eye to nasal opening 7 inches. From other pieces seen it appears that the color on the dorsal surface was a light gray; ventral surface whitish; skin very rough; mouth evidently inferior.

These fragments are not sufficient for definite identification. They resemble *Mobula japonica* (Müller & Henle), a species known from Japan, a fœtus of which was obtained by Dr. Jordan at Misaki. *M. tenkee* (Russell) has been recorded from the East Indies, Coromandel coast, etc.; and *M. kuhlii* (Müller & Henle) from the Indian Ocean. Our species is probably identical with *M. japonica*, but of this we can not be sure. It is called "Híhimánu" by the local fishermen, a name which they apply also to *Stoasodon narinari*.

Cephaloptera japonica Müller & Henle, Plagiostomen, 185, 1841, **Japan**; Schlegel, Fauna Japonica, Poiss., 310, 1850 (Japan).
Diecrobatis japonica, Günther, Cat., VIII, 496, 1870 (after Müller & Henle); Bleeker, Nat. Verh. Kon. Ak. Amsterdam, XVIII, 1879 (name only).

Subclass HOLOCEPHALI.—The Chimæras.

Skeleton cartilaginous. Gill-cavity with 4 clefts within, but having only one external opening, which is covered by a fold of skin. No spiracles; mouth inferior; jaws with teeth, confluent into bony plates; upper jaw, palate, and hyomandibular coalescent with the skull; intestine with a spiral valve; pectoral fins normally developed, placed low; ventral fins abdominal, with claspers in the male; derivative radii sessile on the sides of the basal bones of the limbs; skin scaleless, its muciferous system well developed. This group contains a single order, Chimæroidei.

Order E. CHIMÆROIDEI.—The Chimæroids.

Characters of the order included above. The group contains one existing family, Chimæridæ.

Family XI. CHIMÆRIDÆ.—The Chimæras.

Body elongate, rather robust anteriorly, tapering posteriorly. Head compressed; mouth small, inferior, the upper lip deeply notched; nostrils confluent with the mouth, separated by a narrow isthmus; jaws with the teeth confluent into 4 bony laminæ above and 2 below; no spiracles; pectoral fins free, placed low; ventral fins abdominal, many-rayed, provided in the male with claspers; dorsal fin usually divided, anteriorly with a very strong spine which is grooved behind; caudal fin low, fold-like; skin naked, rarely somewhat prickly; lateral line present, usually with numerous branches anteriorly; 3 free gills and 2 half gills, 1 on each side; isthmus moderate; gillrakers small. Oviparous, the egg cases long, elliptical, with silky filaments. Genera 4; species about 7. Fishes of singular appearance, found chiefly in the seas of the cold regions. Numerous extinct genera are also referred to this family.

Genus 17. CHIMÆRA Linnæus. Elephant Fishes.

Head somewhat compressed, the snout bluntish, protruding, fleshy, not armed at tip with an appendage; eyes very large, lateral; teeth rather strong; lips thickish, the lower with a frenum; lateral line simple on the body, but forking anteriorly, forming several series of mucous tubes on the head; male with a club-shaped cartilaginous hook on the head above the snout; this hook is curved forward and downward, and is armed at its tip with decurved spines; its tip fitting into a depression in front of the eyes; females without this appendage; gill-opening small; pectorals moderate; ventrals rather large, with large bifid claspers in the male; male also with rough appendages at the base of ventrals, protruding from a sheath of skin; first dorsal triangular, preceded by a strong spine, which is grooved behind and serrated on its edges; second dorsal and caudal fins low, often more or less notched; tail extending in the line of the axis of the body, more or less produced in a filament at tip. Skin smooth. Fishes of singular appearance; mostly of the northern seas; not valued for food. The single Hawaiian species is fully described in Section II of this work.

Chimæra Linnæus, Syst. Nat., Ed. X, 236, 1758 (*monstrosa*).

Subclass TELEOSTOMI.—The True Fishes.

Skeleton usually bony, sometimes cartilaginous; skull with sutures; membrane bones (opercle, preopercle, etc.) present; gill-openings a single slit on each side; gills with their outer edges free, their bases attached to bony arches, normally 4 pairs of these, the fifth pair being typically modified into tooth-bearing lower pharyngeals; median and paired fins developed, the latter with distinct rays; ova small; no claspers; heart developed, divided into an auricle, ventricle, and arterial bulb; lungs imperfectly developed or degraded to form a swim-bladder, or entirely absent.

Omitting orders not yet known to be represented in Hawaiian waters we have the following analysis of—

ORDERS OF TRUE FISHES.

a. Body eel-shaped, provided with very many (100 to 125) vertebræ; scales minute or wanting; no ventral fins; gill-openings restricted; gill-arches 4 pairs, the hindmost being modified as pharyngeal bones; palato-pterygoid arch present; premaxillaries atrophied; maxillaries lateral, more or less confluent with the palatines; shoulder-girdle not attached to skull ..... *Apodes*, p. 73

aa. Body not truly eel-shaped; the vertebræ usually in moderate or rather large number (14 to 150); ventral fins usually present; gill-openings typically ample; premaxillary always present, and maxillary usually so; shoulder-girdle near the cranium, usually but not always attached to it; hypercoracoid and hypocoracoid well developed, not coalescent.

b. Gill-arches with the bones reduced in number; air-bladder without duct; ventrals abdominal or subabdominal, if present; no mesocoracoid.

c. Gills pectinate; gill-openings large; dorsal and ventral usually with spines ..... *Hemibranchii*, p. 114

cc. Gills tufted; gill-openings very small; opercle a simple plate; skin with bony plates ..... *Lophobranchii*, p. 117

bb. Gill-arches normal.

d. Ventrals abdominal; pectoral fins inserted low; fins without spines.

e. Air-bladder, if present, with pneumatic duct; lower pharyngeals separate; anterior vertebræ not modified; mesocoracoid typically present ..... *Isospondyli*, p. 52

ee. Air-bladder without pneumatic duct; lower pharyngeals fully united ..... *Synentognathi*, p. 121

dd. Ventral fins usually anterior in position; spines usually present in the fins; pectoral fins not on the plane of the abdomen; parietal bones usually separated by the supraoccipital. (Spiny-rayed fishes chiefly.)

f. Pectoral fins not pediculate, the gill-openings in front of them ..... *Acanthopteri*, p. 137

ff. Pectoral fins pediculate, the basal bones reduced in number and elongate; gills in the axils of the pectorals. *Pediculati*, p. 516

Order F. ISOSPONDYLI.—The Isospondylous Fishes.

Soft-rayed fishes with the anterior vertebræ simple, unmodified, and without auditory ossicles; symplectic present; no interclavicles; opercular bones distinct; pharyngeal bones simple above and below, the lower not falciform; mesocoracoid arch always well developed, as in the Ostariophysi and the Ganoidei, forming a bridge from the hypercoracoid to the hypocoracoid; bones of jaws developed, the maxillary broad, always distinct from premaxillary and forming part of margin of upper jaw; no barbels; shoulder-girdle well developed and connected with the cranium by a bony post-temporal; gills 4, a slit behind the fourth; air-bladder, if present, with a pneumatic duct; dorsal and anal fins without true spines; ventral fins abdominal, sometimes wanting; scales usually cycloid, sometimes ctenoid, occasionally wanting; no developed photophores; adipose fin present or absent; a large group comprising most of the marine soft-rayed fishes, excepting those found in the deep sea, these composing the degenerate group called Iniomi. Some of the forms, as Elopidæ, Albulidæ, etc., show analogies with the ganoid allies of the Cycloganoidei. This indicates the descent of the Isospondyli from a ganoid stock, Amioidei, and from this order or its ancestors doubtless all the bony fishes have sprung.

FAMILIES OF ISOSPONDYLI.

I. *Isospondyli*: Mesocoracoid arch developed, the connection of the shoulder-girdle with the cranium perfect.

a. Dorsal fin inserted more or less before anal (rarely slightly behind it); shore fishes or river fishes, usually silvery in coloration and with the skeleton firm; gular plate present, between branches of lower jaw; mouth large; teeth present, all pointed; axillary scales and sheaths large ..... *Elopidæ*, p. 53

aa. Gular plate none.

b. Lateral line well developed.

c. Teeth present; no accessory branchial organ; mouth small, horizontal ..... *Albulidæ*, p. 54

cc. Teeth none; an accessory branchial organ behind the gill-cavity ..... *Chanidæ*, p. 56
bb. Lateral line wanting; no gular plate.
d. Mouth moderate, terminal, the maxillary of about 3 pieces; stomach not gizzard-like ..... *Clupeidæ*, p. 58
dd. Mouth subinferior, very large, below a tapering pig-like snout; maxillary very long..... *Engraulidæ*, p. 59
II. *Iniomi*: Mesocoracoid, usually abortive or obsolete, the connection of the shoulder-girdle with the cranium imperfect.
a. Post-temporal connected with back of cranium near sides; no photophores or barbel; adipose fin present; body not very elongate; anal distinct; scales present.
b. Maxillary very narrow, rudimentary or obsolete; hypocoracoids not divergent; pseudobranchiæ present. *Synodontidæ*, p. 61
bb. Maxillary well developed, dilated behind; pseudobranchiæ present; pectorals normal..... *Aulopidæ*, p. 66
aa. Post-temporal impinging upon occiput.
c. Vertebræ and neural spines normal, not projecting from the flesh in front of the dorsal fin; photophores present; barbel wanting.
d. Premaxillaries forming entire margin of upper jaw; body scaly; opercles complete..... *Myctophidæ*, p. 67
dd. Premaxillaries not forming the whole margin of upper jaw, the maxillary entering into it; body naked; opercular apparatus incomplete..... *Maurolicidæ*, p. 70
cc. Vertebræ or neural spines projecting through skin of back in front of dorsal fin; body short, deep, compressed; photophores present; mouth obliquely cleft or subvertical..... *Sternoptychidæ*, p. 72

Family XII. ELOPIDÆ.—The Tarpons.

Body elongate, more or less compressed, covered with silvery cycloid scales; head naked; mouth broad, terminal, the lower jaw prominent; premaxillaries not protractile, short, the maxillaries forming the lateral margins of the upper jaw; maxillary composed of about 3 pieces, extending backward beyond the eye; an elongate bony plate between the branches of the lower jaw (analogous to the gular plate in *Amia*); bands of villiform teeth in each jaw and on vomer, palatines, pterygoids, tongue, and base of skull; no large teeth; eye large, with an adipose eyelid; opercular bones thin, with expanded membranaceous borders; a scaly occipital collar; gill-membranes entirely separate, free from the isthmus; branchiostegals numerous (29 to 35); gillrakers long and slender, pseudobranchiæ present or absent; belly not keeled nor serrated, rather broad and covered with ordinary scales; lateral line present; dorsal fin inserted over or slightly behind ventrals; caudal fin forked; no adipose fin; dorsal and anal depressible into a sheath of scales; pectorals and ventrals each with a long accessory scale; parietal bones meeting along top of head; pyloric cæca numerous. Genera 3, species about 5, forming 2 well-marked subfamilies, both widely distributed in the tropical seas. The species are not much valued as food, the flesh being dry and bony.

Genus 18. ELOPS Linnæus. The Tenpounders.

Body elongate, covered with thin, small, silvery scales; dorsal fin slightly behind ventrals, its last rays short, the fin depressible into a sheath of scales; anal fin smaller, similarly depressible; pectorals and ventrals moderate, each with a long accessory scale; opercular bones thin, with expanded, membranaceous borders; a scaly occipital collar; lateral line straight, its tubes simple; pseudobranchiæ present, large; vertebræ 43+29=72. Large fishes of the open seas, remarkable for the development of scaly sheaths. The young are ribbon-shaped and elongate, passing through a series of changes like those seen in *Albula*.

Elops Linnæus, Syst. Nat., Ed. XII, 518, 1766 (*saurus*).
Megilomorus Lacépède, Hist. Nat. Poiss., V, 398, 1803 (*anna-carolina*).
Trichonotus Rafinesque, Analyse de Nature, 88, 1815 (*anna-carolina;* substitute for *Megilomorus*, considered objectionable.)

19. Elops saurus Linnæus. Fig. 8.

Head 3.75; depth about 5; D. 25 (counting rudiments, of which there are 7); A. 16; P. 18; V. 15; vertebræ 47+19=66; scales 14–96–17, counting to middle of belly; eye nearly 5 in head, or 1 in snout or interorbital space; mouth a little over 1.75 in head; pectoral 1.75; ventral a little more than pectoral, less than 2; least depth of caudal peduncle 3 in head.

Body elongate, compressed; head compressed, elongate, pointed; snout short, pointed, more or less rounded above; eye rather large, with broad adipose eyelid covering a good portion; maxillary very long, expanded backward beyond the eye, and with several longitudinal ridges; teeth in broad patches or bands in the jaws, also along edge of maxillary, and on the vomer and palatines; tongue large

rather long, free in front; nostrils close together; interorbital space flattened and with a couple of ridges; gill-openings large; gillrakers 8 + 15, long, the outer portion more or less slightly expanded or enlarged; pseudobranchiæ numerous and rather short; intestine straight, without any convolutions; peritoneum silvery; scales small, of even size; basis of dorsal and anal with broad scaly sheaths; pectoral with scaly flap more than half length of head; ventral flap scaly, more than half length of fin; lateral line continuous, superior at first and then running midway along side of caudal peduncle; origin of dorsal nearer base of caudal than tip of snout, slightly behind base of ventrals, the anterior rays elevated; origin of anal a little behind tip of dorsal, the anterior rays longest; caudal deeply forked, the lobes pointed; pectoral rather short, reaching scarcely halfway to origin of ventrals; ventrals a little shorter than pectorals, reaching more than halfway to anal; caudal peduncle rather long, compressed.

This is one of the greatest of game fishes, in the estimation of anglers who have had the good fortune to fish for it on the coast of Florida, and will doubtless prove one of the most interesting of Hawaiian fishes to sportsmen who visit those islands.

This description is from a specimen (No. 04982), 11 inches long, from Honolulu. We have examined many examples, some of them taken by Dr. Jenkins at Honolulu in 1889, and others dredged in the same locality in November, 1896, by the *Albatross*. Jordan and Snyder obtained it in the same locality in 1900.

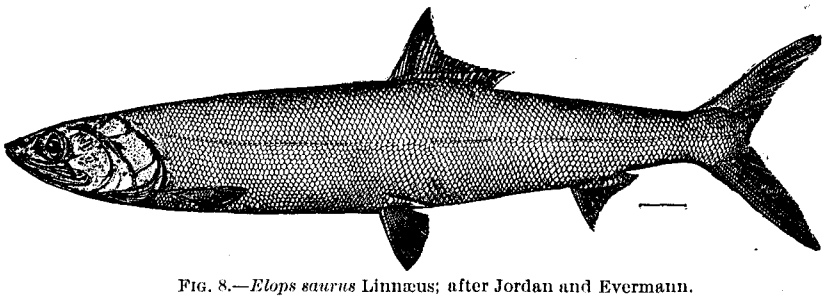


FIG. 8.—*Elops saurus* Linnæus; after Jordan and Evermann.

Elops saurus Linnæus, Syst. Nat., Ed. XII, 518, 1766, **Carolina**; Günther, Cat., VII, 470, 1868 (Cuba; Jamaica; St. Croix; South America; Cape of Good Hope; Zanzibar; Djidda; Pinang; China); Jordan & Evermann, Fishes North and Mid. Amer., I, 410, 1896; Steindachner, Denks. Ak. Wiss. Wien, LXX, 1900, 513 (Honolulu); Fowler, Proc. Ac. Nat. Sci. Phila. 1900, 496 (Hawaiian Islands); Evermann & Marsh, Fishes of Portó Rico, 81, fig. 11, 1900; Jordan & Evermann, Am. Food and Game Fishes, 86, figure, 1902; Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 432 (Honolulu), and of most authors.

Argentina carolina Linnæus, Syst. Nat., Ed. XII, 519, 1766, **Carolina** (on the *Harengus minor bahamensis* of Catesby).

Argentina machnata Forskål, Descr. Anim., 68, 1775, **Djidda, Arabia.**

Mugilomorus anna-carolina Lacépède, Hist. Nat. Poiss., V, 398, 1803, **South Carolina.**

Elops inermis Mitchill, Trans. Lit. and Phil. Soc. N. Y., I, 1815, 445, **New York.**

Elops indicus Swainson, Class. Fish., II, 292, 1839 (after Inagow of Russell, Fishes of Vizagapatam, II, 63, fig. 179, 1803, nonbinomial), **Vizagapatam.**

Elops capensis Smith, Zool. S. Africa, pl. 7, 1845, **Cape of Good Hope.**

Elops purpurascens Richardson, Ichth. China, 311, 1846, **China.**

Family XIII. ALBULIDÆ.—The Bonefishes or Ladyfishes.

Body rather elongate, little compressed, covered with rather small, brilliantly silvery scales; head naked; snout conic, subquadrangular, shaped like the snout of a pig, and overlapping the small, inferior, horizontal mouth; maxillary rather strong, short, with a distinct supplemental bone, slipping under the membranous edge of the very broad preorbital; premaxillaries short, not protractile; lateral margin of upper jaw formed by the maxillaries; both jaws, vomer, and palatines with bands of villiform teeth; broad patches of coarse, blunt, paved teeth on the tongue behind and on the sphenoid and pterygoid bones; eye large, median in head, with a bony ridge above it, and almost covered with an annular adipose eyelid; opercle moderate, firm; preopercle with a broad, flat, membranaceous edge, which extends backward over the base of opercle; pseudobranchiæ present; gillrakers short, tubercle-like; gill-membranes entirely separate, free from the isthmus; branchiostegals about 14; a fold of skin across gill-membranes anteriorly, its posterior free edge crenate; no gular plate; lateral line

present; belly not carinate, flattish, covered with ordinary scales; dorsal fin moderate, in front of ventrals, its membranes scaly; no adipose fin; anal very small; caudal widely forked; pyloric cœca numerous; parietal bones meeting along top of head; vertebræ numerous, 42+28=70. A single species known, found in all warm seas.

In this, and probably in related families, the young pass through a metamorphosis analogous to that seen in the Conger Eels; they are for a time elongate, band-shaped, with very small head and loose, transparent tissues; from this condition they become gradually shorter and more compact, shrinking from 3 or 3.5 inches in length to 2 inches. According to Dr. Gilbert, this process, like that seen in various eels, is a normal one, through which all individuals pass. In the Gulf of California, where these fishes abound, these band-shaped young are often thrown by the waves on the beach in great masses.

Genus 19. ALBULA (Gronow) Bloch & Schneider. The Bonefishes.

The characters of this genus are included above. Only one species known.

Conorhynchus Nozeman, Act. Select., III, 382, 1757 (nonbinomial).
Albula Gronow, Zoophyl., 102, 1763 (nonbinomial).
Albula Bloch & Schneider, Syst. Ichth., 432, 1801 (*conorhynchus=vulpes*).
Butyrinus Lacépède, Hist. Nat. Poiss., V, 45, 1803 (*banana=vulpes*).
Glossodus Cuvier in Agassiz, Spix Pisc. Brasil., 48, 1829 (*forskali=vulpes*).

20. Albula vulpes (Linnæus). *Bonefish; "Oio."* Fig. 9.

Head 3.75 in length; depth 5; D. 15; A. 8; scales 9–71–7; upper lobe of caudal the longer; a broad band of peculiar, elongate, membranaceous scales along middle line of back; accessory ventral scale large.

Brilliantly silvery; olivaceous above; back and sides with faint streaks along the rows of scales; fins plain; axils dusky. Length 18 inches to 3 feet. Tropical seas, on sandy coasts, almost universally distributed and generally abundant. A beautiful and active fish, in most places little valued as food, but in some regions, as Key West, highly appreciated. Highly esteemed as a game fish.

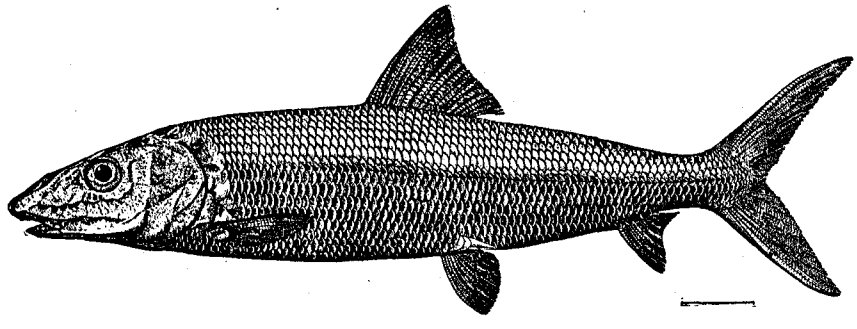


FIG. 9.—*Albula vulpes* (Linnæus); after Jordan and Evermann.

We have a number of specimens from Honolulu and Hilo, all of which have the streaks on the back and upper surface dark and well defined. We have also examined specimens taken at Honolulu by Dr. Wood, and others from the same locality by Jordan and Snyder.

Esox vulpes Linnæus, Syst. Nat., Ed. X, 313, 1758, **Bahamas** (based on the bonefish, *Vulpes bahamensis* of Catesby).
Argentina glossodonta Forskål, Descript. Animal., 68, 1775, **Djidda, Arabia.**
Synodus argenteus Bloch & Schneider, Syst. Ichth., 398, 1801, **Asia.**
Clupea brasiliensis Bloch & Schneider, op. cit., 427, **Brazil.**
Albula conorhynchus Bloch & Schneider, op. cit., 432, **Antilles** (after Gronow); Streets, Bull. U. S. Nat. Mus., No. 7, 76, 1877 (Honolulu); Günther, Rep. Shore Fish., Challenger, Zool., I, part VI, 61, 1880 (Hilo).
Albula plumieri Bloch & Schneider, op. cit., pl. 86, **Antilles.**
Amia immaculata Bloch & Schneider, op. cit., 451. **South America;** after Macabé of Parra.
Butyrinus banana Lacépède, Hist. Nat. Poiss., V, 46, 1803, **Ile de France.**
Argentina sphyræna Lacépède, op. cit., V, 366, 1803, **Mediterranean.**
Clupea microcephala Lacépède, op. cit., 426, **Martinique;** on a drawing by Plumier.

Glossodus forskalii Agassiz, Spix Pisc. Brasil., 49, tab. XXII, fig. 2, and tab. XXIV, fig. 2, 1829, **Bahia.**
Engraulis bahiensis Agassiz, op. cit., 49, pl. 24, fig. 2, **Bahia.**
Butirinus glossodontus, Rüppell, Neue Wirbelthiere, Fish., 80, pl. 20, fig. 3, 1835.
Elops (Butirinus) glossodontus, Swainson, Class. Fish., II, 292, 1839; no description.
Esox argenteus, Forster in Lichtenstein, Descript. Animal., 196, 1844 (Tahiti).
Albula macrocephala Cuvier & Valenciennes, Hist. Nat. Poiss., XIX, 324, 1846, **San Domingo; Martinique.**
Albula parræ Cuvier & Valenciennes, op. cit., 339, **Bahia, Rio Janeiro, Martinique.**
Albula goreensis Cuvier & Valenciennes, op. cit., 342, **Goree.**
Albula bananus, Cuvier & Valenciennes, op. cit., 345 (Ile de France).
Albula neoguinaica Cuvier & Valenciennes, l. c., 350, **New Guinea.**
Albula seminuda Cuvier & Valenciennes, l. c., 351, **New Guinea.**
Albula erythrocheilos Cuvier & Valenciennes, l. c., 352, **Friendly Islands.**
Albula forsteri Cuvier & Valenciennes, l. c., 354, **Tahiti.**
Albula rostrata Gronow in Gray, Cat. Fish. Coll. Gronow, 189, 1854, **American** and **Indian oceans** and **Mediterranean Sea.**
Conorhynchus glossodon, Bleeker, Atlas Ichth., VI, 82, pl. 270, fig. 1, 1870–72 (Java, Madura, Balis, Sumatra, Pinang, Bangka, Biliton, Celebes, Obi-major, Amboyna, Saparua, Ceram, New Guinea).
Albula glossodonta, Klunzinger, Verh. Zool. Bat. Ges. Wien, 1871, 602 (Red Sea); Steindachner, Denks. Ak. Wiss. Wien, LXX, 1900, 513 (Honolulu).
Albula vulpes, Jordan & Gilbert, Synopsis, 258, 1883; Jordan & Evermann, Fishes North and Mid. Amer., I, 411, 1896; Evermann & Marsh, Fishes of Porto Rico, 82, fig. 12, 1900; Jordan & Evermann, Am. Food and Game Fishes, 88, figure, 1902; Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 432 (Honolulu); Snyder, op. cit. (Jan. 19, 1904), 521 (Hanalei Bay, Kauai).

Family XIV. CHANIDÆ.—The Milk-fishes.

Body oblong, compressed, covered with small, firm, adherent scales; lateral line distinct; abdomen broad and flattish; snout depressed; mouth small, anterior, the lower jaw with a small symphyseal tubercle; no teeth; premaxillary joined to upper anterior edge of maxillary; eye with an adipose eyelid; gill-membranes broadly united, free from the isthmus; branchiostegals 4; pseudobranchiæ well developed; an accessory branchial organ in a cavity behind the gill-cavity; dorsal fin opposite the ventrals; anal fin shorter than the dorsal; mucous membrane of œsophagus raised into a spiral fold; intestine with many convolutions; vertebræ about 45. Coloration silvery. Large fishes of the warmer parts of the Pacific. One genus and 3 species known.

Genus 20. CHANOS Lacépède.

Characters of the genus included above.

Chanos Lacépède, Hist. Nat. Poiss., V, 395, 1803 (*arabicus*).
Lutodeira (Kühl) Rüppell, Atlas Reise Nordl. Afrika, 17, 1828 (*chanos*).
Ptycholepis Gray, Dieffenbach's Travels in New Zealand, II, 218, about 1843 (*salmoneus*).

21. Chanos chanos (Forskål). Fig. 10.

Milkfish; "Awa;" "Awa-awa;" "Awa kalamoku;" "Puawa."

Head 4.4 in length; depth 4; D. II, 12; A. II, 9; scales 12–86–14; vertebræ 19 + 26 = 45; eye 3.5 in head; snout 3.5; maxillary 4.3; pectoral 1.6; ventral 1.8; caudal .3 longer than head; dorsal 1.25 in head; B. 4.

Aspect of a large cyprinoid. Body elliptical, moderately compressed; caudal peduncle slender, head pointed, rounded above; eye and side of head covered by a large, transparent, imperforate, adipose eyelid; mouth small, terminal, toothless, transverse, lower jaw included; maxillary broad, slipping under the adipose preorbital, without supplemental bone; opercle truncate behind; pseudobranchiæ very large; gillrakers fine and flexible, very close set, rather long; bones of gillrakers flexible; gill-arches all connected by membrane; lateral line well developed; scales firm, cycloid, with strongly marked longitudinal striæ; scales rather large, hard, firm, enameled, becoming bony when dry, used by the Indians for ornamental work; dorsal inserted somewhat nearer snout than base of caudal, before ventrals, its first ray falcate, its last produced in a short filament, longer than pupil; base of fin with a large scaly sheath; pectoral and ventral each with scaly axillary appendage; anal similar to dorsal, but much smaller; pectorals and ventrals rather small; caudal very long, forked to the base, its lobes subequal, straight; base of fin with small scale; ventrals somewhat falcate.

Color in life of example from Moanalua, silvery, bluish olive above; upper fins dirty whitish; lower fins soiled cream color; lower lobe of caudal with some yellowish.

Color in alcohol, greenish above, the sides brilliantly silvery, fins more or less darkened; inside of ventrals and pectorals blackish.

Length 2 to 5 feet. Pacific and Indian oceans, on sandy shores, north to the Hawaiian Islands, where it is abundant. Our specimens from Honolulu are all under a foot in length.

We have recently received from Mr. Berndt a singular-looking specimen extraordinarily short and deep. It is apparently a dwarf or hunchback example of this species. It has a much shorter and deeper head and body than the species usually possesses and the scales are narrower, but in other respects it differs but slightly from the ordinary type. Head 3.4; depth 2.5; depth of caudal peduncle 7.5; length of caudal 1.8; pectoral 4; ventral 5; eye 3 in head; interorbital width 2.33; snout 3.5; D. 12; A. 9; scales 76, 26, 21 in front of dorsal.

The awa is one of the most important food fishes of the Hawaiian Islands. It occurs about the various islands, but is most abundant around Honolulu. It is, next to the mullet (Ama ama), the most common species frequenting the artificial ponds, into which it runs with the mullet and with

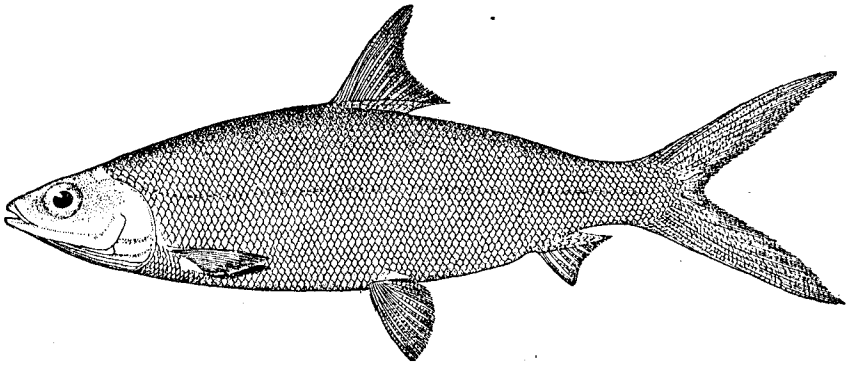


FIG. 10.—*Chanos chanos* (Forskål).

the tide and is restrained in the same way. It is held in esteem as a food fish, but we know nothing of its game qualities. Like the mullet, it is known by different names at different ages. The young are called "puawa;" those of medium size "awa awa;" those of ordinary commercial size "awa;" while very large individuals are "awa kalamoku."

Mugil chanos Forskål, Descript. Animal., 74, 1775, **Red Sea at Djidda, Arabia.**
Chanos arabicus Lacépède, Hist. Nat. Poiss., V, 396, 1803, **Arabia.**
Lutodeira chanos, Rüppell, Atlas zu der Reise im Nordl. Africa, 18, pl. 5, fig. 1, 1828.
Cyprinus pala Cuvier, Règne Animal, Ed. 2, II, 22, 1829; after Russell.
Cyprinus tolo Cuvier, op. cit., 222; after Russell.
Leuciscus zeylonicus Bennett, Proc. Zool. Soc. Lond. 1832, 184, **Ceylon.**
Chanos mento Cuvier & Valenciennes, Hist. Nat. Poiss., XIX, 194, 1846, **Ile de France.**
Chanos chloropterus Cuvier & Valenciennes, op. cit., 195, **Madepolam.**
Chanos machalis Cuvier & Valenciennes, op. cit., 196, **Vizagapatam.**
Chanos orientalis Kühl in Cuvier & Valenciennes, op. cit., 197, **Red Sea.**
Chanos cyprinella Cuvier & Valenciennes, op. cit., 198, **Honolulu, Hawaiian Islands.**
Chanos salmoneus Cuvier & Valenciennes, op. cit., 201, 1846, **between New Caledonia and Norfolk Island;** Günther, Rep. Shore Fish., Chall., Zool., I, part VI, 61, 1880 (Honolulu).
Leuciscus (*Ptycholepis*) *salmoneus*, Gray, in Dieffenbach Trav. New Zeal., II, 218.
Butirinus argenteus Jerdon, Madras Journ. Lit. Sci., XV, 1849, 343, **Madras.**
Butirinus madraspatensis Jerdon, op. cit., 344, **Madras.**
Chanos indicus Bleeker, Enum. Pisc. Arch. Ind., 160, 1859, **East Indies.**
Chanos chanos, Klunzinger, Verh. Bat. Zool. Gen. Wien, 1871, 605; Jordan & Evermann, Fishes North and Mid. Amer., I, 414, 1896; Steindachner, Denks. Ak. Wiss. Wien, LXX, 1900, 514 (Honolulu); Jenkins, Bull. U. S. Fish Comm., XXII. 1902 (Sept. 23, 1903), 432 (Honolulu); Jordan & Snyder, Proc. U. S. Nat. Mus., XXVIII, 1904 (Oct.), 123 (Honolulu).

Family XV. CLUPEIDÆ.—The Herrings.

Body oblong or elongate, more or less compressed, covered with cycloid or pectinated scales; belly sometimes rounded, sometimes compressed, in which case it is often armed with bony serratures; head naked, usually compressed; mouth rather large, terminal, the jaws about equal; maxillaries forming the lateral margins of upper jaw, each composed of about 3 pieces; premaxillaries not protractile; teeth mostly small, often feeble or wanting, variously arranged; adipose eyelid present or absent; gill-rakers long and slender; gill-membranes not connected, free from the isthmus; no gular plate; gills 4, a slit behind the fourth; branchiostegals usually few (6 to 15); posterior lower part of opercular region often with an angular emargination, the tips of the larger branchiostegals being abruptly truncate; pseudobranchiæ present; no lateral line; dorsal fin median or somewhat posterior, rarely wanting; no adipose fin; ventrals moderate or small (rarely wanting); anal usually rather long; caudal fin forked; vertebræ 40 to 56. Genera about 30; species 150; inhabiting all seas, and usually swimming in immense schools; many species ascend fresh waters, and some remain there permanently. The northern and fresh-water species, as in many other families, differ from the tropical forms in having a larger number of vertebral segments.

Genus 21. ETRUMEUS Bleeker.

Body elongate, subcylindrical or somewhat compressed; abdomen rounded, not compressed or serrated; snout pointed; adipose eyelid covering the eye wholly without pupillary slit; mouth terminal, of moderate width, formed as in *Clupea*, but the maxillary more slender; teeth moderate, in patches on jaws, palatines, pterygoids, and tongue; gill-membranes separate, with numerous fine branchiostegals; pseudobranchiæ well developed; pyloric appendages numerous; scales cycloid, entire, and very deciduous; pectoral and ventral fins shielded; no lateral line; dorsal fin rather long, of 18 to 20 rays, placed entirely in advance of ventrals; anal fin low, of moderate length; caudal deeply forked; the scales of the breast more or less adherent, dilated and forming a membranous ventral flap which covers the closed pectoral fins, leaving only the dorsal edges and the extreme tips of the fins visible; axillary scales very large, that of pectoral extending nearly to its tip, that of ventral reaching slightly farther than tip of fin; lateral scales extending continuously on center of caudal fin almost to margin of middle rays.

Etrumeus Bleeker, Verh. Bat. Gen., XXV, 48, 1853 (*micropus*).
Perkinsia Rosa Smith Eigenmann, Amer. Nat., February, 1891, 153 (*othonops*).

22. Etrumeus micropus (Schlegel). "*Makiawa.*" Fig. 11.

Head 4.5 in length; depth 5.5; D. 20; A. 11; P. 16; V. 9; scales about 52; eye 3 in head; snout 3.5; mandible 2; interorbital space 4.3; maxillary 3; width of head 2 in its length; P. 1.5 in head; V. 2.67; least depth of caudal peduncle 3.67 in head.

Body elongate, subcylindrical, somewhat compressed; head elongate, compressed, pointed; snout long, pointed, flattened above, the sides somewhat compressed; eye large, covered by the thick adipose eyelid; mouth small, terminal, the mandible very slightly projecting when the mouth is closed; teeth in fine villiform bands on vomer and palatines, those in jaws minute; maxillary slipping under the preorbital ridge and extending posteriorily a little beyond the anterior edge of eye; nostrils together on upper side of snout, much nearer its tip than anterior edge of eye; interorbital space and top of head flattened and with ridges forming an elongated *W;* preopercle with radiating branching mucous canals giving a striated appearance; opercles more or less smooth; gill-openings large, membranes free from isthmus; gillrakers long, slender, and fine; gill-filaments longer, fine, and the pseudobranchiæ also long; peritoneum pale or silvery; scales all more or less deciduous, mostly falling off in alcoholic specimens, rather large, cycloid, those between the pectorals and ventrals forming a thin broad flap; both pectorals and ventrals with long pointed scaly flaps but little shorter than the fins themselves; origin of dorsal nearer tip of snout than base of caudal by 1.3 eye diameters; anal fin very small, its origin about midway between origin of ventrals and base of caudal; caudal rather small, deeply emarginate; pectorals rather short, about 2.5 in space to ventrals; ventrals small, behind tip of depressed dorsal, and 2 in space to origin of anal; caudal peduncle compressed.

Color in life (No. 03222), steel-olive above, side slightly yellowish, belly silvery; centers of scales above with a diamond-shaped darker olive blotch, there forming lines along the rows of scales; tip of snout dusky; fins pale, not yellowish; base of pectoral a little dusky; some dusky shading on caudal; ventrals pale.

Color in alcohol, brown above, the lower surface of body silvery white; dorsal, caudal, and basal portion of pectoral dusky, portions of the latter, together with the other fins, pale or whitish; each scale on back with a dark brownish spot; tips of snout and mandible dusky brown.

This description from an example from Honolulu, about 9.25 inches long. Our numerous speci-

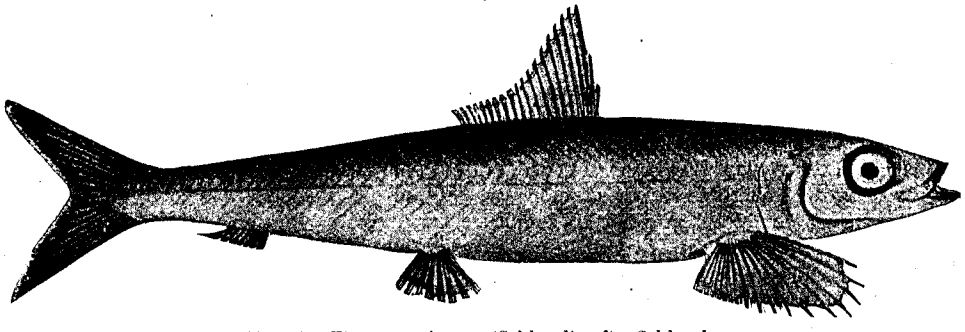


FIG. 11.—*Etrumeus micropus* (Schlegel); after Schlegel.

mens, all from Honolulu, range in length from 3.75 to 9.25 inches. Upon comparing them with Japanese examples, we are unable to detect any specific differences. We have also examined specimens dredged by the *Albatross* off Honolulu in November, 1896, others taken by Dr. Jenkins at Honolulu, 1889, and still others by Doctor Wood.

Clupea micropus Schlegel, Fauna Japonica, Poiss., 236, pl. 107, fig. 2, 1846, **Japan.**
Etrumeus micropus, Bleeker, Verh. Bat. Gen., XXV, 1853, 48 (Japan); Günther, Cat., VII, 467, 1868 (Japan); Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 432 (Honolulu); Snyder, l. c. (Jan. 19, 1904), 521 (Honolulu).
Perkinsia othonops Rosa Smith Eigenmann, Amer. Nat., 1891, 153, **San Diego, California.**

Family XVI. ENGRAULIDÆ.—The Anchovies.

Body elongate, more or less compressed, covered with thin cycloid scales; head compressed; mouth extremely large, more or less oblique, usually overlapped by a pointed, compressed, pig-like snout; gape very wide, the maxillary very long and slender, formed of about 3 pieces, extending backward far behind the eye, in some species behind the head; premaxillaries not protractile, very small, firmly joined to the maxillaries; teeth usually small, sometimes obsolete, usually fine and even, in a single row in each jaw; canines sometimes present; eye large, well forward, without adipose eyelid; preorbital narrow; opercles thin and membranaceous; gillrakers long and slender; branchiostegals slender, 7 to 14 in number; gill-membranes separate or joined, free from isthmus; pseudobranchiæ present; no lateral line; belly rounded or weakly serrate; fins various, the dorsal usually short and median; no adipose fin; caudal forked. Small carnivorous shore fishes, usually swimming in large schools on sandy shores; abundant in all warm seas, occasionally entering rivers. This group is often regarded as a subfamily under the *Clupeidæ*, from which it differs in no character of high importance.

A large family of about 80 species, only one of which is thus far known from the Hawaiian Islands.

Genus 22. ANCHOVIA Jordan & Evermann.

Body oblong, compressed, covered with rather large, thin, deciduous scales; belly rounded or weakly compressed; snout conical, compressed, projecting beyond the very large mouth; maxillary narrow, little movable, usually formed of 3 pieces, extending backward far behind the eye, to the base of mandible or beyond, not beyond gill-opening; premaxillaries very small; teeth small, subequal, present at all ages, usually on the jaws, vomer, palatines, and pterygoids; anal fin moderate

free from caudal (its rays 12 to 40); no pectoral filaments; dorsal inserted about midway of body, posterior to ventrals; pectorals and ventrals each with a large axillary scale; adipose eyelid obsolete; vertebræ about 40 (40–42) in species examined; flesh rather pale and dry, more or less translucent; bones firm; pseudobranchiæ present; branchiostegals 9 to 14; gillrakers long and slender; gill-membranes separate, free from the narrow isthmus. Species about 50; small, carnivorous shore fishes, swimming in large schools on sandy shores of all warm seas, occasionally entering rivers. Most of them are marked by a broad, distinct, silvery band.

Stolephorus Bleeker, Ned. Tijds. Dierk., III, 1865, 303 (*japonicus;* not of Lacépède, whose *Stolephorus japonicus*, after Houttuyn, belongs to Bleeker's genus *Spratelloides*).
Anchovia Jordan & Evermann, Fishes North and Mid. Amer., I, 449, 1896 (October 3) (*macrolepidota*).

23. Anchovia purpurea (Fowler). "*Nehu.*" Fig. 12.

Head 2.67 in length; depth 5.67; D. 13; A. 17; P. 13; V. 7; eye 3.5 in head; snout 4.67; maxillary 1.25; pectoral 1.88; ventral 2.75.

Body elongate, compressed; head elongate, laterally compressed and pointed; snout short, rounded at tip; eyes lateral, anterior to center of head, greater than snout; mouth large, the long maxillary produced backward beyond the posterior margin of eye but falling some distance short of gill-opening, the pig-like snout projecting well beyond the tip of mandible; teeth in the jaws small, fine, extending all along the lower edge of the maxillary; nostrils close together, about midway in snout; interorbital space a little convex; gill-openings large, the isthmus long and narrow, forming a narrow keel in front; gillrakers about 18 + 28, very long, slender, pointed, the longest nearly equal to

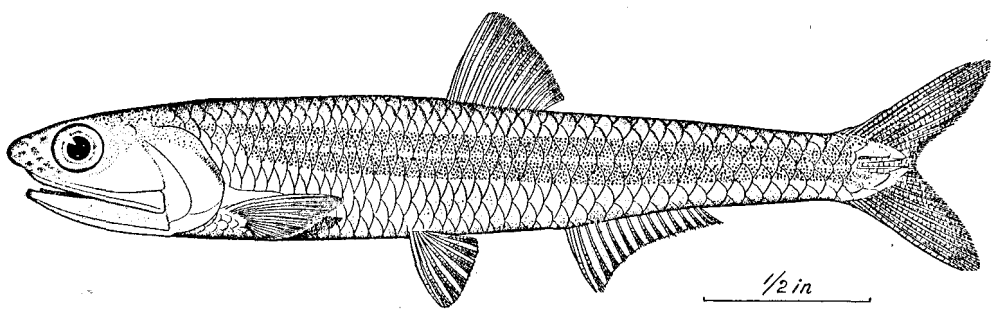


FIG. 12.—*Anchovia purpurea* (Fowler).

eye; gill-filaments rather shorter than the gillrakers; pseudobranchiæ moderately large; intestine short and straight; peritoneum black; scales large, cycloid, deciduous, falling off in preserved examples; pectorals with scaly flaps; origin of dorsal a little nearer tip of snout than base of caudal, and a little behind origin of ventral; origin of anal behind base of last dorsal ray, the first rays of fin encroaching but little upon tip of depressed dorsal; base of anal 1.67 in head; caudal deeply emarginate; pectoral short, about equal to snout and eye; ventrals a little in advance of dorsal and reaching a little more than half way to anal; caudal peduncle rather long, compressed, its least depth a little over 3 in head.

In alcoholic specimens there is a broad silvery longitudinal band from head to base of caudal, rather broader posteriorly; head silvery; dorsal and caudal marked with fine narrow wavy series of pale brownish dots forming cross-bars. This description from an example 2.5 inches long, taken in the market at Honolulu.

We have large series of this species from Honolulu and Hilo, at each of which places it is very abundant. Dr. Jenkins obtained a number of examples at Honolulu in 1889. It was also dredged by the *Albatross* in that vicinity in 1896, and a number of examples were obtained at Kailua, December 31, 1899, by Mr. Richard C. McGregor. The types are 2 specimens (Nos. 23329 and 23330, Mus. Phila. Acad.) each about 2.4 inches long, collected by Dr. Wm. H. Jones.

This species is well marked and has a broader silvery lateral band than either *Anchovia commersoniana* or *Anchovia ischana*. While the anal rays agree with the latter, the fin of *commersoniana* is still longer. The insertion of the anal fin also is more in advance in both *ischana* and *commersoniana*.

Stolephorus purpureus Fowler, Proc. Ac. Nat. Sci. Phila. 1900, 497, Pl. XIX, fig. 1, **Sandwich Islands.**
Anchovia purpurea, Jenkins, Bull. U. S. Fish. Comm., XXII, 1902 (Sept. 23, 1903), 432 (Honolulu; Synder, l. c. (Jan. 19, 1904), 521 (Honolulu).

Suborder INIOMI.—The Lantern Fishes.

Soft-rayed fishes with the anterior vertebræ simple, unmodified, and without auditory ossicles; symplectic present; no interclavicles; opercular apparatus sometimes incomplete; pharyngeal bones unmodified; gill-openings ample; mesocoracoid arch wanting or atrophied; bones of jaws variously developed, the maxillary sometimes cognate with the premaxillary; shoulder-girdle with its post-temporal not normally connected with the skull, but touching it at or near the nape; gills 4, a slit behind the fourth; air-bladder, if present, with a duct; dorsal and anal fins without true spines; ventral fins, if present, abdominal; scales mostly cycloid, often wanting; adipose fin present or absent; skeleton mostly very weakly ossified; photophores present in most species.

Marine fishes, mostly inhabiting the oceanic abysses, closely allied to the typical *Isospondyli*, but lacking the mesocoracoid and having the connection of the shoulder-girdle with the cranium imperfect. In the character of the mesocoracoid, most of these fishes agree with the eels and with the *Haplomi* and the spiny-rayed fishes. These latter have the post-temporal differently attached. This suborder is a provisional one, and its members may be reunited with the *Isospondyli* or otherwise distributed when the osteology of the different families is known. Boulenger relegates those which, like *Synodus*, lack the mesocoracoid to the Haplomi. These lack also the orbitosphenoid, characters of the Isospondyli and the Berycoidei.

Of the 18 families of this order as here defined, only 5 have representatives in the Hawaiian fauna

Family XVII. SYNODONTIDÆ.—The Lizard-fishes.

Body oblong or elongate, little compressed, covered with cycloid scales, rarely naked; mouth very wide, entire margin of upper jaw formed by the long, slender premaxillaries, the latter mostly rudimentary or obsolete, never widened at tip; teeth mostly cardiform on both jaws, tongue, and palatines; canines rarely present; large teeth usually depressible; no barbels; opercular bones usually thin, but complete; gill-membranes separate, free from isthmus; branchiostegals usually numerous; pseudobranchiæ present; gillrakers tubercular or obsolete; no orbitosphenoid or mesocoracoid; lateral line present; adipose fin present, rarely obsolete; dorsal fin short, of soft rays only; pectorals and ventrals present; anal fin moderate or long; caudal forked; skeleton rather well ossified; air-bladder small or wanting; intestinal canal short; sides sometimes with phosphorescent spots or photophores; eggs inclosed in the sacs of ovary and extruded through an oviduct. Genera about 10, species about 40, mostly inhabiting shore waters, some of them descending to the depths.

Three genera and about 4 species known from Hawaiian waters.

a. Vent slightly nearer base of caudal than axil of pectoral; head short, blunt, compressed..... *Trachinocephalus*, p. 61
aa. Vent much nearer base of caudal than base of ventrals; head depressed, with flat, triangular snout.
b. Teeth on the palatines in a single band on each side ..... *Synodus*, p. 63
bb. Teeth on the palatines in a double band on each side..... *Saurida*, p. 65

Genus 23. TRACHINOCEPHALUS Gill.

This genus is closely related to *Synodus*, from which it differs chiefly in form and in the relative development of the fins. Body stout; head short, blunt, compressed, its form much as in the genus *Trachinus;* vent well forward, very slightly nearer base of caudal than base of ventrals, under tip of last dorsal ray; teeth as in *Synodus*, but slender, smaller, and closely set; lower jaw projecting. A single species is known, widely diffused in the tropical seas.

Trachinocephalus Gill, Cat. Fish. Eastern Coast N. Amer., 53, 1861 (*myops*); name only; first defined by Jordan & Gilbert Synopsis, 281, 1883.

24. Trachinocephalus myops (Forster). *"Kawelea;" "Welea."* Fig. 13.

Head 3.5 in length; depth 5; D. 13; A. 16; P. 12; V. 8; scales 4–55–5; width of head only a very little less than twice its length; depth of head 1.6 in its length; snout 1.5 in eye; eye 3 in maxillary; maxillary 1.85 in head; interorbital space 1 in snout, 1.5 in eye; pectoral 2.25 in head; ventral 1; base of anal 3.67 in body; length of depressed dorsal 3.75.

Body elongate, compressed, deepest forward or about the neck, gradually tapering backward with a long tail; head large, elongate, deep, compressed laterally, the upper profile very blunt, gibbous in front; the lower profile a rather long shallow convex curve from tip of snout to below pectoral; snout very short, blunt, obtuse; eye small, its posterior rim nearly midway in space between tip of snout and end of maxillary, the latter considered in the vertical until level with tip of snout; mouth cleft very large and oblique, the maxillary long, with its posterior portion gradually constricted until it is much narrower than at middle of its length; mandible very large, the rami broad and powerful; lips broad, thin; teeth in jaws sharp, more or less unequal, in double series; in upper jaw the outer series more or less concealed by the broad lips; in the lower jaw those in inner series the larger; no vomerine teeth; those on palatines in a single series; tongue a triangular ridge, free in front, with a triangular patch of depressible teeth above, and with a single median series extending backward over the basibranchials; nostrils close together on the sides of snout, the anterior with a ciliated flap; interorbital space deeply concave, each of the supraorbital ridges raised in front; top of head more or less rugose,

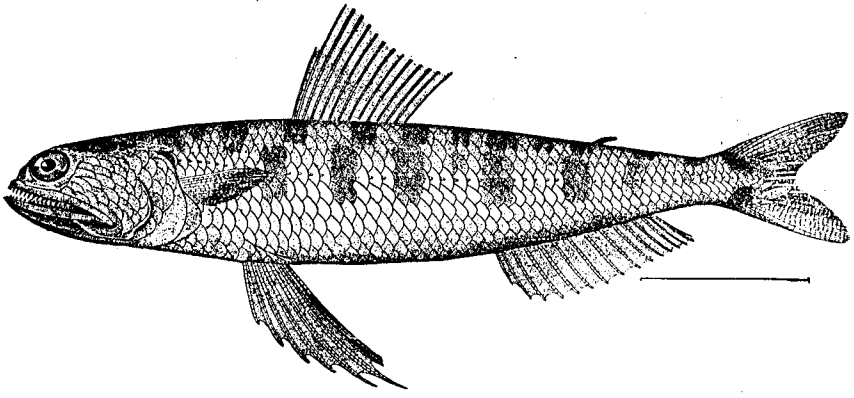


FIG. 13.—*Trachinocephalus myops* (Forster); after Jordan and Evermann.

also the posterior lower border of orbit; gill-openings large, the membranes free from isthmus; no gillrakers, the inner surface of the branchial arches covered with minute asperities; gill-filaments short; no pseudobranchiæ; peritoneum silvery; scales large, cycloid, 6 rows on cheek, a number along edge of preopercle and on opercle; occiput scaly, rest of head bare; scales between ventrals forming a broad scaly flap; scale at axil of pectoral somewhat pointed; ventrals with a scaly flap 2.5 in length of fin; lateral line slightly decurved at first and then straight along side to base of caudal; origin of dorsal nearer tip of snout than origin of adipose fin by an eye diameter; length of last dorsal ray half the length of first developed ray and when depressed the tip of first developed ray reaching 0.75 length of depressed fin; adipose dorsal nearer tip of last depressed dorsal than base of caudal; origin of anal midway between axil of pectoral and base of caudal, and behind base of last dorsal ray; caudal deeply forked; pectoral small, tip not reaching origin of dorsal; ventrals very long, reaching origin of anal, inserted a little before tips of pectorals.

Color in life (No. 03233), pale grayish, silvery below; side of back with 3 wavy stripes of dull yellow, each edged with darker olive, the uppermost most wavy, joining its fellow across the back in about 12 irregular crossbars of dirty yellow, edged with darker, the interspaces pearly-bluish; below the lowest yellow streak are 2 very faint similar streaks lost in the white color of the side; head with streaks continued from the sides but fainter; top of head mottled sand-color; an oblique jet-black spot on the scapular region; dorsal with 2 faint cross-streaks of light yellow and 2 of pearly-blue, besides 2 or 3 dark dots; caudal faint yellowish; lower fins whitish; the ventrals creamy.

This description from a large example (No. 03599), 8.75 inches long, taken at Hilo. Many specimens were obtained from Hilo and Honolulu. We can not separate *T. limbatus* from *T. trachinus* of Japan or *T. myops* of the Atlantic. Probably all constitute a single species.

Salmo myops Forster in Schneider, Syst. Ichth., 421, 1801, **St. Helena.**
Osmerus lemniscatus Lacépède, Hist. Nat. Poiss., V, 236, 1803, **Martinique**; after Plumier.
Saurus truncatus Agassiz, Pisc. Brasil., 82, tab. XLV, 1829, **Brazil.**
Saurus myops, Cuvier, Règne Animal, Ed. II, 268, 1829 (after Forster); Günther, Cat., V, 398, 1864 (Cuba, Jamaica, Japan, Amboyna, Pinang, Mauritius, Port Jackson).
Saurus limbatus Eydoux & Souleyet, Voyage Bonite, Poiss., 199, 1841, **Hawaii.**
Saurus trachinus Schlegel, Fauna Japonica, Poiss., 231, pl. 106, fig. 2, 1842, **Japan.**
Saurus brevirostris Poey, Memorias, II, 305, 1860, **Cuba.**
Synodus myops, Bleeker, Atlas Ichth., VI, 153, pl. 278, fig. 3, 1870-1872 (Sumatra, Pinang, Bangka, Bali, Celebes, Batjan, Amboyna, Ceram).
Trachinocephalus myops, Jordan, Proc. U. S. Nat. Mus., XIII, 1890, 314; Jordan & Evermann, Fishes North and Mid. Amer., I, 533, 1896; Evermann & Marsh, Fishes of Porto Rico, 91, 1900; Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 433 (Honolulu); Snyder, op. cit. (Jan. 19, 1904), 521 (Honolulu; Hanalei Bay, Kauai).

Genus 24. SYNODUS (Gronow) Bloch & Schneider.

First superior pharyngeal cartilaginous; second without teeth; third and fourth separate, with teeth; lower pharyngeals separate; body elongate, subterete; head depressed; snout triangular, rather pointed; interorbital region transversely concave; mouth very wide; premaxillaries not protractile, very long and strong, more than half length of head; maxillaries closely connected with premaxillaries, very small or obsolete; premaxillaries with 1 or 2 series of large, compressed, knife-shaped teeth, the inner and larger depressible; palatine teeth similar, smaller, in a single broad band; lower jaw with a band of rather large teeth, the inner and larger ones depressible; a patch of strong, depressible teeth on tongue in front, a long row along the hyoid bone; jaws nearly equal in front; eye rather large, anterior; supraorbital forming a projection above the eye; pseudobranchiæ well developed; gillrakers very small, spine-like; gill-membranes slightly connected; top of head naked; cheeks and opercles scaled like body; body covered with rather small, adherent, cycloid scales; lateral line present; no luminous spots; dorsal fin short, rather anterior; pectorals moderate, inserted high; ventrals anterior, not far behind pectorals, large, the inner rays longer than the outer; anal short; caudal narrow, forked; vent posterior, much nearer base of caudal than base of ventrals; branchiostegals 12 to 16; stomach with a long, blind sac and many pyloric cœca; skeleton rather firm. Species numerous. Voracious fishes of moderate size, inhabiting sandy bottoms at no great depth, in most warm seas.

Two species known from the Hawaiian Islands, the one here described and a deep-water form (*Synodus kaianus*), described in Section II.

Synodus Bloch & Schneider, Syst. Ichth., 396, 1801 (*synodus*).
Tirus Rafinesque, Caratteri, 56, 1810 (*marmoratus*).
Saurus Cuvier, Règne Animal, Ed. I, 169, 1817 (*saurus*).
Laurida Swainson, Class. Animal., II, 287, 1839 (*mediterranea* = *saurus*).

a. Body elongate, not especially slender; jaws about equal, snout not protruding beyond mandible..... *varius*, p. 63.
aa. Body very slender; snout protruding beyond the mandible..... *kaianus*, in Section II.

25. Synodus varius (Lacépède). "*Uláe.*" Plate II and Fig 14.

Head 3.5 in length; depth 6; D. 13; A. 8; P. 13; V. 8; scales 5-65-11; width of head 1.67 in its length; depth of head 1.8 in its length; snout 4.75 in head; maxillary 1.6; interorbital space 7; eye 1.5 in snout, 4.25 in maxillary; interorbital space 1.75 in snout; pectoral 2; ventral 1; base of anal 3; length of depressed dorsal 1.17.

Body elongate, rounded, the back and ventral surface depressed; head large, elongate, broadly depressed, pointed, with the eyes impinging upon upper profile, and the lower profile from tip of mandible shallowly convex; snout rather long, depressed, sharply pointed; eye well anterior, though the posterior rim is not midway in space between tip of snout and end of maxillary, the latter considered in the vertical until level with tip of snout; mouth-cleft very large, oblique, the maxillary long, with its greatest width a little anterior to the middle of its length; mandible very large and powerful; jaws

about equal in the closed mouth; symphysis pointed; lips thin and broad; teeth in jaws sharp, depressible, directed forward, in 2 irregular series, those forming the outer series in upper jaw more or less concealed by the broad lip, so that only the tips of these larger ones are seen when the mouth is closed; teeth on vomer and palatines depressible, sharp; in a narrow band on each side of the latter; tongue and basi-branchials with a band of depressible teeth, forming a triangular patch of large ones on the former; tongue rather sharply pointed, a little free in front; nostrils on the sides of snout, each pair close together, nearer front margin of eye than tip of snout, the anterior pair with an elevated fleshy rim which ends in a fleshy point; interorbital space concave, a bony ridge rather prominent in front of each eye; top of head all more or less roughened, also the space behind eye; gill-opening large, the narrow membrane free from isthmus; gillrakers developed as small sharp asperities on the inner surface of branchial arches; gill-filaments short; pseudobranchiæ small; peritoneum silvery; scales large, cycloid, 6 rows on cheek; a series of enlarged scales along the margin of preopercle; occiput and sides of head scaly, the rest bare; scales between ventrals forming a broad flap; no scaly flap at base of pectoral; a small short scaly flap at base of ventral; lateral line nearly straight to base of caudal; origin of dorsal midway between tip of snout and origin of adipose dorsal; last dorsal ray a trifle over half length of longest ray of fin, tip of latter reaching a little over two-thirds length of fin when depressed; origin of adipose dorsal about midway between tip of last dorsal ray and base of caudal; anal small, its origin well in front of that of adipose fin and about midway between tip of ventral and base of caudal; caudal deeply emarginate, the lobes pointed; pectoral small, not reaching origin of dorsal; origin of ventrals about midway in length of pectoral.

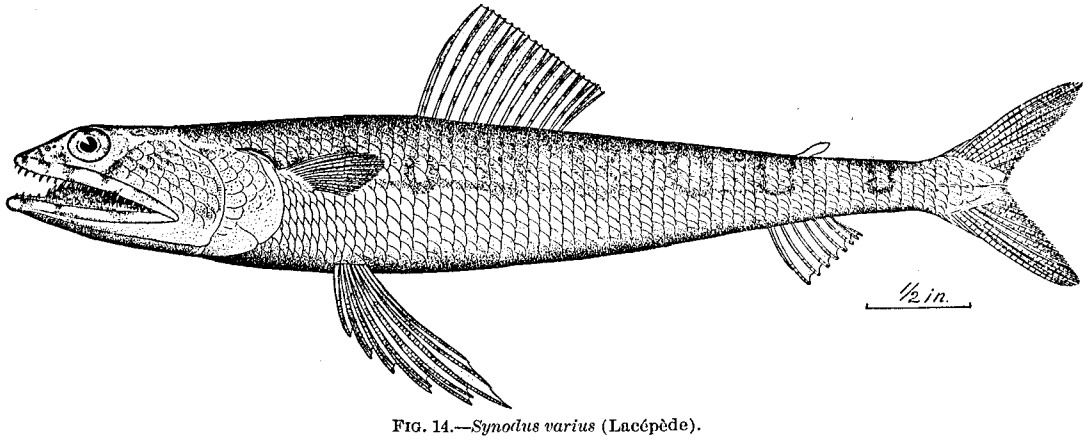


FIG. 14.—*Synodus varius* (Lacépède).

Color when fresh (field No. 03430) ground white; a series of light reddish-brown quadrate spots along side, the markings over the back darker reddish brown; an indistinct bluish longitudinal band showing through just above the lateral row of quadrate spots along the side; a reddish spot on the upper angle of gill-opening; dorsal crossed by light-brown lines transverse to the fin rays; pectoral also crossed by narrow light-brown lines; ventral with 6 orange-colored crossbars.

We have two other examples, the first of which (No. 03236) was light gray when fresh, with dark markings all olive, washed with brownish red; belly white; upper fins pale, with narrow crossbands of white dots; lower fins white. The other specimen (No. 03010) when fresh had the back flesh color, with about 6 reddish-brown lines made up of dark borders to the scales; side with a narrow pale-yellow line, below this a fainter one; lower side and belly white; dorsal fin pale, with small white specks; other fins all pale; iris green.

Another example (No. 03011) in life was pale grayish on back and sides, crossed by 5 or 6 broad greenish-red bars or saddles, red at lower ends; belly white; head marbled with brown, orange, and white; lower jaw white, with some pale brown; fins all pale; iris orange and yellow.

In life another example (No. 03235) was rose red, with dark-brown streaks and marks; lower parts silvery, with bars of salmon-color; side of head with salmon-colored bars below, especially distinct on lower jaw and breast; dorsal and caudal with bars of fine white specks.

Color in spirits, pale brown, darker above, the edge of each scale dark brown, crossed by 5 broad cross-bands, between which are as many similar cross-bands of lighter shade; 3 broad cross-bands across the mandible.

This description from an example (No. 03817), 10.2 inches long, taken at Hilo. Our numerous specimens range in length from 2 to 10 inches. An unusually large specimen recently received from Mr. Berndt, at Honolulu, measures 13.75 inches.

We have many specimens from Hilo and Honolulu.

In some cases the dark mottlings are of the deepest scarlet, others brick red, while those found on sandy shores are olive-green. The species is found in 2 colors, red and green, on the coasts of Japan, as in Hawaii.

Salmo varius Lacépède, Hist. Nat. Poiss., V, 224, pl. 3, fig. 3, 1803, **Ile de France.**
Saurus variegatus Quoy & Gaimard, Voy. Uranie, Poiss., 223, pl. 48, fig. 3, 1824, **Maui.**
Saurus varius, Günther, Cat., V, 395, 1864 (part).
Synodus varius, Steindachner, Denks. Ak. Wiss. Wien, LXX, 1900, 513 (Honolulu; Laysan); Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 433 (Honolulu); Snyder, op. cit. (Jan. 19, 1904), 521 (Honolulu); Jordan & Snyder, Proc. U. S. Nat. Mus., XXVIII, 1904 (Oct.), 125 (Honolulu.)
Synodus sharpi Fowler, Proc. Ac. Nat. Sci. Phila. 1900, 497, pl. XIX, fig. 2, **Hawaiian Islands.** (Types, Nos. 16084 and 16086, Ac. Nat. Sci. Phila.)
Synodus variegatus, Seale, Occas. Papers Bishop Mus., I, part 4, 63, 1901 (Guam).

Genus 25. SAURIDA Cuvier & Valenciennes.

Body subcylindrical, rather elongate; tail tapering; head oblong, depressed; snout rather short, pointed; eye moderate; mouth cleft very wide; intermaxillary very long, styliform, tapering; maxillary thin, long, closely adherent to intermaxillary; teeth cardiform, those in the inner series being the longest, slender, depressible both downward and inward, and present in the jaws, on tongue, and on palatine bones, the latter forming a double band on each side, the inner band being much shorter than the outer; gill-opening very wide, gill-membranes not attached to isthmus; branchiostegals numerous; dorsal fin nearly in the middle of length of body, with 13 or fewer rays; adipose fin small; anal short; caudal forked; pectoral short or of moderate length; ventral 9-rayed, the inner rays not much longer than the outer ones, and inserted before the dorsal, not far from the pectorals. Species few, in the tropical seas of the East Indies, China, Australia, and the Western Pacific.

Saurida Cuvier & Valenciennes, Hist. Nat. Poiss., XXII, 499, 1849 (*tumbil*).

26. Saurida gracilis (Quoy & Gaimard). *"Uláe."*

Head 4.5 in length; depth 6.5; D. 11; A. 10; P. 19; V. 9; scales 4-52-5; width of head 1.5 in its length; depth of head 1.67 in its length; snout 4.5 in head; maxillary 1.5; interorbital space 4.5; eye 1.25 in snout, 4 in maxillary; interorbital space 1 in snout; pectoral 1.3; base of anal 2.5; length of depressed dorsal only slightly less than the length of head.

Body elongate, rounded, the back and ventral surfaces depressed; head small, elongated, broadly depressed, pointed, the eyes impinging slightly upon the upper profile, the lower profile from tip of mandible slightly convex; snout rather long, depressed, flattened, very broad at front of eye, where it is about 0.4 broader than long; eye well anterior, about midway in the space between tip of snout and end of maxillary, the latter considered in the vertical until level with tip of snout; mouth cleft large, oblique, becoming narrow toward its posterior extremity; mandible large, powerful, the jaws equal when mouth is closed; teeth in jaws unequal, those forming an inner series the larger, the lips very narrow, so that most all the teeth are visible when mouth is closed; palatines with 2 bands of teeth, most of them depressible, some of those in front enlarged, the inner band short; tongue very small, rounded, without any teeth, free in front; a median series of fine teeth along the basibranchials; nostrils small, close together on sides of snout, nearer tip of latter than anterior margin of eye, anterior pair with a small fleshy flap; interorbital space broad, somewhat concave but flattened in the middle; a depressed bony ridge rather prominent above each eye in front; top of head roughened on each side of occiput; gill-openings large, the narrow membrane free from the narrow compressed isthmus; gill-rakers as minute asperities; gill-filaments rather short; pseudobranchiæ moderately large; peritoneum pale; scales large, cycloid, about 4 rows on cheek; opercles and occiput scaly, rest of head bare; origin of dorsal midway between tip of snout and posterior margin of adipose fin; last dorsal ray about three-

sevenths length of longest ray of fin, tip of latter reaching as far posteriorly as tip of the former when fin is depressed; origin of adipose dorsal midway between tip of depressed dorsal and base of caudal; origin of anal nearer base of caudal than tip of ventral, the greater part of its base anterior to adipose dorsal; caudal deeply emarginate, the lobes pointed; pectoral small, falling from origin of dorsal; ventrals large, inserted below last third of pectoral and reaching about three-sevenths of the space to origin of anal.

Color in alcohol, dull or muddy brown above, marked with about 6 or more deep-brown saddles or broad cross-bands, the spaces between with deep-brown blotches; similar blotches also along the side; dorsal, caudal, and pectoral dull brownish, with blackish brown crossbars, the last 3 broad and very distinct; lower surface of body dull silvery white, with a very dull yellowish green tint; ventrals very light yellowish green. This description from an example 8.5 inches long, from Hilo.

We have a number of examples from Hilo and Honolulu, many of the small ones deeply colored. This species common on sandy shores at moderate depths.

Saurus gracilis Quoy & Gaimard, Voy. de l'Uranie, Zool., 224, 1824, **Sandwich Islands.**
Saurus ferox Eydoux & Souleyet, Voy. Bonite, Poiss., 197, pl. 7, fig. 3, 1841, **no locality.**
Saurida nebulosa Cuvier & Valenciennes, Hist. Nat. Poiss., XXII, 504, pl. 648, 1849, **Ile de France**; Günther, Cat., V, 399, 1864 (Madagascar; Amboyna; Sandwich Islands); Streets, Bull. U. S. Nat. Mus., No. 7, 76, 1877 (Honolulu).
Saurida tumbil, Fowler, Proc. Ac. Nat. Sci. Phila. 1900, 498 (Hawaiian Islands); not of Bloch.
Saurida gracilis, Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 433 (Honolulu); Snyder, l. c. (Jan. 19, 1904), 521 (Hanalei Bay, Kauai).

Family XVIII.—AULOPIDÆ.

Allied to the *Synodontidæ*, but with the maxillary separate, well developed and dilated behind; hypocoracoids extended downward as in many spiny-rayed fishes; gillrakers mostly long and slender, needle-shaped; eyes normal, large or small; no luminous spots; jaws without fang-like teeth; dorsal fin moderate, nearly median in position; body elongate; pectorals present, normal in form and position; adipose fin normally present; pseudobranchiæ present. This family, as here understood, includes some half-dozen species, fishes of moderate depths, chiefly of the Atlantic. Only one species known from the Hawaiian Islands.

Genus 26. CHLOROPHTHALMUS Bonaparte.

Head elongate; body subterete, covered with moderate-sized, adherent, pectinate or ctenoid scales, which are arranged in straight, parallel, oblique lines; mouth rather large; maxillary well developed, dilated behind, reaching to beyond front of orbit; lower jaw projecting; teeth very small, sharp on jaws, vomer, and palatines, usually minute teeth on tongue; eye very large; dorsal short, inserted before middle of length of body; adipose fin small; anal short; caudal forked; pectorals and ventrals well developed, the ventrals inserted under dorsal and not far behind pectorals, none of the rays forming exserted filaments; gill-openings wide; branchiostegals 10; pseudobranchiæ well developed; gillrakers needle-shaped, rather numerous; color silvery, with darker markings. Deep seas.

Of 4 known species only one, *C. proridens*, occurs in Hawaiian waters. (See Section II.)

Chlorophthalmus Bonaparte, Fauna Italica, fasc. XXVIII, Pesci, 1840 (*agassizii*).
Hyphaloncdrus Goode, Proc. U. S. Nat. Mus., III, 1880, 483 (*chalybeius*).

Family XIX. BATHYPTEROIDÆ.

Characters of the family included below in those of its single genus.

Genus 27. BATHYPTEROIS Günther.

Shape of body like that of *Aulopus*. Head of moderate size, depressed in front, with the snout projecting, the large mandible very prominent beyond upper jaw. Cleft of mouth wide; maxillary much developed, very movable, much dilated behind. Teeth in narrow villiform bands in the jaws; on each side of the broad vomer a small patch of similar teeth; none on palatines or tongue; eye very small; scales cycloid, adherent, of moderate size; rays of pectoral much elongate, some of the upper being separate from the rest and forming a distinct division; ventrals abdominal, 8-rayed, with the

outer rays prolonged; dorsal fin inserted at middle of body or absent; anal short; caudal forked; gill-openings very wide; gill-laminæ well developed, separate from each other; gillrakers long; pseudobranchiæ none. Deep-sea fishes.

Bathypterois Günther, Ann. and Mag. Nat. Hist. 1878, 5th series II, 183 (*longifilis*).
Synapteretmus Goode & Bean, Oceanic Ichth., 64, 1896 (*quadrifilis*).

The single Hawaiian species of this family is fully described in Section II.

Family XX. MYCTOPHIDÆ.—The Lantern Fishes.

Body oblong or moderately elongate, more or less compressed, covered with scales which are usually cycloid, but sometimes ctenoid; mouth wide; entire margin of upper jaw formed by the long and slender premaxillaries, closely adherent to which are the slender maxillaries; teeth various, mostly villiform, in bands in the jaws, also on the pterygoids, palatines, and tongue, and on the vomer in adults; no barbels; gill-membranes separate, free; branchiostegals 8 to 10; pseudobranchiæ well developed; gillrakers long and slender; lateral line usually present; scales prominent and often enlarged; cheeks and opercles scaly; adipose fin present; dorsal fin short, median, of soft rays; pectorals and ventrals present; anal fin moderate; caudal forked; air-bladder small; intestinal canal short; luminous spots or photophores more or less regularly placed along sides of body; larger luminous glands often present on head or on caudal peduncle.

Species about 100. Small fishes, very widely distributed in the open sea. They live away from the shores, ordinarily at a considerable depth, coming to the surface at night or in stormy weather, descending by day.

a. Dorsal fin long, ending not much, if any, before front of anal fin.
  b. Caudal photophores 4 or 3, never 2; dorsal fin not much longer than anal; body deep or slender, not much contracted behind; caudal peduncle robust; edge of preopercle more or less oblique.
    c. Head with large luminous glands before or below the eye ..... *Diaphus*, p. 67.
    cc. Head without large luminous glands ..... *Nannobrachium*, p. 67.
  bb. Caudal photophores 2, never 3 or 4; dorsal fin notably shorter than anal, its rays 9 to 14; anal rays 16 to 20; body deep anteriorly; caudal peduncle slender, edge of preopercle nearly vertical; pectorals long, placed high; no luminous glands on head; eye large.
    d. Scales cycloid; maxillary scarcely enlarged at tip; last rays of dorsal not behind first of anal.
      e. Snout prominent, projecting beyond tip of lower jaw; scales of lateral line more or less enlarged; caudal peduncle very slender; usually a luminous gland on its upper surface.
        f. Lateral line well developed ..... *Rhinoscopelus*, p. 68.
        ff. Lateral line none ..... *Centrobranchus*, p. 69.
      ee. Snout little prominent, scarcely projecting beyond tip of lower jaw; scales of lateral line usually not enlarged; no luminous glands on upper edge of tail; moderately elongate ..... *Myctophum*, p. 69.
    dd. Scales ctenoid, firm; tail with a luminous gland above ..... *Dasyscopelus*, p. 69.
aa. Dorsal and anal short, similar, far apart ..... *Neoscopelus*, p. 69.

Genus 28. DIAPHUS Eigenmann & Eigenmann.

This genus is closely related to *Æthoprora*, its chief character being the division of all or nearly all of the photophores by a horizontal cross-septum of black pigment, giving them the form of the Greek letter *Φ*, *theta*. This septum is readily injured or destroyed in badly preserved specimens, and perhaps all species called *Æthoprora* have it. Of the 5 known species 3 have been taken in Hawaiian waters, and are described in Section II.

Diaphus Eigenmann & Eigenmann, Proc. Cal. Ac. Sci., 2d series, III, 1890, 3 (*theta*).
? *Æthoprora* Goode & Bean, Oceanic Ichth., 86, 1896 (*metopoclampa*).
? *Collettia* Goode & Bean, Oceanic Ichth., 83, 1896 (*rafinesquei*)

Genus 29. NANNOBRACHIUM Günther.

This genus is closely allied to *Lampanyctus*, from which it differs chiefly in the small pectorals. Caudal peduncle with luminous blotches above and below; photophores small, arranged as in *Lampanyctus;* scales of lateral line enlarged in all species, so far as known; last ray of dorsal more or less behind front of anal. Several species, only one Hawaiian (*Nannobrachium nigrum*) described in Section II.

Nannobrachium Günther, Deep-sea Fishes Challenger, 199, 1887 (*nigrum*).
Stenobrachius Eigenmann & Eigenmann, Proc. Cal. Ac. Sci., III, 1890, 5 (*leucopsarum*).

Genus 30. RHINOSCOPELUS Lütken.

Body oblong, slender, compressed, with slender and elongate caudal peduncle covered with smooth, stiff scales, those in the lateral line much larger than the others; head compressed; cleft of mouth very wide; jaws about equal; snout projecting beyond tip of lower jaw; premaxillary long and slender; maxillary well developed, reaching nearly or quite to angle of preopercle, without considerable posterior dilation; teeth in villiform bands in the jaws, on the palatines, pterygoids, and tongue; eye moderate, its diameter less than one-third length of head; gillrakers very long and slender; dorsal fin premedian; pectoral large; adipose dorsal small; anal fin larger than dorsal; pectoral narrow, elongate; precaudals 2; supraanals about 18, in 2 groups, the break being over middle of the long anal fin and at end of first third of the series, approximately; anterolaterals 1 or 2; mediolaterals 2 or 3. Species few, mostly of the Atlantic.

Alysia Lowe, Proc. Zool. Soc. London 1849, 14 (*loricata=coccoi*); name preoccupied.
Rhinoscopelus Lütken, Vid. Selsk. Natur. Copenhagen, VII, 1892, 237 (*coccoi*).

27. Rhinoscopelus oceanicus Jordan & Evermann. Fig. 15.

Head 3.5 in length; depth 4.1; eye 2.5 in head; snout very short, about 6; interorbital 3.5; D. about 12; A. about 18; scales 2–35–3.

Body strongly compressed, particularly posteriorly, where it tapers into the long, slender caudal peduncle; head exceeding depth of body; mouth large, somewhat oblique, the jaws equal, the maxillary reaching beyond the orbit, its posterior end club-shaped; eye large; anterior profile rather evenly

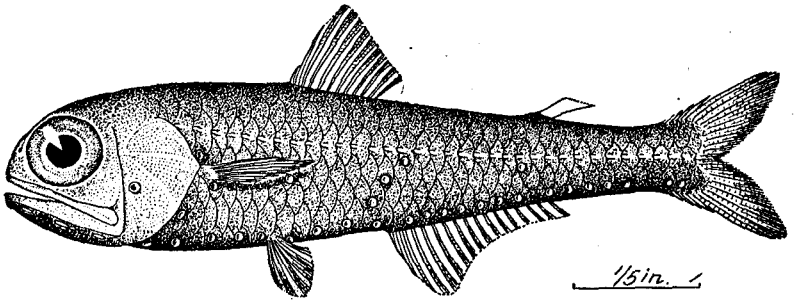


FIG. 15.—*Rhinoscopelus oceanicus* Jordan & Evermann; from the type.

convex from tip of snout to nape; teeth difficult to make out, but a single row of minute ones can be seen on the edge of each jaw, the exterior granular or short; the villiform stripe, if it exists, being invisible even with the aid of a good lens; teeth on vomer and edges of palatines more distinct than those on jaws, forming a broader line as if there were 2 or more rows; no granular patches visible on disk of palatine bone; an elevated acute mesial line separating one nasal prominence from the other; interorbital space convex, rounded; preopercle nearly vertical, sloping slightly backward from above downward; scales large, undulated and very irregularly and sparingly toothed or crenate, and having about 3 basal furrows; scales of lateral line conspicuous and more persistent; 7 photophores along base of anal, 5 along lower edge of caudal peduncle, 2 at base of caudal, 1 on middle of side above last anal photophore, 4 on each side of belly between ventrals and origin of anal fin, 5 between base of ventral and gill-opening, 1 on side above base of ventral, a row of 3 upward and backward from front of anal, 1 above and 1 below base of pectoral, and 1 on lower anterior portion of opercle; origin of dorsal somewhat behind base of ventrals, the posterior rays, together with those of anal, divided to the base; no spine at base of caudal.

Color in alcohol, uniform brownish, the scales, especially on middle of side, metallic steel blue; top of head brownish; side of head bluish; photophores black with silvery center; fins dusky whitish.

During the Agassiz South Pacific expedition of the *Albatross* in 1899–1900, 2 examples of this species were taken in the surface tow net at 8 p. m., September 8, 1899, at latitude 10° 57′ N., longitude 137° 35′ W., southeast of the Hawaiian Islands. These are apparently distinct from *R. coruscans*, the type of which came from between St. Helena and Ascension islands, and other specimens from

between Australia and New Zealand. They are near *R. andreæ* Lütken, from which they seem to differ in the blunter snout, the more slender tail, and in having the postero-lateral photophore somewhat before the adipose fin.

Type, No. 50622, U. S. N. M. (field No. 05805), 1.3 inches long, collected by the *Albatross* at 8 p. m., September 8, 1899, at the surface at 137° 35′ W., 10° 57′ N.; cotype, No. 2736, U. S. F. C., same size, collected at same time and place.

Rhinoscopelus oceanicus Jordan & Evermann, Bull. U. S. Fish Comm., XXII, 1902 (Apr. 11, 1903), 168, **near Hawaiian Islands.**

Genus 31. CENTROBRANCHUS Fowler.

This genus is close to *Rhinoscopelus*, from which it seems to differ in the character of the gillrakers, which are short sparse clusters of asperities on the first arch. Two species known, both from Hawaiian waters. (See Section II.)

Centrobranchus Fowler, Proc. Ac. Nat. Sci. Phila. 1903 (Jan. 13, 1904), 754 (*chærocephalus*).

28. Centrobranchus chœrocephalus Fowler.

This species, fully described in Section II of this work, was based by Mr. Fowler on 4 specimens in the Museum of the Philadelphia Academy, which were originally identified by Mr. Fowler with *Rhinoscopelus coruscans* (Richardson), and later thought by us to be identical with the specimen which we described as *R. oceanicus*. Upon a reexamination of his specimens Mr. Fowler finds them to represent a distinct genus as indicated above.

Centrobranchus chærocephalus Fowler, Proc. Ac. Nat. Sci. Phila. 1903 (Nov.), 754, **near Sandwich Islands.** (Type, No. 7972, Ac. Nat. Sci. Phila. Coll. Dr. Wm. H. Jones.)

Rhinoscopelus oceanicus Jordan & Evermann, Bull. U. S. Fish Comm., XXII, 1902 (Apr. 11, 1903), 168 (only the reference to Dr. Jones's specimens).

Genus 32. MYCTOPHUM Rafinesque.

Body oblong, compressed, covered with cycloid scales, those in the lateral line not much enlarged; caudal peduncle rather slender; head short, compressed, with limb of preopercle nearly vertical; mouth large; jaws about equal; premaxillaries long and slender; maxillaries well developed; snout more or less blunt and declivous; teeth in villiform bands on jaws, palatines, pterygoids, and tongue; eye large, gillrakers long and slender; air-bladder small; dorsal fin entirely in front of anal, overlapping it little or not at all; ventrals 8-rayed, under or but slightly in front of first dorsal rays; pectorals well developed; soft dorsal slender; precaudal photophores 2; supraanals in 2 groups, with 1 or 2 postero-laterals above the interval between them. Species rather numerous, widely distributed, 4 known from Hawaiian waters, and described in Section II.

Myctophum Rafinesque, Indice d'Ittiologia Siciliana, 56, 1810 (*punctatum*).
Scopelus Cuvier, Règne Animal, Ed. II, 169, 1817 (*humboldti*).
Nyctophus Cocco, Giorn. Sicil., 44, 1829 (amended orthography of *Myctophum*).

Genus 33. DASYSCOPELUS Günther.

Dorsal and anal fins touching the same vertical, but not overlapping; scales hard, persistent, ctenoid, those of lateral line much enlarged; anal terminating below adipose dorsal; body elevated, somewhat compressed; caudal peduncle rather slender; luminous scales on the back of caudal peduncle; arrangement of photophores much as in *Myctophum*. Species few, remarkable for the firm, rough scales. Two species known from the Hawaiian Islands (*D. spinosus* and *D. pristilepis*) described in Section II.

Dasyscopelus Günther, Cat., V, 405, 1864 (*asper*).

Genus 34. NEOSCOPELUS Johnson.

Body oblong, compressed; mouth-cleft not extending beyond eye, the upper borders formed entirely of the premaxillary; the maxillary dilated below and furnished with a small supplementary piece; scombinate bands of teeth in both jaws, on palatine bones, and on vomer, also scombinate

patches of teeth on the entopterygoids; body covered with large, caducous scales; first dorsal placed over the abdominal ventral fins; pectoral fins long, their inferior rays not thicker than the rest. (Goode & Bean.)

Neoscopelus Johnson, Proc. Zool. Soc. London 1863, 44 (*macrolepidotus*).

29. Neoscopelus alcocki Jordan & Starks.

Head 3 in length; depth 4; D 13; A. 12; scales 4–33–4; eye 5 in head; snout 3.5; maxillary 2.

Body rather robust, subfusiform; head rather pointed in profile, broad and somewhat depressed above; mouth large, oblique, maxillary extending to below posterior margin of orbit, not dilated behind, posterior border truncate; teeth small, in villiform bands; eye moderate, cheek broad, not oblique in position; scales large, entire, firm, roughened on the surface, nearly all fallen in specimen examined; lateral line well developed; luminous spots large, in about 6 rows on breast, about 14 in a lengthwise series from isthmus to ventrals, then a median and 2 lateral rows, to opposite front of anal, 10 spots in outer row, the posterior one smaller; an oblong circle of 10 small photophores about the vent; a row of 15 small photophores, continuous with inner lateral row before vent, from opposite vent to base of caudal, most of the median members of this series double; there is also an inner series of minute white dots along base of anal rays; a median row of small photophores behind anal below caudal peduncle. Dorsal rather large, inserted before ventral, its longest rays about half head; longest anal ray 2.4 in head; caudal well forked; pectoral long, 1.1 in head; ventral long, 1.75; gillrakers long and slender, 3+12 in number.

Color, pale or brownish above, belly black; a dusky shade at base of caudal and pectoral; inside of mouth black; luminous spots pale, with a dark ring.

This species is very close to *Neoscopelus macrolepidotus* of the Atlantic. The sole important difference apparently lies in the arrangement of the photophores on the posterior part of body. In the figures (Nos. 108 and 109) given by Goode & Bean (Oceanic Ichthyology), the arrangement is quite unlike that seen in the Japanese fish; the two lateral rows of spots found on the abdomen are represented as continuous to the base of caudal. In the Japanese fish the outer row is not continued behind the front of anal. The inner lateral series is continued, the spots becoming smaller. There is a ring of little spots about the vent, and a series of little dots along base of anal.

The species abundant about Hawaii, called *Neoscopelus macrolepidotus* by Gilbert & Cramer, seems to be the same as the Japanese fish.

Neoscopelus macrolepidotus, Gilbert & Cramer, Proc. U. S. Nat. Mus., XIX, 1897 (Feb. 5), 414 (near Honolulu); not of Johnson.
Neoscopelus alcocki Jordan & Starks, Bull. U. S. Fish Comm., XXII, 1902 (August 13, 1904), 580, pl. 2, figs. 1 and 2, **Albatross Station 3709, Suruga Bay, Japan,** in 173 to 260 fathoms. (Type, No. 51477, U. S. Nat. Mus.)

Family XXI. MAUROLICIDÆ.

Body moderately elongate, compressed, scaleless; barbels none; margin of upper jaw formed by the maxillary and premaxillary, both of which are provided with teeth; opercular apparatus incomplete; gill-opening very wide, the outer branchial arch extending forward to behind the symphysis of lower jaw; pseudobranchiæ present; air-bladder none; adipose fin rudimentary; series of luminous photophores present along the lower side of head, tail, and body; a single dorsal fin without spines. (Goode & Bean.) Genera 4 or 5, with some 8 or 10 species. Deep-sea fishes, represented in the Hawaiian Islands by a single known species.

Genus 35. ARGYRIPNUS Gilbert & Cramer.

Body much compressed, oblong or elongate, passing gradually into the slender tail, covered with very thin, flexible, cycloid, deciduous scales; head longer than deep, without spines, its bones thin and flexible; maxillary sickle-shaped, with spatulate supplemental bone; eye large; dorsal fin on middle of back, without anterior spinous dilatation; a large (double) luminous organ on preopercle and series of equidistant organs on branchiostegals, isthmus, breast, abdomen, and lower part of side; a continuous series from above base of ventral fin to about end of anterior third of base of anal fin; a closely set series of 5 spots above middle of anal fin, and another series of 15 beginning above hinder end of anal and extending to anterior rudimentary rays of caudal. The single species of this genus (*Argyripnus ephippiatus*) is fully described in Section II.

Argyripnus Gilbert & Cramer, Proc. U. S. Nat. Mus., XIX, 414, 1897 (February 5, 1897) (*ephippiatus*).

Genus 36. ARGYROPELECUS Cocco.

Body much elevated and compressed, passing abruptly into the short tail; no scales, the skin covered with silvery pigment; series of luminous spots along the lower side of head, body, and tail; head large, compressed and elevated, the bones thin but ossified; cleft of mouth wide, vertical, the lower jaw prominent; margin of upper jaw formed by the maxillary and premaxillary, both of which have a sharp edge beset with minute teeth; lower jaw and palatine bones with a series of small curved teeth; eyes large, very close together, lateral but directed upward; angle of preopercle with a spine usually directed downward; pectorals well developed; ventrals very small; humeral arch and pubic bones prolonged into flat-pointed processes, which project in the median line of the belly; a series of imbricated scales from the humeral bone to the pubic spine, forming a ventral serrature; dorsal fin short, median, preceded by a serrated, osseous ridge, consisting of several neural spines prolonged beyond the muscles; adipose fin rudimentary; anal fin short; caudal forked; gill-opening very wide, the outer branchial arch extending forward to behind the symphysis of the lower jaw and beset with very long gillrakers; branchiostegals 9, the arch near lower jaw and parallel with it; pseudobranchiæ and air-bladder present; 4 pyloric cœca. Small pelagic fishes found in most seas, coming to the surface at night, descending into deep water by day.

The single Hawaiian species of this genus is fully described in Section II.

Argyropelecus Cocco, Giorn, Sci. Sicil., fasc. 77, 146, 1829 (*hemigymnus*).
Pleurothyris Lowe, Fishes of Madeira, 64, 1861 (*olfersi*).

Family XXII. CHAULIODONTIDÆ.

Body more or less elongate, covered with thin caducous scales, or sometimes naked; photophores present; mouth large, the teeth irregular in size; maxillary entering margin; no pseudobranchiæ; interopercle rudimentary; gill-openings wide; dorsal and anal moderate or large. Deep-sea fishes of rather small size but voracious habits. Some 7 genera and about 20 species known.

Genus 37. CYCLOTHONE Goode & Bean.

Body elongated, somewhat compressed, apparently devoid of scales; lower parts with inconspicuous series of luminous spots, with the latter arranged approximately as in *Gonostoma*, but usually much less conspicuous; head conical, compressed; cleft of mouth very wide, oblique, extending behind the eye; lower jaw strongly projecting; maxillary long and slender, sickle-shaped, somewhat dilated posteriorly, but covering only an inconsiderable portion of the cheek; upper jaw with a single series of needle-like teeth, some of which are enlarged; lower jaw with similar teeth, and in some species with a few canines in front; teeth on vomer sometimes in patches, sometimes reduced to a single pair of fangs; palatine and pterygoid teeth present or absent; eye moderate, not conspicuous; gill-opening very wide, the membranes free from isthmus; gillrakers numerous, long and slender; pseudobranchiæ none; no air-bladder; dorsal and anal moderate, opposite, the latter much the longer; adipose fin sometimes present. The 3 Hawaiian species of this genus are fully described in Section II.

Cyclothone Goode & Bean, Bull. Mus. Comp. Zool., x, No. 5, 221, 1883 (*lusca*).
Sigmops Gill, Proc. U. S. Nat. Mus. 1883, 256 (*stigmaticus*).

Family XXIII. ASTRONESTHIDÆ.

Stomatoid fishes, with adipose dorsal present, and with scaleless body; dorsal fin inserted behind vent, but in front of anal. A single genus with few species; fishes of the deep sea.

Genus 38. ASTRONESTHES Richardson.

Body rather elongate, compressed, scaleless; head compressed; snout of moderate length; mouth wide; lower jaw prominent; teeth pointed, unequal; upper jaw with 4 long, curved canines, front of lower with 2; maxillary teeth fine, subequal; palatines with a single series of small pointed teeth, similar to those on tongue; eye moderate, not longer than snout; throat with a long fleshy barbel; dorsal fin rather long, inserted entirely in front of anal behind ventrals; adipose fin present; caudal forked;

paired fins long; gillrakers minute; no pseudobranchiæ; no air-bladder; sides and belly with very many small luminous spots; a small luminous patch below eye. Small fishes of the deep sea, remarkable for their strong teeth, the lower jaw much stronger than in *Malacosteus*. The single Hawaiian species is fully described in Section II.

Family XXIV. STOMIATIDÆ.

Body elongate, tapering, naked or covered with very thin and deciduous scales; head oblong; snout short and rounded; eyes large and far forward; opercular apparatus imperfectly developed; mouth enormous, with deep lateral cleft; lateral margin of upper jaw formed by maxillary and provided with teeth along the edges; teeth usually strong, unequal, some of them often fang-like or barbed; gill-membranes not joined, free from the isthmus; branchiostegals numerous (12 to 17); a long barbel at throat; no pseudobranchiæ; dorsal fin short, median or posterior, without spines; anal free, far behind and small; caudal distinct; pectorals low down on the scapular arch and narrow; ventrals inserted far backward; stomach cœcal, and pyloric appendages absent; sides with phosphorescent spots; skeleton feebly ossified; eggs extruded through oviducts. Deep-sea fishes of extremely voracious habits.

The single Hawaiian genus and species of this family are fully described in Section II.

Family XXV. PARALEPIDIDÆ.

Body elongate, somewhat compressed, formed much as in a barracuda, covered with cycloid scales of moderate or rather large size; head long, usually scaly on the sides; mouth very large; lower jaw projecting; premaxillary not protractile, very long and slender, forming the entire margin of upper jaw; maxillary long and slender, closely adherent to premaxillary; teeth rather strong, pointed, in single series on the jaws and palatines; some of them on lower jaw and palatines sometimes very long and fang-like, and most of them freely depressible; opercular bones thin; pseudobranchiæ present; gill-membranes separate, free from the isthmus; branchiostegals about 7; gillrakers short, sharp, spine-like; eye large; lateral line present, its scales usually enlarged; dorsal fin short and small, behind the middle of the body, nearly or quite over the ventrals; adipose fin present; anal fin low, rather long; caudal fin short, narrow, forked; pectorals rather small, placed low; pyloric cœca none; no air-bladder; phosphorescent spots few or none. Voracious fishes of the open seas or the deep seas.

The single Hawaiian genus and species of this family are fully described in Section II.

Family XXVI. STERNOPTYCHIDÆ.

Fishes "with compressed, ventradiform body, carinated contour, deeply and obliquely cleft and subvertical mouth, whose upper margin is constituted by the supramaxillaries as well as the intermaxillaries; branchiostegal arch near and parallel with lower jaw, scapular with an inferior projection, and with one or more of the neural spines abnormally developed, and projecting above the back in advance of the dorsal fin." (Gill.)

Genera 2, species about 10; deep-sea fishes, rising toward the surface at night or in stormy weather.

a. Body covered with large, very thin, deciduous scales; no anterior spinous dilatation of the dorsal fin..... *Polyipnus*, p. 72
aa. Body mostly scaleless, covered with a silvery pigment; dorsal fin of a triangular bony lamella, very thin in front, but strengthened along its hind margin, followed by several rays..... *Sternoptyx*, p. 73

Genus 39. POLYIPNUS Günther.

This genus differs from *Sternoptyx* in having the body covered with large, very thin, and deciduous scales, and in lacking the anterior spinous dilatation of the dorsal fin. Three species known.

Only one species of this genus known from the Hawaiian Islands. (See Section II.)

Polyipnus Günther, Rept. Deep-Sea Fishes, Challenger, XXII, 170, 1887 (*spinosus*).

Genus 40. STERNOPTYX Hermann.

Body much elevated and compressed, passing abruptly into a short and compressed tail, the angle made by the hind margin of the trunk and the lower edge of the tail being filled up by a broad fold of the integument, of peculiar transparent appearance, resembling thin cartilage; this fold bears the anal fin and is supported by interhæmal rays; head short, compressed, deep, with extremely short snout and a wide, subvertical mouth; eyes large, lateral; margin of upper jaw formed by maxillary and intermaxillary, the latter being very short, and each of these bones having a sharp edge which is armed with a series of very small teeth, somewhat unequal in size; lower jaw with a similar dentition; vomer and palatines toothless; bones of the head firm, some of them terminating in short spines, namely the angle of the preopercle, the postero-inferior angle of the mandible, and the symphysis of the humeral bones; gill-opening very wide, the gill-membrane being attached to the isthmus; gills 4, the branchial arches long, not angularly bent, the branchial slits being closed by a membrane in their upper portion; a few of the gillrakers are prolonged, needle-shaped and widely set, the others being quite rudimentary; pseudobranchiæ present; greater portion of body scaleless, covered with a silvery pigment; a luminous organ occupies the inner side of the opercle close to its lower end, another is placed at the anterior end of the ceratohyal, and finally a very large glandular mass is lodged on the upper edge of the anterior end of the clavicle; a series of luminous spots runs along the lower edge of the abdomen and is separated from the series of the other side by a cartilaginous fold occupying the median line of the abdomen; another series runs on each side of the isthmus, a row of 3 above and behind the root of the ventrals, and another row of 3 above the vent; the luminous organs on the lower part of tail consist anteriorly of a row of 4, of which the first is prolonged toward the back as a narrow band, terminating about the middle of the depth of the body in a globular black spot with a white center; posteriorly in front of the caudal rays there is another row of 4 small spots; the dorsal fin occupies the middle of the back and consists of a triangular bony lamella, very thin in front, but strengthened along its hind margin, and followed by several rays; adipose fin absent, or represented by a very low membranous fringe of the dorsal margin of the tail; the anal fin is incompletely developed, extending from the vent to the root of the caudal fin, its rays being rudimentary, widely set, and scarcely free; caudal fin broad and forked; pectorals well developed, close to the lower profile; ventrals small, the pelvic bone with a bifid spine in front pointing forward. (Günther.)

The single Hawaiian species (*Sternoptyx diaphana*) is described in Section II.

Sternoptyx Hermann, Naturforscher, XVI, 8, 1781 (*diaphana*).

Order G. APODES.—The 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 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 palato-pterygoid arch; the absence of ventral fins; the absence of the mesocoracoid or præcoracoid arch; the reduction or total absence of the scales; there are no spines in the fins; the gill-openings are comparatively small; there are no pseudobranchiæ; the vertebræ are in large number and none of them specially modified; the tail is isocercal—that is, with the caudal vertebræ remaining in a straight line to its extremity, as in the embryos of most fishes, 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 a 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.

FAMILIES OF HAWAIIAN APODES.

a. *Enchelycephali:* Gill-openings well developed, leading to large interbranchial slits; tongue present; opercle and branchial bones well developed; scapular arch present.
b. Body covered with linear, imbedded scales ..... *Synaphobranchidæ*, p. 74
bb. Scales wholly wanting; eggs, so far as known, of moderate size, much as in ordinary fishes.
c. Tip of tail with a more or less distinct fin, the dorsal and anal fins confluent around it; coloration always plain, brownish, blackish, or silvery, the fins often black-margined; posterior nostril without tube, situated entirely above the upper lip; tongue broad, largely free anteriorly and on sides; pectorals well developed. *Leptocephalidæ*, p. 74
cc. Tip of tail without rays, projecting beyond the dorsal and anal fins (not filiform); posterior nostril on the edge of upper lip; anterior nostril near tip of snout, usually in a small tube; tongue usually adnate to the floor of mouth; coloration frequently variegated ..... *Ophichthyidæ*, p. 80
aa. *Colocephali:* Gill-openings small, roundish, leading to restricted interbranchial slits; tongue wanting; pectoral fin (typically) wanting; opercle feebly developed; fourth gill-arch modified, strengthened, and supporting pharyngeal jaws.
d. Scapular arch obsolete or represented by cartilage; heart not far back; pectorals wanting; skin thick; coloration often variegated ..... *Muræniдæ*, p. 87

Family XXVII. SYNAPHOBRANCHIDÆ.

This group consists of deep-sea eels, differing from the *Anguillidæ* in having the gill-opening 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, imbedded 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; branchiostegals 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 opercle; 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 body; muscular and osseous systems well developed; stomach very distensible. Deep-sea fishes.

Genus 41. SYNAPHOBRANCHUS Johnson.

Dorsal beginning behind vent. This genus contains 2 or 3 species, deep-sea fishes from the Atlantic and Pacific.

The single Hawaiian species of this genus is fully described in Section II.

Synaphobranchus Johnson, Proc. Zool. Soc. Lond. 1862, 169 (*kaupii*).

Family XXVIII. LEPTOCEPHALIDÆ.—The 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 depth. Most of them undergo a metamorphosis, the young being loosely organized and transparent, band-shaped, and with very small head. The body grows smaller with age owing to the compacting of the tissues. The two genera found in the Hawaiian Islands are not well separated and should perhaps be considered as one.

a. Insertion of dorsal behind middle of pectoral.
b. Gape of mouth scarcely reaching orbit.....*Promyllantor*, p. 75
bb. Gape of mouth reaching at least to below middle of eye.....*Leptocephalus*, p. 75
aa. Insertion of dorsal before middle of pectoral.
c. Teeth present on jaws and vomer.....*Congrellus*, p. 76
cc. No teeth on jaws or vomer.....*Veternio*, p. 78

Genus 42. PROMYLLANTOR Alcock.

Body stout, with the muscular and osseous systems well developed, and the tail about as long as the trunk; eye rather small, cleft of mouth narrow, not extending behind middle of eye; villiform teeth, in broad bands in jaws, and in a broad, confluent patch on palate; nostrils lateral; tongue free; gill-openings widely separate; 4 gills with wide clefts; no scales; muciferous cavities of head well developed; the dorsal begins some distance behind the occiput; pectoral and vertical fins well developed, the latter confluent. Allied to *Congermurœna*. (Alcock). This genus differs from *Leptocephalus* in the dentition and in the posterior position of the nostrils. Deep-sea fishes of the Arabian seas and about the Hawaiian Islands.

The single Hawaiian species (*P. alcocki*) is fully described in Section II.

Promyllantor Alcock, Ann. Mag. Nat. Hist., October, 1890, 6th series, No. 6, 310 (*purpureus*).

Genus 43. LEPTOCEPHALUS Scopoli. The Conger Eels.

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 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;* vertebræ about 56 + 100. In most warm seas. This genus contains the well known and widely distributed conger eel and 3 or 4 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 genera and species of the supposed family of *Leptocephalidæ* have been described, but there is no doubt that all of them are larvæ, some of eels, as *Conger*, *Congermurœna*, *Oxystomus*, and *Nettastoma*, others of isospondylous fishes, as *Albula*, *Elops*, *Alepocephalus*, *Stomias*, etc. (Günther, Cat., VIII, 136.) It is thought by Dr. 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*.

(*a*) *Larval forms.*

Leptocephalus Scopoli, Int. Hist. Nat., 1777, 453 (*morrissi*).
Oxyurus Rafinesque, Caratteri, 19, 1810 (*vermiformis*).
Helmictis Rafinesque, Indice d'Ittiologia Siciliana, 62, 1810 (*punctatus*).
Helmichthys Costa, Fauna Napoli, Pesca, 1854 (*diaphanus*).
† *Leptocephalichthys* Bleeker, Act. Soc. Sci. Ind. Nederl., I, Manado, 69, June, 1856 (*hypsclosoma*).
† *Diaphanichthys* Peters, Monatsber. Ak. Wiss. Berl. 1864, 339 (*brevicaudus*).

(*b*) *Adult forms.*

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

Conger Cuvier, Règne Animal (2d ed. McMurtrie's), II, 257, 1831 (*conger*).

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

Ophisoma Swainson, Nat. Hist. Class'n Fishes, II, 334, 1839 (*acuta*). Substitute for *Ariosoma;* not *Ophisomus* Swainson, Nat. Hist. Class'n Fishes, II, 277, 1839,=*Pholis* Scapoli.

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

Gnathophis Kaup, Aale Fische Hamburg Mus., 7, in Abhand. Natur. Verein Hamburg, IV, 1858–1866.

30. Leptocephalus marginatus (Valenciennes). "*Puhi úha.*"

Head 2 in trunk; head and trunk about 1.67 in tail; eye 2 in snout, 1.67 in interorbital space; snout about 3.75 in head; interorbital space a little over 5; mouth about 2.3; pectoral 2.67.

Body more or less rounded, the tail posteriorly tapering and compressed; head rather long, depressed, and pointed; snout pointed, depressed above, and projecting beyond the mandible; eye small, anterior; mouth rather large, extending posteriorly slightly beyond eye; lips thick, fleshy, and broad; teeth blunt, rather short, more or less cylindrical, a patch on vomer and front of mouth above, a small patch on each side of the symphysis of mandible, those along the jaws forming a cutting edge; tongue large, thick, and free in front; anterior nostrils in short tubes near tip of snout, the posterior situated very near upper front margin of eye; interorbital space elevated convexly and flattened in the middle; sides of head rather swollen; gill-openings rather large; peritoneum silvery; skin perfectly smooth; head with a number of mucous pores; lateral line well developed and continuous, the pores about 120; origin of dorsal beginning over the first third of pectoral, its height greater than that of anal; margin of caudal rounded, its length about equal to snout and half of eye; pectoral more or less rounded, the rays just above the middle the longest. In life the young has traces of obscure crossbars.

Color in alcohol, dark lucid brown above and on the vertical fins, which are margined with black; lower surface of body pale or whitish, more or less soiled with pale brown; a dark blackish brown streak from lower margin of eye above and behind the corner of mouth; pectorals brown, their lower margins whitish, the upper portions of their extremities with a black blotch, which is always distinct.

The above description is based on a specimen 39 inches long (No. 03759) from Hilo. Three other specimens (Nos. 03758, 03359, and 03760), 30, 24, and 30 inches long, respectively, are in the collections from Hilo, and 2 specimens (Nos. 03713 and 03727), 24 and 38 inches long, respectively, were obtained at Kailua. Young individuals have traces of obscure cross-bands. An example from Hilo showed the pectoral in life with a large blotch, edged with white. In the collection made by Dr. Jenkins are 4 specimens, 19 to 25 inches long. We have one larva, probably of this or some species of *Leptocephalus*, obtained at Hilo. It is about 2 inches long, and can not be certainly identified.

The species is rather abundant about lava rocks, and is common at Samoa. The native Hawaiian name, *puhi uha*, signifies slippery eel.

Conger marginatus Valenciennes, Voy. Bonite, Poiss., 201, pl. 9, fig. 1, 1841, **Sandwich Islands;** Günther, Shore Fishes, Challenger, Zool., I, part VI, 61, 1880 (Reefs at Honolulu); Steindachner, Denks. Ak. Wiss. Wien, LXX, 1900, 514 (Laysan).

Conger altipinnis Kaup, Wiegm. Arch., XXII, 1856, 72, **Bourbon.**

Conger noordzieki Bleeker, Act. Soc. Sci. Ind. Neerl., Amboyna, II, 1857, 86, **East Indies.**

Leptocephalus marginatus, Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 421 (Honolulu); Snyder, op. cit. (Jan. 19, 1904), 515 (Honolulu; Hanalei Bay, Kauai).

Genus 44. CONGRELLUS Ogilby.

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.

Congrellus Ogilby in Jordan & Evermann, Fishes North and Mid. Amer., III, 2801, 1898 (November 26) (*balearica*).

a. Snout not longer than eye, rounded, projecting slightly beyond tip of lower jaw; lips thick; gill-openings less than eye; origin of dorsal in front of base of pectoral ..... *bowersi*, p. 77

aa. Snout longer than eye, flat, projecting considerably beyond tip of lower jaw; lips thin; gill-openings a little greater than eye; origin of dorsal slightly behind base of pectoral..... *æquoreus*, p. 77

31. **Congrellus bowersi** Jenkins. Fig. 16.

Head 1.6 in trunk; head and trunk a little shorter than tail; width of head 2.5 in its length; snout 4.5 in head; eye 4.25; interorbital space 6; pectoral 3.4; pores about 147 in lateral line.

Body rather short, compressed, the tail tapering posteriorly; head elongate, rounded, conically pointed in front; snout a trifle less than eye, rounded, elongate, with its tip bluntly pointed; eyes very large, high in front of head; mouth large, the snout protruding slightly beyond tip of mandible, corner of mouth nearly under middle of eye; lips rather thick, fleshy lobes on either side of each jaw; teeth all fine and rather numerous in jaws and on vomer; anterior nostrils in short tubes at tip of snout, the posterior on sides of snout nearer front of eye than tip of snout; interorbital space flattened and with a median ridge; head without swollen appearance; gill-openings about two-thirds eye; peritoneum silvery, with small gray dots; skin smooth; head with a number of mucous pores, a large one just behind the anterior nostril; origin of dorsal at about the last sixth of the space between

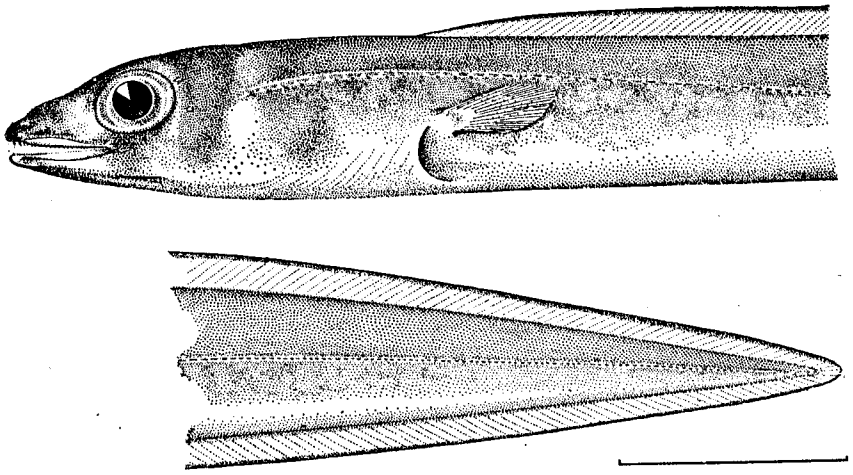


FIG. 16.—*Congrellus bowersi* Jenkins; from the type.

posterior margin of eye and origin of pectoral; caudal small, or the marginal fin around the end of tail very narrow; pectoral rather short and rounded.

Color in alcohol, brown, slightly darker above and somewhat clouded on head, where 2 dark brown crossbars are formed; fins all pale brown; edges of dorsal, caudal, and anal narrowly edged with black, especially distinct posteriorly. Color in life (No. 03419), body translucent, colorless; snout dusky; a dusky band through eye and over head; a dusky transverse band across nape and half way down on side; a dusky saddle in front of dorsal; a narrow dark margin on dorsal and anal.

This description is based primarily upon a specimen (No. 04923) 14.5 inches long, obtained at Hilo. One other specimen (No. 04922) 11 inches long was taken at Hilo; four examples (Nos. 03419, 04919, 04920, and 04921), each about 11 inches long, at Honolulu. The collection obtained by Dr. Jenkins at Honolulu contains eight examples, ranging in length from 8 to 11 inches.

Congrellus bowersi Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 422, fig. I, **Honolulu**; Snyder, op. cit. (Jan. 19, 1904), 515 (Honolulu).

32. **Congrellus æquoreus** (Gilbert & Cramer). Fig. 17.

Head 6.5 to 6.8; depth 15 to 18; head and trunk much shorter than tail, about 1.6 in latter; pectoral rays 14 or 15.

Body slender, compressed; head as deep as wide, tapering forward to a flat snout; snout 3.5 to 3.8 in head, slightly more than twice as long as eye, and projecting two-thirds the diameter of eye beyond tip of lower jaw; eyes somewhat elliptical, their upper margins near dorsal profile; angle of mouth reaching middle of orbit; lips thin; maxillary teeth close-set in a broad villiform band, the

outer teeth longer than the inner, the vomerine teeth much larger, forming a broad transverse patch in advance of maxillary teeth, with a very few small teeth on the shaft; mandibular teeth in a narrow cardiform band anteriorly, diminishing much in size toward angle of mouth; anterior nostril a broad, short tube situated on the antero-lateral part of snout, a little nearer mouth than dorsal profile; posterior nostril a large, elliptical opening in front of upper third of eye, less than its own diameter from eye; interorbital space about equal to long diameter of eye; gill-openings far apart, their width a little greater than diameter of eye, the distance between them about 5 in head; gills 4, no rakers; tongue free; peritoneum silvery, speckled, or brownish; intestine black; pores of snout arranged as follows: A small pair under tip of snout just in front of anterior teeth, a large one in front of, a second above, and a third immediately behind the anterior nostril, 4 others along the side of upper jaw, and one behind angle of mouth; a row of about 10 pores on each ramus of mandible, beginning at tip of lower jaw and extending beyond its posterior angle; lateral line above middle of body anteriorly; dorsal fin beginning slightly behind base of pectoral, its distance from occiput equaling distance of latter from center of eye; pectoral small, pointed and equal to snout.

Color in alcohol, brown, head and back dusky; a large, dark, opercular spot, another small one above each eye, and a dark streak on snout in front of eye; side of tail with coarse black specks, much

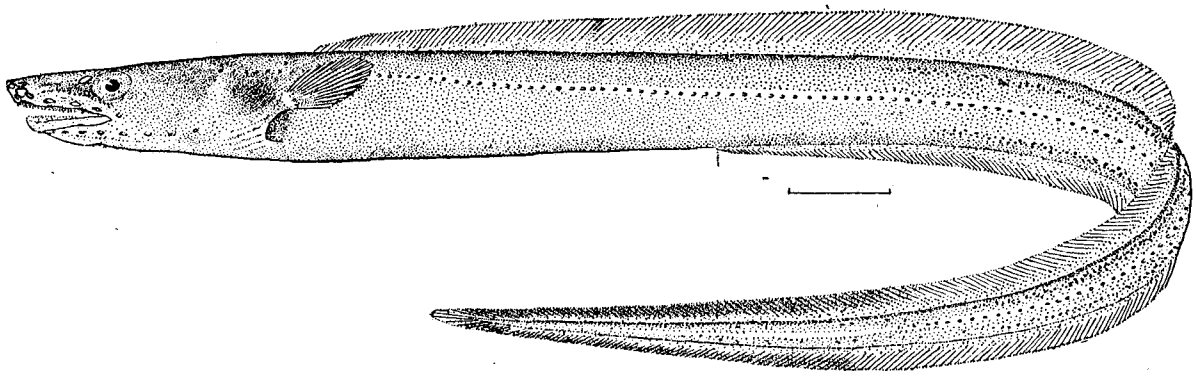


FIG. 17.—*Congrellus æquoreus* (Gilbert & Cramer); from the type.

more numerous in one of the specimens than in the other, and mainly collected into 2 lengthwise lines running parallel with the bases of the dorsal and anal; the other specimen is almost plain; marginal portions of dorsal and anal fins dusky, becoming black posteriorly, and the basal portions light; inside of mouth a little dusky (Gilbert & Cramer).

This species is known from two specimens, 16.25 and 18.5 inches long, respectively, dredged by the *Albatross*, December 6, 1891, between Molokai and Lanai in 375 fathoms, and several others dredged by the *Albatross* in 1902.

Congermuræna æquorea Gilbert & Cramer, Proc. U. S. Nat. Mus., XIX, 1896 (Feb. 5, 1897), 405, pl. XXXVII (misprinted *arquorea* on plate), **Albatross station 3474, Lat. N. 21° 12′, Long. W. 157° 38′ 30″,** in 375 fathoms. (Type, No. 47696, U. S. Nat. Mus.)

Genus 45. VETERNIO Snyder.

Body without scales; lateral line present; tail much longer than head and trunk; head long, snout pointed; lower jaw much shorter than upper. No teeth; vomer, maxillaries, and mandible with broad, smooth, hard areas; tongue free; nostrils not tubular, the anterior ones near tip of snout, with narrow rims; posterior ones oblong, near the eyes; gill-openings separate, with broad, lunate slits; fins well developed, dorsal inserted above base of pectorals. Color uniform.

The absence of teeth serves to distinguish *Veternio* from closely related genera.

Veternio Snyder, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), 516 (*verrens*).

33. Veternio verrens Snyder. Plate 5, fig. 1.

Head, from tip of snout to upper edge of gill-opening, 0.64 of trunk; depth 0.42 of head; eye 0.13; snout 0.26; length of pectoral 0.36.

Head very long and pointed, upper profile sloping gently from tip of snout to occiput; interorbital space flat, its width 0.16 of head; snout slender, projecting beyond lower jaw a distance equal to 0.5 of diameter of eye; cleft of mouth somewhat oblique, extending beyond eye a distance equal to 0.3 of pupil; no teeth, the vomer, maxillaries, and mandible with broad, flat, smooth surfaces; tongue free, tip rounded; lips thin, simple; anterior nostrils at end of snout, with low rims and posterior flaps; posterior nostrils close to upper anterior part of eye, without rims, rounded oval in shape; a pair of large mucous tubes at tip of snout, a tube immediately behind anterior nostril and one on each side of snout just above the latter; gill-openings lunate, their width about 0.15 of length of head; lateral line somewhat above middle of body anteriorly, gradually extending downward and reaching middle of body a short distance beyond the vent. Pectoral inserted just below middle of body, obtusely pointed, upper rays longest, lower border convex; dorsal inserted above middle of base of pectoral, height of fin at a point above tip of pectoral equal to vertical diameter of eye, at a point twice the length of head behind the vent, the length of rays equals length of snout; 65 rays between its insertion and a vertical through the anal opening; anal inserted immediately behind vent, its height equal to 0.5 the length of snout. Color plain, fins edged with black.

Color in spirits brown, darker above than below; pectorals brownish, growing black toward tips; dorsal brownish, shading into black along edge; anal bordered with black, the band about half as wide as pupil and sharply defined.

A single mutilated specimen (type, No. 50862, U. S. Nat. Mus.) from the Honolulu market measures 10.63 inches from snout to vent. The tail was severed 12.6 inches behind the vent.

Veternio verrens Snyder, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), 516, pl. 2, fig. 3, Honolulu.

Family XXIX. NETTASTOMIDÆ.

Eels without pectoral fins, with the tongue not free, the posterior nostrils remote from the lip, the gill-openings small, separate, and subinferior, the vent remote from the head, the tail ending in a slender tip or filament, the dorsal and anal fins moderately developed, and the jaws produced, slender, and straight, the upper the longer, and both, as also the vomer, armed with bands of sharp, close-set, recurved, subequal teeth. This family contains a few species of deep-sea eels, closely allied to the *Muræenesocidæ* in technical characters, but more resembling the *Nemichthyidæ* in appearance, form of the head, and in dentition. Deep-sea fishes with fragile bodies and thin skin charged with black pigment. A single Hawaiian genus and species, described in Section II.

Family XXX. NEMICHTHYIDÆ.—The Snipe Eels.

Body excessively slender, not strongly compressed, deepest near the middle, tapering backward to the tail, which usually ends in a long and slender filament, and forward to a very long and slender neck, which is abruptly enlarged at the occipital region; no scales; lateral line represented by one or more rows of pores; head resembling that of *Tylosurus;* the head proper, small, short, and rather broad, with flat top and vertical sides; nostrils large, close together in front of the eye, without tube or flap; jaws excessively prolonged, almost needle-like, the upper the longer and somewhat recurved; teeth in both jaws small, very numerous, close-set, retrorse; gill-openings rather large, running downward and forward, separated by a narrow isthmus or partly confluent; pectorals well developed; anal fin higher than dorsal, beginning near the vent, becoming obsolete on the caudal filament; dorsal beginning close behind occiput, its anterior rays soft, succeeded by a long series of very low, simple, spine-like rays, which are slightly connected by membrane, their height rather less than the length of the interspaces; on the tail these spines again give place to soft rays; the soft rays of the fins are connected by thin membranes instead of being imbedded in thick skin, as in eels generally. Color translucent, the lower parts dark, the back pale; stomach not distensible; muscular and osseus systems well developed; abdominal cavity extending far behind the vent. The species are little known and their anatomy has not been studied; they are certainly eels, and their nearest relation seems to be with the *Nettastomidæ.*

Genus 46. SERRIVOMER Gill & Ryder.

Nemichthyids with the head behind eyes of an elongated parallelogramic form, with moderately attenuated jaws; branchiostegal membranes confluent at posterior margin, but with the branchial aperture limited by an isthmus except at the margin, and with lancet-shaped vomerine teeth in a crowded (sometimes doubled) row. A single Hawaiian species. (See Section II.)

Serrivomer Gill & Ryder, Proc. U. S. Nat. Mus. 1883, 260 (*beani*).

Family XXXI. OPHICHTHYIDÆ.—The Snake Eels.

This family includes those scaleless enchelycephalous eels with end of the tail projecting beyond dorsal and anal fins; without rudiment of a caudal fin; with anterior nostrils placed in upper lip, opening downward; gill-openings not confluent; tongue more or less fully adnate to floor of mouth. The species are, for the most part, moderate or small in size, and they are very abundant in the tropical seas, especially about coral reefs. The eggs are numerous, of moderate size, similar to those of ordinary fishes. Genera about 12; species nearly 100. Many of the species are singularly colored, the bands or spots heightening the analogy between them and the serpents.

Only 8 species of this large family are thus far known from the Hawaiian Islands.

a. Body without traces of fins anywhere ..... *Sphagebranchus*, p. 80
aa. Body with distinct dorsal and anal fins.
  b. Vomerine teeth, none ..... *Leiuranus*, p. 81
  bb. Vomerine teeth present.
    c. Pectorals present.
      d. Teeth sharp, pointed, some of them often canine or fang-like.
        e. Dorsal inserted over or before gill-opening; canines small ..... *Microdonophis*, p. 82
        ee. Dorsal behind gill-opening; lips fringed; canines large ..... *Brachysomophis*, p. 83
      dd. Teeth blunt, mostly granular or molar ..... *Myrichthys*, p. 84
    cc. Pectorals wanting ..... *Callechelys*, p. 85

Genus 47. SPHAGEBRANCHUS Bloch.

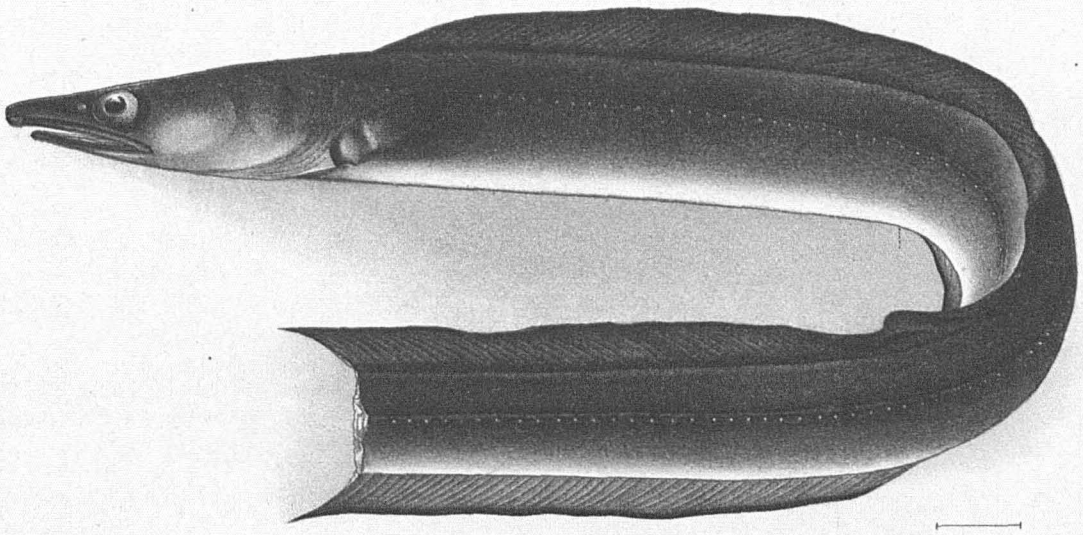
This genus contains several little-known species of small eels, remarkable for showing no trace of fins in the adult stage. The snout projects beyond the small mouth, giving a shark-like profile, and the small teeth are mostly uniserial. The gill-slits are inferior and converging. The name *Sphagebranchus* was based on a species which evidently belongs to the genus. It has therefore clear priority over *Ichthyapus* and *Apterichthys*.

This genus is the most simple in structure among the *Ophichthyidæ*, as *Ophichthus* is probably the most specialized. The loss of fins is doubtless due to degeneration, but *Sphagebranchus* seems nearer the primitive type than *Brachysomophis* or *Ophichthus*.

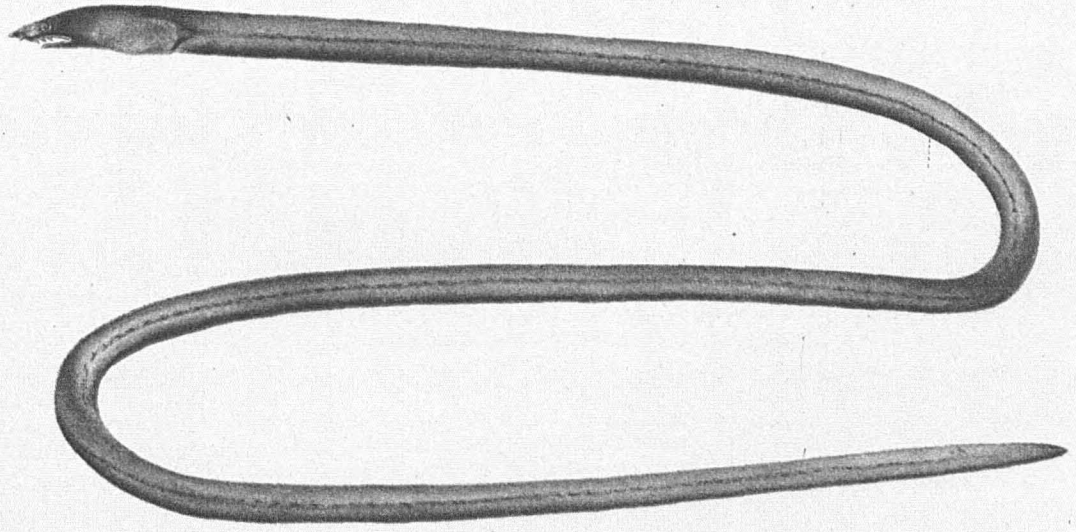
Sphagebranchus Bloch, Ichthyologia, XII, 79, pl. 419, fig. 2, 1797 (*rostratus*).
Cæcilia Lacépède, Hist. Nat. Poiss., II, 135, 1800 (*branderiana* = *cæcus*); not *Cæcilia* L., a genus of *Batrachia*.
Apterichthys De la Roche, Ann. Mus. Nat. Hist. Paris, XIII, 325, 1809 (*cæcus*).
Branderius Rafinesque, Analyse de la Nature, 93, 1815 (*cæcus*).
Ichthyapus Brisout de Barneville, Revue Zoologique, 219, 1847 (*acutirostris*).
Ophisurapus Kaup, Apodes, 29, 1856 (*gracilis*).

34. Sphagebranchus flavicaudus Snyder. Plate 5, fig. 2.

Head, measured to upper edge of gill-opening, 18 in length, 9.5 in trunk including head, 8.3 in tail; depth 3.9 in head; snout 5.5. Snout long, slender, and sharp, projecting beyond upper jaw, tip of latter reaching beyond eye a distance equal to diameter of pupil; eye midway between tip of snout and angle of mouth, its diameter contained 3 times in length of snout; anterior nostril with a short tube on ventral side of snout a little nearer its tip than to border of eye; posterior nostril without tube, placed below anterior margin of eye; upper lip with a fold extending from nostril to angle of mouth; teeth of jaws in a single series; a group of 4 canines at end of upper jaw, all being beyond end of lower jaw when it is closed; a few sharp teeth on anterior part of vomer; gill-openings inferior, converging, the distance between them about equal to diameter of eye; width of gill-opening 7.9 in head; no fins; tail pointed.



1. VETERNIO VERRENS SNYDER.



2. SPHAGEBRANCHUS FLAVICAUDUS SNYDER.

A. HOEN & CO., LITH.

Color in alcohol, pale olive, the tail nearly white.

The description is from the type, No. 50863, U. S. Nat. Mus., 14.45 inches long. Two examples from off the northeast coast of Hawaii. One from station 4055, depth 50 to 60 fathoms (cotype, 7509, L. S. Jr. Univ. Mus.), measures 9.6 inches. The head 17 in length, 10 in head and trunk. In life it was pinkish anteriorly, the posterior third tinged with lemon-yellow. The other specimen, from station 4061, depth 24 to 83 fathoms, measures 8.66 inches; head 15.4 in length, 8.3 in head and trunk. In life the color was light orange, fading to lemon-yellow posteriorly; an indistinct, light, median, dorsal stripe extending from occiput to tip of tail; ventral surface slightly tinged with purple, the tint extending about twice the length of head beyond anal opening; side of head with 2 white spots, the anterior one just behind eyes, the posterior one indistinctly connected over the occiput with its fellow on opposite side.

Sphagebranchus flavicaudus Snyder, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), 516, pl. 2, fig. 4, **Albatross Station 3874, between Mauai and Lanai, in 21 to 28 fathoms.**

Genus 48. LEIURANUS Bleeker.

Body cylindrical; mouth small, below the sharp, projecting snout; teeth pointed, of moderate size, uniserial in jaws; 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 *Chlevastes*, but in technical respects nearer *Ophichthus*, distinguished by the absence of vomerine teeth.

Leiuranus Bleeker, Verh. Bat. Gen. Muræn., XXV, 24, 36, 1853 (*lacepedii=semicinctus*).
Stethopterus Bleeker, op. cit., 24, 1853 (*vimineus=semicinctus*).

35. Leiuranus semicinctus (Lay & Bennett).

Head 6.25 in trunk; tail a little longer than trunk without head; eye about 2 in snout, 1.67 in interorbital space; snout about 6 in head; interorbital space 7.3; mouth from tip of snout 3.5; pectoral about 7.

Body more or less rounded and rather slender, the tail tapering posteriorly to a conical horny point; head pointed, rather thick and swollen; snout short, depressed, flattened, and shark-like in appearance, with the edges more or less thin; eyes small, and placed wholly before the corners of mouth; teeth in jaws in a single series, pointed, and hooked backward; no vomerine teeth; tongue adnate to floor of mouth, small; mandible small, its tip, when mouth is closed, very much nearer anterior margin of eye than tip of snout; anterior nostrils in small tubes, inferior, on lower surface of snout and opening downward; posterior nostrils large, in the lips, and opening downward; interorbital space very slightly convex, nearly flat; skin smooth; the head about the branchial region more or less wrinkled; head with a few mucous pores, those in the lateral series from head about 147; origin of dorsal about over middle of pectoral; dorsal and anal low; pectoral small and short.

Color in alcohol, whitish, with 24 deep brown broad cross-blotches, the first 2 on top of head much narrower than the others, those on trunk becoming narrower, most of them anteriorly not meeting below, and those on tail meeting more or less perfectly below; tips of snout and tail white.

This species was not obtained by us in Hawaii, but it has been recorded from those islands by Lay and Bennett, by Fowler, and by Snyder. The above description is based upon a specimen (No. 6642, Stanford University Museum) 17.5 inches long, obtained by Jordan and Snyder at Yaeyama, Ishigaka Islands, in the southern Riu Kiu Archipelago. It was also found by Jordan and Kellogg at Samoa.

Ophisurus semicinctus Lay & Bennett, Zool. Capt. Beechey's Voyage, 66, pl. XX, fig. 4, 1839, **Oahu.**
Ophisurus (Sphagebranchus) vimineus Richardson, Voy. Sulphur, 107, pl. LII, figs. 16-20, 1843, **China.**
Ophisurus vimineus Richardson, Ichth. China, 314, 1846, **China** (Coll. Sir Edward Belcher).
Stethopterus vimineus, Bleeker, Verh. Bat. Gen., XXV, 24, 1853 (Sibogha; Sumatra).
Leiuranus lacepedii Bleeker, op. cit., 36, 1853, **Sibogha; Sumatra.**
Leiuranus colubrinus Kaup, Cat. Apod. Fish., 2, 1856, **Java**; Bleeker, Atlas Ichth., IV, 42, pl. IX, fig. 1, part, 1864 (East Indies).
Ophisurus multizonus Cuvier in Kaup, l. c. (name only), **China, Mauritius, and Malayan Archipelago.**
Liuranus semicinctus, Günther, Cat., VIII, 54, 1870 (East Indies; Fiji Islands; China).
Leiuranus semicinctus, Fowler, Proc. Ac. Nat. Sci. Phila. 1900, 494 (Hawaiian Islands); Jordan & Snyder, Proc. U. S. Nat. Mus., XXIII, 1901, 866 (Yaeyama, Ishigaka Islands, Japan); Snyder, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), 516 (Honolulu).

Genus 49. MICRODONOPHIS Kaup.

Body more or less rounded; head and trunk much longer than tail, which is more or less rounded and pointed; head rounded; snout pointed and projecting; teeth large and somewhat canine-like, in one row on vomer; nostrils anterior, each in a small tube, the posterior pair opening in the lips downward; pores of lateral line continuous; dorsal beginning over gill-opening or origin of pectoral; pectoral short. Coloration variegated with rather large dark spots, those on the head small, absent in *M. macgregori*. Only two species known from Hawaii.

Microdonophis Kaup, Apodal Fishes, 6, 1856 (*altipinnis*).

a. Origin of dorsal slightly in advance of gill-opening or base of pectoral; anterior nostrils in short fleshy tubes on tip of snout. Color white, rendered somewhat shaded on upper portions by very minute points of gray; back and upper surface with numerous round brown spots and about 17 indistinct transverse dark brown bands.....*fowleri*, p. 82

aa. Origin of dorsal farther in advance of base of pectoral, midway in length of head; anterior nostrils in conspicuous tubes on lower surface of snout in front. Color brownish olive, the lower surface light yellowish washed with silvery; upper surface of body dark, covered with minute blackish dots..... .....*macgregori*, p. 82

36. Microdonophis fowleri Jordan & Evermann. Plate 6.

Head about 4.8 in trunk, measured from gill-opening to vent; tail shorter than head and trunk by the length of the former; eye nearly 1.6 in snout or 1.5 in interorbital space; snout 6 in head; interorbital space about 6.75; mouth 2.75; pectoral a little over 4.25 in head.

Body elongate, cylindrical, the tail tapering gradually to a conical horny point; head cylindrical and pointed; snout moderately long and pointed, slightly flattened above, projecting over and beyond the mandible; eye elongate, small, anterior and superior, about midway in length of mouth; mouth rather large; lips somewhat fringed; teeth large and canine-like in front of jaws, and on vomer in a single row; tongue small, adnate to floor of mouth; anterior nostrils in short tubes near tip of snout, the posterior with broad flaps on the lips and opening downward; interorbital space concave, each supraocular ridge slightly elevated; peritoneum silvery; skin perfectly smooth; head with mucous pores, a series of which encircle the head above and about midway in its length; lateral line well developed, the pores about 140; origin of dorsal slightly in advance of gill-opening or base of pectoral; pectoral small, the rays just above the middle the longest, the fin rounded; dorsal fin long and low, its height about equal to length of snout; anal similar to dorsal, its height a trifle less.

General color, when fresh, white, rendered somewhat shaded on upper portions by very minute points (seen only with a good lens) of gray; back and upper surface with numerous round brown spots and about 17 indistinct transverse dark brown cross-bands which do not extend over the dorsal; interspaces between spots on head yellow; pectoral bright lemon-yellow; end of tail for about 1 inch from point bright yellow; spots on margin of dorsal brown, with yellow borders; a band of yellow from under one eye backward, upward, across top of head, and down under the other eye; a transverse series of pores with black margins encircles head above and about midway in its length, a similar series over head along margin of mouth, then up, back of eye, over head; pores of lateral line without black margins.

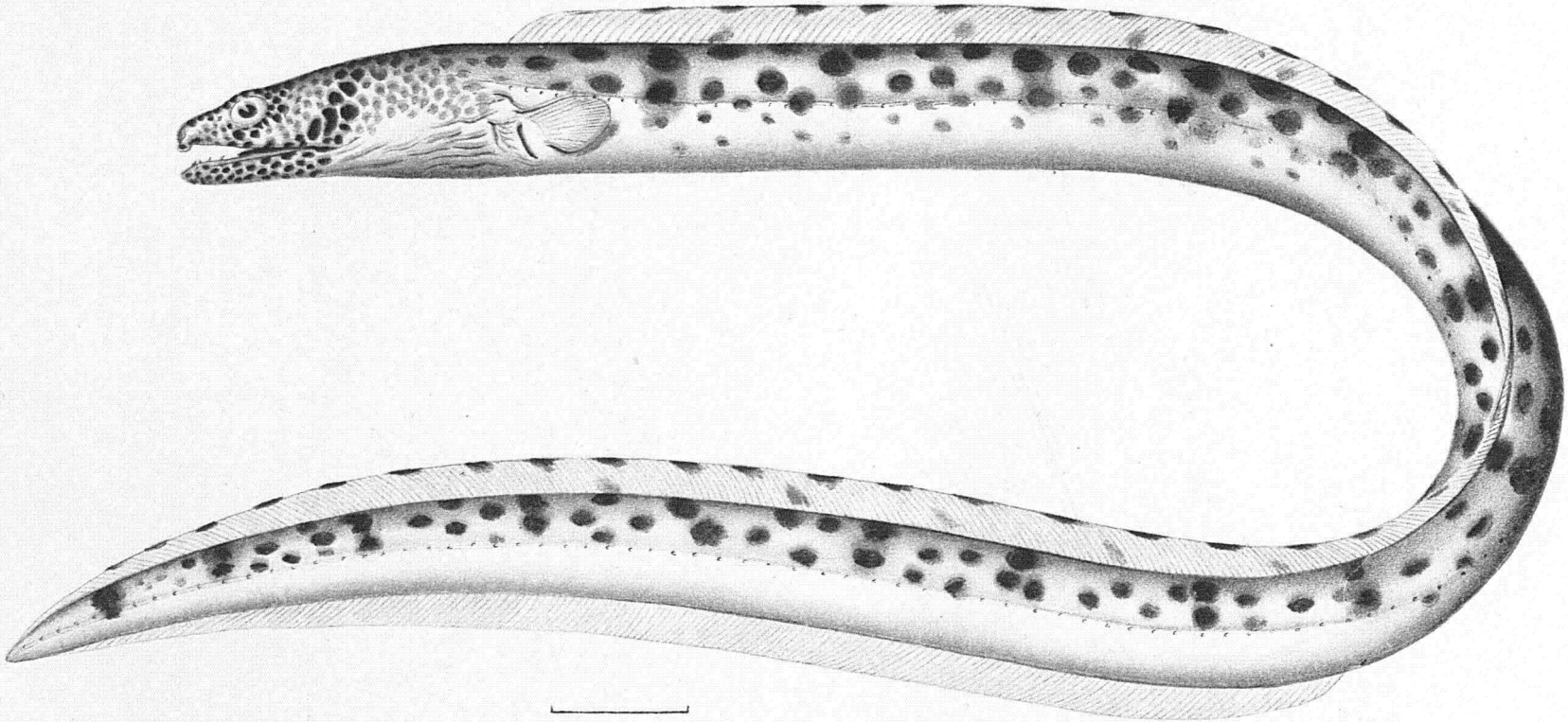
Three specimens of this species are now known, the type (No. 50613, U. S. Nat. Mus.), a specimen 23 inches long, obtained by us in the Honolulu market, another example obtained by the *Albatross* in the Honolulu market, and a third specimen recently received from Mr. E. L. Berndt.

Microdonophis fowleri Jordan & Evermann, Bull. U. S. Fish Comm., XXII, 1902 (April 11, 1903), 164, Honolulu; Snyder, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), 516 (Honolulu).

37. Microdonophis macgregori Jenkins. Fig. 18.

Head 4.8 in trunk; head and trunk 1.75 in tail; eye 2 in snout, a little over one in interorbital space; snout 5.2 in head; mouth from tip of snout 3; pectoral 3.5.

Body more or less rounded, rather slender, the tail tapering posteriorly to a conical horny point; head elongate, pointed, somewhat compressed; snout small, well produced beyond mandible, pointed, and conical; eye small, much nearer corner of mouth than tip of snout or midway between tip of mandible and corner of mouth; mandible broad; lip of upper jaw with a fringe of short fleshy barbels; teeth sharp, pointed, in a single series on vomer and in jaws; nostrils anteriorly in conspicuous fleshy



MICRODONOPHIS FOWLERI JORDAN & EVERMANN. TYPE.

JULIUS BIEN & CO. LITH. N.Y.

tubes on lower surface of snout in front; interorbital space a little more than the eye and convex; gill-openings low, the space between rather broad; skin smooth; head with many mucous pores; lateral line well developed; origin of dorsal midway in length of head; dorsal and anal low; pectoral rather small.

Color in alcohol, brownish olive; lower surface light yellowish washed with silvery; upper surface of body dark, being covered with minute blackish dots.

This species is probably the type of a new genus, *Jenkinsiella*, characterized by the fringe of short

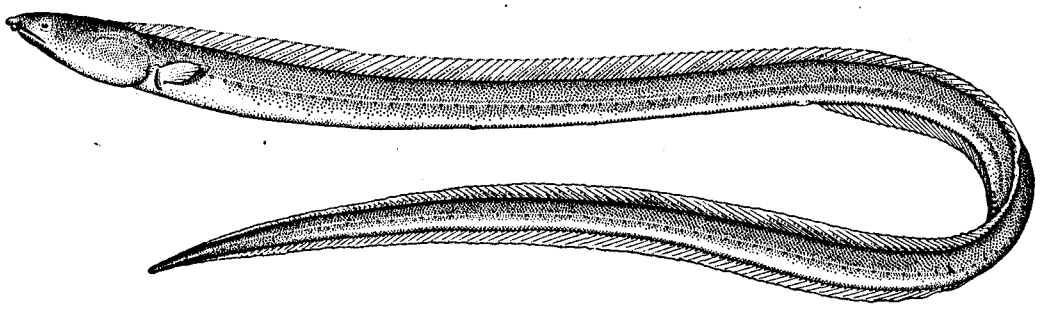


FIG. 18.—*Microdonophis macgregori* Jenkins; from the type.

fleshy barbels on upper lip. The only known specimen is an example 10.5 inches long obtained by Mr. Richard C. McGregor, February 1, 1900, at Lahaina, Maui; type, No. 50721, U. S. Nat. Mus.

Microdonophis macgregori Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 422, fig. 2, **Lahaina, Maui.**

Genus 50. BRACHYSOMOPHIS Kaup.

This genus differs from *Mystriophis* chiefly in the presence of a conspicuous fringe of papillæ on the lips. The vomerine teeth are canine. Species chiefly East Indian; one recently described from the Hawaiian Islands.

Brachysomophis Kaup, Apodes, 9, 1856 (*horridus*).

38. Brachysomophis henshawi Jordan & Snyder. Plate 7.

Head measured to gill-opening, 7.5 in total length, 3.8 in length to vent; depth 2.5 in head; eye 1.5 in snout; snout 10 in head.

Body cylindrical, the head greatly depressed, swollen laterally in the region of the occiput, narrowing anteriorly to the pointed snout; a conspicuous transverse depression in the postorbital region; interorbital space concave, its width equal to length of snout; a slight supraorbital crest ending in a prominent wart-like protuberance behind eye; nostrils with minute tubes, the anterior located midway between tip of snout and eye, the posterior on lip between eye and anterior nostril; mouth large, length of cleft 2.9 in head; lower jaw projecting beyond the upper; outer edge of lips with a row of rather course papillæ; teeth of upper jaw in 2 rows, the outer ones small and close-set, the inner ones larger; vomer with a single row of 5 or 6 widely spaced canines, the anterior of which is about equal in length to diameter of eye, the others growing successively smaller; tip of jaw with 3 minute teeth separated from the lateral rows by a wide space; lower jaw with a single row of widely spaced fang-like teeth; teeth all sharply pointed, many of those in each jaw depressible; no tongue; gill-openings below middle of body, their length equal to width of space between them, or to distance between tip of snout and posterior border of eye; one-fourth of base of pectoral above gill-opening; length of pectoral equal to distance between tip of snout and center of pupil; dorsal inserted behind gill-opening a distance contained 2 times in space between gill-opening and pupil; height of fin a short distance behind its origin about equal to diameter of pupil, slighly higher in region above vent; origin of anal just behind

vent; height of fin equal to that of dorsal; both dorsal and anal become low on posterior part of tail; the membranes growing thick, passing into slight ridges and finally disappearing near tip of tail.

A row of large mucous tubes passing over head in the depression behind eye; 6 conspicuous tubes on top of head, 4 being on the interorbital region, 2 on the snout; 4 tubes on upper lip; anterior ends of lateral lines connected by a curved row of tubes passing over occiput; about 125 tubes in lateral line, the posterior ones very small.

Color gray, with a yellowish tint; a few brownish-black spots about as large as pupil thinly scattered above the lateral line, the mucous pores on anterior part of body edged with blackish; dorsal brownish black, with a broad marginal band of white, posterior part of fin without dark color; anal immaculate.

One specimen 20 inches long, type, No. 51399, U. S. Nat. Mus., Honolulu. Collector, Mr. E. L. Berndt. Named for Henry W. Henshaw, the well-known naturalist, now resident at Hilo, Hawaii, to whom we are indebted for several rare specimens.

The large Japanese eel described by Schlegel as *Ophisurus porphyreus* has the lips fringed and should be referred to *Brachysomophis* instead of *Mystriophis*. It may stand as *Brachysomophis porphyreus*.

Brachysomophis henshawi Jordan & Snyder, Proc. U. S. Nat. Mus., XXVII, 1904, 940, **Honolulu.**

Genus 51. MYRICHTHYS Girard.

Teeth mostly blunt and molar; pectoral fins small; dorsal beginning on the head before gill-opening; otherwise essentially as in *Ophichthus*. Coloration variegated. Species numerous, found in most tropical seas, one known from the Hawaiian Islands, another from Johnston Island.

Ophisurus Swainson, Class. Fish., II, 334, 1839 (not of Lacépède = *Ophichthus*).
Myrichthys Girard, Proc. Ac. Nat. Sci. Phila. 1859, 58 (*tigrinus*).

a. Pectoral rounded; spots large, in 2 longitudinal series, 1 series above lateral line, the other on lateral line, the spots of the 2 series alternating with each other ..... *magnificus*, p. 84
aa. Pectoral lunate; spots in 4 longitudinal series, 1 series above, 1 on, and 2 below lateral line ..... *stypurus*, p. 84

39. Myrichthys magnificus (Abbott).

Body cylindrical, tapering very gradually to tail, which terminates in a conico-acute horny point; head small, facial outline with an oblique curvature; snout rather obtuse, with upper jaw extending much beyond the lower, making the nasal teeth visible when mouth is closed; teeth all very small, conical, acute, 6 standing irregularly on disk of nasal bone; teeth upon palate, vomer, and mandible biserial, and placed very close to each other; dorsal inserted at the occiput, terminating before it reaches the horny extremity of tail; anal coterminal with dorsal; pectoral small, circular, with 20 rays.

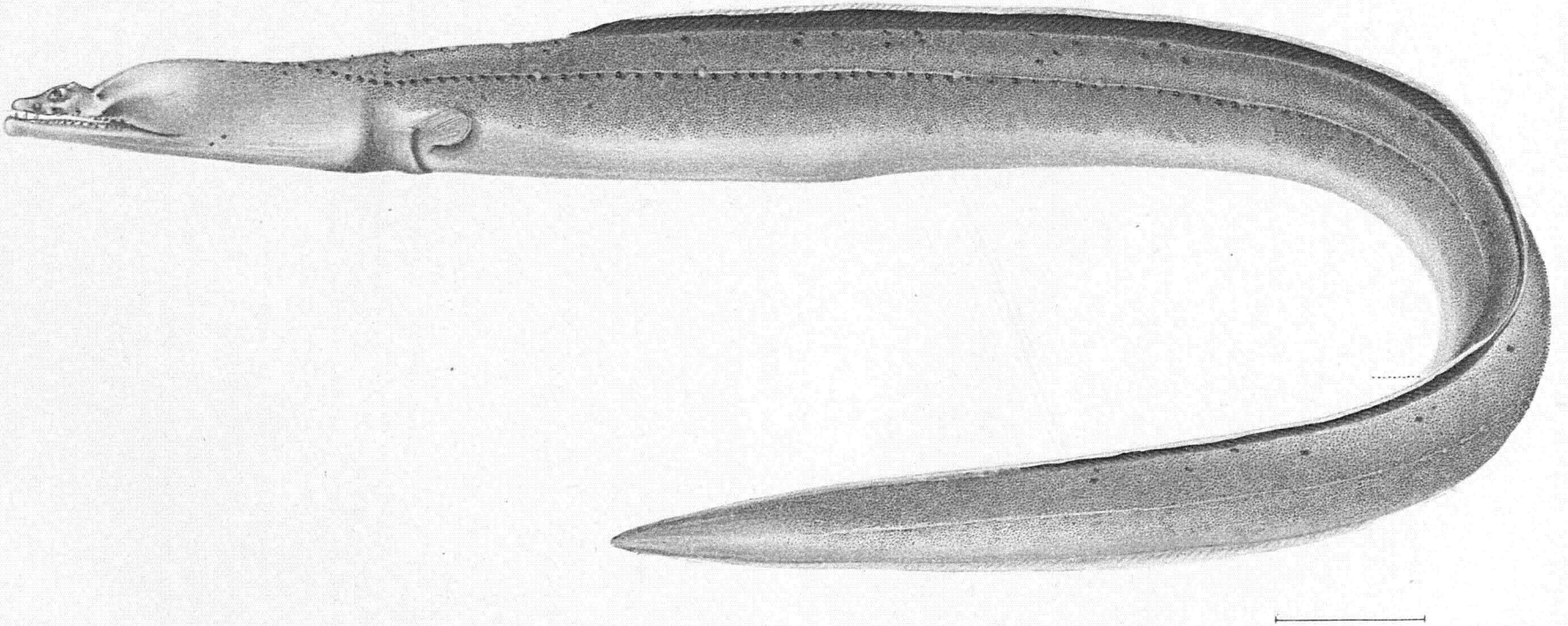
Color in alcohol, pink, darkest upon back; color nearly lost upon belly, which is nearly white; at base of anterior nasal tubes 2 very small dark chocolate-brown semicircular spots, and behind these, anterior to orbits, 2 similar markings, but larger and deeper in color; commencing at the insertion of dorsal are 2 series of spots of chocolate-color, separated only by that fin, and, if viewed from above, having the appearance of transverse bands, though they are not directly opposite in every case; upon the sides is a single series of spots of the tints of the dorsal markings, two-thirds the width of side, measuring from base of dorsal to center of belly; upon the belly are 3 rows of small circular spots which are very irregular as to position.

This description, modified from Dr. C. C. Abbott, is based upon 2 specimens, the larger having a total length of 19 inches (8 inches from snout to anus, or 1.5 to gill-opening), collected in the Hawaiian Islands by Dr. J. K. Townsend in 1835. The species was not obtained by us.

Pisoodonophis magnifica Abbott, Proc. Ac. Nat. Sci. Phila. 1860, 476, **Hawaiian Islands**; Günther, Cat., VIII, 55, 1870 (after Abbott).
Myrichthys magnificus, Fowler, Proc. Ac. Nat. Sci. Phila. 1900, 494, pl. XVIII, fig. 3 (from Abbott's type).

40. Myrichthys stypurus (Smith & Swain). Fig. 19.

Head 5.3 in trunk; head and trunk together slightly longer than tail, exceeding the latter by length of snout; snout blunt, 5.5 in head; eye 2.5 in snout, 3 in interorbital space; gape of mouth moderate, extending beyond eye, 3.5 in head; anterior nasal tubes turned downward, conspicuous; posterior nostrils large; teeth in lower jaw less blunt than in *M. xysturus* Jordan & Gilbert, in 2



BRACHYSOMOPHIS HENSHAWI JORDAN & SNYDER. TYPE.

JULIUS BIEN & CO. LITH. N.Y.

series in front, becoming 3 posteriorly; 2 rows (the outer row being larger) of bluntish, conical teeth on each side of upper jaw, preceded by a patch of 8 on extremity of nasal bone; smaller teeth on vomer in a band of 2 series; dorsal and anal fins rather high, the highest part of dorsal exceeding length of snout; dorsal beginning at nape, at a distance from snout equal to half of length of head; pectoral short, 1.5 in its base, 1.75 in snout, its free margin lunate; gill-opening oblique, its width equaling base of pectoral and 1.75 in isthmus; end of tail rather blunt and little compressed.

Ground color, in spirits, light olivaceous; round brown spots in 4 series on side, extending on dorsal but becoming fainter on fin; second series on lateral line, the spots of third mostly smaller; spots of different series sometimes alternating regularly, sometimes without definite order; diameter of most of spots in upper 2 series exceeding snout; a fourth series of much smaller spots (not half the

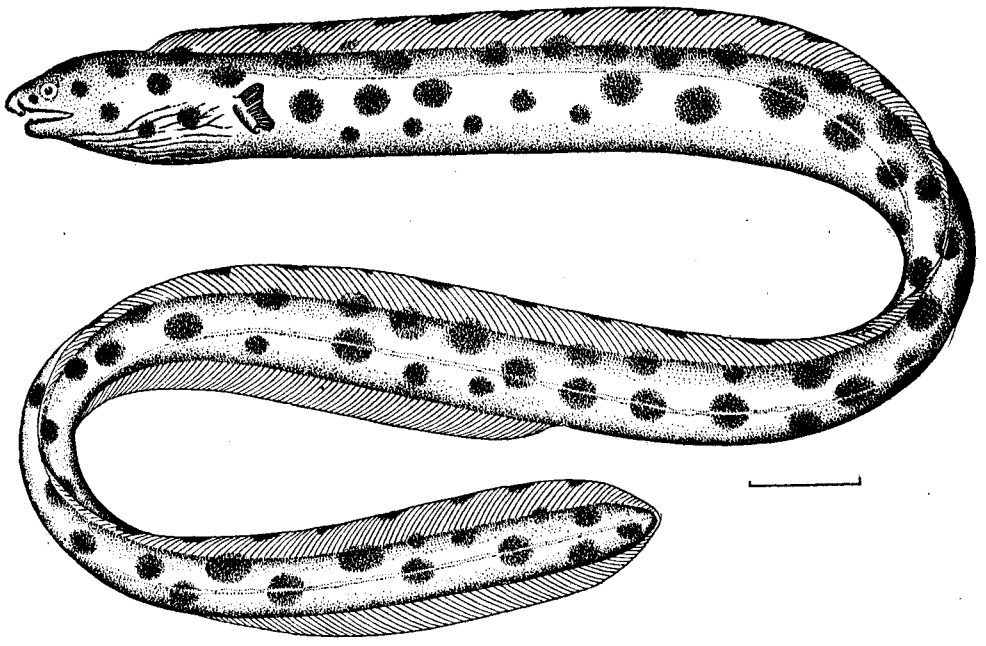


FIG. 19.—*Myrichthys stypurus* (Smith & Swain); from the type.

diameter of largest ones) along side of belly, almost disappearing on tail; small, irregular, more or less confluent spots on upper half of dorsal, the fin narrowly margined with whitish; anal plain, light olivaceous; pectoral with 1 or 2 small, obscure, brown spots.

One fine specimen (No. 26817, U. S. Nat. Mus.), 24.25 inches in length, was taken at Johnston Island, about 700 miles southwest of the Hawaiian Islands, in the spring of 1880, by the captain of a vessel belonging to the North Pacific Guano Company.

Ophichthys stypurus Smith & Swain, Proc. U. S. Nat. Mus., V, 120, July 8, 1882, Johnston Island.

Genus 52. CALLECHELYS Kaup.

Short oval head; straight depressed snout, and very depressed mandible; fore nostril tube dependent, the hinder one situated under the eye and furnished with a small flap; no pectorals; highly developed dorsal; less expanded anal; only a solitary nasal tooth, which is large, elongated, blunt, and inclined backward; 8 teeth implanted in the elliptical palatine bone, short, slender, and curved; about 10 vomerines, of which the 6 anterior ones are stouter, and are arranged in two rows; 24 teeth stand on the entire border of the mandible. (Kaup.) This genus contains one American, three East Indian, and one Hawaiian species, which agree in the elongate, compressed body, absence of pectoral fins, and the anterior insertion of the dorsal. In other respects *Callechelys* is close to *Ophichthus*.

Callechelys Kaup, Apodes, 28, 1856 (*guichenoti*).

41. Callechelys luteus Snyder. Plate 8, fig. 1.

Head, measured to upper edge of gill-opening, 16.6 in length, 10.5 in head and trunk, 6.7 in tail; snout 7.1 in head; cleft of mouth 3.4. Body extremely long and slender, tapering gradually from head to tail; depth at gill-opening 2.7 in head; width of body 1.4 in depth; gill-pouches greatly expanded, making head deeper and broader than body; snout sharp, projecting two-thirds of its length beyond lower jaw; eye midway between tip of snout and angle of mouth; tongue small, free on sides and at tip; teeth on jaws and vomer projecting backward, movable though not depressible; 3 large canines just posterior to nostril tubes, the median one being anterior to tip of lower jaw; 2 short rows of teeth on vomer, a single row on maxillaries and on lower jaw; anterior nostril with a tube equal in length to diameter of eye, inferior in position, halfway between tip of snout and end of closed lower jaw; posterior nostrils on lip, below the eye, provided with an anterior, valve-like flap; gill-openings slit-like, inferior, distance between lower edges of openings equal to half the length of snout; width of gill-opening equal to distance from tip of snout to posterior border of eye. Dorsal inserted on occiput above angle of mouth; height at a point above gill-slit equal to distance between tip of snout and posterior border of eye, above anal opening equal to width of gill-slit; fin not reaching tip of tail; membrane thin, the rays being distinctly visible; anal inserted immediately behind vent, its height equal to half the width of gill-opening; tip of tail sharp, there being no caudal fin; pectorals absent.

Color in alcohol, white, rather finely blotched with brownish black, the spots not so numerous on ventral surface as elsewhere; fins colored like body. In life, the upper parts, including dorsal fin, are white, mottled with black and lemon-yellow; under parts white, rather sparsely mottled with black, except on throat, where the spots are numerous.

One example, 22.3 inches long, caught while swimming about the ship at night, attracted by the lights.

Type, No. 50864, U. S. Nat. Mus., southern coast of Molokai.

Callechelys luteus Snyder, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), 517, pl. 3, fig. 5, **Albatross Station 3821, near the southern coast of Molokai.**

Family XXXII. 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 2 of them, *Moringua* (=*Raitaboura*=*Stilbiscus*) and *Aphthalmichthys*, are found in the West Indies as well as in the East.

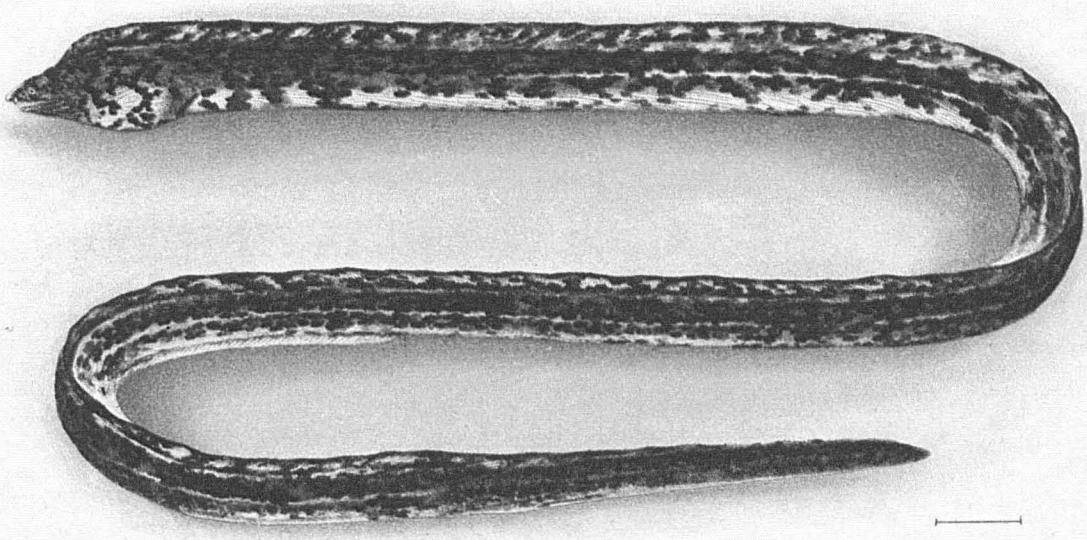
Genus 53. MORINGUA Gray.

Characters included with those of the family.

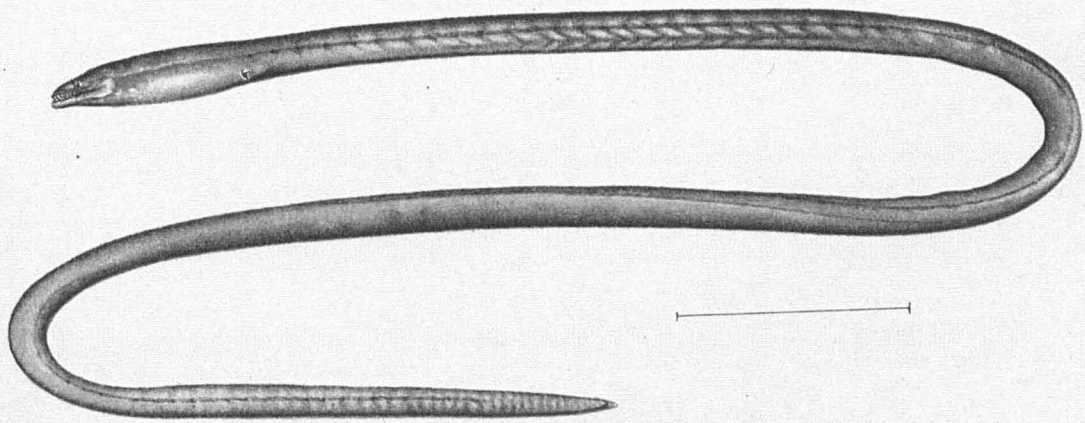
Moringua Gray, Ill. Ind. Zool., II, fig. 1 (*linearis*),
Stilbiscus Jordan & Bollman, Proc. U. S. Nat. Mus. 1888, 541 (*edwardsi*).

42. Moringua hawaiiensis Snyder. Plate 8, fig. 2.

Head, measured to gill-opening, 15.4 in length; tail 3.3; depth 4.16 in head. Body cylindrical and extremely elongate, the tail tapering to a sharp point; snout pointed, its length 6.7 in head; lower jaw projecting beyond upper a distance equal to diameter of pupil; cleft of mouth extending beyond eye a distance equal to pupil; teeth on jaws and vomer sharp, long, and fang-like anteriorly; tongue adnate to floor of mouth; eye very small, the diameter equal to about 5 in snout; gill-opening a vertical slit, equal to 1.7 in length of snout; lateral line slightly arched above branchial chamber, discontinued about a head's length from tip of tail; number of pores 113. Pectorals present, minute, the rays easily distinguishable; the base equal to half the gill-opening, length a little less than diameter of pupil; dorsal and anal fins scarcely developed, indicated by slight ridges commencing



1. CALLECHELYS LUTEUS SNYDER.



2. MORINGUA HAWAIIENSIS SNYDER.

A. HOEN & CO., LITH.

about a head's length behind anal opening, growing larger and more distinct in region where lateral line ceases; caudal fin distinct, pointed, its length equal to width of interorbital space.

Color in alcohol pale brown, no spots or bars.

One specimen, 12.6 inches long, from Honolulu reef. Type, No. 50865, U. S. Nat. Mus.

Closely related to *M. javanicus* of the East Indies, but differing from that species as described in having pectoral fins with distinct rays, longer head, and longer tail.

Moringua hawaiiensis Snyder, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), 517, pl. 3, fig. 6, **Honolulu.**

Family XXXIII. MURÆNIDÆ.—The Morays.

The *Muræniduæ* 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 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. These eels 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. We exclude from the *Muræniduæ* the genus *Myroconger*, from St. Helena, which has pectoral fins and is probably the type of a distant family. The remaining species are referable to 10 or 12 genera, most of which are found in America. About 120 species are known. The *Muræniduæ* without fins are the simplest in structure, but their characters are those of degradation, and they are farther from the primitive stock than such genera as *Muræna* or *Enchelycore*.

a. Vertical fins well developed, dorsal beginning on head.
  b. Posterior nostrils tubular; 2 pairs of nasal barbels present ..... *Muræna*, p. 87
  bb. Posterior nostrils not tubular, sometimes with a raised border.
    c. Anterior nostril very large, as large as eye, with dilated border suggesting the nostril of a horse.. *Enchelynassa*, p. 90
    cc. Anterior nostril not so large.
      d. Teeth mostly acute.
        e. Posterior nostrils with inconspicuous rims or none; snout moderate ..... *Gymnothorax*, p. 91
        ee. Posterior nostrils with conspicuous funnel-form border; snout very long and pointed..... *Eurymyctera*, p. 105
      dd. Teeth mostly blunt or molar ..... *Echidna*, p. 105
aa. Vertical fins rudimentary, confined to end of tail.
        f. Only anterior nostrils tubular; tail about as long as trunk..... *Uropterygius*, p. 111
        ff. Both anterior and posterior nostrils tubular; tail much shorter than trunk ..... *Scuticaria*, p. 112

Genus 54. MURÆNA Linnæus.

This genus, as now restricted, contains some 10 species, found in tropical seas, distinguished from *Gymnothorax* and from the rest of the family by the presence of 2 pairs of nasal barbels. The name *Muræna*, originally applied to all eels, should be restricted to the group typified by *Muræna helena*. It was first limited by Thunberg & Ahl, in 1789, to the eels without pectoral fins, those with such fins being set off as *Ophichthus*. The nominal species of the following key are doubtless color variations of a single species.

Muræna Linnæus, Syst. Nat., Ed. X, 244, 1758 (*helena*, etc., after *Muræna* Artedi, Gen. Pisc., 23, 1738, in part, including all eels, and *Muræna* Klein, Hist. Nat. Pisc., 28, 1742, in part, including all eels without pectoral fins); Thunberg & Ahl, De Muræna et Ophichtho, 6, 1789 (restricted to *helena*, etc., including species without pectoral fins); Günther, and of authors generally (not of Bleeker).

Muræophis Lacépède, Hist. Nat. Poiss., V, 630, 1803 (*helena*, etc.)

Limamuræna Kaup, Cat. Apodes, 95, 1856 (*guttata*).

a. Color, brown, with conspicuous white spots intermingled with black and brown spots; a row of white spots crossing the ventral line.
b. The white spots in three longitudinal rows, the brown spots irregularly scattered ..... *lampra*, p. 89
bb. The white spots smaller, forming more or less distinct vertical rows; dark brown spots in 2 longitudinal rows. *kauila*, p. 90
aa. Color, brown, with fine yellow and blackish spots and reticulating lines ..... *kailuæ*, p. 88

43. Muræna kailuæ Jordan & Evermann. Plate 9 and Figs. 20 and 21.

"Puhi oa;" "Puhi kauila."

Head 7 in total length; depth 11.5; eye 14 in head; snout 6; interorbital 12; gape 2.75.

Body short, stout, and moderately compressed; distance from tip of snout to vent less than that from vent to tip of tail by a distance equal to two-thirds length of head; head very small and pointed; snout long, quadrate, the jaws equal, the lower curved so that the mouth does not completely close; lips thin, the teeth showing; each side of upper jaw with a single series of unequal, sharpish canine-like teeth, inside of which is a single depressible fang-like tooth near middle of side; front of median line with 2 long, sharp, fang-like, depressible teeth; shaft of vomer with a single series of short, movable teeth; each side of lower jaw with a single series of unequal, sharp canines, those in front largest; eye small, midway between angle of mouth and tip of snout; anterior nostrils each in a pointed filament whose length is about half that of eye, situated at tip of snout just above lip; posterior nostrils each

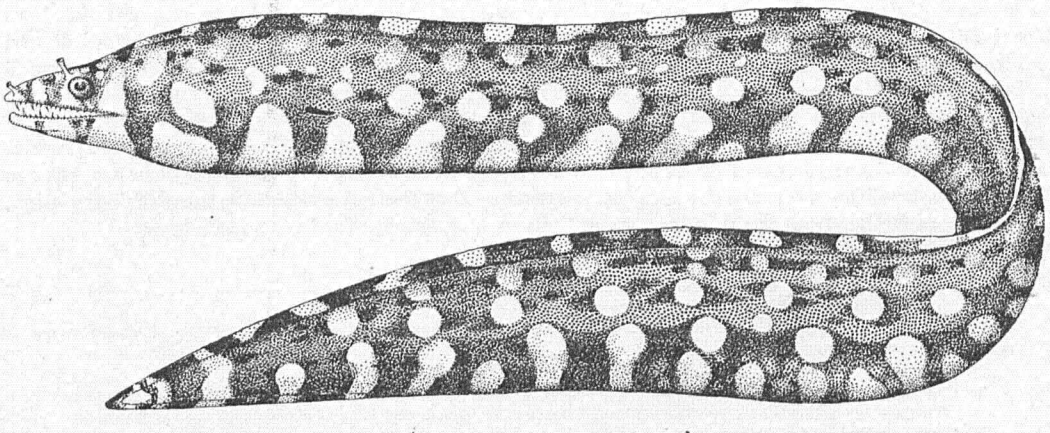
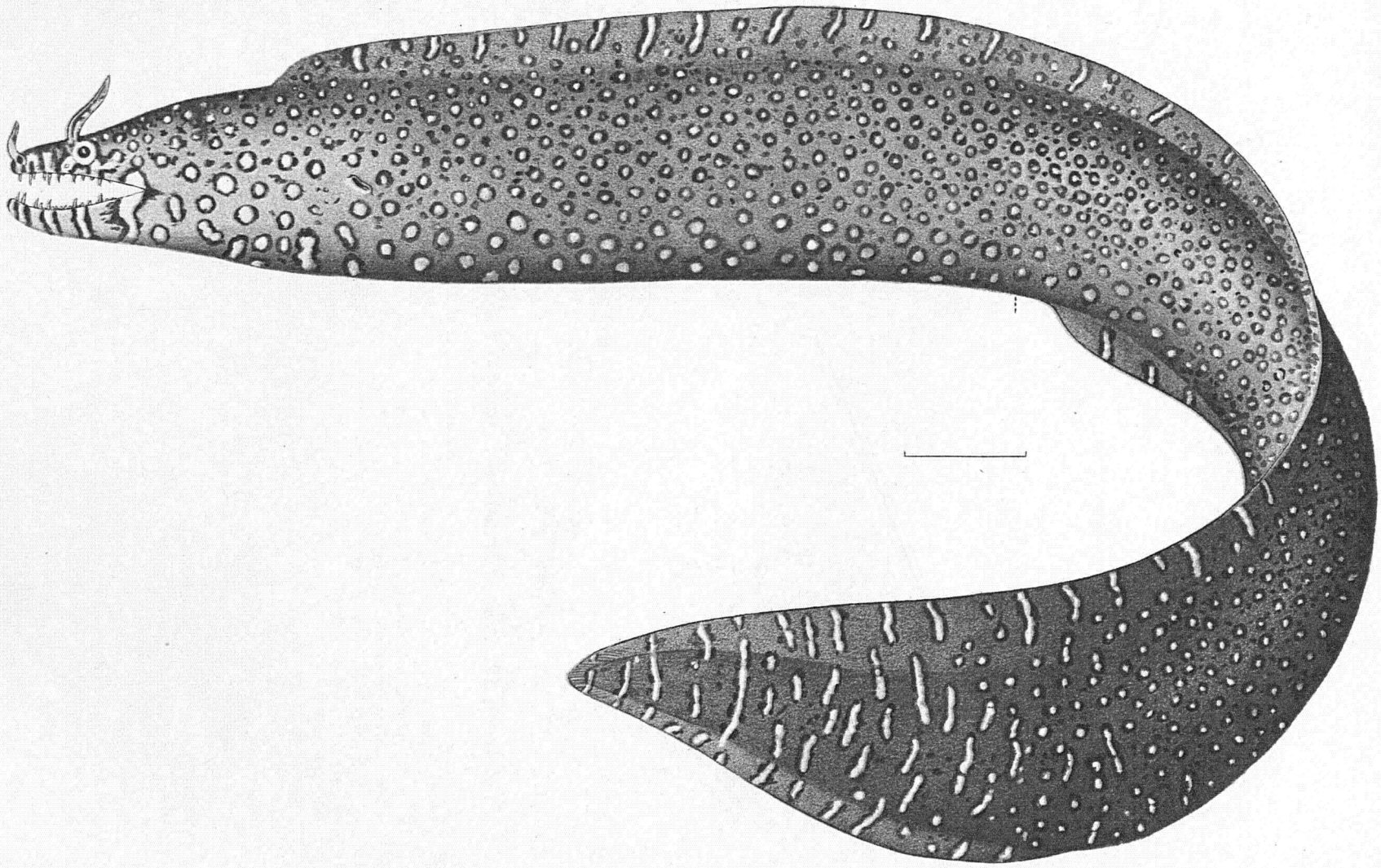


FIG. 20.—*Muræna kailuæ* Jordan & Evermann. Type of *M. lampra* Jenkins.

with a long filament, equal to snout in length, and situated just above anterior edge of eye; interorbital space very narrow and flat; gill-opening small, nearly circular; dorsal fin very low anteriorly, increasing much in height on tail; anal low.

Ground color in life, dark brown, with fine yellow and blackish spots and reticulating lines, the yellow predominating on anterior part of body; end of tail dark purplish brown; edge of dorsal and anal dull dark red, with short pale bands bordered with darker and with small pale spots interspersed; ground color of cheek and throat yellow, with pale spots bordered with black; jaw orange red, with pale black-edged bars; tips of jaws bright coral red; tips of nostril filaments bright red.

Color in alcohol, body with a ground color of light grayish brown, marked with fine whitish lines or specks, and profusely covered with numerous small, round, white spots, each ocellated with black; among these are scattered larger black spots and blotches; white spots smallest on back and largest on belly, where some are as large as eye; a broad, dark brown bar over nape, extending on side to level of eye; top of head and snout with fine white spots; side of snout with a well-defined vertical white bar about midway between eye and tip; a short white line downward to mouth from front of eye, and a similar longer one downward and backward from posterior lower angle of eye; lower jaw crossed by 3 V-shaped white bars opening forward and bordered by darker; tip of jaw with 2 oblique white bars



MURAENA KAILUÆ JORDAN & EVERMANN. TYPE.

JULIUS BIEN & CO. LITH. N.Y.

separated by a narrow brown line; last V-shaped white bar extending across angle of mouth and forming a large white area at base of upper jaw, behind which the angle of the mouth is dark brown; inside of mouth mottled brown and white; nasal filaments mottled with brown and white; throat light brown, with large white spots, some of which unite to form oblong spots or lines; gill-opening not surrounded by dark; anal fin dark brown, crossed by about 28 short white bars; posterior portion of tail crossed by about 12 distinct but somewhat irregular vertical white bars, which extend upon dorsal and anal fins; tip of tail brownish black, with 1 or 2 whitish specks.

We have examined the following specimens of this form: The type, from Kailua, Hawaii; a specimen sent from Laysan Island by Mr. Max Schlemmer; one from Honolulu, sent by Mr. E. L. Berndt; one collected by the *Albatross* at Honolulu, and another at station 3881, in Napili Harbor, Maui.

This species is subject to great variations, especially in color. The form described by Jenkins as *Muræna lampra* has been described as follows:

Head 3.25 in trunk; head and trunk 2.25 in tail; eye 1.67 in snout; interorbital space 1.5 in eye; snout about 5.3 in head; mouth about 2.2.

Body rather short, deep, compressed, the tail tapering posteriorly; head elongate, deep, compressed; snout long, conical, pointed, tip rounded, not produced; eyes lateral, much nearer corners of

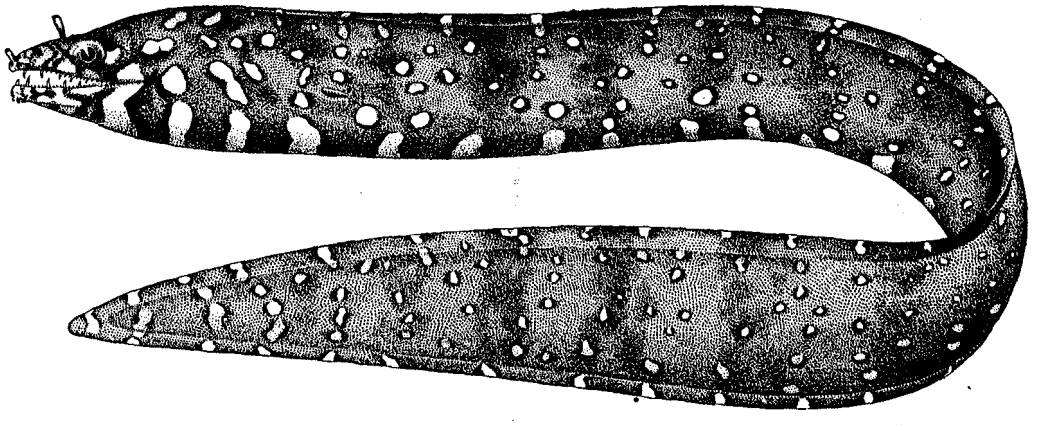


FIG. 21.—*Muræna kailuæ* Jordan & Evermann. Type of *M. kauila* Jenkins.

mouth than tip of snout; jaws rather large, equal, mouth not completely closing, so that some of the teeth are always more or less visible; teeth in jaws varying, some of them more or less fang-like, in 2 series in upper jaw posteriorly, the inner enlarged and depressible; vomer with 2 large depressible fangs in front, followed by a median series of small teeth; nostrils all in tubes, the posterior pair about as long as eye; interorbital space very narrow; gill-openings small, about midway in depth of body; head with a number of pores; origin of dorsal about over last third of space between corner of mouth and gill-opening, the fin rather high, decreasing posteriorly; anal similar to dorsal; caudal small and confluent with dorsal and anal.

Color in life, very bright, the groundwork of light brown, with conspicuous white spots intermingled with black and brown spots; 3 longitudinal rows of white spots on body, one row on outer margin of dorsal and a row of large white spots or blotches across the ventral surface, largest between head and anal fin; black as well as brown spots small, irregularly placed, but generally following the line of rows of white spots; very brilliant red on snout and jaws; no dark margin to gill-opening.

The above description is based upon the type (No. 50680, U. S. Nat. Mus.), a specimen 7.75 inches long, collected in 1889 by Dr. Jenkins from the coral reef in front of Honolulu. Another example (No. 03709), 19 inches long, was obtained for us at Kailua, Hawaii, by Mr. Goldsborough.

The form called *Muræna kauila* by Jenkins is described as follows:

Head 7.3; depth 16; tail a little longer than head and trunk; snout 4 in head; eye 1.5 in snout; interorbital 2.25; mouth 2 in head.

Body elongate, compressed; tail tapering posteriorly; head elongate, pointed, sides swollen a little above behind eyes; snout long, slightly convex in profile; mouth large; jaw arched, not completely closing, upper slightly the longer; teeth uniserial in jaws, compressed, with long canines with intervening smaller teeth; 2 large depressible canines on vomer; 3 or 4 large depressible canines below eye, forming an inner series on each side of upper jaw; lips thin, not concealing teeth when mouth is closed; eye about midway in length of mouth; nostrils in long tubes, the posterior larger, equal to eye; interorbital space flattened; gill-opening small, 0.75 in eye; roof of mouth with a single median series of small teeth beginning below front margin of eye and running back well beyond its posterior margin; dorsal beginning nearly midway between corner of mouth and gill-opening; caudal small, rounded.

Color in life, light brown, with 2 longitudinal rows of dark brown spots about the diameter of snout gradually fading into one row on the posterior portion of the tail; many clear white spots as large, or larger than pupil, over head, body, fins, and tail, many of the spots forming more or less distinct vertical rows over fins and dorsal portions, some confluent on throat and belly, each one surrounded by a dark-brown margin; about 30 white spots crossing the ventral line; nasal tubes bright red; bright red bars on snout and lower jaw, and bright red undulations posterior to angle of mouth.

Color in alcohol, brown, with the white and dark brown spots distinct; white spots edged with dark brown; bright red undulations posterior to angle of mouth fading out.

A single specimen, the type, No. 50684, U. S. Nat. Mus. (original No. 304), 13 inches long, taken by Dr. Jenkins from the coral rocks on the reef at Honolulu in 1889. The *Albatross* also obtained an example at station 3881, Napili Harbor, Maui, in 1902.

Muræna kailuæ Jordan & Evermann, Bull. U. S. Fish Comm. 1902 (Apr. 11, 1903), 165, Kailua, Hawaii (type, No. 50614, U. S. Nat. Mus.); Snyder, op. cit., 1902 (Jan. 19, 1904), 518 (Honolulu; Albatross station 3881, Napili Harbor, Maui).

Muræna lampra Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 413, fig. 3, Honolulu. (Type, No. 50680, U. S. Nat. Mus.)

Muræna kauila Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 424, fig. 4, Honolulu.

Genus 55. ENCHELYNASSA Kaup.

Fore nostril funnel-shaped and capable of being shut up by a valvular elongation of its hinder border. Hinder nostril nearly as big as the eye, with a raised border. Rictus of the jaws open in the middle. Nasal bone reaching as far back as the middle of eye, armed with 27 teeth on its circumference, a pairless one in the middle and 5 longer ones, between the second and third of which stand 3 or 4 small ones, between the third and fourth 4 small ones, and between the fourth and fifth 1 small one. Palatines 16, whereof the second, onward to the sixth, are supported before and behind by small teeth; on the inner row there are 9 longer acicular teeth. On the mesial line 3. On the vomerine no more than 2 small conical toothlets visible. Mandibulars, 22 smaller ones in the outer, and 6 to 8 longer in the inner row, approximated to the symphysis. The eyes are situated above the middle of the jaws. There are 4 pores on the upper jaw and mandible difficult to find in the porous skin. (Kaup.)

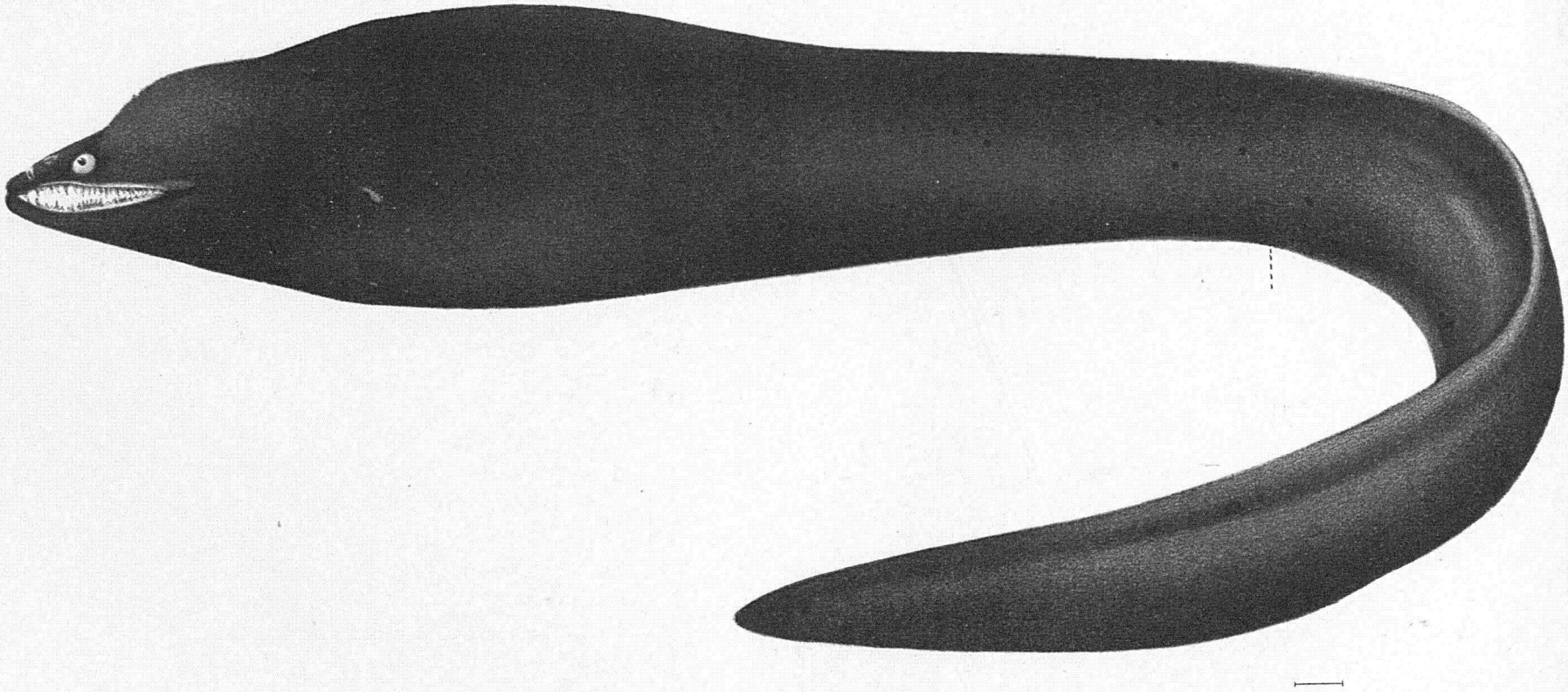
This genus is distinguished from *Gymnothorax* by the enlarged and dilated posterior nostril, which suggests the nostril of a horse. The teeth are very numerous, some of them being long and sharp, as in the Japanese genus *Æmaria*. These are morays of huge size, found in the Pacific, perhaps all belonging to one species; but if so, the variation in the number of teeth is considerable.

a. Snout long, 5.5 in head; eye 3 in snout ..... *bleekeri*, p. 90
aa. Snout shorter, 6.5 in head; eye 2 in snout ..... *vinolentus*, p. 91

Enchelynassa Kaup, Weigmann's Archiv 1855, 213 (*bleekeri*); Kaup, Apodes, 72, 1856.

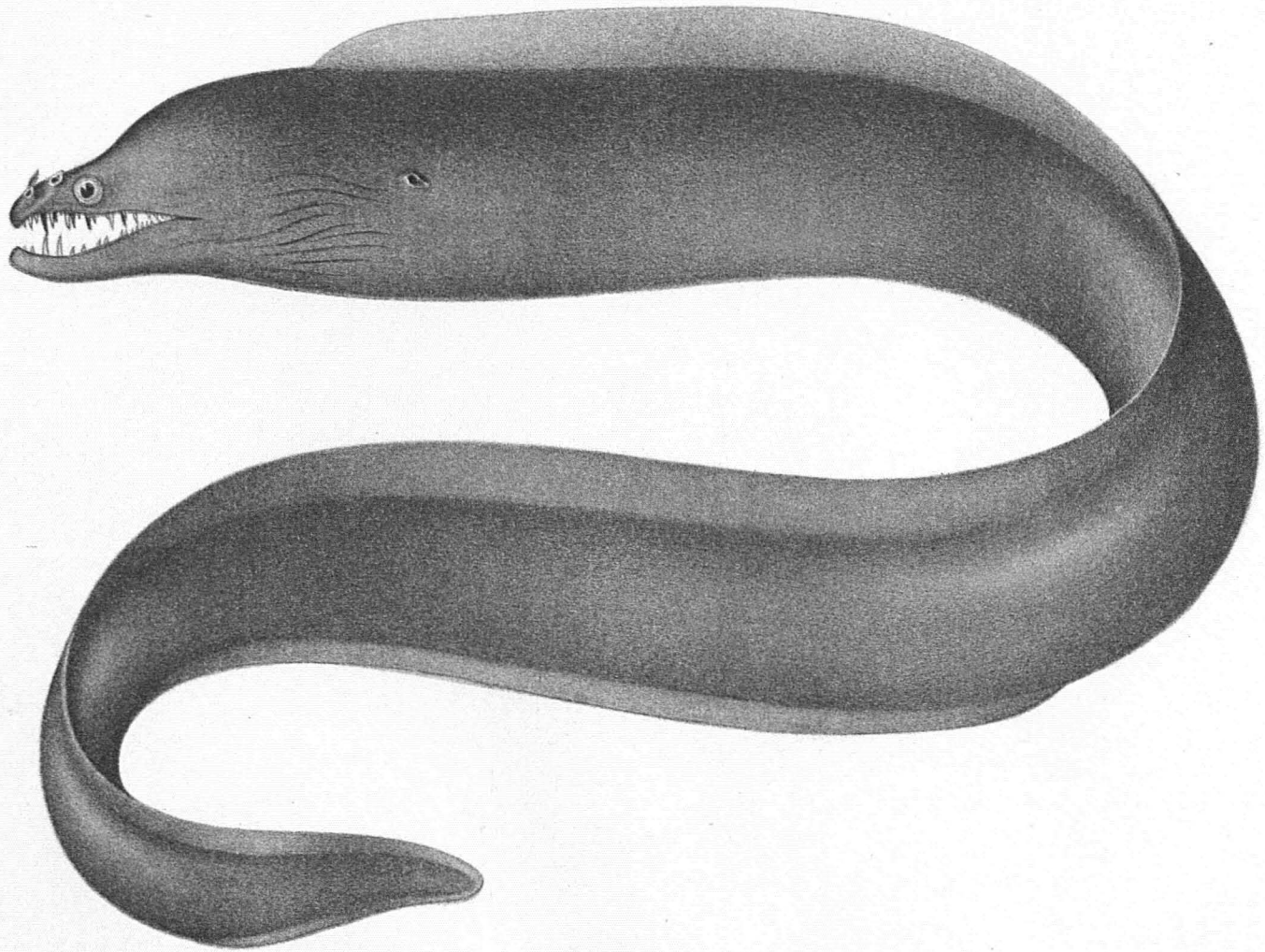
44. Enchelynassa bleekeri Kaup. Plate 10.

Head, measured to gill-opening, 7.1 in the length; depth 9; snout 5.5 in head; eye 3 in snout; interorbital space 1.5; cleft of mouth 1.75 in head; origin of dorsal on a vertical passing midway between angle of mouth and gill-opening; height of fin about equal to length of snout, the membrane very thick



ENCHELYNASSA BLEEKERI KAUP.

JULIUS BIEN & CO. LITH. N.Y.



GYMNOTHORAX VINOLENTUS JORDAN & EVERMANN. TYPE.

JULIUS BIEN & CO. LITH. N.Y.

and fleshy; anal arising immediately behind vent, its height equal to one-half the length of snout; both dorsal and anal continuous with the very short caudal; tail slightly longer than head and body; anterior nostril located at a point one-third the distance between tip of snout and border of eye, the edge with a low, thickened rim and a posterior flap edged with tentacles; posterior nostril situated on dorsal side of snout midway between anterior nostril and eye, the opening oval, surrounded by a broad, thin membrane; teeth lanceolate-canines, the lateral notches not evident on some of the smaller ones; those of upper jaw in 2 rows, the inner ones larger, their length about equal to two-thirds the diameter of eye; a row of 4 or 5 long teeth on vomer, followed by a short row of small teeth; anterior vomerine teeth and those of inner series of jaw depressible; teeth of lower jaw in 2 series, the inner row having 4 or 5 large, depressible ones; width of gill-opening equal to or slightly more than half the length of snout.

Color in alcohol, brownish, with a few small, darker spots scattered over the body.

A very large example, 52 inches long, apparently identical with the scantily described *Enchelynassa bleekeri* of Kaup, was obtained at Honolulu. Another, equally large, was taken at Samoa in 1902.

Enchelynassa bleekeri Kaup, in Wiegmann's Archiv 1855, 214, taf. 10, fig. 3; Kaup, Apodes, 72, fig. 55, 1856, **locality unknown.**

45. Enchelynassa vinolentus (Jordan & Evermann). Plate II.[a]

Head 2.67 in trunk; head and trunk a little shorter than tail; eye 2 in snout, 1.5 in interorbital space; snout 6.5 in head; mouth about 2.

Body compressed, rather deep; head compressed, pointed, more or less swollen on top; snout long, pointed, bent over at tip; eye small, much nearer tip of snout than corner of mouth; mandible long, projecting beyond tip of snout and bent up, the mouth not closing so that only the tips of the jaws meet; lips rather thin, not concealing the teeth; teeth biserial, of more or less irregular size, those in inner series much larger and also depressible like the few large vomerine fangs; anterior nostrils in rather large tubes, situated 0.67 of an eye diameter from tip of snout, and the posterior nostrils at some little distance above and anterior to front margin of eye, with their rims somewhat expanded and flattened down; interorbital space convex; gill-opening about 0.75 of an eye diameter; body more or less smooth and with thick, tough skin; head with a number of pores; origin of dorsal well before gill-opening, or about last third or fourth of space between corner of mouth and the latter; marginal fin around end of tail rather narrow.

Color in alcohol, deep purplish brown, marked all over with very small indistinct darker spots so that it appears almost uniform.

The collections contain a single specimen, type, No. 50615, U. S. Nat. Mus. (original No. 03726), 29 inches long, obtained by Messrs. Goldsborough and Sindo at Kailua, Hawaii. The species may be identical with *Enchelynassa bleekeri* Kaup, but its larger teeth, distinct nasal flap, and higher dorsal and anal fins seem to indicate its distinctness.

Gymnothorax vinolentus Jordan & Evermann, Bull. U. S. Fish Comm., XXII, 1902 (Apr. 11, 1903), 165, **Kailua, Hawaii.**
? *Muræna canina* Quoy & Gaimard, Voy. Uranie, 247, 1824, **Rawak** and **Waigiou Islands.**

Genus 56. GYMNOTHORAX Bloch & Schneider. The Morays. *"Puhi."*

This genus, as here understood, comprises the great bulk of the *Muræniдæ*, including nearly all the species with sharp teeth, the body normally formed, only the anterior nostrils tubular, and the dorsal fin beginning on the head. *Priodonophis*, with serrated teeth, has been recognized as a distinct genus by Bleeker, but the character in question disappears by degrees and seems not to be suitable for generic distinction. 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.

Gymnothorax Bloch, Ichthyologia, XII, 71, 1797 (*reticulatis*).
Lycodontis McClelland, Calcutta Journ. Nat. Hist., V, 1844, 174 (*liturata=tile*).
Thærodontis McClelland, Calcutta Journ. Nat. Hist., V, 1844, 174 (*reticulata=tesselata*).
? *Sidera* Kaup, Cat. Apodes, 70, 1856 (vomerine teeth molar) (*pfeifferi*).
Polyuranodon Kaup, l. c., 96, 1856 (*kuhli=polyuranodon*).

[a] Plate labeled *Gymnothorax vinolentus.*

Tæniophis Kaup, Neue Aälahnliche Fische des Hamburger Museums Nachtrag 1, 1859, in Abhand. Naturwissenschaft, IV, 1858–1866 (*westphali=funebris*).
Priodonophis Kaup, l. c., 22, 1859 (*ocellatus*).
Neomuræna Girard, U. S. Mex. Bound. Surv., Fish., 76, 1859 (*nigromarginata=ocellatus*).
Pseudomuræna Johnson, Proc. Zool. Soc. London 1862, 167 (*maderensis*).

a. Vomer with teeth.
b. Vomerine teeth sharp and pointed.
c. Teeth in more than 1 series in one or both jaws.
d. Teeth biserial in each jaw.
e. Jaws not completely closing, the teeth not concealed by the lips.
f. Jaws about equal ..... *eurostus*, p. 92
ee. Jaws completely closing, the teeth concealed by the lips.
g. Eye comparatively small, 2.67 in snout ..... *laysanus*, p. 93
gg. Eye larger, 1.67 in snout ..... *meleagris*, p. 94
dd. Teeth in unequal number of series in upper and lower jaw.
h. Vomer with large depressible fangs in front.
i. Vomer without teeth excepting the fangs; teeth biserial in upper jaw and uniserial in lower. *gracilicauda*, p. 94
ii. Vomer with a series of about 6 smaller teeth on shaft besides the fangs in front; teeth biserial anteriorly and triserial posteriorly in upper jaw; biserial anteriorly and uniserial posteriorly in lower ..... *ercodes*, p. 95
hh. Vomer without large fangs.
j. Teeth of lower jaw uniserial; vomer with a single median series of small teeth ..... *leucostictus*, p. 96
jj. Teeth of lower jaw biserial; vomer with 3 short sharp teeth ..... *waialuæ*, p. 97
cc. Teeth uniserial in each jaw.
k. Vomerine teeth not large and fang-like.
l. Vomer with a row of small sharp teeth; jaws equal ..... *mucifer*, p. 97
ll. Vomer with only 5 small teeth; lower jaw somewhat projecting ..... *berndti*, p. 98
kk. Vomerine teeth large and fang-like, depressible.
m. Vomer with numerous teeth.
n. Vomerine teeth not forming a fork in front ..... *undulatus*, p. 98
nn. Vomerine teeth forming a fork in front ..... *flavimarginatus*, p. 99
mm. Vomer with but few large fang-like depressible teeth.
o. Vomer with but 1 fang ..... *goldsboroughi*, p. 100
oo. Vomer with but 2 or 3 fangs ..... *petelli*, p. 100
bb. Vomerine teeth short and blunt, or rounded.
p. Anterior nostril in a long tube, about 2 in eye.
q. Tail pointed, moderately slender; mouth not completely closing ..... *steindachneri*, p. 101
qq. Tail blunt; mouth completely closing.
r. Eye large, 1.16 in snout ..... *hilonis*, p. 102
rr. Eye small, 2.5 in snout ..... *nuttingi*, p. 103
pp. Anteror nostril in short tube, more than 2 in eye ..... *pictus*, p. 103
aa. Vomer toothless ..... *xanthostomus*, p. 104

46. Gymnothorax eurostus (Abbott).

Head large, depressed; the facial outline very slightly oblique; eye large, circular, slightly behind extremity of snout, and 1.5 diameters distant; jaws of equal length, rather slender, the lower with a slight upward curve at its extremity making the large mandibular teeth partially visible when mouth is closed; nasal teeth 10, biserial, the inner row twice as large as the outer, conical, acute, and with a decided inward inclination; palatine teeth, 28 in the outer row, 9 in the inner, the former short, very much compressed, acute and with an inward inclination; the inner series widely set, of various lengths, and more than twice as large as those of outer row, a gape in the series beginning posteriorly opposite posterior margin of orbit and ceasing opposite anterior edge of orbit; vomerine teeth 12, 9 of which are in a direct line, the remaining 3 concurrent with the central 3 of the series; lower jaw armed with a complement of 24 compressed, acute teeth having a decidedly inward inclination, the posterior 12 of these closely set in an unbroken series, and the anterior 12 arranged in pairs, except at the extremity of the jaw where they form 2 square patches of 4 teeth; fold of skin enveloping dorsal fin very thick, and arising behind occiput nearly perpendicularly; fin of uniform height for two-thirds its length, thence slowly decreasing to its termination.

Color in alcohol, head and body uniform reddish brown, nearly black upon the under surface of tail; body everywhere minutely spotted and reticulated with pale yellowish. (Abbott.)

This species is known only from Abbott's type (No. 984, Ac. Nat. Sci. Phila.), a specimen collected

in 1835 by Dr. J. K. Townsend in the Hawaiian Islands, measuring 13.5 inches in length, and 1.5 inches from tip of snout to gill-opening, or 6 inches to anus.

Thyrsoidea eurosta Abbott, Proc. Ac. Nat. Sci. Phila. 1860, 478, **Hawaiian Islands**; Günther, Cat., VIII, 94, 1870 (no description).

Lycodontis eurosta, Fowler, Proc. Ac. Nat. Sci. Phila. 1900, 494, pl. XVIII, fig. 4 (Abbott's type).

47. **Gymnothorax laysanus** (Steindachner). Plate 12 and Fig. 22.

Head 2.3 in trunk; tail longer than head by the length of the latter without eye and snout; eye 1.67 in snout, 1.5 in interorbital space; snout 6 in head; interorbital space 7; mouth 2 and an eye diameter in head.

Body rather deep and compressed; tail tapering at its extremity to a rather sharp point; head pointed and compressed; snout pointed, the tip rounded; eye rather small, much nearer corner of mouth than tip of snout; mouth horizontal and jaws equal; teeth in jaws biserial, the inner series the larger and depressible; vomerine teeth pointed and in a single series; each jaw with some enlarged canines in front, which are depressible; anterior nostril in small tube at tip of snout; posterior nostril over front of eye above; gill-openings smaller than eye; body more or less smooth; head with few pores; origin of dorsal a little nearer corner of mouth than gill-opening; fin around end of tail more or less pointed.

Color in alcohol, dark brown above; belly and lower surface pale; everywhere reticulated, speckled or mottled with darker, or blackish brown on upper portions. The above description is from a speci-

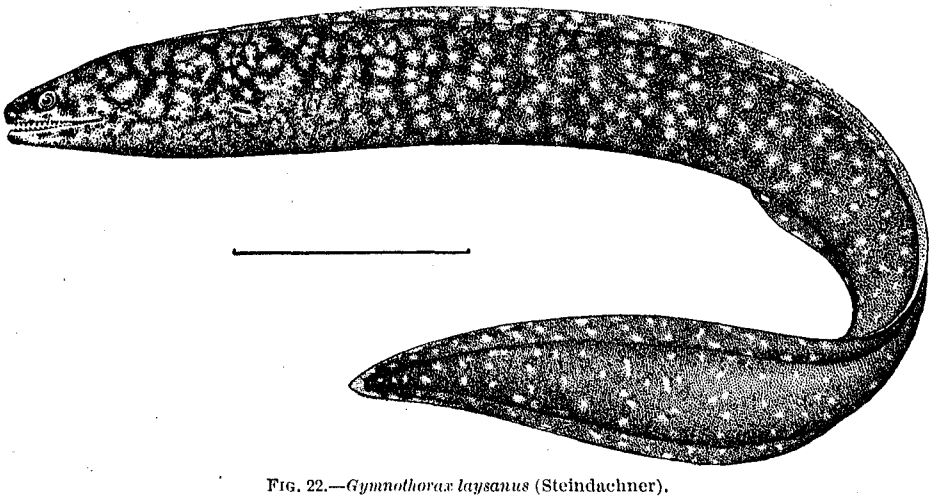


FIG. 22.—*Gymnothorax laysanus* (Steindachner).

men (No. 04913) 10 inches long, from Honolulu. The species shows considerable variation in color and other characters with age.

Color in life (No. 03357), brown, profusely covered with rather large roundish black spots, interspersed among which are more numerous and much smaller white specks, these more or less uniformly distributed over the body and fins; edges of dorsal and anal fins darker; tip of caudal narrowly edged with white.

The young may be described as follows, from a specimen 4.5 inches long (No. 04916), taken on the reef at Honolulu, August 15, 1901.

Head 2 in trunk; head and trunk about 1.3 in tail; eye about 1.5 in snout, 1 in interorbital space; snout 5 in head; mouth 2 and a little less than an eye diameter in head.

Body elongate and compressed; head moderately compressed laterally, pointed; neck swollen and a little thicker than body; snout short, bluntly rounded, rather deep; eye small, anterior, about midway between tip of snout and corner of mouth; mouth large, jaws nearly equal, or snout only very slightly protruding and when closed the lips entirely concealing the teeth; teeth in 2 rows along

edges of upper jaw extending posteriorly to eye at least; teeth in mandible in a single series, very unequal and anteriorly from the symphysis about 4 enlarged canines forming a short inner series; vomer with 2 large fangs, the posterior the larger; anterior nostril in a short fleshy tube; interorbital space rather flat; gill-openings small; body smooth, a few longitudinal wrinkles about branchial region of head; head with a number of pores, especially along upper jaw; origin of dorsal well anterior to gill-opening; dorsal and anal each rather high; caudal ending in a rounded point.

Color in alcohol, dark brown, variegated with 4 rows of longitudinal whitish spots, the third or series next to lowest not continued to end of tail; a number of similar whitish spots on the vertical fins, head, and belly; many blackish blotches of similar size between the white spots on body; edge of caudal very narrowly white.

Of this species, which is abundant in the Hawaiian Islands, we have a more or less complete series of specimens, from the young *parvibranchialis* to the adult *laysanus*. Our collection contains a total of more than 30 specimens, ranging in length from 4.5 to 13.5 inches, and representing the following localities: Honolulu; Waikiki Reef, Honolulu; Cocoanut Island, Hilo; and Hilo.

Muræna laysana Steindachner, Anzeiger Denks. Ak. Wiss. Wien, XVI, June 27, 1900, 177, **Laysan Island** (coll. Dr. Schaiunsland, 1896-97); Denks. Ak. Wiss. Wien, LXX, 515, pl. VI, fig. 1, 1900, (Laysan).

Lycodontis parvibranchialis Fowler, Proc. Ac. Nat. Sci. Phila. 1900 (Nov. 6, 1900), 494, pl. XVIII, fig. 1, **Hawaiian Islands.**

Gymnothorax laysanus, Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 425 (Honolulu); Snyder, l. c. (Jan. 19, 1904), 518 (Honolulu; Hilo).

48. Gymnothorax meleagris (Shaw).

Head 2.3 in trunk; tail exceeding head and trunk by length of mouth; eye 2.67 in snout or 2 in interorbital space; snout 5.5 in head; interorbital space 7.25; mouth 2.25.

Body rather deep and compressed; tail tapering posteriorly; head compressed, pointed; snout rather long and pointed, the tip obtusely rounded; eye small, about midway between tip of snout and corner of mouth; mouth rather large; jaws about equal, closing, the thick tough lips concealing the teeth; teeth strong and sharp, those in anterior part of jaws enlarged and canine-like, the vomerine in a single series; nostrils in small tubes at tip of snout, the posterior pair above and anterior to eye; interorbital space convex; gill-opening large, eye about 1.4 in its length; skin smooth and thick; a few pores on head; origin of dorsal about midway between corner of mouth and gill-opening; caudal small and roundly pointed.

Color in alcohol, dark brown, variegated all over by very numerous small round whitish spots with borders darker brown than the body color, those on fins very small; tip of tail narrowly edged with white.

This description is based upon a specimen (No. 03391) 32 inches long, from Honolulu. Another small example (No. 03716), from the same locality, is dark brown with a slightly purplish tint; the general color between the white spots is more or less mottled with darker. In life the color (No. 03391) is olive-brown, mottled with darker, scarcely paler below or darker on fins; body covered everywhere with punctated spots of yellowish and yellowish white, each of them darker edged; tip of tail white; no margin on fins; angle of mouth uncolored; gill-opening dusky; vent dusky.

This species is apparently not common in the Hawaiian Islands. It was not found by Doctor Jenkins, and only 2 examples were secured by us.

Muræna meleagris Shaw, Nat. Misc., pl. 220, 1809, **Brazil?**

Thyrsoidea chlorostigma Kaup, Cat. Apod. Fish., 89, 1856, **Seychelles.**

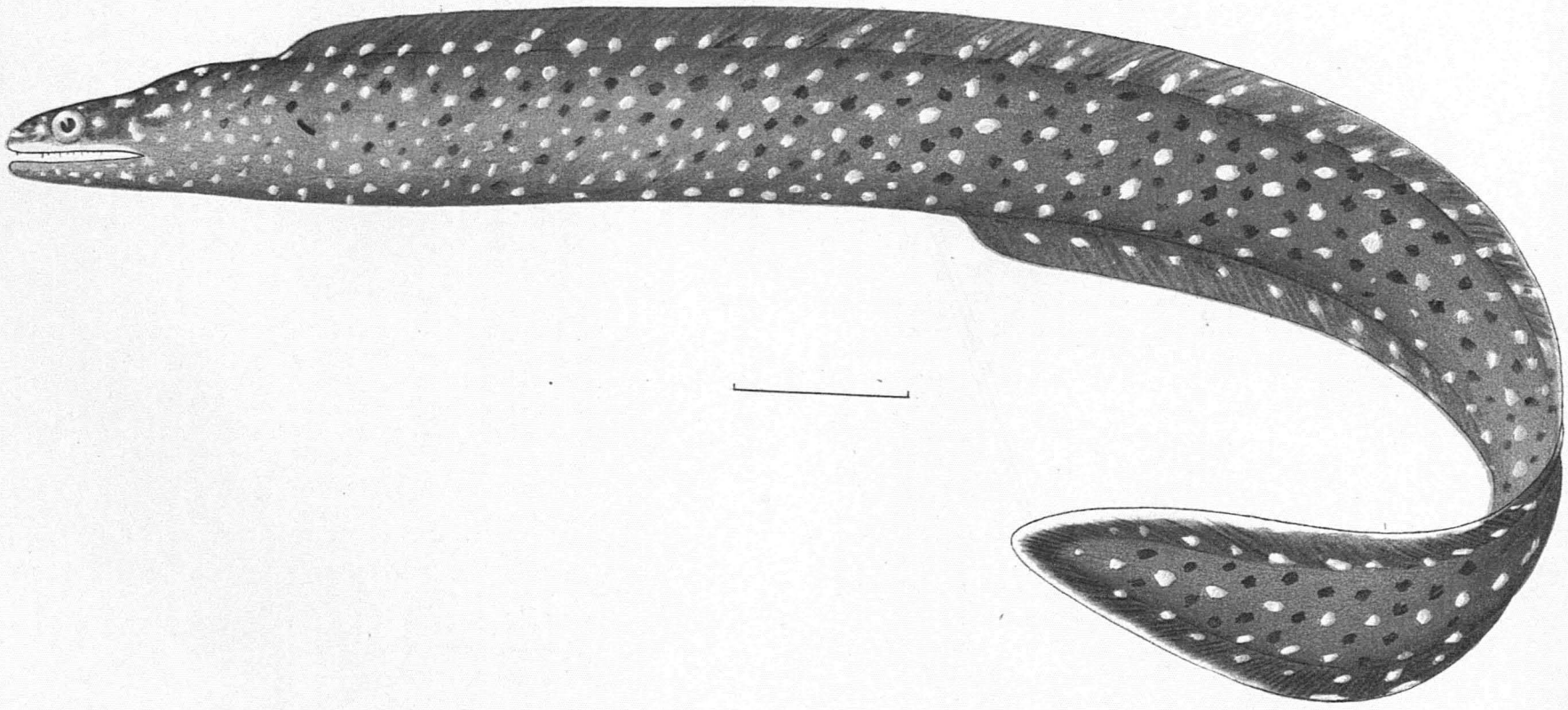
Thyrsoidea meleagris, Kaup, op. cit., 91, 1856 (after Richardson).

Gymnothorax meleagris, Bleeker, Faune Madagascar, pl. IV, Poiss., 73, 1874 (Mauritius; Arch. Seychelles); Snyder, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), 518 (Honolulu).

49. Gymnothorax gracilicauda Jenkins. Fig. 23.

Head 2.75 in trunk; head and trunk 1.3 in tail; eye 1.5 in snout, one in interorbital space; snout 5.5 in head; interorbital space about 9; mouth 2.5.

Body compressed, rather deep; tail long and tapering to narrow tip; head elongate, compressed, little swollen above, blunt in front; snout rather long, compressed, convex above, tip blunt; eye moderate, a little nearer corner of mouth than tip of snout; mouth rather large, horizontal, jaws equal, not completely closing; teeth large, powerful, biserial in upper jaw, uniserial in mandible; inner series



GYMNOTHORAX LAYSANUS (STEINDACHNER).

JULIUS BIEN & CO. LITH. N.Y.

in upper jaw larger than those of outer series, 4 in number; vomer with 2 large depressible fangs in front, otherwise edentulous; anterior nostrils in short tubes near tip of snout, posterior pair without tubes, just above eyes; interorbital space narrow, convex; gill-openings small; skin rather thin; origin of dorsal a little nearer gill-opening than corner of mouth; caudal very small and roundly pointed.

Color in alcohol, pale brown, more or less uniform, marked with irregularly formed light brown spots arranged in about 40 or more ill-defined transverse bars; these bands not extending on belly or

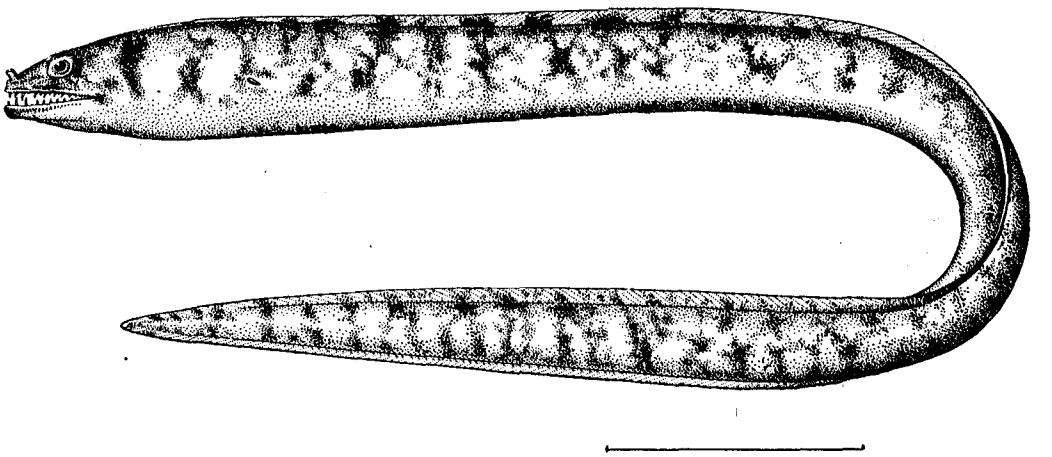


FIG. 23.—*Gymnothorax gracilicauda* Jenkins; from the type.

ventral surface of trunk, or even upon anal fin, though they are all somewhat distinct on the dorsal fin; corner of mouth brown. This may be the young of *G. steindachneri*.

This description from an example 8.25 inches long, taken at Honolulu in 1889, by Dr. Jenkins. The species is known to us only from the Hawaiian Islands and from 2 examples, the type described above and another obtained by the *Albatross* off Molokai.

Gymnothorax gracilicauda Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 426, fig. 6, **Honolulu**; Snyder, l. c. (Jan. 19, 1904), 518 (Albatross station 3834, southern coast of Molokai).

50. Gymnothorax ercodes Jenkins. Fig. 24.

Head 6.6 in total length, or 3 in distance from tip of snout to vent; depth 12; snout 6.6; eye 1.3; gape 2.6; tip of snout to vent 1.35 in tail; interorbital width slightly greater than eye, or nearly equal to snout.

Body moderately elongate and much compressed; tail more compressed and pointed; mouth

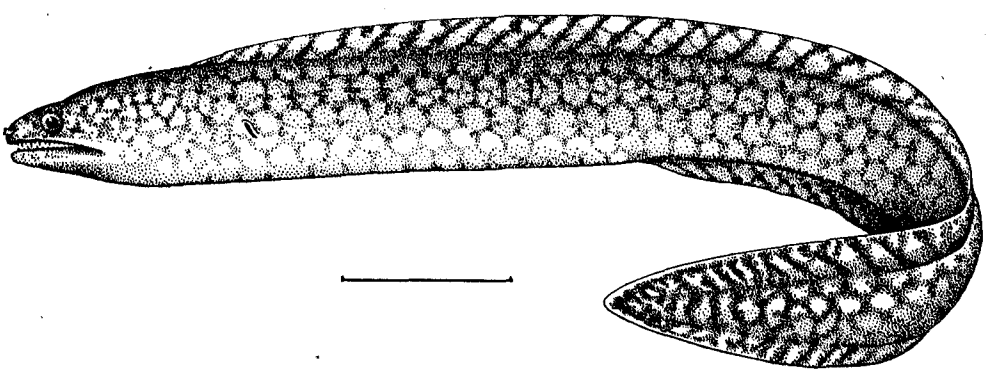


FIG. 24.—*Gymnothorax ercodes* Jenkins; from the type.

rather large, gape reaching beyond eye a distance equal to length of snout; lower jaw scarcely the shorter, not much curved; teeth all pointed, in 2 series anteriorly and 3 series posteriorly in upper jaw, lower jaw with teeth in 2 series anteriorly, laterally and posteriorly in a single series; 2 large sharp-pointed depressible teeth on anterior part of vomer, followed by a series of about 6 smaller teeth on the shaft; anterior nostril in a short tube whose length is one-fourth diameter of eye, situated near tip of snout just above lip; posterior nostril without tube, situated above margin of eye just in front of vertical through middle of eye; gill-slit moderate, its length 1.5 in eye; origin of dorsal slightly in front of gill-opening, height of fin 3.5 in head; anal similar, but lower.

Color in alcohol, body and fins light brown on a whitish background, the brown arranged in a somewhat regular network, giving the appearance of rows of indistinct whitish spots surrounded by polygonal brownish interspaces, which are most distinct on tail; no white border to the fins or tip of tail, and no dark area around gill-opening.

The only specimen known is the type, No. 50843, U. S. Nat. Mus. (original number 2354), a specimen 8.5 inches long, obtained by the *Albatross* at Honolulu in 1891.

Gymnothorax crocdes Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 428, fig. 8, Honolulu.

51. Gymnothorax leucostictus Jenkins. Fig. 25.

Head 2.3 in trunk; head and trunk less than length of tail by a space a trifle greater than length of latter; eye about 2 in snout, 1 in interorbital space; snout 5.5 in head; mouth 2.3.

Body deep, compressed; tail tapering gradually posteriorly where it is greatly compressed; head compressed, sides above slightly swollen; snout elongate though rather short, blunt, rounded, not projecting beyond mandible; jaws even; eye small, covered with the skin of head, a little nearer corner of mouth than tip of snout; mouth horizontal, the rather thin lips more or less concealing teeth; teeth

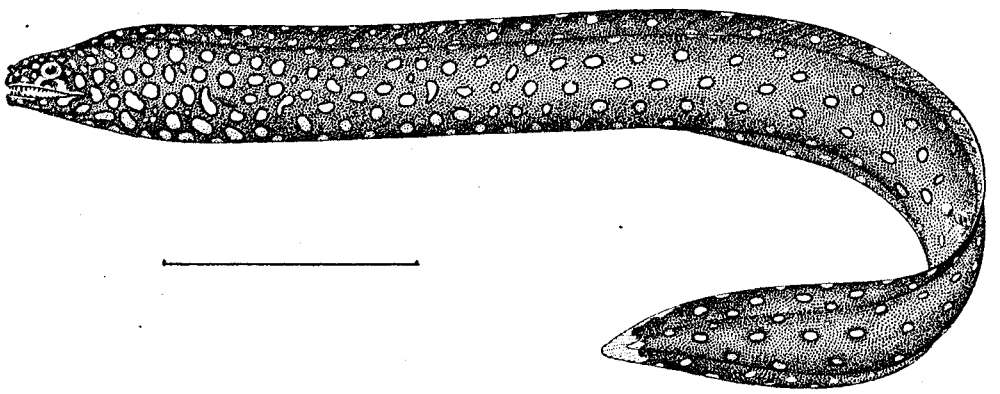


FIG. 25.—*Gymnothorax leucostictus* Jenkins; from the type.

rather large, sharp, in several series, or in a broad patch on each side of upper jaw, uniserial in mandible; large canines in front of both jaws, vomer with a single median series of small ones; anterior nostrils in short fleshy tubes near tip of snout; interorbital space narrow and convexly elevated; gill-openings small, a little below middle of its depth and about equal to eye; pores of body small; origin of dorsal a little before corner of mouth, fin rather high, and together with anal, which is more or less similar, confluent with small caudal.

Color in life, dark brown; head, body, fins, and tail covered with numerous distinct white spots, larger than eye on the trunk, smaller elsewhere; tip of tail white; margin or gill-opening brownish-black. The two specimens examined, taken by Dr. Jenkins at Honolulu, are each about 6.5 inches long, and do not differ in coloration.

The species is distinguished from *G. meleagris* by the more anterior insertion of the dorsal, and the larger and fewer white spots, which are larger on the trunk than elsewhere.

Gymnothorax leucostictus Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 425, fig. 5, Honolulu. (Type, No. 50681, U. S. Nat. Mus.)

52. Gymnothorax waialuæ Snyder. Plate 13, fig. 1.

Head, measured to gill-opening, 8 in length; depth 2 in head; tail 1.9 in length; snout 5 in head; cleft of mouth 2.5 in head. Body compressed, the width in middle of trunk equal to half the depth; interorbital space slightly convex; jaws equal; cleft of mouth extending beyond eye a distance equal to longitudinal diameter of eye; width of suborbital space equal to vertical diameter of eye; gill-opening an oblique slit equal to vertical diameter of eye; teeth in jaws mostly long, sharp, and depressible, the 2 in anterior median part of upper jaw longest, those below eye in 2 series, the outer ones short and close set; 3 short, sharp teeth on vomer; anterior nostril tubes near tip of snout, their height equal to diameter of eye; posterior nostrils without rims, located above and a little anterior to eyes; dorsal inserted on head anterior to gill-opening; fin highest posteriorly, its height behind middle of tail equal to longitudinal diameter of eye; anal inserted immediately behind the vent, about half as high as dorsal; caudal slightly longer than height of dorsal.

Color in alcohol, white tinged with yellow, with 20 black bands, nearly all encircling the body and extending on fins; tip of snout white, tip of tail black; the first black band covering snout, except the tip between the nostrils, extends backward beyond eye, and sends a line downward to corner of mouth, where it meets a round, black blotch; chin and throat white; sides of lower jaw black; a white space between eye and corner of mouth; the second band passes over occiput, not complete below; third band incomplete, passing over back between gill-openings, a dusky prolongation passing downward behind gill-opening; other bands complete, anterior ones broader above than below, posterior ones of about equal width throughout; a narrow, dusky stripe extends forward along lower surface from vent to a point a little anterior to gill-openings.

This species closely resembles *G. petelli*, the young of which it may prove to be. The species differ in color and in dentition. The light spaces on the body of *G. petelli* are reddish brown; on the anal fin they are white, on the dorsal reddish brown bordered with white near edge of fin; caudal usually tipped with white; snout reddish brown; teeth in a single series, those of the jaws not depressible, except 2 or 3 on anterior median portion of upper jaw.

A single specimen, 4.2 inches long, from a small tide pool in the reef at Waialua Bay, Oahu.

Gymnothorax waialuæ Snyder, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), 520, pl. 6, fig. 11, **Waialua Bay, Oahu.** (Type, No. 50870, U. S. Nat. Mus.)

53. Gymnothorax mucifer Snyder. Plate 14, fig. 1.

Head, measured to gill-opening, 3.3 in length; depth 2.25 in head; snout 5; cleft of mouth 2.3. Snout rather slender and pointed, jaws equal, closing completely; teeth in one series, slender, lance-like with slight constrictions near base, their edges smooth; 3 depressible median canines in upper jaw, the longest (posterior) one equal in length to diameter of eye; a row of small, sharp teeth on the vomer; eye midway between tip of snout and angle of mouth; width of space between eyes 2 in snout; gill-opening a narrow slit equal to diameter of eye, located on a level with upper lip; nostril tubes 2 in eye; posterior nostrils with scarcely perceptible rims, located above and just anterior to eye; origin of dorsal anterior to gill-opening a distance equal to space between tip of snout and posterior border of eye; height of fin above gill-opening equal to diameter of eye, about 1.33 times as high near middle of tail, the membrane not very fleshy; anal inserted immediately behind vent, appearing for much of the length like a thickened fold of the skin.

Color in alcohol, rich dark brown with flakes of white, which are gathered in clouds and more or less definite vertical bars; the flakes scattered rather evenly on head, scarcely perceptible on lower jaw and snout; throat and belly lighter than other parts, the white and brown being about equal; dorsal growing darker toward the edge, where it is nearly black, with white flakes like those of the body arranged in oblique bars; anal edged with white; corner of mouth dark; no spot at gill-opening.

The species is represented by a single example, type, No. 50868, U. S. Nat. Mus., from the Honolulu market. It measures 13.5 inches from tip of snout to vent. The tail, which has been injured, measures 14.75 inches in length.

Gymnothorax mucifer Snyder, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), 519, pl. 5, fig. 9, **Honolulu.**

54. Gymnothorax berndti Snyder. Plate 15, fig. 2.

Head, measured to gill-opening, 6.7 in length, 3.8 in tail; depth 1.8 in head; snout 5; cleft of mouth 2. Profile, a gently sloping straight line between tip of snout and posterior part of interorbital space, whence it abruptly curves upward over the greatly swollen occipital region; snout slender and pointed; lower jaw projecting slightly beyond upper; mouth closing completely; teeth in a single series in each jaw, large, smooth-edged, close set, firmly embedded, the anterior ones somewhat longer than the others; median canines absent; 5 small teeth on the vomer; nostril tubes equal in height to diameter of pupil; posterior nostrils without rims, located above and just posterior to border of eye; orbit round; width of space between eyes equal to half the distance between tip of snout and center of pupil; gill-opening located on a level with eye, the slit equal in width to diameter of eye; origin of dorsal on a vertical midway between gill-opening and corner of mouth, fin membrane thick and fleshy; height of fin near middle of tail equal to half the length of snout; anal inserted immediately behind vent, appearing as a ridge of skin, the highest part about 1.7 in eye; length of caudal equal to vertical diameter of eye.

Color gray, with fine brown reticulations over which is a coarse network of brown bands.

Color in alcohol, white, tinged with brown, more clear along the upper lip, on lower jaw, and on belly; finely clouded and reticulated with brown, except on jaws and anal fin, all overlaid with a brown-colored, coarse network of rather broad bands, the meshes becoming finer on head and broken up into elongate, crooked spots on jaws; gill-opening brown; dorsal with oblique bars which connect with reticulations of body; anal blackish brown, with a broad, white border.

This description is of the type, No. 50867, U. S. Nat. Mus., an example 37 inches long, obtained in the Honolulu market through the kindness of Mr. E. Louis Berndt. Two other specimens of about the same size were likewise obtained. One has the fine reticulations less distinct than those of the type and the bands of the coarse ones a little narrower, about equal to width of pupil. The snout measures 4.2 in head; jaws equal. The other, a female, 31 inches long (cotype, No. 12791, L. S. Jr. Univ. Mus.), when compared with the type, has a more slender head, the occipital region being less swollen. The color is similar, except that the bands of the large reticulations are narrower and the dorsal is conspicuously, though narrowly, edged with white. There are 2 large, depressible fangs in the anterior median portion of the upper jaw.

G. berndti may be distinguished from all other Hawaiian eels by the broad brown reticulations on the body. Named for Mr. E. Louis Berndt, the efficient inspector of fisheries at Honolulu.

Gymnothorax berndti Snyder, Bull. U. S. Fish Comm., XXII, 1902 (Jan. 19, 1904), 518, pl. 4, fig. 8, Honolulu.

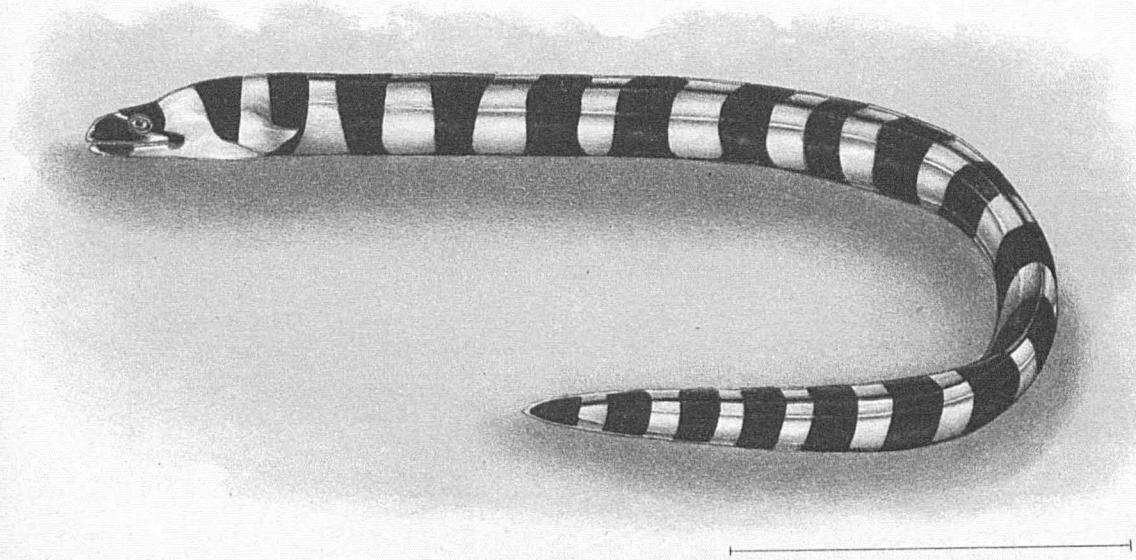
55. Gymnothorax undulatus (Lacépède). "*Puhi laumili.*" Plate 16.

Head 2 in trunk; head and trunk a little shorter than tail; eye 2.3 in snout, 1.5 in interorbital space; snout 5.67 in head; mouth 2 and an eye diameter in head.

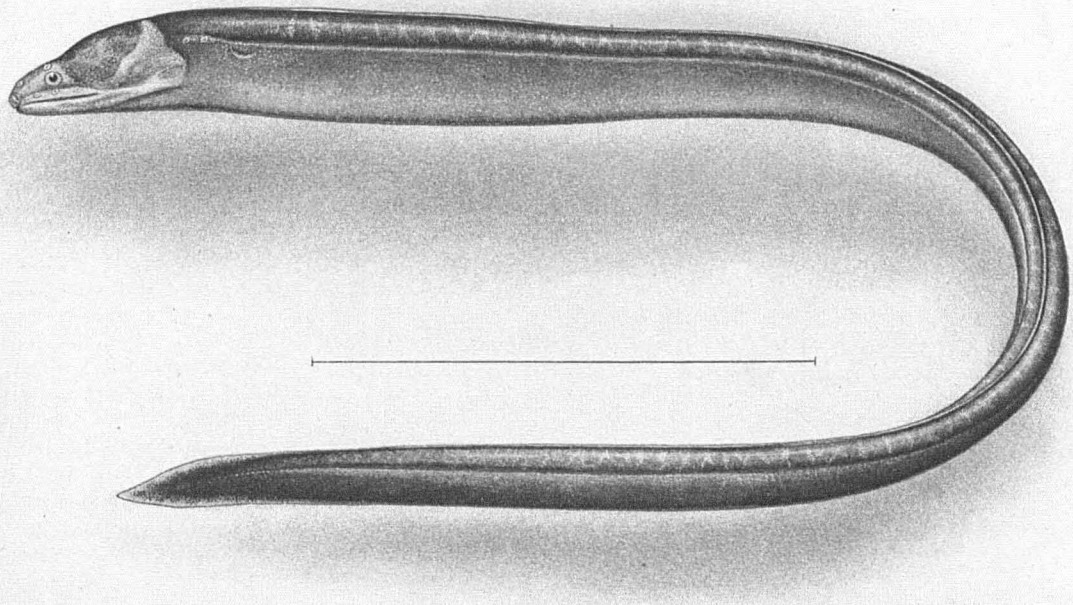
Body compressed; tail tapering gradually, greatly compressed posteriorly; head compressed and swollen; snout elongate, the tip bluntly pointed and not projecting beyond mandible; jaws even; eye rather small, superior and nearer tip of snout than corner of mouth; mouth horizontal, closing, the thick lips completely concealing teeth; teeth large, uniserial, many of them more or less canine-like, those along the sides directed backward; vomerine teeth in a single series, large, fang-like depressible; anterior nostrils in short fleshy tubes, the posterior pair directly above eyes in front, interorbital space convex, the forehead rising rather abruptly behind; gill-openings a little shorter than eye; skin very rough, with many fine wrinkles; branchial region of head with many rather deep longitudinal folds or wrinkles; dorsal beginning much nearer corner of mouth than gill-opening; caudal roundly pointed.

Color in alcohol, deep purple, brown or blackish, speckled, spotted and reticulated with whitish; often very variable.

Here described from an example (No. 04802) 35 inches long, from Honolulu. This is one of the most abundant eels occurring among the Hawaiian Islands and is also very numerous at Samoa. Our collection contains more than 40 specimens, all from Honolulu except one dredged by the *Albatross* at station 3824, off the southern coast of Molokai, in 222 to 498 fathoms. The specimens range in length from 10 to 36 inches, the majority of them exceeding 20 inches.

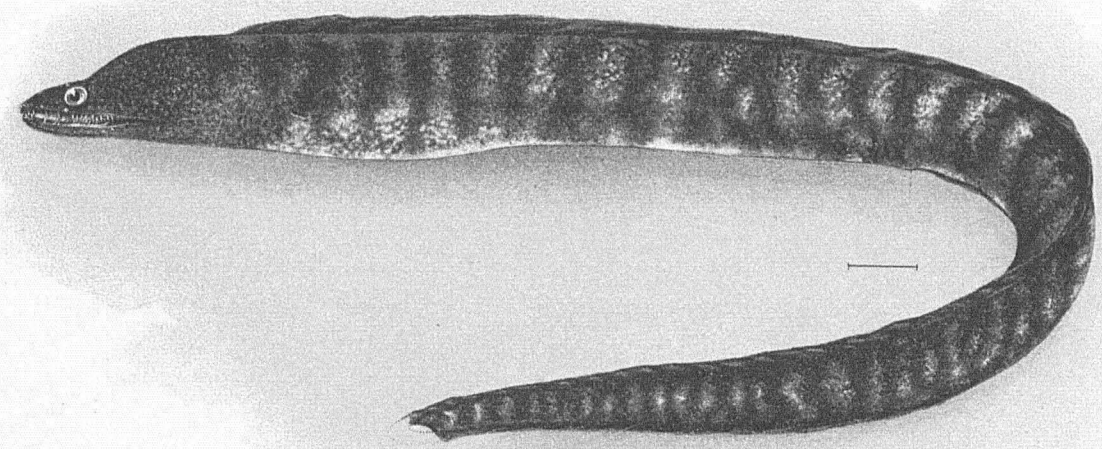


1. GYMNOTHORAX WAIALUAE SNYDER.

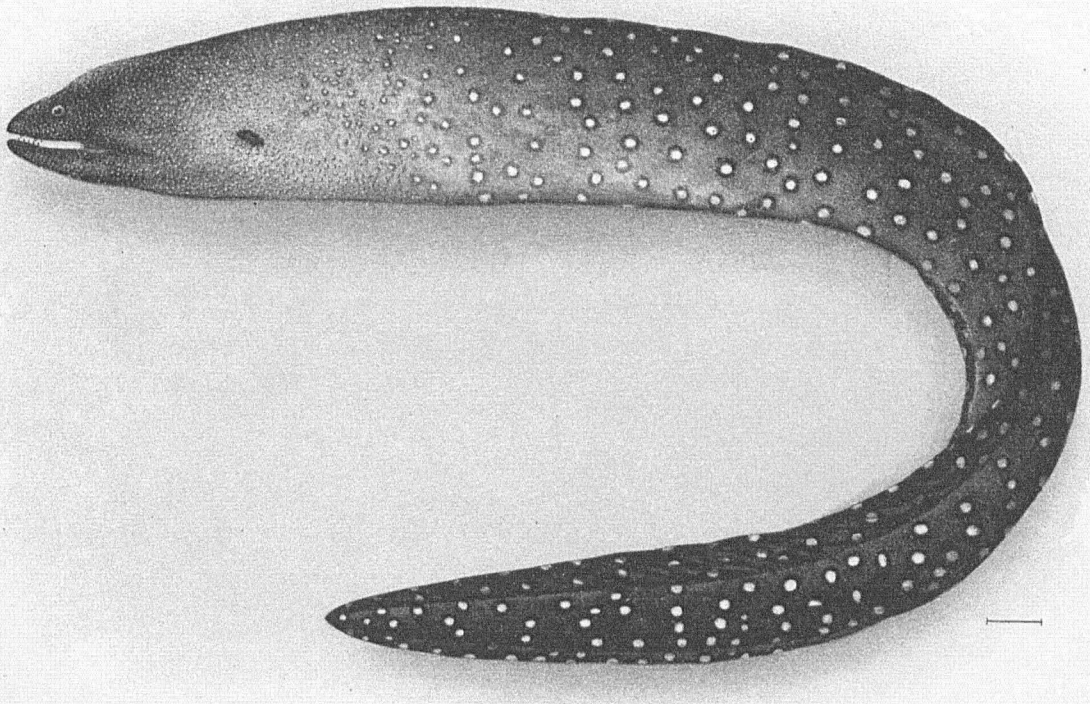


2. UROPTERYGIUS LEUCURUS SNYDER.

A. HOEN & CO., LITH.

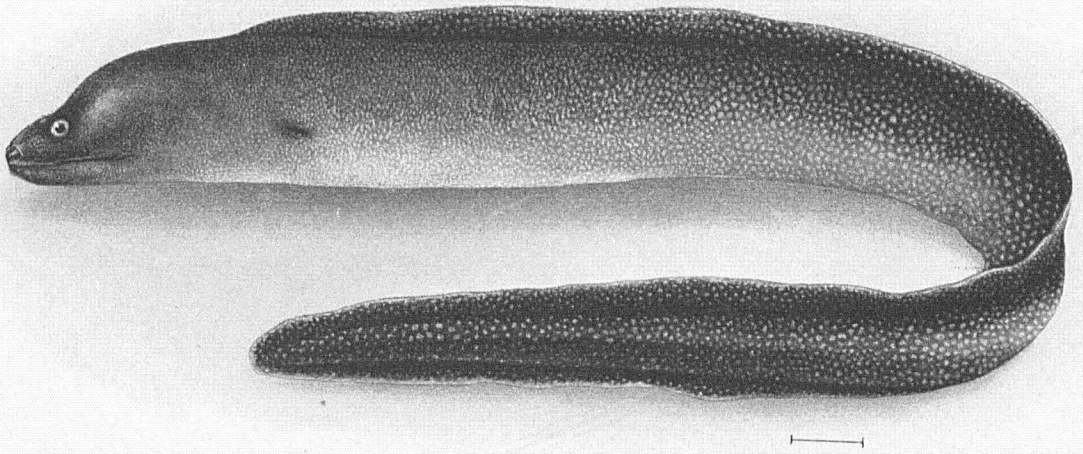


1. GYMNOTHORAX MUCIFER SNYDER.

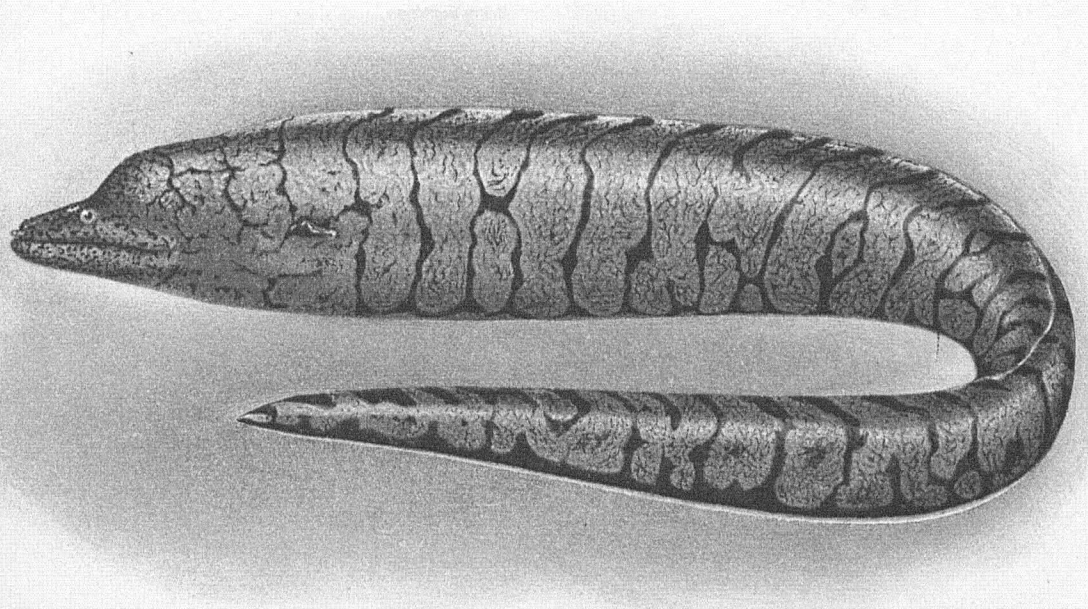


2. GYMNOTHORAX XANTHOSTOMUS SNYDER.

A. HOEN & CO., LITH.

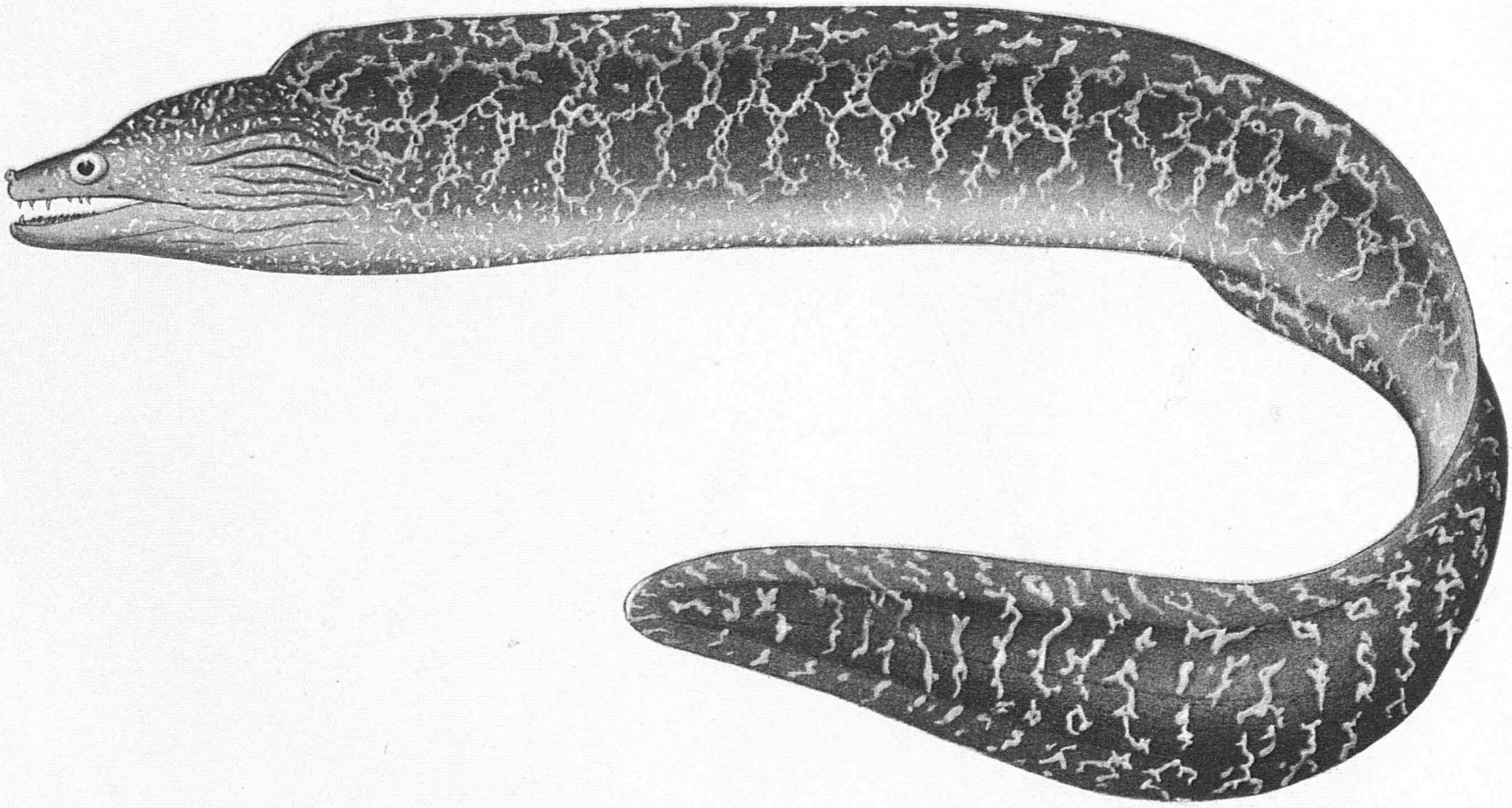


1. GYMNOTHORAX NUTTINGI SNYDER.



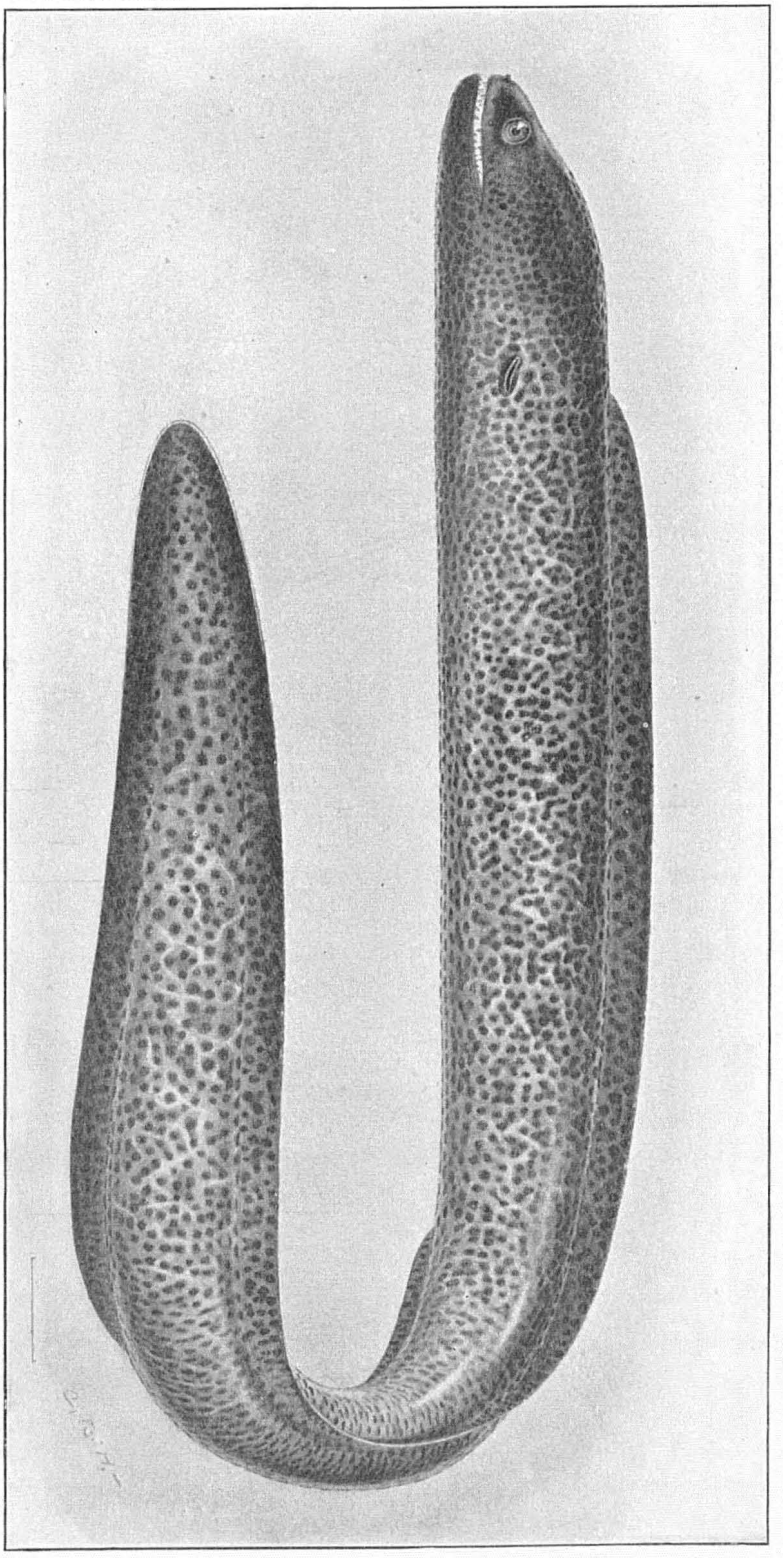
2. GYMNOTHORAX BERNDTI SNYDER.

A. HOEN & CO., LITH.



GYMNOTHORAX UNDULATUS (LACÉPÈDE).

JULIUS BIEN & CO. LITH. N.Y.



GYMNOTHORAX FLAVIMARGINATUS (RÜPPELL). TYPE OF G. THALASSOPTERUS JENKINS.

This species is very savage and voracious. In the stomach of one example (No. 04813, from Honolulu) a *Teuthis* 7.88 inches long was found, though the eel measured only 30 inches in total length. Another eel about 22 inches in length had swallowed a large goatfish which, though more or less macerated, was as long, if not much longer, than the *Teuthis* mentioned.

Muræenophis undulata Lacépède, Hist. Nat. Poiss., V, 629, 644, 1803, **South Seas.**
Muræna marmorata Quoy & Gaimard, Voy. Uranie, 247, 1824, **Waigiu, Rawak.**
Muræna valenciennei Eydoux & Souleyet, Voy. Bonite, Poiss., 207, pl. 8, fig. 1, 1842, **Sandwich Islands.**
Muræna cancellata Richardson, Voy. Ereb. & Terror, Fish., 87, pl. 46, fig. 1–5, 1847, **Western Australia; Sumatra.**
Muræna blochii Bleeker, Verh. Batav. Genoot., XXV, 49, 1853, **Sibogha; Sumatra.**
Muræna agassizi Bleeker, Nat. Tydsch. Ned. Ind., VIII, 458, 1855, **Cocos Islands.**
Thyrsoidea cancellata, Kaup, Cat. Apod. Fish., 76, fig. 59, 1856; after Richardson.
Gymnothorax cancellatus, Bleeker, Atlas Ichth., IV, 93, tab. 176, fig. 3, tab. 177, fig. 2, and tab. 183, fig. 1, 1864 (Bencoolen; Priaman; Sumatra; Batu; Singapore; Nova-Selma; Cocos Islands; Amboyna).
Gymnothorax agassizi, Bleeker, op. cit., IV, 95, tab. 185, fig. 2, 1864-65 (Nova-Selma; Cocos Islands; Amboyna).
Gymnothorax blochi, Bleeker, op. cit., IV, 102, tab. 180, fig. 2, 1864-65 (Sibogha; Sumatra).
Thyrsoidea kaupii Abbott, Proc. Ac. Nat. Sci. Phila. 1860, 477, **Hawaiian Islands.**
Muræna nubila, Günther, Fish. Zanzibar, 127, 1866; not of Richardson.
Muræna undulata, Günther, Cat., VIII, 110, 1870 (Zanzibar; Cocos Islands; East Indies; and Hawaiian Islands); Streets, Bull. U. S. Nat. Mus., Nos. 7, 77, 1877 (Honolulu).
Lycodontis kaupi, Fowler, Proc. Ac. Nat. Sci. Phila. 1900, 494, pl. XVIII, fig. 6 (Abbott's type).
Lycodontis pseudothyrsoidea, Fowler, Proc. Ac. Nat. Sci. Phila. 1900, 494 (Hawaiian Islands); not of Bleeker.
Gymnothorax undulatus, Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 426 (Honolulu); Snyder, op. cit. (Jan. 19, 1904), 518 (Honolulu; Albatross Station 3824, off the southern coast of Molokai).

56. Gymnothorax flavimarginatus (Rüppell). Plate 17.

Head 2.8 in trunk; head and trunk shorter than tail; eye 2.25 in snout, about 2 in interorbital space; snout 5.75 in head.

Body compressed, tail tapering to a point; head compressed, bluntly rounded in front; snout rather elongate, pointed, rounded above, tip blunt; eye small, a little nearer tip of snout than corner of mouth; mouth closing, jaws about even; teeth covered with thick skin of lips; teeth in jaws in a single series, some of them canine-like anteriorly, those on vomer large, fang-like, and depressible; anterior nostrils in short tubes at tip of snout, posterior pair above and over eyes; interorbital space convex; gill-opening a little longer than eye; skin smooth, and a number of pores on head; no lateral line; origin of dorsal about midway between posterior margin of eye and gill-opening; caudal small, forming a rounded point.

Color in alcohol, dark brown; head in front and fins dusky or blackish; body everywhere mottled and blotched with deep brown; gill-openings blackish; posterior edges of dorsal, anal, and tip of caudal very narrowly margined with whitish; belly and throat pale.

Color in life (No. 03548), very dark brown, nearly black; light interspaces smoky-yellow; outer margin of vertical fins lemon-yellow, below which the color is bright green, gradually losing itself in dark brown. Color in life of another example (No. 03375), 3 feet long, body and fins mottled yellowish and brown, brown forming irregular granular spots of various sizes, but all less than pupil; fins a little darker, no pale edges; gill-opening and angle of mouth black; throat streaks brownish and spots on jaws smaller.

This description is based upon the type of *G. thalassopterus*, No. 50619, U. S. Nat. Mus., a specimen 23 inches long, from Honolulu, which seems to be identical with this species.

Our collection contains 17 fine examples of this species, all from Honolulu, and ranging in length from 8 to 36 inches. A specimen was obtained in 1889 by Doctor Jenkins and others were secured by the *Albatross* in 1902. One small example was obtained by us at Cocoanut Island, at Hilo, also several young from the reef at Waikiki. Others have been recently received from Mr. Berndt, at Honolulu.

Muræna flavimarginata Rüppell, Fische des rothen Meeres, 119, taf. 30, fig. 3, 1828, **Red Sea.**
Muræna flavomarginata, Günther, Shore Fishes, Challenger, Zool., I, Part VI, 61, 1880 (Honolulu).
Gymnothorax flavimarginatus, Bleeker, Atlas Ichth., IV, 95, pl. 176, fig. 2, and pl. 178, fig. 3, 1864-65 (part).
Gymnothorax thalassopterus Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (Sept. 23, 1903), 427, pl. 2, **Honolulu**; Snyder, op. cit. (Jan. 19, 1904), 518 (Honolulu).

57. Gymnothorax goldsboroughi Jordan & Evermann. Fig. 26.

Head nearly 3 in trunk (exclusive of head and tail), or 9 in total length; head and trunk about 1.5 in tail; eye 1.75 in snout, 1.2 in interorbital space; snout 5 in head; interorbital space 7.5; mouth 2.

Body rather compressed, the tail gradually tapering narrowly behind; head compressed, swollen above; snout pointed, the tip blunt and the sides compressed; eye rather small, a trifle nearer tip of snout than corner of mouth; mouth large, snout slightly projecting beyond mandible; lips rather fleshy and concealing the teeth when the mouth is closed; teeth in a single series in jaws, anteriorly large and canine-like, and the vomer with a single large, depressible fang; anterior nostrils at tip of snout in small tubes; posterior nostrils directly above eye in front; interorbital space more or less flattened like top of snout; gill-opening about equal to eye; skin smooth; head with a number of mucous pores; origin of dorsal a little nearer corner of mouth than gill-opening; caudal small.

Color in alcohol, brown, covered all over body except anal fin with round or roundish white spots, those on anterior part of body small, very small and numerous on head, becoming larger on trunk,

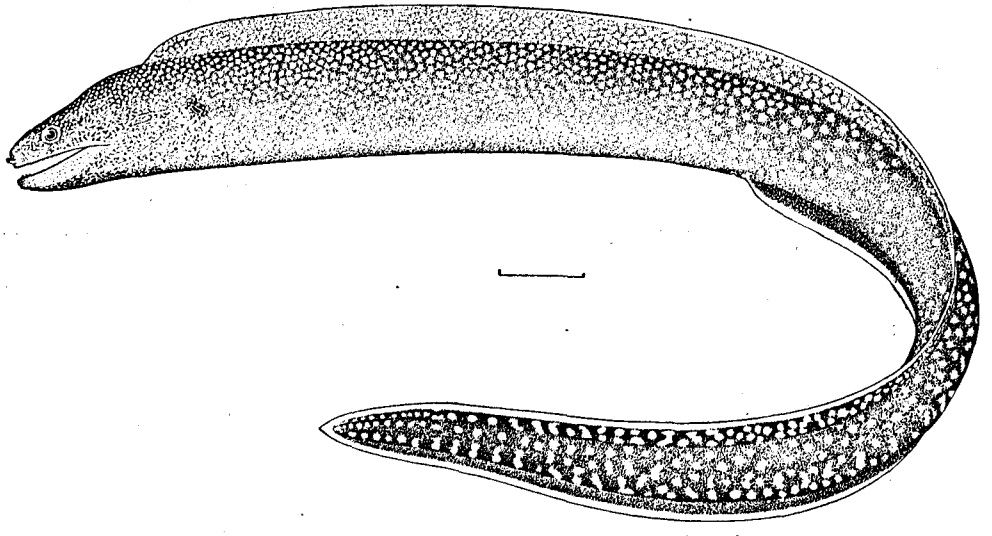


FIG. 26.—*Gymnothorax goldsboroughi* Jordan & Evermann; from the type.

and finally increasing very much in size on tail where they are scattered and rather far apart; reticulations around the light spots blackish brown upon posterior part of dorsal fin, same color as base of anal; margins of anal and dorsal fins whitish; gill-opening and anus bordered with blackish brown. General color of body in life, brown, rather pale olivaceous anteriorly, and covered all over with small white spots which are close-set and small on head where the dark color forms a network; spots sparse and irregular on posterior parts, and also much larger; vent and gill-opening dusky; dorsal colored like the body, with a broad white edge, growing broader behind; anal dark brown, unspotted, and with a broad pale border.

This species is known from the type, a specimen 21 inches long, obtained by us at Honolulu, and another example from Honolulu recorded by Mr. Snyder.

Gymnothorax goldsboroughi Jordan & Evermann, Bull. U. S. Fish Comm., XXII, 1902 (Apr. 11, 1903), 167, Honolulu. (Type, No. 50617, U. S. Nat. Mus.); Snyder, op. cit. (Jan. 19, 1904), 518 (Honolulu.)

58. Gymnothorax petelli (Bleeker). Fig. 27.

Head 2.88 in trunk; tail a little longer than head and trunk; eye 2 in snout, 1.3 in interorbital space; snout 5.25 in head; interorbital space 8.5; mouth from tip of mandible 2.25.

Body rather deep and compressed; head compressed, branchial region and top of head swollen; snout rather short and pointed; eye small, a little nearer angle of mouth than tip of snout; mouth