in tail; body rather deep, the depth 19 in length; cleft of mouth $2\frac{3}{8}$ in head; teeth above in one

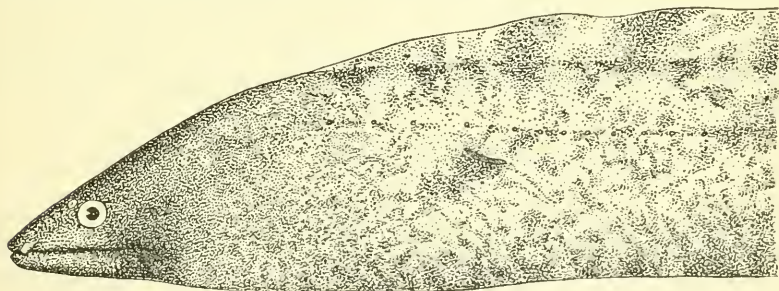


FIG. 21.—ECHIDNA KISHINOUEI.

series in front, in two or three series behind; the posterior teeth smaller and blunt; lower teeth mostly uniserial; mouth closing completely; eye small; snout short, blunt, about 7 in head; dorsal high,

beginning well before gill opening at end of second third of head; lower jaw with a few large pores.

Light brown, everywhere closely marbled with dark brown, above and below, the dark streaks confluent; head largely dark brown; gill opening a little darker.

One specimen $12\frac{1}{2}$ inches long, Type No. 6481, Leland Stanford Junior University Museum, taken at Okinawa, in the northern Riu Kiu by Yonekichi Komeyama. The species is nearer *Echidna delicatula* Kaup, but both trunk and tail are proportionately longer. The dorsal in *E. amblyodon* is inserted farther back.

It is named for Professor Kishinouye, of the Imperial Fisheries Bureau, in recognition of his deep interest in the fish fauna of Japan.

30. UROPTERYGIUS Rüppell.

Ichthyophis LESSON, Voyage de la Coquille, II, 1830, p. 120 (*pantherinus*=*marmoratus*; not of Fitzinger, 1829, a genus of Reptiles).

Uropterygius RÜPPELL, Neue Wirbelthiere, Fische, 1838, p. 83 (*concolor*).

Gymnomurena GÜNTHER, Cat. Fish., VIII, 1870, p. 133 (not of Lacépède, which is *Echidna*).

Scutica JORDAN and EVERMANN, Fish N. M. America, I., 1896, p. 403 (*necturus*).

This genus contains those morays which have the fins altogether wanting or developed only at the tip of the tail; the teeth are small, pointed, subequal, the mouth of moderate size, and the anterior nostrils only provided with a tube. The typical species have the tail about as long as the rest of the body, but the single Japanese species agrees with the related genus *Channomurena* in the extreme shortness of the tail. The typical species have tubes on the anterior nostrils only. These, by some error, were indicated by Jordan and Evermann as forming a distinct subgenus, *Scutica*, but *Scutica* is an exact synonym of *Uropterygius*. The species having tubes on the posterior nostrils should have been set apart from the others. For this group, the type being *Ichthyophis tigrinus* Lesson, we may suggest the new generic name, *Scuticaria*. *Murenoblenna*, used for this group by Kaup, is not available, as its original type was a *Myrine*. (*οὐρά*, tail; *πτερύγιον*, a little fin.)

50. UROPTERYGIUS OKINAWÆ Jordan and Snyder, new species.

Head $8\frac{1}{2}$ in trunk, $13\frac{1}{2}$ in total length; depth 2 in head; tail very short, $2\frac{1}{10}$ in rest of body: snout very blunt, not depressed, 6 in head; cleft of mouth $2\frac{3}{4}$ in head; lower jaw slightly projecting; eye very small, 3 in snout; anterior nostrils with a slight tube, shorter than eye; posterior nostril with a low rim, placed over front of eye; mouth closing completely; teeth numerous, sharp, in two rows in each jaw, and on vomer; canines of vomer and of inner series of jaws depressible; about 20 teeth on each side of mandible; no conspicuous pores on head,

except 2 or 3 on anterior part of edge of upper jaw; no trace of fins except a very slight fold on top of tail.

Color uniform cinnamon brown above and below; a darker shade about gill opening.

One specimen in excellent condition, No. 6482, Leland Stanford Junior University Museum, from Okinawa, in the northern Riu Kiu,

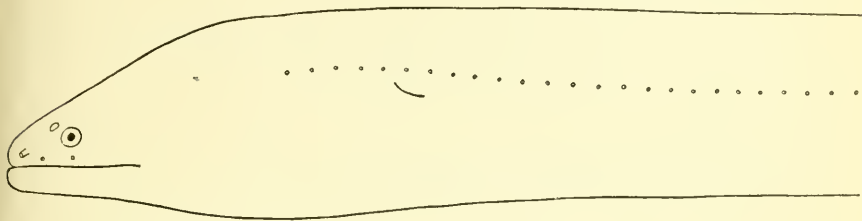


FIG. 22.—UROPTERYGIUS OKINAWAE.

collected by Yonekichi Komeyama, of Tokyo. It is distinguished from other species of the genus by the very long body and very short tail. From other Japanese morays, the absence of fins on the back at once separates it.

RECAPITULATION.

Order SYMBRANCHIA.

Family I. MONOPTERIDÆ.

1. *Monopterus* Lacépède.

1. *albus* (Zuiew). Okinawa, Amami-Oshima.

Order APODES.

Suborder ENCHELYCEPHALI.

Family II. ANGUILLIDÆ.

2. *Anguilla* Shaw.

2. *japonica* Schlegel. Hakodate, Aomori, Same, Matsushima, Sendai, Tokyo, Misaki, Wakanoura, Omura Bay, Kurume, Nagasaki.

Family III. SYNAPHOBRANCHIDÆ.

3. *Synaphobranchus* Johnson.

3. *affinis* (Günther). Totomi Bay, Tokyo, Misaki.

4. *iraconis* Jordan and Snyder. Myiako.

5. *jenkinsi* Jordan and Snyder. Enoshima.

4. *Histiobranchus* Gill.

6. *bathybius* (Günther). Not taken by us.

Family IV. LEPTOCEPHALIDÆ.

5. *Leptocephalus* Scopoli.
7. *myriaster* (Brevoort). Hakodate, Mororan, Matsushima, Same, Tokyo, Misaki, Hakata, Hiroshima, Wakanoura, Kobe, Onomichi, Nagasaki.
8. *erebennus* Jordan and Snyder. Misaki, Wakanoura.
9. *kiusiuanus* Jordan and Snyder. Hakata.
10. *japonicus* Bleeker. Not seen.
(a) *heterognathus* Bleeker. Not seen.
11. *riukiuanus* Jordan and Snyder. Yaeyama, Ishigaki Islands.
12. *nystromi* Jordan and Snyder. Nagasaki.
13. *retrofiuctus* Jordan and Snyder. Tokyo.
6. *Congrellus* Ogilby.
14. *megastomus* (Günther). Misaki, Totomi.
15. *anago* (Schlegel). Tokyo, Misaki, Kobe, Wakanoura, Nagasaki.

Family V. MURENESOCIDÆ.

7. *Murenesox* McClelland.
16. *cincereus* (Forskål). Tokyo, Misaki, Tsuruga, Wakanoura, Onomichi, Hiroshima, Nagasaki.
8. *Oryzonger* Bleeker.
17. *leptognathus* Bleeker. Awa.

Family VI. NETTASTOMIDÆ.

9. *Nettastoma* Rafinesque.
18. *parviceps* Günther. Not seen by us.
10. *Chlopsis* Rafinesque.
19. *hierasfer* Jordan and Snyder. Wakanoura.

Family VII. MYRIDÆ.

11. *Myrus* Kaup.
20. *uropterus* (Schlegel). Not seen by us.
12. *Muraenichthys* Bleeker.
21. *owstoni* Jordan and Snyder. Yaeyama, Riukiu.
22. *hatai* Jordan and Snyder. Wakanoura.
23. *aoki* Jordan and Snyder. Misaki.

Family VIII. OPHICHTHYIDÆ.

13. *Sphugebranchus* Bloch.
24. *moseri* Jordan and Snyder. Suruga Bay.
14. *Callochelys* Kaup.
25. *melanotenia* Bleeker. Yaeyama.
15. *Leirurus* Bleeker.
26. *semieinctus* (Lay and Bennett). Yaeyama.

Family VIII. OPNICTHYIDÆ—Continued.

16. *Chlerastes* Jordan and Snyder.
 27. *colubrinus* (Boddaert). Yaeyama.
17. *Pisoolonophis* Kaup.
 28. *zophistius* Jordan and Snyder. Misaki.
18. *Xyrias* Jordan and Snyder.
 29. *revulus* Jordan and Snyder. Misaki.
19. *Microdonophis* Kaup.
 30. *erabo* Jordan and Snyder. Misaki, Awa, Okinawa.
20. *Ophichthus* Ahl.
 31. *cephalozona* Bleeker. Not seen.
 32. *urolophus* (Schlegel). Not seen.
 33. *asakusa* Jordan and Snyder. Misaki.
 34. *tuchidæ* Jordan and Snyder. Misaki.
 35. *stenopterus* Cope. Not seen.
21. *Mystriophis* Kaup.
 36. *porphyreus* (Schlegel). Wakanoura.
22. *Brachysomophis* Kaup.
 37. *crocodolimus* (Bennett). Not seen.
23. *Oryzomus* Rafinesque.
 38. *macrorhynchus* Bleeker. Misaki, Onasagawa, Tokyo.

Family IX. MORINGUIDÆ.

24. *Aphthalnichthys* Kaup.
 39. *abbreviatus* Bleeker. Yaeyama.
 40. *javanicus* Kaup. Not seen.

Suborder COLOCEPHALI.

Family X. MURENIDÆ.

25. *Muraena* Linnaeus.
 41. *pardalis* Schlegel. Wakanoura.
26. *Gymnothorax* Bloch.
 42. *albimarginatus* (Schlegel). Not seen.
 43. *kidako* (Schlegel). Tokyo; Misaki, Wakanoura.
 44. *microsewskii* (Steindachner). Not seen.
 45. *revesi* (Richardson). Not seen.
 46. *reticularis* Bloch. Wakanoura; Misaki.

Family X. MURENIDÆ—Continued.

27. *Enasia* Jordan and Snyder.
 47. *lichenosa* Jordan and Snyder. Wakanoura; Misaki.
28. *Strophidon* McClelland.
 48. *brunneri* Bleeker. Yaeyama.
29. *Echidna* Forster.
 49. *kishinouyei* Jordan and Snyder. Okinawa.
30. *Uropterygius* Rüppell.
 50. *okinawæ* Jordan and Snyder. Okinawa.