

A REVIEW OF THE ELASMOBRANCHIATE FISHES OF JAPAN.

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In the present paper is given a record of the species of Elasmobranchiate fishes, sharks, rays, and chimeras, known to inhabit the waters of Japan. It is based on the collections made by Messrs. Jordan and Snyder during the summer of 1900, and on the material contained in the Japanese museums and in the United States National Museum, some of which were collected by the U. S. Fish Commission Steamer *Albatross*. The accompanying figures are chiefly by Mr. William Sackston Atkinson.

Subclass SELACHII.

This includes among recent fishes the sharks and the rays, marine fishes mostly of large size, abounding in all seas.

We begin the group with the archaic type, the order or suborder Notidani, proceeding thence from the more generalized sharks to the specialized skates. The true sharks form an almost perfect gradation into the skates, but there are no forms extant which connect the Notidani with modern sharks.

(*κέλαχος*, shark; the word originally meaning cartilage.)

ORDERS OF SELACHII IN JAPAN.

- a.* Gill-openings 6 or 7; dorsal fin single; vertebral column imperfectly segmented, each segment being equivalent to 2 vertebrae, and bearing 2 neural arches; anal fin present.....NOTIDANI, I.
- aa.* Gill-openings 5; vertebral column well segmented, each segment forming a neural arch and 1 centrum.
- b.* Vertebrae each with the internal calcareous lamellae radiating from the central ring; anal fin present.....ASTEROSPONDYLI, II.
- bb.* Vertebrae with the internal calcareous lamellae not radiating, but arranged in one or more concentric circles or series around the central ring; no anal fin; palatoquadrate arch not articulated to the skull.
- c.* Gill-openings lateral; dorsal fins 2.....TECTOSPONDYLI, III.
- cc.* Gill-openings ventral; dorsal fins small and posterior, or wanting; body and pectoral fins forming a depressed disk.....BATOIDEI, IV.

Order I. NOTIDANI.

Sharks with the branchial apertures in increased number, 6 or 7; only one dorsal fin. Vertebral column imperfectly segmented so that from each segment 2 neural arches and 2 vertebral bodies arise. Among existing sharks this group contains 2 families. Numerous genera represented by fossils seem allied to these and to the Cestraciont types.

(*Notidanus*, *νωτιδανός*, dry back, the Greek name of some shark, in Athenæus.)

a. Palatoquadrate apparatus articulated with the postorbital processes of the skull; body moderately elongate; teeth in the two jaws unlike; mouth inferior.

HEXANCHIDÆ, I.

aa. Palatoquadrate apparatus not connected with the skull; body greatly elongate, almost eel-shaped; dorsal, anal, and ventrals close together on posterior part of body; teeth in the two jaws alike; mouth anterior. . . CHLAMYDOSELACHIDÆ, II.

Family I. HEXANCHIDÆ.

Body moderately elongate, somewhat depressed anteriorly, tapering toward the caudal fin. Head depressed, oblong, with the snout projecting. Eyes submedian or anterior, without nictitating membrane. Mouth subinferior, large, arched in front; no labial fold. Teeth in the two jaws unlike; in the upper jaw 1 or 2 pairs of awl-shaped teeth, the next six teeth broader and each provided with several cusps, one of which is much the strongest. Lower jaw with 6 large comb-like teeth on each side, besides the smaller posterior teeth. Spiracles small, on the side of the neck. Only one dorsal fin, without spine, opposite the anal, and similar to it. No pit at the root of the caudal. Gill-openings wide, 6 or 7 in number. Viviparous sharks, sometimes reaching a very large size. Species of the warm seas.

a. Gill-openings, 7 on each side *Heptranchias*, I.

I. HEPTRANCHIAS Rafinesque.

Heptranchias RAFINESQUE, Caratteri, 1810, p. 14 (*cinereus*).

Notorhynchus AYRES, Proc. Cal. Acad. Sci., I, 1856, p. 72 (*maculatus*).

Heptanchus of AUTHORS.

Gill-openings 7 on each side. Lower teeth uniform in size or decreasing toward corners of mouth; cusps on the cutting edge more or less regularly graduated.

(*ἑπτὰ*, seven; *βράγχια*, gills.)

a. NOTORHYNCHUS. Median tooth of lower jaw with the central cusp small or wanting.

b. Color, gray; cusps of most teeth growing smaller from the second *dani*, I.

1. HEPTRANCHIAS DEANI Jordan and Starks.

ABURAZAME (FAT SHARK).

Heptanchias deani JORDAN and STARKS, Proc. Cal. Acad. Sci., 1901, L, p. 348; Misaki.

Head, 6 in length; width of body at pectorals, $1\frac{1}{2}$ in head; eye about $4\frac{1}{2}$; snout about $3\frac{1}{2}$; width of mouth at corners, $2\frac{1}{2}$; pectorals, $1\frac{1}{2}$; base of ventrals, 2; depth of caudal peduncle, $4\frac{1}{4}$ in head.

Body very elongate, more or less rounded, though somewhat depressed in front; tail compressed, elongate, tapering. Head elongate, pointed, compressed, broader than deep; snout produced, compressed above, flat, roundly pointed; eye large, anterior, lateral, superior; mouth large, triangular, narrowly rounded in front; symphysis of mandible a little before eye, which is over anterior part of mouth; lips not especially thick; corners of mouth forming a long groove equal to one-half length of exposed dental margin of mandible; teeth in upper jaw sharp, long, pointed, hooked backward, without lateral cusps; a median tooth at symphysis of mandible with two or three small cusps on each side; teeth in mandible 4 on each ramus, each tooth with a serrated cutting edge composed of 6 or more cusps; first cusp with a very small notch in front, second enlarged, and all arranged in the formula $1+1+3+1$, $1+1+4+1$, $1+1+5+1$, $1+1+6+1$, according to individual size; while the cutting edge is continuous it is not uniform and even, as depth of each tooth is a little less behind, edge above a trifle oblique; inner buccal fold in mandible thick and fleshy; tongue not free from floor of mouth; nostrils large, about midway on snout below, between its tip and front of eye; interorbital width convexly flattened. Spiracles small, superior, and about midway between eye behind and gill-opening. Gill-openings large, broad, becoming progressively smaller behind, all entirely in front of root of pectoral.

Body very finely roughened.

Dorsal fin small, its greater portion before origin of the anal; anal low, its base long; pectorals small, edges posteriorly slightly emarginate; ventrals low, base long, origin nearer origin of anal than origin of pectoral; caudal very long, lower lobe deep in front, then very narrow till near end, where a terminal notch is formed. Caudal peduncle compressed, somewhat triangular in cross section, flattened above.

Color in spirits dark gray brown above and on the upper parts of fins, below pale or whitish; in a photograph in the Imperial University a few whitish spots are shown.

Length $38\frac{2}{3}$ inches (98 cm. 3 mm.).

This description from the original type, a female, No. 12620, ichthyological collections, Leland Stanford Junior University Museum. It

was taken at Misaki by Kumakichi Aoki, with hook and line, in deep water.

The species is not rare on the coast of southern Japan.
(Named for Bashford Dean.)

Family II. CHLAMYDOSELACHIDÆ.

FRILLED SHARKS.

Body very elongate and slender, the tail tapering to a point. Head very broad and depressed. Snout broad. Eyes lateral and without nictitating membrane. Nostrils large, the nasal cavity separate from the mouth. Mouth anterior, the jaws almost equal. Teeth in oblique rows, the bases extended backward, and the cusps slender. Spiracles present. Gill-openings six. Dorsal fin posterior, without spine; anal fin well developed. No pit at root of caudal. First gill-membrane not free across the isthmus, but joined by median and rather thick membrane. Intestine said to have a spiral valve. Anterior basi-branchial cartilages present.

2. CHLAMYDOSELACHUS Garman.

Chlamydoselachus GARMAN, Bull. Essex Inst., Jan. 17, 1884, p. 47 (*anguineus*).
Chlamydoselache GÜNTHER (variant in spelling).

Opercular flap forming a broad frill over first gill-opening. Eyes rather small; mouth very large, extending far beyond the eye. Teeth similar in the jaws, each with three slender, curved, subconical cusps, separated by a pair of rudimentary denticles, on a broad base; no median series of teeth above like that on the symphysis of the mandible. Mouth larger than broad, and with no labial folds at angles. Pupil horizontally elongated. Fins broad, rounded; caudal without a notch.

Of this genus but a single living species is known. It inhabits the open sea in waters of some depth, and is most abundant in the Kuro Shiwo or warm current on the east coast of Japan.

(*χλαμύς*, mantle or frill; *σέλαχος*, shark.)

2. CHLAMYDOSELACHUS ANGUINEUS Garman.

RABUKA; KAGURAZAME (SCAFFOLD SHARK).

Chlamydoselachus anguineus GARMAN, Bull. Essex Inst., Jan. 17, 1884, p. 47, with figs.; Japanese seas; Bull. Mus. Comp. Zool., 1885, XII, No. 1, with plates and account of anatomy; off Japan.—GÜNTHER, Deep Sea Fishes Challenger, 1884, p. 2, with plates; Japan.—COLLETT, Bull. Soc. Zool. France, 1890, p. 219; Funchal, Madeira.—JORDAN and EVERMANN, Fish N. M. America, I, 1896, p. 15 (after Garman).

Head about $7\frac{1}{2}$ in length; depth about $12\frac{2}{3}$; tail $1\frac{1}{6}$ in trunk and head; eye $8\frac{1}{6}$ in head; snout 4; maxillary $1\frac{2}{3}$; interorbital space $2\frac{1}{4}$; width of

mouth at corners $2\frac{1}{3}$; internasal space $3\frac{2}{3}$; pectoral $1\frac{1}{2}$; internasal space $1\frac{2}{3}$ in interorbital space.

Body very elongate and tail greatly compressed, roughened, and tapering to a point. Head rather small, oblong, greatly depressed, broad, and its greatest depth two-thirds its width; snout depressed, broadly rounded, and projecting but little beyond mandible; eye small, its posterior margin about first two-fifteenths of length of head; nostrils large, lateral, on sides of snout and a little low in position; mouth very large, more than half the head; teeth tricuspid, spaces between each cusp with a small denticle at base, similar in both jaws, and in formula $\frac{13-0-13}{11-1-11}$; well separated, in oblique rows, with not more than 6 teeth in each row; tongue small, slightly elongate, point rounded, and a little free in front; inside of mouth roughened, especially the tongue. Gill-openings very large, first the largest, the others progressively smaller; inner edges of branchial arches roughened; gill-filaments flattened, adnate to interbranchial septa except at tip; pharynx long and broad; gill-membrane joined to isthmus medially by a thick membrane.

Scales very small and sharp, a little enlarged along lateral line, most of edges of fins, and jaws, becoming especially large at angle of the latter.

Dorsal small, its origin about over that of anal; anal about twice as large as dorsal; pectoral small, broad, with a very blunt angle; ventrals large, broad, and rounded; caudal with broad lower lobe, tapering to an elongate and sharp point, upper rays very short and uniform.

Color in spirits uniform brown.

Length $39\frac{1}{2}$ inches (99 cm. 6 mm.).

This description from a Misaki specimen.

Kuro Shiwo, off Izu, Sagami, and Awa, on the east coast of Japan; our three specimens from off Misaki, in Sagami. It has also been taken off Madeira and off Norway in deep water, and it is probably widely distributed.

Our largest example measures $59\frac{1}{4}$ inches (148 cm. 6 mm.).

(*anguineus*, from *anguis*, the slow worm, the word allied to *Anguilla* = ἄγχελυς, eel.)

Order II. ASTEROSPONDYLI.

TYPICAL SHARKS.

The essential character of this order is in the structure of the vertebrae. The calcareous lamellae within each vertebra radiate from the central ring. The group contains the great body of living sharks, including all of those with 5 gill openings, 2 dorsals, and an anal fin.

(ἀστῆρ, star; σπόνδυλος, vertebra.)

FAMILIES OF ASTEROSPONDYLI.

- I. CESTRACIONTES. Palatoquadrate apparatus articulated to preorbital part of skull; dorsal fins with spines; head short and blunt; teeth of differing forms in the same individual HETERODONTIDÆ, III.
- II. GALEI. Palatoquadrate apparatus not articulated with skull; no dorsal spines; head more or less pointed in profile; teeth not differing widely in form in the same individual.
- a.* First dorsal fin over or behind ventrals; spiracle present; no nictitating membrane.
- b.* Tail not bent upward; nostrils not confluent with the mouth.
- c.* Sharks oviparous SCYLIORHINIDÆ, IV.
- cc.* Sharks ovoviviparous HEMISCYLLIDÆ, V.
- aa.* First dorsal fin inserted more or less in advance of ventrals.
- d.* First dorsal fin high, highest anteriorly, its base wholly in front of that of ventrals.
- cc.* Caudal fin not innate, its upper lobe two or more times length of lower, with a notch below toward its tip; side of tail not keeled.
- f.* Last gill-opening above base of pectoral.
- g.* Tail moderately developed, forming less than one-third of the total length; eyes with nictitating membranes.
- h.* Head normally formed CARCHARIDÆ, VI.
- hh.* Head hammer-shaped or kidney-shaped by the extension of its sides SPHYRNIDÆ, VII.
- gg.* Tail exceedingly long, forming about one-half the total length; eyes without nictitating membrane ALOPIDÆ, VIII.
- ff.* Last gill-opening entirely in front of pectoral; snout ending in a long flat blade MITSUKURINIDÆ, IX.
- cc.* Caudal fin lunate; caudal peduncle with a keel on each side; size large.
- i.* Last gill-opening entirely in front of pectorals.
- j.* Gill-openings moderate; teeth large and sharp LAMNIDÆ, X.
- jj.* Gill-openings very wide, nearly meeting under throat; teeth very small and numerous; size enormous.
- CETORHINIDÆ, XI.
- ii.* Last gill-opening above base of pectorals; teeth small; size large RHINODONTIDÆ, XII.

Family III. HETERODONTIDÆ.

CESTRACIONT SHARKS.

Body elongate; obtusely trihedral, gradually tapering backward; head high, with the forehead declivous, and little prominent. Mouth rather narrow, the upper lip divided into 7 lobes, the lower with a fold; dentition similar in both jaws, small obtuse teeth in front, and the lateral teeth molar-like and enlarged. Nostrils confluent with the mouth. Gill-openings 5. Spiracles small. Dorsal fins 2, and each provided with a strong spine. Caudal fin usually notched at tip. Oviparous, the egg-cases very large, subconical, without tentacles, and spirally twisted. Small sharks now inhabiting the Pacific Ocean. Species supposed to belong to the same family are widely distributed as fossils in the Mesozoic and earlier periods.

3. HETERODONTUS Blainville.

Heterodontus BLAINVILLE, Nouv. Bull. Scien., 1816, p. 121 (*philippi*).

Cestracion CUVIER, Règne Animal, 1st ed., 1817, p. 129 (*philippi*).

Gypropleurodus GILL, Proc. Acad. Nat. Sci. Phila., 1862, p. 489 (*francisci*).

Tropidodus GILL, Proc. Acad. Nat. Sci. Phila., 1862, p. 489 (*pantherinus*).

Body elongate, thick and heavy anteriorly, and the tail tapering. Head thick, oblong, broad. Snout bluntly rounded, rather long, and protruding. Eyes small, high, with the ridges above more or less prominent. No nictitating membrane. Mouth rather small and narrow; teeth small and obtuse in front, in the young pointed, and provided with 3 to 5 cusps; the posterior teeth molar-like, twice as broad as long, and arranged in oblique series, one series being formed by much larger teeth than those in the other series. Spiracles small, a short distance from the lower part of the eye. Gill-openings rather narrow. Scales small, sometimes cruciform. First dorsal opposite the space between pectorals and ventrals; second dorsal in advance of anal; pectorals very large and below gill-openings; caudal fin moderate, more or less bent upward. Species about 5, and usually placed in one genus, *Heterodontus*, often called by the later name of *Cestracion*. (ἑτερόδοντος, differing: ὀδοῦς, tooth.)

3. HETERODONTUS JAPONICUS (Duméril).

NEKOZAME (CAT SHARK).

Heterodontus philippi var. *japonica* DUMÉRIL, Hist. Nat. Poiss., I, 1870, p. 424; Japan.

Cestracion japonicus MIKLOUICHO-MACLAY and MACLEAY, Proc. Linn. Soc. N. S. Wales, VIII, p. 428, pl. xx; Japan.—ISHIKAWA, Prel. Cat., 1897, p. 61; Tokyo.

Heterodontus japonicus STEINDACHNER, Reise Aurofa, 1898, p. 224; Kobe.

Heterodontus zebra BLEEKER, Verh. Bat. Gen., XXVI, 1854, p. 127; Nagasaki (not of Gray).

Head $6\frac{1}{2}$; depth $6\frac{1}{2}$ in length; width of body at pectorals $1\frac{1}{2}$ in head; eye $5\frac{1}{3}$; snout $1\frac{1}{2}$; mouth about 3; interorbital space 2; width of mouth $1\frac{2}{3}$; ventrals $1\frac{1}{2}$.

Body elongate, thick, heavy, compressed anteriorly; tail rounded, tapering backward. Head broader than deep, oblong, elevated above; snout very blunt, flattened above, much longer than interorbital space; cheeks rounded, convex, full, swollen; eye very full, elongated horizontally, high, and nearer gill-opening than tip of snout; snout protrudes so that mouth is not terminal; teeth tricuspid in front, median cusp largest, but posteriorly becoming molar-like, rounded and large; lips very thick, fleshy, with a deep fold at corners of mouth; nostrils large and confluent with mouth; interorbital space broad, concave, and superorbital ridges elevated on both sides. Spiracles very distinct, a short distance below posterior margin of eye. Gill-openings in front

at first, then rising above base of pectoral, first largest, equal to $1\frac{1}{2}$ in the interorbital space, the others progressively smaller to last, which is one-half the length of first.

Body rough on the top of head and back. Fins large, first and second dorsal each with a strong, sharp-pointed spine, the origin of first midway between tip of snout and origin of the second dorsal; first dorsal higher than second, its margin concave and its height a little less than head; second dorsal with its origin midway between origin of first dorsal and tip of caudal, low, and with its margin also concave; anal smallest fin, posterior to second dorsal; pectorals very large, equal to caudal, broad and with margin straight; origin of ventral nearer first dorsal than second dorsal, short, blunt behind, and margin straight; caudal with lower lobe broad. Caudal peduncle long, compressed, flattened above and below, its least depth equal to its breadth a trifle more than eye or about $2\frac{1}{2}$ in interorbital space.

Color in spirits pale brown, dark above; across snout a broad pale bar, then one behind eye, crosswise, above, two narrow pale bars between eye and first dorsal, then two more from first dorsal, two more between first and second dorsal, two from second dorsal, a broad pale one on middle of caudal peduncle, and then another at junction of caudal and caudal peduncle; pectorals and ventrals pale above.

Length $19\frac{1}{2}$ inches (48 cm. 5 mm.).

Described from a specimen from Nagasaki.

Coasts of Japan; generally common southward. Our specimens taken at Misaki, Tokyo, Wakanoura, Kobe, Hakata, and Nagasaki. It is close to the Australian *Heterodontus philippi*, differing at least in the coloration. To the Chinese species *Heterodontus zebra*^a it is still nearer, but according to Steindachner it differs in coloration, in the form of the head, and of the individual fins.

Family IV. SCYLIORHINIDÆ.

CAT SHARKS.

Dorsal fins 2, both rather small, without spines, the first more or less behind the ventrals; anal fin present, usually before the second dorsal; caudal fin rather long, usually with a basal lobe; the tail not keeled and not bent upward. Spiracles present, close behind eye; no nictitating membrane; gill openings small, the last one above the root of the pectorals. Mouth usually broad, with small teeth, several series being in function; teeth small, each with a median cusp and 1 to 4 small cusps on each side; nostrils near mouth, not confluent with it, sometimes provided with carti. Gill openings 5, nearly equidistant. Mucous pores about head numerous, especially on lower side of snout. Oviparous. Egg cases large, quadrate, with prehensile tubes at the angles. Small sharks, the species rather numerous in warm seas.

^a*Cestracion zebra* Gray, Zool Miscel., 1831, p. 5; Canton.

- a. SCYLIORHININÆ. Nasal and buccal cavities separate; spiracles close behind eye; gill openings nearly equidistant; teeth small, usually tricuspid.
- b. Nostrils separated from each other by a broad isthmus.
- c. Scales on upper margin of the tail little if at all enlarged, usually similar to those on rest of body, or at any rate not forming a serrated edge.
- d. Head not very broad; stomach not inflatable; second dorsal behind anal, which is far from caudal.....*Halaelurus*, 4.
- dd. Head extremely broad; stomach capable of great inflation; second dorsal over anal.....*Cephaloscyllium*, 5.

4. HALÆLURUS Gill.

Halaelurus GILL, Ann. Lye. Nat. Hist. N. Y., 1861, p. 407 (*bürgeri*).

Body and head slender; spiracle small, close behind eye; nasal and buccal cavities separate; nasal valves simple, without lobe or groove, the nostrils separated by a broad interspace; teeth small, tricuspid. First dorsal behind ventrals, second dorsal behind anal, which is far from caudal.

Very small spotted sharks, allied to *Scyliorhinus* and *Catulus*.
(ἀλ5, sea; αἰλουρός, cat.)

4. HALÆLURUS BURGERI (Müller and Henle).

Scyllium burgeri MÜLLER and HENLE, Plagiost., 1837, p. 8, pl. II; Nagasaki.—SCHLEGEL, Fauna Japonica, Poiss., 1850, p. 301; Nagasaki.—BLEEKER, Act. Soc. Sci. Ind. Neerl., I, 1856, Amboyna, p. 69; Amboyna.—GÜNTHER, Cat. Fish Brit. Mus., VIII, 1870, p. 404; Japan, Formosa, Amboyna.—DUMÉRIL, Hist. Nat. Piss., I, 1870, p. 320; Nagasaki.

Halaelurus burgeri GILL, Am. Lye. Nat. Hist. N. Y., 1861, p. 407.

Head $7\frac{2}{3}$; depth about $12\frac{1}{2}$ in length; width of head $1\frac{1}{6}$ in its length; snout $2\frac{1}{2}$ in head; interorbital space $2\frac{1}{2}$; width of mouth about 2; eye 4; eye $1\frac{2}{3}$ in snout; $1\frac{2}{3}$ in interorbital space; pectoral $1\frac{1}{4}$ in head; base of anal 2.

Body very elongate, depressed somewhat in front, and tail long and tapering. Head small, rather broad, but not as broad as long, and depressed above; snout depressed, produced, lateral profile pointed, but when seen from above, broadly rounded; eyes rather large, lateral, about in center of length of head; mouth very broad, mandible beginning in front of eye, and corners below posterior part of eye; teeth small, numerous, tricuspid in both jaws; nostrils rather large, nearer eye than tip of snout, but not confluent with mouth; interorbital space broad and flattened like top of head and snout. Spiracles large and directly behind the eye at a very short distance. Gill-openings small, lateral, and above base of pectorals.

Body very finely roughened.

First dorsal much larger than second, its origin much nearer base of lower caudal lobe in front than tip of snout, and behind ventrals; second dorsal entirely behind anal and distant from first dorsal 3 times

the latter's base; anal small, low, its origin a little nearer origin of ventrals than origin of lower caudal lobe; pectorals larger than other fins, broad, and with their margin nearly straight; ventrals rather long; caudal equal to space between origin of its lower lobe, which is not very deep.

Color light brown, a trifle darker above; small round black spots irregularly grouped in double rows over back, on the sides, and between them more or less of a warmer tint; lower parts pale, immaculate, except on tail, where there are one or two dark spots; spots on caudal small.

Total length $15\frac{1}{2}$ inches (39 cm., 4 mm.).

This description is from a dried skin taken at Nagasaki by M. Yahi-ro.

Coast of Japan and southward, not common; seen at Misaki and Nagasaki.

(Named for M. Burger, who collected specimens and paintings about Nagasaki for Temminck and Schlegel.)

5. CEPHALOSCYLLIUM Gill.

Cephaloscyllium GILL, Am. Lyc. Nat. Hist. N. Y., 1861, p. 407 (*laticeps*).

This genus differs from *Catulus* in the very broad head, and in the power or habit of inflating the stomach when disturbed.

(κεφαλή, head: *Scyllium*.)

5. CEPHALOSCYLLIUM UMBRATILE Jordan and Fowler, new species.

NANUKAZAMI (SEVEN DAY SHARK); OSEIBUKA (CROWD SHARK).

Cephaloscyllium laticeps NYSTROM, Kong. Svensk Vet. Ak., 1887, p. 49; Nagasaki—ISHIKAWA, Prel Cat., 1897, p. 62; Tokyo (not *Scyllium laticeps* Duméril, which is an Australian species).

Head $6\frac{1}{5}$ in length; depth about 8; depth of head $1\frac{1}{3}$ in its length; snout $2\frac{2}{3}$ in head; interorbital space 2; width of mouth about 2; eye $3\frac{1}{3}$ in interorbital space; mouth 2 in head; pectoral $1\frac{1}{4}$; depth of caudal peduncle about 3 in interorbital space.

Body elongate, more or less depressed anteriorly, tail narrow, tapering downward. Head rather large, broad, its breadth a little less than length; snout produced, bluntly rounded, flattened above; eye small, lateral, nearer tip of snout than first gill-opening; mouth large, rather broad; teeth small, numerous, tricuspid; nostrils nearer tip of snout than eye, not confluent with mouth; interorbital space broad, flat; spiracles small, behind eye, and a little below, or for space less than diameter of the eye; gill-openings 5, posterior smallest, and a little above base of pectoral.

Scales small, rough.

First dorsal much larger than second, behind ventrals; space between it and second dorsal much greater than base of first dorsal; origin of

second dorsal nearer first dorsal than base of caudal lobe; anal fin below, and a trifle in front of second dorsal; pectorals large, nearer tip of snout than origin of ventrals; ventrals rather low, their origin nearer origin of anal than that of pectoral; caudal longer than head.

Color pale brown, very light below, marbled above with shades of dark and deep brown; on back five broad cross bars of pale ruddy brown, with blotches of darker brown, first behind the eye, next over base of pectoral, next between it and first dorsal where another is, and finally last at second dorsal; on caudal, two broad cross bars, one at base of caudal, the other near its tip. Length $38\frac{1}{2}$ inches (98 cm).

Type a dried skin, No. 12693 Ichthyological collections, Stanford University Zoological Museum.

Locality, Nagasaki.

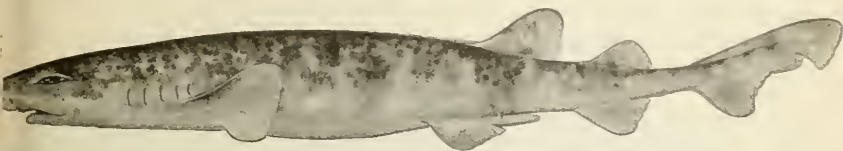


FIG. 1.—CEPHALOSCYLLIUM UMBRATILE,

Coast of Japan southward, apparently quite rare, as we have obtained only one specimen from Nagasaki, collected by Mr. Yahiro. From the same locality it is also recorded by Nystrom.

(*umbratilis*, shaded.)

Family V. HEMISCYLLIIDÆ.

This group is closely allied to the *Scyliorhinidae*, differing mainly in being ovoviviparous, the young being brought forth alive as in most sharks. The nasal and buccal cavities are confluent, the anal is behind the second dorsal, the large spiracles are more or less behind the eye, and the body is usually marked with dark cross-bands.

- a. HEMISCYLLINÆ. Sides of head with no dermal flaps or cirri; spiracles very distinct below the eye; anal far behind second dorsal *Chiloscyllium*, 6.
- aa. ORECTOLOBINÆ. Sides of the head with dermal flaps or cirri; spiracles wide, oblique slits behind and below the eye..... *Orectolobus*, 7.

6. CHILOSCYLLIUM Müller and Henle.

Chiloscyllium MÜLLER and HENLE, Plagiostomen, 1837, p. 17 (*plagiosum*).

Synchismus GILL, Am. Lyc. Nat. Hist. N. Y., 1861, p. 408 (*tuberculatus*).

Spiracle very distinct, below the eye. Nasal and buccal cavities confluent; nasal valve folded, with a cirrus. Lower lip well developed, continuous across the symphysis. Teeth small, triangular, with or without lateral cusps. Last two gill-openings close together. Dorsal

fins two, the first behind the front of ventrals. Anal far behind second dorsal, close to caudal. East Indies.

(*Χείλος*, lip; *Scyllium*, a related genus of sharks.)

6. CHILOSCYLLIUM INDICUM (Gmelin).

Squalus sp. GRONOW, Mus. Ich., I, p. 61, No. 133; India (from a specimen in which the anal fin was cut away).

Squalus indicus GMELIN, Syst. Nat., I, 1788, p. 1503 (after Gronow).

Chiloscyllium indicum GÜNTHER, Cat. Fish, VIII, 1870, p. 411; China, Japan, India, Cape Seas, Java, Ceylon, etc. (and of most recent authors).—JORDAN and EVERMANN, Proc. U. S. Nat. Mus., 1902; Formosa.

Squalus gronovianus LACÉPÈDE, Hist. Nat. Poiss., I, 1798, p. 280, pl. xi, fig. 1 (after Gronow).

Squale dentelé LACÉPÈDE, Hist. Nat. Poiss., I, 1798, p. 281, pl. xi, fig. 1.

Squalus tuberculatus BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 137.

Synchisimus tuberculatus GILL, Am. Lyc. Nat. Hist. N. Y., 1861, p. 408.

Scyllium plagiosum BENNETT, Life of Raffles, 1830, p. 694.

Chiloscyllium plagiosum MÜLLER and HENLE, Plagiost., 1837, p. 17.—DUMÉRIL, Elasmobr., 1870, p. 328 (and of various authors).

Scyllium ornatum GRAY, Ind. Zool., III, 1830-35, pl. c, fig. 1; India.

Chiloscyllium griseum MÜLLER and HENLE, Plagiost., 1837, p. 19.

Chiloscyllium margaritiferum BLEEKER, Ned. Tyds. Dierk., I, 1851, p. 243.

Scyllium hasselti BLEEKER, Verh. Bat. Gen., XXIV, 1852, Plagiost., p. 19.

Scyllium phymatodes BLEEKER, Verh. Bat. Gen. Plagiost., p. 21.

Squalus caudatus GRONOW, Syst., Ed. Gray, 1854, p. 8.

Head 8 in length; depth 13; snout $2\frac{1}{2}$ in head; interorbital space $2\frac{2}{3}$; width of head $1\frac{1}{2}$ in its length; eye 3 in interorbital space; base of pectoral $2\frac{1}{2}$ in head; base of anal $1\frac{3}{4}$.

Body very elongate, slender, tail long and tapering. Head long, depressed, broadly rounded above, flattened below; snout broadly depressed, produced, and rounded above so that lateral profile is bluntly pointed; eyes small, high, lateral, rather far apart, in middle of length of head; mouth very broad, transversely straight, nearer eye than tip of snout; mandible with a broad, undivided flap, posterior edge undulated; teeth pointed, with a basal cusp on each side, numerous, rather small; nostrils large, confluent with corners of mouth, and each with a pointed barbel; interorbital space elevated a little, very broad, flattened. Spiracles very large, below and behind eye. Gill-openings about equal, the posterior above root of pectoral, and last two very close together.

Scales rather large and coarse.

Origin of first dorsal a little nearer tip of snout than origin of lower caudal lobe, similar to second dorsal, and only a trifle larger, space between two fins about equal to head; anal short, far behind second dorsal and only separated from caudal by a deep notch; pectorals broad, a little shorter than head, and nearer the tip of snout than origin of ventrals; ventrals before first dorsal, their tips reaching nearly to

middle of its base; caudal not bent up, upper lobe low, straight, and lower lobe long, deeper than upper and with a notch near its tip. Back with a low median keel.

Color in alcohol pale brown above, whitish beneath, and with thirteen broad deep brown cross-bars above, between which on median line of back a deep brown spot; sides of body and broad cross-bars with a number of light spots, of more or less irregular size, and some of those on sides of abdomen greatly enlarged.

Head with a number of pores.

Length 26 $\frac{1}{4}$ inches.

This description from a male from Formosa, loaned us by Dr. Shinosuke Matsubara.

Coasts of China and Formosa, recorded once from Nagasaki by Günther.

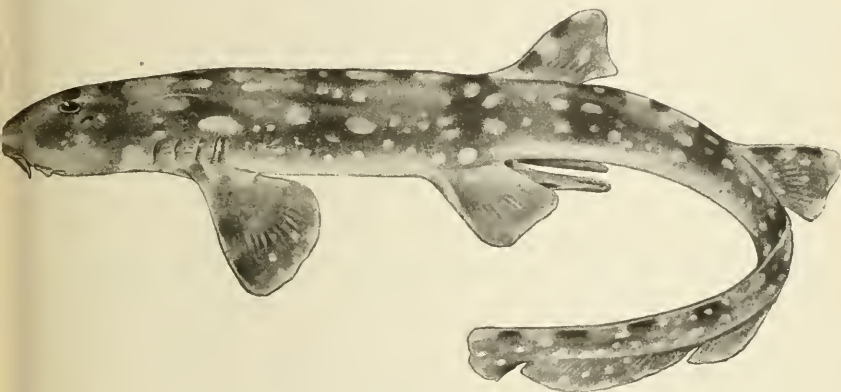


FIG. 2.—CHILOSCYLLIUM INDICUM.

The synonymy above given is from Günther; we have no means of valuing the nominal species included by Günther under the name of *Chiloscyllium indicum*.

7. ORECTOLOBUS Bonaparte.

Orectolobus BONAPARTE, Selach., 1836, p. 11 (*barbatus*).

Crossorhinus MÜLLER and HENLE, Plagiost., 1837, p. 21 (*barbatus*).

Spiracle a wide oblique slit behind and below the eye; nasal and buccal cavities confluent. Head broad, flat, the snout very obtuse; mouth wide, partly anterior, a free nasal cirrus; sides of head with numerous skinny flaps; chin with or without barbels. Lips well developed. Anterior teeth rather large, long, and slender, without lateral lobes; lateral teeth smaller, tricuspid in few series; last two gill-openings close together. First dorsal behind ventrals, the second before anal, which is very close to caudal. Tail short.

(ὄρεκτός, stretched out; λόβος, lobe).

7. ORECTOLOBUS BARBATUS (Gmelin).

Squalus barbatus GMELIN, Syst. Nat., 1788, p. 1493; New Holland (after Barbu
of Broussonet, Act. Paris, 1780, p. 657).

Crossorhinus barbatus MÜLLER and HENLE, Plagiost., 1837, p. 21, pl. v.—SCHLEGEL,
Fauna Japonica, Poiss., 1850, p. 301; Nagasaki.—DUMÉRII, Elasmobr., I,
1870, p. 338; Australia, Japan, China.—GÜNTHER, Cat. Fish, VIII, 1870,
p. 414; Japan, Tasmania, Australia.—MACLEAY, Australian Fishes, 1881, p.
301; Port Jackson.

Squalus maculatus BONNATERRE, Encycl. Meth., 1788, p. 8 (after Broussonet;
Coll. Capt. Cook).

Squalus appendiculatus SILAW, Naturalists' Miscellany, 1809, p. 727.

Head $6\frac{1}{4}$ in length; depth 9; depth of body $1\frac{1}{2}$ in head; depth of head
about $1\frac{2}{3}$ in its length; length of head $1\frac{1}{3}$ in its width; eye $9\frac{1}{2}$ in head;
2 in spiracle; $3\frac{1}{2}$ in snout; $4\frac{1}{2}$ in interorbital space; snout 3 in head, $1\frac{1}{3}$
in interorbital space; $1\frac{2}{3}$ in space between spiracles; width of mouth 2
in breadth of head; pectoral about $1\frac{1}{4}$; base of ventral $1\frac{2}{3}$ in length of
pectoral; caudal peduncle 3 in space between spiracles.

Body elongate, very much depressed and broadened anteriorly; tail
rather narrow, compressed, tapering. Head very broad, flattened,
its breadth greater than length; snout broad, profile very blunt, trun-
cate, with rounded edges, upper surface flat; eyes very small, superior,
superorbital ridges slightly elevated and broadly flattened; jaws nearly
equal, upper projecting beyond but little; teeth without cusps, sharp,
elongate, pointed; lips very thick, fleshy, fringed inside; nostrils con-
fluent with mouth, lateral, far apart, inferior; mouth with deep labial
groove at corner, which is a little in front of eye; tongue broad, flat,
compressed, little free in front; sides of head and snout each with 9
compressed dermal flaps or appendages of different sizes, first pair
from nostrils are largest; interorbital space like rest of top of head,
flat. Spiracles very large below and behind eyes. Gill-opening rather
small, above pectorals.

Scales small, rough when stroked backwards.

First dorsal the larger, higher than second; space between its base
and that of second two-thirds length of its own base, and its origin
over posterior part of base of anal; origin of second dorsal nearer
origin of ventral than tip of anal; anal smallest, beginning directly
behind second dorsal; pectorals large, broad, margin truncate; ven-
trals nearer origin of anal than first gill-opening; caudal moderate,
with a notch near tip, equal to space between origin of first dorsal and
base of second posteriorly.

Color in spirits pale brown, whitish beneath; upper surface beauti-
fully marbled and variegated with darker brown; crosswise about ten
broad dark bars made up of similar mottlings; a whitish spot behind
the corner of spiracle.

Length 33 inches (84 cm. 2 mm.).

Described from a female taken at Hakata.

Japan to Australia, rather common to the southward. Our specimens from Nagasaki, and one from Hakata, where it was found abundant. The identity of the Japanese species with the Australian *Orectolobus barbatus* is yet to be proved.
(*barbatus*, bearded.)

Family VI. CARCHARIIDÆ.

TYPICAL SHARKS.

Sharks with two dorsal fins, the first short and high, entirely before the ventrals, the second comparatively small, opposite the anal; no spines; gill-openings moderate, the last above the base of the pectorals; tail more or less bent upward from the base of the caudal fin; sides of tail not keeled; eyes with nictitating membranes; head not hammer-shaped, the snout longitudinally produced, as usual among sharks. Spiracles small or obsolete. Species oviparous.

A large family, found in all seas. The species are often closely related and difficult of determination.

a. MUSTELINE: Teeth flat and paved, without cusps or ridges; spiracles present; no pit at root of tail; labial folds well developed.

b. Teeth very blunt. *Mustelus*, 8.

aa. CARCHARINE: Teeth more or less compressed, with entire or serrate sharp edges.

c. Spiracles present.

d. Root of tail without pit.

e. Teeth rather small, each with a medium cusp and one or two small lateral cusps on each side.

f. Teeth larger, with sharp cusps; snout of moderate length; embryo not attached to uterus by a placenta *Triakis*, 9.

ee. Teeth larger, with a single cusp, oblique, notched and coarsely serrated on the outer margin. *Galeus*, 10.

dd. Root of tail without conspicuous pit above; teeth all coarsely serrate, alike in both jaws, and all with a deep notch on outer margin; caudal fin with a double notch *Galeocerdo*, 11.

cc. Spiracles obsolete; lower teeth narrower than upper teeth.

g. Angle of mouth without groove or with merely a slight depression, which does not extend along either jaw.

h. First dorsal fin inserted posteriorly, nearer ventrals than pectorals; embryo not joined to the uterus by a placenta; slender sharks, with very strongly serrated teeth *Prionace*, 12.

hh. First dorsal inserted anteriorly, nearer pectorals than ventrals; embryo (so far as known) attached to the uterus by a placenta.

i. Teeth all serrate more or less (entire in the very young).

Carcharias, 13.

gg. Angle of mouth provided with more or less distinct groove, which extends along one or both jaws; teeth entire, or very nearly so, more or less obliquely placed, their points turned away from the median line; embryo (so far as known) with placenta.

Scoliodon, 14.

8. MUSTELUS Cuvier.

DOG SHARKS.

Mustelus CUVIER, Règne Animal, 1st ed., 1817, p. 128 (*mustelus*).

Pleuracromylon GILL, Proc. Ac. Nat. Sci. Phila., 1864, p. 148 (*laris*).

Galeus JORDAN and EVERMANN, Fish. N. Mid. Am., 1, 1896, p. 29 (after Rafinesque 1810).

Body elongate, slender; snout comparatively long and flattened; mouth crescent-shaped, with well-developed labial folds; teeth small, many rowed, flat and smooth, rhombic, arranged like pavement, alike in both jaws, and blunter than in any other sharks; eyes large, oblong; spiracles small, just behind the eyes; pectoral fins large; first dorsal large, not much behind pectorals; second dorsal somewhat smaller; anal opposite second dorsal and still smaller; ventrals well developed; basal lobe of caudal almost obsolete, the tail nearly straight; embryo attached to the uterus by a placenta, or else without placenta, those so attached belonging to the subgenus *Pleuracromylon*. Small sharks, among the smallest of the American species.

(*mustelus*, a weasel or marten; the same word used for shark, as is the synonymous word *galeus*.)

8. MUSTELUS MANAZO Bleeker.

MANAZO; HOSHIZAME (STAR-SPOTTED SHARK); HOSHINOKURI (STAR CHESTNUT).

Mustelus vulgaris SCHLEGEL, Fauna Japonica, Poiss., 1850, p. 303, pl. cxxxiv Nagasaki (not of Müller and Henle).—NYSTROM, Kōng, Svensk, Ak. Vet. 1887, p. 50; Nagasaki.

Mustelus manazo BLEEKER, Verh. Bat. Gen., XXVI, 1854, Japan, p. 126; Nagasaki.—GÜNTHER, Cat. Fish, VIII, 1870, p. 387; Japan.—DUMÉRIL, Elasmobranches, I, 1870, p. 403 (after Bleeker).—ISHIKAWA, Prel. Cat., 1897, p. 62. Hokkaido, Boshu, Tokyo.—JORDAN and SNYDER, Proc. U. S. Nat. Mus. 1900, p. 336; Tokyo, Hakodate.

Head $6\frac{1}{2}$ in length; depth $11\frac{1}{2}$; width of head $1\frac{1}{2}$ in its length; depth of head 2; snout $2\frac{1}{2}$; width of mouth 3; interorbital space $2\frac{1}{3}$; eye $4\frac{2}{3}$; space between spiracles $1\frac{2}{3}$; pectoral about $1\frac{1}{3}$; height of dorsal $1\frac{2}{5}$; caudal peduncle $1\frac{1}{4}$ in eye.

Body long, slender, back elevated in front; tail long, tapering. Head broad, broader than greatest depth of body, depressed in front, elevated behind; snout greatly produced, depressed, flattened, rather broadly rounded; eyes elongate, lateral, in middle of length of head; mouth obtusely angular, breadth much greater than either of rami and tip of mandible not before eye; teeth small, pavement-like, in many rows; lips thin, at corners of mouth a fold on each side; nostril very large; on lower surface of head, nearer eye and mouth than tip of snout; interorbital space broad, flattened. Spiracles small, very near posterior margin of eye. Gill-openings rather small, posteriorly above base of pectoral in front.

Body everywhere very finely roughened.

First dorsal larger than second, nearer origin of pectoral than that of ventral; origin of second dorsal nearer that of first dorsal than tip of caudal, and with greater part of its base in front of anal; anal smallest nearer caudal than ventral; pectorals a little larger than first dorsal, broad, very slightly emarginate; ventrals small, origin nearer that of anal than pectoral; caudal short, a little less than space between two dorsals. Caudal peduncle rather long, least depth greater than least width.

Color in spirits uniform grayish-brown, much darker above, pale below; upper surface of body anteriorly, also along the lateral line, marked with small, round, whitish spots.

Length 22 inches (56 cm.).

This description taken from our largest example, a male, secured at Tokyo.

Coasts of Japan, generally abundant in shallow bays, especially to the southward, our specimens from Hakodate, Aomori, Matsushima, Tokyo, Misaki, Kobe, Onomichi, Hiroshima, and Hakata. It is a small shark, reaching a length of about $2\frac{1}{2}$ feet, and is used for food. In young specimens the tips of the caudal and dorsals are blackish.

(*Manazo*, the Japanese name.)

9. TRIAKIS Müller and Henle.

Triakis MÜLLER and HENLE, Magazine of Natural History, II, 1838, p. 36, (*scyllum*).

Triacis, corrected spelling.

Body compressed, elongate; mouth large, crescent-shaped, with well-developed long labial folds; teeth moderate, numerous, similar in both jaws, each with a longer median cusp, and one or two smaller ones on each side; eyes small, with nictitating membrane; spiracles small, behind the eyes; no pit at the root of the caudal; no lower lobe to the caudal; first dorsal fin opposite the space between the pectorals and ventrals. Embryo without placenta. Coloration variegated, black and gray. Pacific and Indian oceans.

($\tau\rho\epsilon\acute{\iota}\varsigma$, three; $\acute{\alpha}\kappa\acute{\iota}\varsigma$, point).

9. TRIAKIS SCYLLIUM Müller and Henle.

KOROZAME (KORO, INCENSE BURNER; ZAME, SHARK).

Triakis scyllum MÜLLER and HENLE, Plagiostomen, 1838, p. 63, pl. xxvi; Nagasaki.—DUMÉRII, Elasmobr., 1870, p. 397 (after Müller and Henle).—JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 336; Tokyo.

Triacis scyllum GÜNTHER, Cat. Fish, VIII, 1870, p. 384 (after Müller and Henle).—ISHIKAWA, Prel. Cat., 1897, p. 62; Tokyo, Sagami.

Head $6\frac{2}{5}$ in length; depth $8\frac{2}{3}$; width of head $1\frac{1}{2}$ in its length; depth of head 2; snout $2\frac{1}{2}$; interorbital space a trifle over 2; eye $6\frac{1}{4}$; width of mouth $2\frac{4}{5}$; snout to mouth $2\frac{2}{3}$; space between spiracles $1\frac{3}{4}$; base of dorsal $1\frac{1}{3}$; base of anal 2.

Body long, slender, back elevated, and tail compressed, tapering. Head depressed, flattened below, much broader than deep; snout in profile pointed, rounded, when seen from above very broadly rounded and flattened; eye small, lateral, with nictitating membrane; mouth very broad, crescent-shaped, not angular, so that it begins in front of eye and ends below middle; teeth small, numerous, sharp-pointed, tricuspid; labial fold at the corner of mouth on each side; nostrils large, on lower surface of head, nearer mouth than tip of snout; inter-orbital space broad, flattened. Spiracles small, directly behind eyes. Gill-openings lateral, posterior above base of pectoral.

Body entirely roughened, the prickles coarser above.

First dorsal large, a little nearer origin of second dorsal than tip of snout, also nearer origin of pectoral than that of ventral; second dorsal midway between posterior base of first dorsal and anterior base of lower caudal lobe; anal well behind second dorsal; pectoral shorter than head, its posterior margin slightly emarginate, reaching beyond middle of space between its own origin and that of ventral; ventrals nearer origin of anal than posterior base of pectorals; caudal small, $4\frac{1}{4}$ in total length. Caudal peduncle narrow, compressed above and beneath. Lateral line present along sides, superior.

Color dark gray brown, with a number of indistinct broad blackish cross-bars; in the upper surface of body a number of scattered, indistinctly defined, blackish spots; lower surface of body pale; sides and lower portions of pectorals and ventrals grayish brown.

Length $16\frac{1}{2}$ inches (47 cm.).

This description from an example from Tokyo.

Coasts of southern Japan; rather common in the Inland Sea. A small shark, reaching a length of about $2\frac{1}{2}$ feet. Our specimens from Tokyo, Tsuruga, Onomichi, and Hakata.

(*scylium*, the cat shark; from $\sigma\kappa\acute{\upsilon}\lambda\omega$, to rend.)

10. GALEUS Rafinesque.

TOPES.

Galeus^a RAFINESQUE, Caratteri Aleuni Nuovi Generi, 1810, p. 13, in part (*galeus*, etc., although that species is not explicitly mentioned, the first species mentioned being a species of *Pristiurus*, *P. melastomus*).

^aFrom the definition, and from Rafinesque's custom of taking Linnæan specific names as generic, making such species always the types of his genera, we may infer that *Squalus galeus* was his type of *Galeus*. At least this arrangement may be accepted pending an agreement as to the generic nomenclature of sharks. In case the name *Galeus* is finally used for *Pristiurus* or for *Mustelus*, the present genus will become *Galeorhinus*. In a private notebook belonging to Rafinesque, now preserved in the Smithsonian Institution, he refers to *Galeus*, *Carcharias*, and several other genera named by Cuvier in 1817, as "described by me in 1810, but don't you tell it!" Pending a decision of the application of *Galeus* and *Carcharias* we retain them for the groups to which Rafinesque obviously intended the names to apply.

Galeorhinus BLAINVILLE, Bull. Sci. Philom., 1816, p. 121 (*galeus*).

Galeus CUVIER, Règne Animal, 1st ed., 1817, p. 127 (*galeus*).

Eugaleus GILL, Proc. Ac. Nat. Sci. Phila., 1864, p. 148 (*galeus*).

First dorsal opposite the space between the pectorals and ventrals; mouth crescent-shaped, with the teeth alike in both jaws, oblique, notched, and serrated; spiracles present, small; nictitating membrane present; no pit at the base of the caudal; caudal fin with a single notch. Tropical seas.

(γαλέος, a kind of shark, like a weasel.)

10. GALEUS JAPONICUS (Müller and Henle).

YERAKUFUKA.^a

Galeus japonicus MÜLLER and HENLE, Plagiostomen, 1838, p. 58, pl. xxii; Nagasaki.—DUMÉRIEIL, Elasmobranches, I, 1870, p. 391 (after Müller and Henle).—GÜNTHER, Cat. Fish, VIII, 1870, p. 380 (after Müller and Henle).—NYSTROM, Kong, Svensk, Vet. Ak., 1887, p. 50; Nagasaki.

Head $6\frac{1}{2}$ in head; depth $9\frac{1}{4}$; width of head $1\frac{3}{5}$ in its length; interorbital space $2\frac{1}{2}$; snout $2\frac{2}{5}$; pectoral $1\frac{1}{4}$; width of mouth $2\frac{1}{5}$; eye $2\frac{1}{2}$ in interorbital space.

Body elongate, back elevated in front, sides compressed. Head greatly depressed, elongate, convex above, flattened beneath; snout pointed in profile; when viewed from above, roundly pointed, flattened; eyes elongate, lateral; nictitating membrane large, well developed; mouth crescent shaped, though rather bluntly obtuse at symphysis of mandible; corners of mouth each with a well-developed labial fold; teeth very oblique, without serrations on their edges, and with several short cusps behind; nostrils laterally inferior, moderately large, nearer mouth than tip of snout; interorbital space broad, slightly elevated and flattened in middle. Spiracle a small slit a short distance behind eye. Gill openings 5, in front of the base of pectoral above.

Surface of body finely roughened.

Dorsals similar, far apart, origin of first much nearer tip of snout than origin of second; origin of second dorsal much in advance of anal, nearer first dorsal than tip of snout, and midway between origin of ventral and origin of lower caudal lobe; anal small, its origin nearer caudal than ventrals; pectorals large, with emarginate edges, reaching beyond origin of dorsal; ventrals behind first dorsal, their origin nearer that of anal than origin of pectoral; caudal much larger than head, with a notch near tip so that terminal portion is one and two-thirds the lower lobe. Caudal peduncle long, much deeper than broad, flattened above and below, without any pit.

Color in alcohol light gray-brown, below lighter or whitish.

Length $26\frac{3}{4}$ inches.

^a*Yeraku*, the antefeudal period; *fuka*, shark. *Yeraku* is the name of the period in Japanese history preceding the feudal period, or Tokugawa. It closed about 1600.

Described from a very large specimen from Nagasaki, where examples, 15 feet or more long, were seen.

A very large shark, reaching a length of 25 feet and a weight of nearly 2,000 pounds. The head of a huge specimen is in possession of M. Yahiro, proprietor of a natural-history shop in Nagasaki. It has the snout very short, nostrils midway in its length; teeth serrate, alike in both jaws, those in back deeply notched; width of jaws much exceeding snout; jaws with short labial fold; spiracles small; second dorsal a little smaller than first, slightly before anal; caudal considerably less than space between dorsals.

This species was taken at Onomichi, Hiroshima, and Nagasaki, and it appears to be generally common on the shores of Kiusiu.

11. GALEOCERDO Müller and Henle.

Galeocerdo MÜLLER and HENLE, Plagiostomen, 1838, p. 59 (*tigrinus*).

Boreoguleus GILL, Ann. Lyc. Nat. Hist. N. Y., VII, 1861, p. 411 (*arcticus*).

Mouth crescent shaped; teeth alike in both jaws, large, oblique, coarsely serrated on both margins, with a deep notch on outer margin; spiracles present; caudal fin with a double notch; a pit on the tail above and below at the base of the caudal fin; first dorsal opposite the space between pectorals and ventrals. Large sharks, found in most seas.

(γαλεός, a kind of shark, like γαλή, the weasel; κερδών, a fox or weasel.)

11. GALEOCERDO TIGRINUS Müller and Henle.

Galeocerdo tigrinus MÜLLER and HENLE, Plagiostomen, 1838, p. 59; Pondicherry.—

GÜNTHER, Cat. Fish, VIII, 1870, p. 378; Japan, East Indies.—DUMÉRIL, Elasmobranches, I, 1870, p. 393; Pondicherry (Coll. Dussumier).

Head, $7\frac{1}{4}$ in length; depth, about 10; snout, $3\frac{1}{2}$ in head; interorbital space, $1\frac{1}{3}$; width of mouth at corners, about $1\frac{3}{6}$; eye, $5\frac{2}{3}$ in the interorbital space; space between nostrils, 2.

Body elongate, tapering to caudal. Head very much broader than deep, depressed; eyes small, lateral, nearer snout than gill opening; snout broad, short, rounded; mouth very broad, rounded; teeth numerous, rather large, compressed, with several basal cusps, and with edges more or less serrated; a labial fold at corners of mouth; nostrils large, inferior, about midway between tip of snout and eye; interorbital space very broad, flat. Spiracles very small behind eye. Gill openings large, posteriorly above base of pectoral.

Body very finely roughened.

First dorsal beginning about first fourth of interspace between origin of pectoral and that of ventral; second dorsal small, a little nearer origin of first dorsal than tip of caudal; anal small, beginning behind origin of second dorsal; pectorals rather long; ventrals very

much nearer anal than pectorals; caudal very long, lower lobe produced. Caudal peduncle rather short.

Color brown above, whitish or pale below, upper surface marbled or blotched with dark brown.

Length about 51 inches.

This description from a dried skin, a young male from Nagasaki, collected by M. Yahiro.

East Indies, rarely northward to southern Japan. Dr. Günther records a young specimen from Japan. It is probable that comparison will show that the American species, *Galcoercdo maculatus* (Ranzani), is distinct from *G. tigrinus*.

(*tigrinus*, tiger-like.)

12. PRIONACE Cantor.

Prionodon MÜLLER and HENLE, Plagiostomen, 1838, p. 36 (*glaucus*, etc., name preoccupied).

Prionace CANTOR, Malayan Fishes, 1850, p. 399 (substitute for *Prionodon*).

Cymocephalus (KLEIN) GILL, Ann. Lyc. Nat. Hist. N. Y., 1861, p. 401 (*glaucus*).

Large sharks, with the body and head slender; no spiracles; the teeth in both jaws strongly serrated in the adult, those in the upper jaw broad, those below narrower, straight, and claviform; first dorsal large, inserted midway between axils of pectorals and ventrals; second dorsal much smaller, usually not larger than anal; embryo not attached to the uterus by a placenta. Species rather few; large, slender, swift, voracious sharks of the warm seas.

(*πίων*, saw; *ἄκίς*, point.)

12. PRIONACE GLAUCA (Linnæus).

Squalus glaucus LINNÆUS, Syst. Nat., 10th ed., 1758, p. 235; seas of Europe.

Carcharias glaucus GÜNTHER, Cat. Fish., VIII, 1870, p. 364; England, St. Helena, Pondicherry, Port Arthur, Australia.—DUMÉRIL, Elasmobr., 1870, p. 353; New Zealand.

Carcharhinus glaucus JORDAN and GILBERT, Synopsis, 1883, p. 22; San Francisco, Monterey.

Prionace glauca JORDAN and EVERMANN, Fish North and Middle America, I, 1896, p. 33; San Francisco, Monterey.

Squalus ceruleus BLAINVILLE, Fauna Française, 1828, p. 91; Mediterranean.

Squalus hirundinaceus VALENCIENNES, in MÜLLER and HENLE, Plagiostomen, 1838, p. 37; Brazil.

Snout very long, nostrils rather nearer to mouth than to extremity of snout; no labial fold except a groove at angle of mouth; teeth of upper jaw oblique, scarcely constricted near base; lower teeth slender, triangular in young examples, lanceolate, with a broad base, in old ones. Pectoral fin long, falciform, extending to dorsal, which is nearer ventrals than root of pectorals. Color light bluish gray above, paler below.

A large shark of the warm seas, occasionally taken in Europe and on the coasts of Japan and California. A mounted specimen from off Misaki is in the Imperial Museum of Tokyo, and a photograph is in the Imperial University, taken from a large specimen secured at Misaki. We have no specimens. Whether this species is really identical with the European *glauca* is uncertain.

(*γλαυκός*, grayish blue.)

13. CARCHARIAS Rafinesque.

Carcharias RAFINESQUE, Caratteri Aleuni, Nuovi Generi, 1810, p. 10 (in intention; the only species named being *C. taurus*, an *Odontaspis*); *Squalus carcharias* RAFINESQUE, not of Linnæus, being the intended type as shown by the Indice d'Ittiologia Siciliana, 1810, p. 44, where the Pesce-Cane of Sicily is called *Carcharias lamia*. The definition of Rafinesque, copied from Lacépède, is intended to cover the sharks allied to *C. lamia*.

Carcharias CUVIER, Règne Animal, 1st ed., 1817, p. 125 (*carcharias*, expressly identified with *Canis carcharias* of Bêlon [de Aquatilibus, I, p. 60], which is the species commonly called, after Rafinesque, *Carcharias lamia*).

Carcharinus BLAINVILLE, Journ. Phys., 1816, p. 264 (*commersoni*, a name based on Lacépède's figure of "*Squalus carcharias*;" it apparently represents *Carcharias lamia*).

Eulamia GILL, Ann. Lyc. Nat. Hist. N. Y., 1861, p. 401 (*lamia*).

Platypodon GILL, Ann. Lyc. Nat. Hist. N. Y., 1861, p. 401 (*menisorrh*).

Isogomphodon GILL, Ann. Lyc. Nat. Hist. N. Y., 1861, p. 401 (*oryrhincus*).

Lamiopsis GILL, Ann. Lyc. Nat. Hist. N. Y., 1861, p. 401 (*temmincki*).

Body rather robust. Head broad, depressed; mouth inferior; teeth in both jaws strongly serrated in adult, less so or entire in young; those in upper jaw broad or narrow, those below narrow, straight and nearly erect. No spiracles. First dorsal large, placed not far behind pectorals; pectorals falcate; second dorsal small. Embryos attached by placenta to the uterus, as in *Scoliodon*, *Triakis*, and *Galeus*. Species very numerous and difficult of separation. Voracious sharks of the warm seas.

If the name *Carcharias* be transferred to *Odontaspis*, the present genus must be called *Carcharhinus*.

(*καρχαρίων*, an old name of *C. lamia*, from *καρχαρός* jagged; the name first applied to *Squatina*, from its rasp-like skin.)

13. CARCHARIAS JAPONICUS (Schlegel).

MEJHO (WHITE EYE); WANIZAME (CROCODILE-SHARK).

Prionodon japonicus SCHLEGEL, Fauna Japonica, Poiss., 1850, p. 302; Nagasaki.

Head $5\frac{3}{4}$ in length; depth about 7; snout $2\frac{3}{4}$ in head; width of mouth $2\frac{1}{2}$; interorbital space $1\frac{1}{2}$; pectoral about $1\frac{1}{2}$; snout from tip to tip of mandible $2\frac{1}{2}$; eye 4 in interorbital space.

Body rather elongate, back high, elevated, tail compressed and tapering. Head very broad, depressed, flattened, neck and back rapidly becoming elevated behind; snout in profile elongate, more or

ess roundly pointed, when viewed from above very broad, rounded, not forming distinct point, flattened like rest of top of cranium; eyes small, lateral, nearer tip of snout than first gill-opening; breadth of mouth much greater than length of either of rami of mandible, which form a rounded angle at symphysis; teeth finely serrate, upper rather broad, compressed, lower more elongate; nostrils large, on lower surface of snout, nearer tip of mandible than tip of snout; interorbital space very broad, flat, slightly convex in middle. Gill-openings rather small, last above base of pectoral.

Body finely roughened.

First dorsal about midway between tip of snout and origin of second dorsal, elevated, its height a little greater than interorbital space; second dorsal small, low, much nearer origin of first dorsal than tip of caudal; anal small, its origin nearer that of pectoral than tip of caudal, a little before second dorsal; pectoral large, nearer tip of snout than origin of ventral; ventrals rather low, much nearer anal than pectoral; caudal three and three-fifths in body, lower lobe low. Caudal peduncle rather thick, rounded, flattened above and below, and with deep pit at its base above.

Color in alcohol deep gray-brown above, lower surface of body whitish; terminal portions of fins more or less white.

Length $17\frac{1}{2}$ inches (43 cm. 5 mm.).

This description from a small specimen from Kawatana.

Coasts of Japan. A large shark, generally common. Specimens were seen at Hakodate, Tokyo, Wakanoura, Kawatana, and Nagasaki. A head in Yahiro's collection is from a specimen 25 feet long, and said to have weighed 2,000 pounds. It presents the following characters:

Snout rather short, acute, bluntish at tip; nostrils midway between tip of snout and mouth; the eye much nearer angle of mouth; width of mouth almost twice length of snout; teeth not large, uppermost faintly serrate, subtriangular, without distinct notch on lower margin, and lower teeth erect, almost entire, long, narrow.

In young of 3 feet the snout is obtuse, and a little longer than mouth is broad; eye about midway between angle of mouth and snout; teeth weakly serrate, small, upper broad, not notched, nearly erect, and lower narrow; second dorsal small, smaller than anal; pectoral to near end of dorsal, long, narrow; first dorsal not dusky; second dorsal, pectoral, and lower lobe of caudal tipped with black.

This species has been identified with *Carcharias gangeticus*, *Carcharias melanopterus*, and *Carcharias bleckeri*, but it seems to be distinct from all other East Indian and Polynesian species, and there seems to be no evidence that any of these occur in Japan. *Carcharias melanopterus* of Polynesia has the fin lobes much blacker than in *C. japonicus*.

One small specimen from Nagasaki differs only in having a slightly more pointed snout.

14. SCOLIODON Müller and Henle.

Scoliodon MÜLLER and HENLE, Wiegmann's Archiv. f. Naturg., 1837, I, p. 397
(*laticaudus*.)

Teeth entire, or very nearly so, oblique and flat, the points directed toward the sides of the mouth, so that the inner margins are more or less nearly horizontal, the teeth in front more nearly erect; teeth not swollen at the base, each of them with a deep notch on the outer margin below the sharp point; lips with conspicuous grooves. Otherwise as in *Carcharias*, from which the genus is scarcely distinct. Size small.

(σκολιόδον, oblique: ὀδούδον, tooth.)

- a. Length of the anal nearly equal to its distance from ventrals; outer angle of pectorals almost a right angle; pectorals black; upper jaw without labial fold. *laticaudus*, 14. f.
- aa. Length of anal much less than its distance from ventrals; outer angle of pectorals acute.
- b. Upper jaw without labial groove; length of snout about equal to distance of eye from gill opening *acutus*, 15.
- bb. Upper jaw with a short labial groove; cleft of mouth much broader than long *walbechmi*, 16.

14. SCOLIODON LATICAUDUS (Müller and Henle).

Carcharias (Scoliodon) laticaudus MÜLLER and HENLE, Plagiostomen, 1838, p. 28, pl. VIII; East Indies.—DUMÉNIL, Elasmobranches, II, 1870, p. 343 (same types).

Carcharias laticaudus GÜNTHER, Cat. Fish., VIII, 1870, p. 358; Bengal, East Indies, China, Amoy, Japan.

Carcharias (Scoliodon) macrorhynchus BLEEKER, Verh. Bat. Gen., XXIV, 1851, Plagiost., p. 31, pl. 1, fig. 1; Batavia.—DUMÉNIL, Elasmobranches, II, 1870, p. 343 (after Bleeker).

Snout from front margin of mouth equal to, or a little more than, distance of eye from gill-opening; a very short labial groove at angle of mouth, not extending on upper jaw, and for a very short distance only on lower. Pectoral fin with posterior margin nearly straight, upper angle nearly a right one, not extending to first dorsal; base of anal equal to, or but little less than, its distance from ventral, and its pointed lobe terminates at a distance from root of caudal; terminal lobe of caudal obliquely truncated. Pectoral fins black. Length, 18 inches. (Günther.)

East Indies: noted by Dr. Günther from Jamrach's Collection in Japan, a record which needs verification.

(*latus*, broad; *cauda*, tail.)

15. SCOLIODON ACUTUS (Rüppell).

Carcharias acutus RÜPPELL, Neue Wirbelthiere, Fische, 1837, p. 65, pl. XVIII, fig. 4; Red Sea.—GÜNTHER Cat. Fish., VIII, 1870, p. 358; Cape Seas, Pinang, Vizagapatam, Japan.

Carcharias (Scoliodon) acutus MÜLLER and HENLE, *Plagiostomen*, 1838, p. 29.—CANTOR, *Malayan Fishes*, 1850, p. 399.—DUMÉRIL, *Elastiobranches*, II, 1870, p. 345; East Indies, China.

Snout from front margin of mouth equal to, or a little less than, distance of eye from gill-opening; very short labial groove at angle of mouth, not extending on upper jaw, and for a very short distance only on lower. Pectoral with posterior margin slightly concave, upper angle pointed, extending to, or somewhat beyond, origin of dorsal; length of base of anal one-half, or less, its distance from ventral; its pointed terminal lobe terminates not far from root of caudal; terminal caudal lobe tapering. Posterior margin of pectoral whitish, upper margin of caudal blackish. Length 17 inches. (Günther.)

East Indies: Noted by Dr. Günther as collected by Mr. Jamrach in Japan. This record needs verification.

16. SCOLIODON WALBEEHMI (Bleeker).

Carcharias (Scoliodon) walbeehmi BLEEKER, *Nat. tyds. Ned. Ind.*, X, 1856, p. 353; Bintang.—DUMÉRIL, *Elastiobranches*, II, 1870, p. 344 (after Bleeker).

Carcharias walbeehmi GÜNTHER, *Cat. Fish.*, VIII, 1870, p. 359; Bintang, Japan.—NYSTROM, *Kong. Svensk. Vet. Ak.*, 1887, p. 50; Nagasaki.

Scoliodon walbeehmi JORDAN and EVERMANN, *Proc. U. S. Nat. Mus.*, XXV, 1902, p. 318; Formosa.

Snout from front margin of mouth, more than distance of eye from gill-opening; a short labial groove at angle of mouth extending for a short distance on upper jaw as well as lower; distance between outer angles of nostrils equal to that of nostril from extremity of snout. Pectoral fin with posterior margin slightly concave and upper angle pointed, extending somewhat beyond origin of dorsal fin; the length of base of anal fin is about two-fifths of its distance from ventral, and its pointed terminal lobe terminates at some distance from root of caudal; terminal caudal lobe tapering. Coloration uniform. (Günther.)

Coasts of southern Japan, not common. This or some related species was seen at Nagasaki, and at Kawatana on the bay of Omura, but no specimens were secured. We have examined a specimen from Formosa.

(A personal name.)

Family VII. SPHYRNIDÆ.

HAMMER-HEADED SHARKS.

General characteristics of the *Carcharidæ*, but the head singularly formed, kidney-shaped or "hammer"-shaped, from the extension of its sides, the nostrils being anterior and the eyes on the sides of the "hammer;" mouth crescent-shaped, under the "hammer;" teeth of both jaws similar, oblique, each with a notch on the outside near the

base; no spiracles; last gill-opening over the pectoral; first dorsal and pectorals large, the dorsals nearer pectorals than ventrals; second dorsal and anal small; a pit at the root of the caudal; caudal fin with a single notch toward its tip, its lower lobe developed. One genus with 5 species, inhabiting most warm seas. Large sharks, known at once by the singular form of the head, which is not quite the same in any two species.

15. SPHYRNA Rafinesque.

Sphyrna RAFINESQUE, Indice d'Ittiol, Siciliana, 1810, p. 60 (*zygæna*).

Cestrorhinus BLAINVILLE, Journ. Phys., 1816, p. 264 (*zygæna*).

Zygæna CUVIER, Règne Animal, 1st ed., 1817, p. 127 (*zygæna*; name preoccupied in Insects).

Platysqualus SWAINSON, Classif. Anim., II, 1839, p. 318 ("*tiburo*" = *tudes*).

Cestracion KLEIN (pre-Linnaean) in Gill, Ann. Lyc. Nat. Hist. N. Y., VIII, 1861, p. 412 (*zygæna*).

Eusphyrna GILL, Ann. Lyc. Nat. Hist. N. Y., VIII, 1861, p. 412 (*blochii*).

Renieps GILL, Ann. Lyc. Nat. Hist. N. Y., VIII, 1861, p. 412 (*tiburo*).

Characters of the genus included above. In the form of the head, there is a perfect gradation among the species, from the narrow hammer of *S. blochii*, with the lobes three times as long as broad and deeply grooved along the anterior edge, to the kidney-shaped head of *S. tiburo*, in which the anterior grooves are obsolete.

(σθύρα, hammer.)

SPHYRNA:

- a. Nostril with a well-developed groove, which extends along the front of the hammer-shaped head, the anterior and posterior outlines of which are nearly parallel *zygæna*, 17.

17. SPHYRNA ZYGÆNA (Linnæus).

SHINOKUZAME (HAMMER SHARK): KASEBUKA (CROSS-STAFF SHARK).

Squalus zygæna LINNÆUS, Syst. Nat., 10th ed., 1758, p. 234; Europe, America.

Cestracion zygæna DUMÉRII, Elasmobranches, II, 1870, p. 382.

Sphyrna zygæna JORDAN and GILBERT, Synopsis, 1883, p. 25.—JORDAN and EVERMANN, Fish. North and Mid. Am., I, 1896, p. 45; Cape Cod, Point Conception.

Squalus malleus RISSO, Ichth. Nice, 1810, p. 34; Nice.

Zygæna malleus SCHLEGEL, Fauna Japonica, 1847, p. 306, pl. cxxxviii; Nagasaki.—STORER, Fish. Mass., 1867, p. 238.—GÜNTHER, Cat., VIII, 1870, p. 381.—NYSTROM, Kong. Svensk. Vet. Ak., 1887, p. 49; Nagasaki.

? *Zygæna lewini* LORD, in Griffith, Animal Kingdom, X, 1834, p. 640; Leewards, Australia.

Zygæna subarcuata STORER, Proc. Bost. Soc. Nat. Hist., 1848, p. 70; Cape Cod.

Head truly hammer-shaped; width of head about twice its length; length of hinder margin of hammer nearly equal to width near eye; nostril close to eye; prolonged into a groove which runs along nearly the whole front margin of head; first dorsal large; second quite small; smaller than anal; pectoral rather large. Color gray.

A large voracious shark, reaching a length of 15 feet or more, found

in all warm seas; occasionally northward to California, Massachusetts, and France, rather common in Japan, as far northward as Tokyo. Our specimens from Nagasaki, Misaki, and Wakanoura. The species needs comparison with the Hammer-head shark of Atlantic.

(ζύγαινα, *Zygæna*, the ancient name, from ζυγόν, yoke.)

Family VIII. ALOPIIDÆ.

THRESHER SHARKS.

Body moderately elongate, the snout rather short; mouth crescent-shaped; teeth equal in both jaws, moderate sized, flat, triangular, not serrated; the third tooth of the upper jaw on each side much smaller than the others; gill-openings moderate, the last one above the root of the pectorals; no nictitating membrane; spiracles just behind eye, minute or absent; first dorsal large, midway between pectorals and ventrals; second dorsal and anal very small; caudal fin exceedingly long, about as long as the rest of the body, a pit at its root, a notch on the upper lobe near its tip; lower lobe moderately developed; no caudal keel; ventrals rather large; pectorals very large, falcate. A single species, reaching a large size, inhabiting most seas, known at once by the great length of the tail.

16. ALOPIAS Rafinesque.

Alopius RAFINESQUE, Caratteri di Alcuni Generi, 1810, p. 12 (*macrourus*=*vulpes*).

Alopecius MÜLLER and HENLE, Plagiostomen, 1838, p. 74 (amended orthography).

The characters of the genus are included above.

(ἀλώπός, a fox; Latin, *vulpes*. *A. vulpes* was known to the ancients as ἀλωπεκίας, fox-like.)

18. ALOPIAS VULPES (Gmelin).

ONAGAZAME (LONG-TAILED SHARK); NADEBUKA (SMOOTH SHARK); NEZUMEZAME (RAT-TAILED SHARK).

Squalus vulpes Gmelin, Syst. Nat., I, 1788, p. 1496; Mediterranean (after Pennant).

Carcharias vulpes DE KAY, New York Fauna, IV, Fishes, 1842, p. 348, pl. LXI, fig. 199.

Alopius vulpes DUMÉRIL, Elasmobr. I, 1865, p. 421.—DAY, Fishes of India, Supplement, 1888, p. 810.—JORDAN and GILBERT, Synopsis, 1883, p. 27.—JORDAN and EVERMANN, Fish. North and Middle America, I, 1896, p. 45.

Alopecius vulpes GÜNTHER, Cat. Fish., VIII, 1870, p. 393.

Squalus vulpinus BONNATERRE, Tableau Encycl. Ichthy., 1788, p. 9; Mediterranean (after Pennant).

Alopius macrourus RAFINESQUE, Caratteri di Alcuni Generi, 1810, p. 12; Sicily, *Squalus alopecius* GRONOW, Cat. Fishes, 1854, p. 7.

Body fusiform, cylindrical, thickest before dorsal fin; back regularly arched from above pectorals to end of snout, and gradually decreasing in size posteriorly to caudal. Head short, bluntly conical;

snout blunt; eye rather large; mouth horse-shoe shaped, teeth about $\frac{22+22}{19+19}$, third or fourth tooth on either side of center of upper jaw smaller than others. Spiracles very small or wanting. Last gill-openings above or slightly in front of pectorals.

Body more or less roughened.

First dorsal high, triangular, somewhat higher than its base is long, slightly slender toward its summit, superior angle rounded; second dorsal similar in shape, but much smaller; anal small, placed behind second dorsal, which it resembles; pectorals long, wide, emarginate, with small process behind; ventrals wider than high, nearest first dorsal; caudal nearly as long or longer than body, composed of three distinct lobes, one small, triangular, at under side of tip, a second long and low, extending along upper side of tail, and a third short and broad, at lower base of tail.

Color, slate-blue above, beneath soiled white, marked with obsolete bluish spots; pupils a longitudinal slit, edged with golden.

Length, 12 feet.

A large shark, abounding in all warm seas, common on the east coast of Japan. It was seen at Misaki, Nagasaki, Tokyo, and Yokohama. No one has yet compared specimens of the Japanese fish with those from California or the Mediterranean, and the species may prove different.

(*rulpes*, fox.)

Family IX. MITSUKURINIDÆ.

Skeleton flexible; snout produced in a flat, flexible blade varying in length; spiracles large; teeth acicular, only the lateral ones with small basal cusps; last gill-opening above base of pectorals; fins all low, the ventral with very long base; the claspers very small; lower lobe of caudal long; no pit at root of caudal; first dorsal well advanced; second shorter and higher than anal.

Two genera are known: *Mitsukurina*, and the extinct genus *Scapanorhynchus* of the Eocene. Dr. Arthur Smith Woodward regards *Mitsukurina* as identical with *Scapanorhynchus*. In the latter genus, however, the rostral blade is much longer than in *Mitsukurina*, and minor differences are apparent.

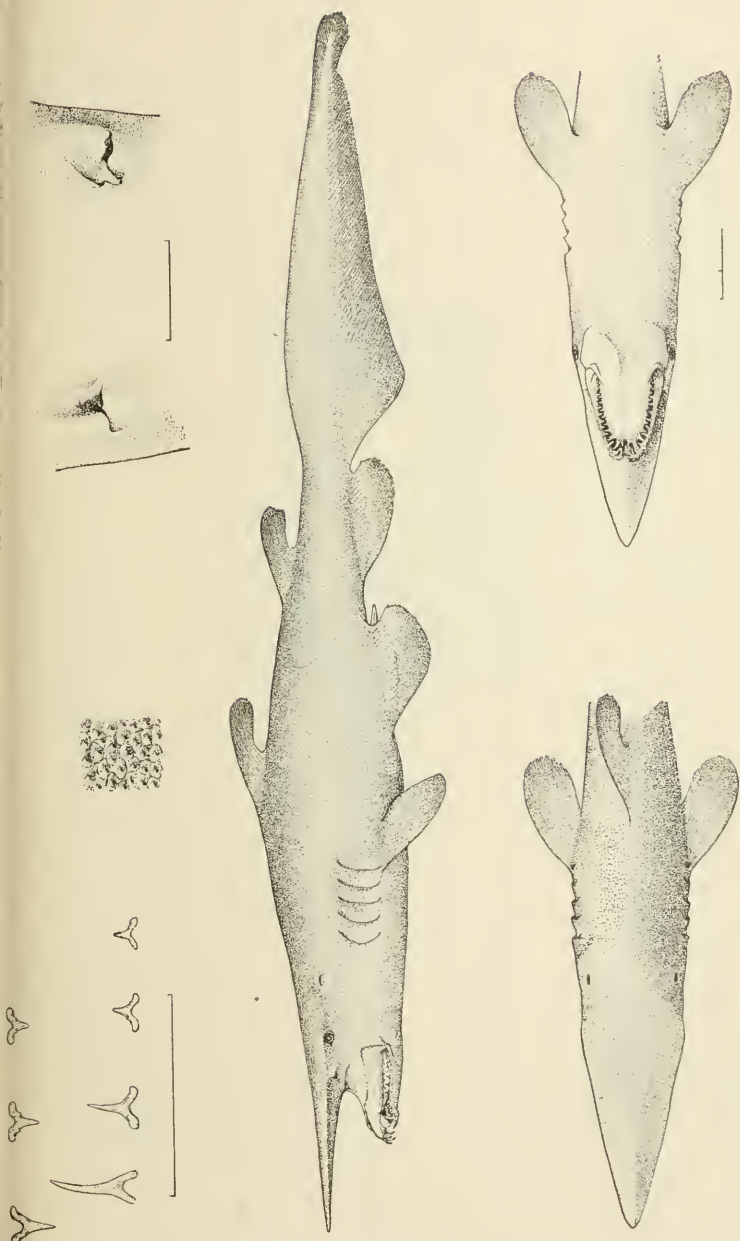
The family is closely allied to the *Odontaspididæ*, differing in the produced snout.

17. MITSUKURINA Jordan.

Mitsukurina JORDAN, Proc. Cal. Acad. Sci., 1898, p. 200 (*owstoni*).

Characters of the genus included above.

(Named for Kakichi Mitsukuri, professor of zoology in the Imperial University of Tokyo.)



MITSUKURINA OWSTONI JORDAN.
FOR EXPLANATION OF PLATE SEE PAGE 621.

19. MITSUKURINA OWSTONI Jordan.

Mitsukurina owstoni JORDAN, Proc. Cal. Ac. Sci., 1898, p. 200; Misaki.

Length of specimen, apparently young male, 42 inches. Head (to first gill-opening) $4\frac{2}{3}$ in length; depth about 10; snout from eye $1\frac{2}{5}$ in head; from front of mouth $2\frac{1}{7}$; length of blade of snout from its insertion below $1\frac{1}{5}$; length of gill area $2\frac{2}{3}$; depth of last gill 6; eye 12 in snout from eye; interorbital area $2\frac{2}{3}$; spiracle a little smaller than eye; length of one mandible $2\frac{2}{5}$ in head; length of maxillary $2\frac{2}{5}$; pectoral base $1\frac{3}{4}$ in length of pectoral fin, which is $2\frac{2}{3}$ in head; first dorsal base $1\frac{3}{4}$ in its height, which is $2\frac{3}{4}$ in head; second dorsal base $1\frac{3}{4}$ in its height, which is 3 in head; ventral base 2 times its height, length of base 3 in head; claspers very short (perhaps immature), nearly 12 in head; anal base $2\frac{1}{3}$ times its height and $2\frac{1}{3}$ in head; caudal, measured from above, $2\frac{1}{5}$ in length of body; greatest height of lower lobe nearly 3 in head.

Body elongate, compressed behind, flesh and skeleton extremely limp, folding like a wet rag. Head moderate; snout produced in a long, flat, flexible, leaf-like blade, somewhat like that of *Polyodon spathula* but narrower, more limp and more pointed; median line of snout with a thick, rounded median keel; lower side of the blade free for a considerable distance backward from upper jaw, almost to eyes; eye small, without nictitating membrane; mouth inferior, with elongate cleft; dentary bones broad, loosely connected, movable, capable of being spread wide apart, but normally lying close together and nearly parallel; a notch at symphysis, tip of lower jaw strongly curving upward and inward; similar notch at tip of upper jaw between rather loosely joined maxillary; middle of each jaw without teeth in front; teeth few-rowed, about $1\frac{3}{5}$ on each side, all needle-shaped, very slender, pointed, more or less curved backward and inward; each tooth with a two-rooted base, large teeth in front simple, smaller ones on sides of jaws each with two small basal cusps; second and third tooth of lower jaw longest; the second about as long as eye; first and second tooth of upper jaw similar to these but somewhat shorter; lateral teeth of both jaws progressively smaller, but all slender and sharp; nostrils large, about as large as eye, their distance from eye twice the eye; each nostril with a small notch on lower edge and a free flap within. Spiracle large. Gill-openings about equal in height, the last above base of pectoral.

Skin everywhere rough, the scutes very small, granulated. No lateral line or conspicuous mucous pores.

Fins all thin, flexible, papery, the broad bones somewhat exerted from soft flesh; first dorsal short, moderately high, not emarginate, the insertion above axil of pectoral, second dorsal lower, remote from first, interspace $1\frac{1}{2}$ in head, the insertion nearly midway between

ventrals and anal; anal much longer than second dorsal, rather lower pectorals short, narrow, rounded flexible rays longest; ventrals with very long base; no caudal keel; no pit at root of caudal; lower lobe of caudal long and rather high, with a sharp notch near its tip.

Color light reddish gray, brownish above; fins darker brown; nucha region a little darker; belly paler. (Jordan.)

The type specimen, now in the Imperial University of Tokyo, was captured in deep water off Misaki and presented by Capt. Alaric Owston, of Tokohama, for whom it is named. Captain Owston had had engravings of this species made, and scattered them far and wide among the Japanese fishermen, but until 1902 he found no second specimen and no one who knew the fish. In a recent letter (November, 1902) he announces the acquisition of another specimen.

Family X. LAMNIDÆ.

MACKEREL SHARKS.

Sharks of large size, with the body stout, the mouth wide, with large teeth, and the tail slender, the caudal fin lunate, the two lobes not very unequal, the upper lobe strongly bent upward; caudal peduncle with a strong keel on each side; gill-openings wide, all in front of the pectorals, entirely lateral, not extending under the throat; first dorsal large; pectorals large; ventrals moderate; second dorsal and anal very small; a pit at the root of the caudal; spiracles minute or absent. Numerous fossil species are known. In this family the dentition, as well as the muscular system, reaches its highest degree of specialization known among sharks.

a. LAMNINÆ. Teeth slender and sharp, with entire edges.

b. Teeth without basal cusps, long, flexuous, acute; first dorsal inserted nearly midway between pectorals and ventrals *Isuropsis*, 1'

bb. Teeth each with one or two basal cusps; first dorsal not far behind pectorals. *Lamna*, 1'

aa. CARCHARODONTINÆ: Teeth with serrated edges, compressed, triangular in form without basal cusp *Carcharodon*, 2'

18. ISUROPSIS Gill.

Isuropsis GILL, Ann. Lyc. Nat. Hist. N. Y., VIII, 1861, p. 153 (*glaucus*).

Snout rather long and pointed; the body formed much like that of a tunny or mackerel; first dorsal large, inserted, entirely behind pectorals, nearly midway between pectorals and ventrals; pectorals large; second dorsal and anal very small; caudal peduncle slender; teeth long, lanceolate, with sharp, entire cutting edges and no basal cusps. (ἴσος, equal; οὐρά, tail; the two lobes of the tail being nearly equal in appearance. From *Isurus* it is separated by the backward insertion of the dorsal.)

20. ISUROPSIS GLAUCA (Müller and Henle).

AOZAME (BLUE SHARK); MOROZAME.

Oxyrhina glauca MÜLLER and HENLE, Plagiostomen, 1838, p. 69, pl. XXIX; Nagasaki (erroneously stated to be from Java).—SCHLEGEL, Fauna Japonica, Poiss., 1850, p. 303; Nagasaki.—DUMÉRIL, Elasmobranches, 1870, p. 409 (after Müller and Henle).

Lamna glauca GÜNTHER, Cat. Fish., VIII, 1870, p. 391; Cape Seas, St. Helena.

Snout long, pointed; teeth in four rows, very long, flexuous, without denticles at base. Spiracles very small. First dorsal inserted well backward, midway between pectoral and ventral, scarcely longer than high, its upper angle rounded. Color dark blue, white below. Coasts of Japan and southward, rather common about Nagasaki. Many jaws and a stuffed fœtus are in possession of Mr. Yahiro. A specimen 7 feet long was taken by Jordan and Snyder at Matsu-shima, the head having been preserved.

(*glaucus*, hoary blue.)

19. LAMNA Cuvier.

Lamna CUVIER, Règne Animal, 1st ed., 1817, p. 126 (*cornubicus*).

Lamia RISSO, Eur. Merid., III, 1826, p. 123 (*cornubicus*, name preoccupied).

Selanonius FLEMING, British Animals, 1828, p. 169 (*walkeri*=*cornubicus*).

Body short and stout, the back considerably elevated; snout prominent, pointed; teeth triangular, pointed, entire, each one with a small cusp on each side at base; one or both of these sometimes obsolete on some of the teeth in the young; gill-openings wide; dorsal and pectoral fins somewhat falcate; second dorsal and anal fins very small, nearly opposite each other; first dorsal close behind the root of the pectorals. This genus is very close to *Isurus*, with which fossil forms seem to connect it. Perhaps the two should be united under the older name, *Isurus*.

(*λάμνα*, a kind of shark, from *λαμία*, a horrible anthropophagous monster, a bugbear used by the Greeks to frighten refractory children.)

21. LAMNA CORNUBICA (Gmelin).

SALMON SHARK; MACKEREL SHARK; PORBEAGLE.

Squalus cornubicus GMELIN, Syst. Nat., I, 1788, p. 1497; shores of Cornwall (after Beaumaris of Pennant).

Lamna cornubica GÜNTHER, Cat. Fish., VIII, 1870, p. 389.—JORDAN and GILBERT, Synopsis, 1883, p. 30.—JORDAN and EVERMANN, Fishes North and Middle Am., I, 1896, p. 19 (and of most authors).

Snout conical, pointed, rather longer than cleft of mouth; teeth $1\frac{2}{10}$ - $1\frac{4}{14}$ on each side; third tooth on each side in the upper jaw small; first dorsal beginning over axil of pectorals. Color bluish gray. A large and fierce pelagic shark reaching a length of 10 feet. (Jordan and Evermann.)

Common in Europe and rather frequent on the coast of southern Alaska, where it is very destructive to the salmon, thence southward to California. It has been ascribed to Japan by Dr. Günther, and may occur in Japanese waters, but no authentic record exists, and no specimens are in Japanese museums. It is unknown to naturalists at Nagasaki, but it may be looked for at the mouths of salmon rivers, as the Ishigari, in Hokkaido.

(*cornubicus*, from Cornwall, from which region the species was early described.)

20. CARCHARODON Smith.

MAN-EATER SHARKS.

Carcharodon ANDREW SMITH, Proc. Geol. Soc. London, V, 1837, p. 86 (*capensis*=*carcharias*).

General characters of *Isurus* and *Lamna*, but with a different dentition, the teeth being large, flat, erect, regularly triangular, their edges serrated; first dorsal moderate, nearly midway between pectorals and ventrals; second dorsal and anal very small; pectorals large, ventrals moderate; caudal peduncle rather stout; spiracles minute or absent. Sharks of very large size; the strongest and most voracious of all fishes; pelagic, found in most warm seas.

(*κάρχαρος*, jagged; *ὀδούς*, tooth.)

22. CARCHARODON CARCHARIAS (Linnæus).

MAN-EATER SHARK; GREAT WHITE SHARK.

Lamia RONDELET, Hist. Poiss., 1558, p. 305; Nice, Marseilles (good figure).

Squalus carcharias LINNÆUS, Syst. Nat., 10th ed., 1758, p. 235; Europe (after Artedi; not of most later authors).

Carcharodon carcharias JORDAN and GILBERT, Synopsis, 1883, p. 875.—JORDAN and EVERMANN, Fish. North and Middle Am., I, 1896, p. 50.

Carcharias verus AGASSIZ, Poiss. Foss., II, 1836, p. 91.

Carcharodon rondeleti MÜLLER and HENLE, Plagiostomen, 1838, p. 70; Mediterranean Sea and Atlantic Ocean (after Rondelet).

Carcharodon rondeleti GÜNTHER, Cat. Fish., VIII, 1870, p. 392.

Carcharias atwoodi STORER, Proc. Bost. Soc. Nat. Hist., II, 1848, p. 71; Provincetown, Massachusetts.

Carcharodon capensis SMITH, III, Zool. S. Africa, 1842, pl. iv; Cape of Good Hope.

Carcharodon smithi BONAPARTE, Selach. Tab. Anal., 1839, p. 9 (after Smith).

Body stout; depth about $5\frac{1}{2}$ in total length; mouth very large; both jaws with five rows of large, triangular, serrated teeth, those in lower jaw narrower, about $\frac{2}{3}$ in each row; first dorsal somewhat behind pectorals; caudal fin large and strong. Color leaden gray; tips and edges of pectorals black. One of largest of sharks, reaching a length of 30 feet. It is found in all temperate and tropical seas, and is occasionally taken both in the Atlantic and Pacific. One caught near Soquel, California, was about 30 feet long and had a young sea lion,

weighing about 100 pounds, in its stomach. (Jordan and Evermann.)

A large pair of jaws is preserved in the museum of the Imperial University, taken somewhere off the east coast of Hondo, near Misaki. This constitutes the only record of the species from Japan.

(*καρχαρίας*, an old name of *Carcharias lamia* and of other man-eating sharks.)

Family XI. CETORHINIDÆ.

BASKING SHARKS.

Sharks of immense size with the gill-openings extremely wide, extending from the back nearly to the median line of the throat, all of them in front of the pectorals; mouth moderate, the teeth very small, numerous, conical, without cusps or serratures; no nictitating membrane; spiracles very small, above the corners of the mouth; first dorsal large, midway between pectorals and ventrals; second dorsal and anal small; caudal fin lunate, the upper lobe considerably the larger; caudal peduncle keeled; pectorals and ventrals large. Brain very small. A single genus, with probably but one species: the largest of living fishes, pelagic, and inhabiting the northern seas.

21. CETORHINUS Blainville.

? *Tetroras* RAFINESQUE, Caratteri, 1810, p. 11 (*angiora*).

Cetorhinus BLAINVILLE, Journ. Phys., 1816, p. 264 (*gunneri*=*maximus*).

Selache CUVIER, Règne Animal, 1st ed., 1817, p. 129 (*maximus*).

Polyprosopus COUCH, Hist. Brit. Fish., I, 1861, p. 67 (*rashleighanus*=*maximus*).

Hamnera VAN BENEDEK, Bull. Ac. Roy. Belge, XXXI, 1871, p. 504 (*aurata*, fossil).

The characters of the genus are included above.

(*κίητος*, whale; *ρίνη*, a shark (*Squatina*), from *ρίνη*, a file or rasp, the rough skin of this shark being used for polishing wood and marble.)

23. CETORHINUS MAXIMUS (Gunner).

UBAZAME (OLD WOMAN SHARK); TEGUZAME (LONG-NOSED SHARK); BAKAZAME (FOOLISH SHARK); ZOZAME (ELEPHANT SHARK).

Squalus maximus GUNNER, Trondhjem, Selskabskr., III, 1765, p. 33; Coast of Norway.

Selachus maximus STORER, Fish. Mass., 1867, p. 229.

Selache maximus GÜNTHER, Cat. Fish., VIII, 1870, p. 394.

Cetorhinus maximus JORDAN and GILBERT, Synopsis, 1883, p. 31.—JORDAN and EVERMANN, Fish N. M. Amer., I, 1896, p. 51.

Squalus gunnerianus BLAINVILLE, Journ. de Phys., 1810, p. 256 (after Gunner).

Squatius peleginus BLAINVILLE, Journ. de Phys., 1810, p. 257; Europe.

Squalus homianus BLAINVILLE, Journ. de Phys., 1810, p. 257 (after Everard Home).

Cetorhinus shawi BLAINVILLE, Journ. de Phys., 1816, p. 264 (after Shaw).

Squalus isodus SAVERIO MACRI, Mem. della R. Ac. Sci. Napoli, I, 1819, p. 55, pl. I, fig. 1; pl. II, fig. 2; Naples.

Squalus elephas LE SUEUR, Journ. Ac. Nat. Sci. Phila., II, 1821, p. 343; New Jersey.

Squalus cetaceus GROXOW, Cat. Fish, 1854, p. 6; Norway.

Squalus rashleighanus COUCH, Trans. Linn. Soc., XIV, 1825, p. 91; Cornwall (a monstrosity).

Acanthias blainvillei CAPELLO, Plagiostom., I, 1866, p. 21.

Polyprosopus macei COUCH, Hist. Brit. Fishes, 1861, p. 67; England.

Head small; snout blunt; eyes small; teeth in 6 or 7 rows in each jaw, about 200 in each row. Gill-rakers slender, long and close set, resembling whalebone. Body rugose, the skin very rough with small spines. First dorsal large, triangular, over the space between pectorals and ventrals; second dorsal much smaller, rather larger than anal; pectorals long; tail large. Largest of the sharks, reaching a length of nearly 40 feet. (Jordan and Evermann.)

Found in Arctic seas and occasionally off the coast of Japan. It is figured by Dr. Matsubara in the colored plates of The Principal Aquatic Animals of Japan, under the name of "Ubazame." No specimens were seen by us in Japan.

(*maximus*, greatest.)

Family XII. RHINEODONTIDÆ.

WHALE SHARKS.

Very large sharks, formed much as in *Cetorhinus*, the caudal hunate, with well-developed lower lobe and a keel on each side of the tail. Origin of first dorsal in advance of ventrals; second dorsal small, opposite anal; no spines, no nictitating membrane, snout broad and flat; eyes very small; spiracles very small, mouth and nostril near extremity of snout. Teeth conical, or with a heel at base, very small and numerous. Gill-openings wide, the last one above the base of the pectorals. Species very few, mostly in the Pacific.

22. RHINEODON Smith.

Rhineodon ANDREW SMITH, Illustr. S. Afr. Fishes, 1837 (*typicus*).

Micristodus GILL, Proc. Ac. Nat. Sci. Phila., 1865, p. 177 (*punctatus*).

Rhineodon GÜNTHER, revised spelling (*typicus*).

Teeth conical, very small. Characters otherwise included above. (*ρίον*, snout; *ὀδόν*, tooth.)

24. RHINEODON TYPICUS Smith.

? *Rhineodon typicus* SMITH, Illustr. S. Afr. Fish, 1837; Cape of Good Hope.

? *Micristodus punctatus* GILL, Proc. Ac. Nat. Sci. Phila., 1865, p. 177; Gulf of California.

Rhineodon pentalineatus KISHINOUE, Zool. Anzeiger, Nov. 25, 1891, p. 694; Capo Imbo, Japan.

A gigantic shark from Japan has been described by Dr. Kishinouye under the name of *Rhinodon pentalincatus*. It is apparently a species of *Rhinodon*, but it is impossible to say whether it is different from *Rhinodon typicus* or *Rhinodon punctatus*, or whether these two nominal species differ from each other. *Rhinodon typicus* is widely diffused in the tropical seas and has been lately taken in Florida, a record having been published by Mr. Barton A. Bean. It is probably the only species of the genus. The following is Dr. Kishinouye's description:

Head flat, blunt; eyes very small, situated on sides of head near margin of colored area; nictitating membrane wanting; mouth nearly straight, terminal; a labial fold runs from nostril to corner of mouth on upper jaw, and shorter fold from corner of mouth on lower jaw; teeth very minute, numerous, nearly equal in size and shape, each acutely pointed, laterally compressed, and with an ellipsoidal root; band of teeth in upper jaw curved a little, each end of band with a detached group of teeth, band in lower jaw crescent-shaped, and in each band arranged in a great many transverse rows, about 300 in number, middle part of band with 16-30 teeth in one row; nostrils at anterior extremity of head, and opening at labial boundary of mouth. Gill-openings 5, very wide, the second pair widest, measuring 86 cm., last pair most narrow, opening above base of pectorals, where body is very broad and high. Spiracles nearly same size as eye and on the same level.

Skin fine grained, except five longitudinal smooth bands, one dorsal median, two pairs lateral; ventral lateral band seems to be continuous with keel on each side of tail.

First dorsal fin inserted a little behind middle of body; second dorsal fin very small; anal very small, just below second dorsal; pectorals large, strong; ventrals inserted below first dorsal; caudal large, lunate, its ventral lobe well developed; clasper simple, with dorsal groove.

Color grayish brown, with round white spots and transverse bands, ventral side colorless; round white spots small and crowded near anterior end of body, gradually larger and fewer backward; caudal, second dorsal, ventrals, and anal destitute of white markings.

Length at present 800 cm., in circumference behind pectorals, 365 cm. (stuffed specimen), but when fresh measuring nearly 1,000 cm.

Taken in a drift net June 10, 1901, off Cape Inubo: now in the collection of Tsurutame Oseko of Asakusa Park, Tokyo. (Kishinouye.)

The Japanese form is known only from the example described above. When taken it was covered with many sucking fishes (*Echeneis*), and one, besides an oak pole, was taken from its stomach. It is said to differ from *Rhinodon typicus* Smith and *Micristodus punctatus* Gill in the form of the teeth and the labial fold. But it is impossible to distinguish species in this genus until its members are better known.

(*typicus*, typical.)

Order III. TECTOSPONDYLI.

Calcareous lamellæ arranged in one or more concentric series or rings about a central axis in each vertebra. Spiracles present. Anal fin wanting. Dorsal fins 2, with or without spine. As here understood, the order *Tectospondyli* includes the sharks of the groups called *Cyclospodyli* and *Tectospondyli* by Hasse. The vertebrae in the order of Rays show similar structures, and it is probable that from sharks of this group the Rays are descended.

(τέκτων, builder; σπόνδυλος, vertebra.)

FAMILIES OF TECTOSPONDYLI.

- a.* CYCLOSPONDYLI: Vertebrae with calcareous lamellæ arranged in a ring about the central axis; pectoral fins normal, not expanded or deeply notched; anal fin absent; spiracles present, no nictitating membrane; gill-openings before pectorals; caudal bent upward, lower lobe little developed.
- b.* Dorsal fins each provided with a stout spine, first dorsal far in advance of ventrals.....SQUALIDÆ, XIII.
- bb.* Dorsal fins without spine, first dorsal over or in advance of ventrals.
- c.* Snout not produced in form of a saw; no barbels; first dorsal much before ventrals; skin moderately rough.....DALATIDÆ, XIV.
- cc.* Snout produced in a long, flat blade, with sharp, saw-like teeth on each side; a pair of barbels below snout; first dorsal before ventrals.
PRISTIOPHORIDÆ, XV.
- aa.* TECTOSPONDYLI: Vertebrae with calcareous lamellæ ranged in several concentric series or rings about a central axis; pectoral fins very large, expanded horizontally, and extended forward at base in front, giving body the form of the flattened disk of rays; anterior extension separated from neck by a deep notch, in which gill-openings lie; no anal fin; dorsal fins small, posterior; mouth broad, anterior.....SQUATINIDÆ, XVI.

Family XIII. SQUALIDÆ.

DOG-FISHES.

Body more or less elongate. Head depressed. Eyes lateral, without nictitating membrane. Mouth inferior, rather large, arched, a deep groove on each side. Teeth compressed, variously formed. Nostrils inferior, separate; spiracles rather large; gill-openings moderate, all in front of the pectoral fins. Dorsal fins 2, each armed with a spine; the first dorsal in front of the ventrals; anal fin wanting; caudal fin with the lower lobe small or obsolete, ventral fins inserted posteriorly, not much before second dorsal. Oviparous. Genera 6 or more; species about 15; rather small sharks, chiefly of the Atlantic. These sharks represent a comparatively primitive type, apparently not descended from any other existing *Squali*.

- a.* Body rather elongate; no fold of skin along side of belly; dorsal spines both directed backward.

- b. Upper teeth simple, without smaller enspis at base.
- c. Teeth alike in both jaws, subquadrate, each with a nearly horizontal oblique cutting edge and a point directed outward *Squalus*, 23.
- cc. Teeth unequal; upper teeth erect, with a single cusp; lower teeth more or less oblique, points directed outward; dorsal spines not hidden.
- d. Scales leaf-shaped, with a strong midrib, and sometimes a lateral rib on each side, attached by a peduncle; dorsal spines strong. *Lepidorhinus*, 24.
- dd. Scales not leaf-shaped and not pedunculate at base.
- c. Scales not imbricate, each of three or four radiating spinules; dorsal spines strong *Deania*, 25.
- ee. Scales imbricate, each with three or more strong ribs, each ending in a spine, the middle strongest; dorsal spines short *Zameus*, 26.
- bb. Upper teeth each with 1 or 2 small cusps at base on each side.
- f. Teeth unequal, upper erect and tricuspid, lower oblique. *Etmopterus*, 27.
- ff. Teeth equal, very small, and tricuspid in both jaws. *Centroscyllum*, 28.

23. SQUALUS Linnæus.

Squalus LINNÆUS, Syst. Nat., X, 1758, p. 233 (*acanthias*, first species named; includes all sharks).

Squalus RAFINESQUE, Caratteri di Alcuni Generi, 1810, p. 13 (*acanthias* and *ayato*; first restriction of the name *Squalus* to species with spiracles and without anal fin).

Acanthorhinus BLAINVILLE, Journal de Physique, 1816, p. 263 (*acanthias*).

Acanthias RISSO, Hist. Nat. Eur. Mérid., III, 1826, p. 131 (*acanthias*).

Entoxychirus GILL, Proc. Ac. Nat. Sci. Phila., 1862, p. 496 (*ayato*).

Body rather slender. Mouth little arched, with a long, straight, deep, oblique groove on each side; no labial fold. Teeth rather small, all simple, equal in the two jaws, their points so much turned aside that the inner margin forms the cutting edge. Spiracles rather wide, just behind the eye. Fins moderately developed, the first dorsal larger than the second, much in advance of the ventral fins, which are behind the middle of the body, although in advance of the second dorsal. Dorsal spines strong, not grooved. Tail scarcely bent upward. Small sharks, abounding in the temperate seas.

(*squalus*, shark, a word cognate to the Greek *γαλῆ*.)

25. *SQUALUS MITSUKURII* Jordan and Snyder, new species.

TSUNOZAME (HORN SHARK); TSUNOGE (HORNY FISH).

Squalus mitsukurii JORDAN and SNYDER, Check List, 1901, p. 129; Misaki, name only.

Head about $4\frac{3}{5}$ in body; width of head $1\frac{1}{5}$ in its length; snout $2\frac{2}{3}$, interorbital space 2; width of mouth $2\frac{1}{3}$; tip of snout to mouth 2; eye $2\frac{2}{3}$ in interorbital space.

Body moderately elongate, tail tapering moderately behind. Head broad, depressed, flattened above; snout pointed in profile, when viewed from above angular, tip rather broadly rounded, and upper surface flattened; eyes rather large, lateral, a little nearer tip of snout than

first gill-opening; mouth very broad, slightly curved, a deep labial fold at each corner; lips thin; teeth moderate, forming a cutting edge in each jaw; nostrils rather large, inferior, while nearer eye than tip of snout they are nearer the latter than mouth; interorbital space is broad, very elevated, flattened more or less like upper surface of head. The spiracles large, directly behind eye. Gill-openings in front of base of pectoral.

Body everywhere finely roughened.

Origin of first dorsal spine a trifle nearer tip of snout than that of second dorsal; first dorsal spine is three-fifths height of fin; spine of second dorsal three-fourths height of fin; pectorals large, smaller than head, reach beyond base of first dorsal, emarginate behind; ventrals nearer second dorsal than first; caudal broad, lower lobe rather long. Caudal peduncle rather long, with a pit at base above. Lateral line indistinct along side.

Color in alcohol gray above, white beneath; upper surface of pectorals and ventrals grayish.

Length $28\frac{1}{2}$ inches.

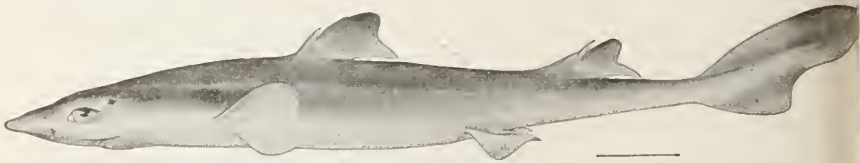


FIG. 3.—*SQUALUS MITSUKURII*.

Type No. 7184, Ichthyological Collections, Leland Stanford Junior University Museum. Locality, Misaki.

Coasts of Japan, generally common from Hokkaido as far southward as Formosa. Numerous large adults taken at Misaki, one of them the type, a female. Several embryos were also obtained, part of them from this specimen. A young example was also obtained from near Aomori in Tsugaru Straits, and another one, probably of the same species, from Formosa. Specimens are in the Imperial Museum from Kagoshima, and Boshu in Awa near Misaki. These are recorded by Ishikawa^a as *Acanthias vulgaris* and *A. uyatus*, but the two specimens are alike.

(Named for Prof. Kakichi Mitsukuri, who was present with Messrs. Jordan and Snyder at Misaki, when the type was taken.)

24. *LEPIDORHINUS* Bonaparte.

Lepidorhinus BONAPARTE, Selach. Tab. Analyt., 1836, p. 9 (*squamosus*).

Scymnodon BOCAGE and CAPELLO, Proc. Zool. Soc. Lond., 1864, p. 263 (*ringens*).

Macheplilus JOHNSON, Proc. Zool. Soc. Lond., 1867, p. 713 (*dumerili*).

This genus is close to *Centrophorus*, differing in the form of the scales, which are leaf-shaped and pedunculate, with a strong mediar

^a Prel. Cat., p. 61.

keel which ends in a point. The single Japanese species belongs to the subgenus *Scymnodon*, characterized by the presence of three keels, the scale ending in three points.

(λεπίς, scale; ρύρη, shark.)

26. LEPIDORHINUS FOLIACEUS (Günther).

Centrophorus foliaceus GÜNTHER, Deep Sea Fishes, Challenger, 1887, p. 5, pl. II, fig. A (off Enoshima).

Head $4\frac{3}{8}$ in body; width of head $1\frac{1}{2}$ in its length; snout $3\frac{1}{5}$; interorbital space 2; width of mouth $2\frac{1}{2}$; snout to mouth $1\frac{3}{4}$; space between spiracles 3; eye about $1\frac{3}{4}$ in interorbital space.

Body rather elongate, tail tapering. Head elongate, depressed, broad; snout broad, flattened, tip broadly rounded; eyes large, lateral, nearer snout than gill-opening; mouth rather small, slightly curved, with deep labial fold at each corner; lips thin; teeth forming cutting edges in jaws, those in lower jaw with several small cusps; nostrils large, inferior, nearer eye than tip of snout, and nearer latter than mouth; interorbital space broad, flattened. Spiracles large, round, space between one and one-half in interorbital space. Gill-openings low, in front of pectorals.

The body covered with large leaf-shaped scales, 3 pointed, keeled in front and on a pedicle; they are large on trunk, both above and below, but especially enlarged in front of first dorsal.

Both dorsals provided with sharp spines, with only the tips exposed; origin of first dorsal nearer tip of snout than base of second, and a short distance behind base of pectoral; pectoral short, truncate, less than two in head; ventrals small, in front of second dorsal, nearer tip of caudal than tip of snout; caudal four and one-fourth in body. Caudal peduncle short, its depth three in interorbital space.

Color in alcohol uniform gray brown, edges of nostril and lower lips blackish.

Length $14\frac{1}{4}$ inches.

Described from a specimen from Misaki, taken in deep water by K. Aoki.

Deep waters off Japan, known only from off Enoshima and Misaki in Sagami Bay. Our specimen is from near Misaki.

(*foliaceus*, leaf-like.)

25. DEANIA Jordan and Snyder.

Deania JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXV, 1902, p. 80 (*eqlantia*).

Scales minute, villous, each star-like, and with three or four long points. The skin velvety to the touch. Snout long, flattish. Dorsal spines strong. In other regards similar to *Centrophorus*, but the squamation quite different.

(Named for Prof. Bashford Dean, of Columbia University, in recognition of his researches in sharks, those of the present genus among others.)

27. DEANIA EGLANTINA Jordan and Snyder.

Deania eglantina JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXV, 1902, p. 80; Totomi Bay.

Head $3\frac{3}{4}$ in length; depth about $9\frac{2}{3}$; snout about 2 in head; eye $4\frac{6}{7}$; $2\frac{6}{7}$ in snout; 2 in width of snout; $3\frac{5}{7}$ in space from tip of snout to mouth; space between spiracles $1\frac{2}{3}$ in width of snout.

Body rather elongate, slender; scales each with short, bush-like spines, with two small prickles on each side, whole body having a kind of hairy appearance.

Head large, greatly depressed; snout long, depressed, broad; eyes large, lateral, anterior margin nearer tip of snout than gill-opening; skin around eyes more or less loose, free; nostrils large, on lower side of snout laterally, about midway between tip of snout and eye; mouth opening below posterior part of eye, rather broad; lips moderately fleshy; teeth small, compressed, with a small basal cusp; spiracles rather large, nearer eye than first gill-opening, space between a little more than length of snout. Gill-openings in front of base of pectoral, largest about half eye.



FIG. 1.—*DEANIA EGLANTINA*. a, upper jaw; b, lower jaw; c, scale (much enlarged.)

Dorsal fins each with a spine, base of first a little behind tip of pectoral, rather short, sharply pointed, and projecting little above skin; second dorsal spine nearly as high as fin, upper half exposed pectorals about equal to snout; ventrals small, posterior, entirely in front of second dorsal spine; caudal elongate, lower lobe little produced.

Color in spirits, uniform grayish-brown.

This description from the original type, a young female from Totomi 12 inches in length, dredged by the U. S. Fish Commission steamer *Albatross*.

(*eglantinus*, the brier rose.)

26. ZAMEUS Jordan and Fowler, new genus.

Zameus JORDAN and FOWLER, new genus (*squamulosus*).

Dorsal fins each with a small, partly concealed spine; no anal fin mouth wide, little arched; a long, deep, straight, oblique groove on

each side of mouth; teeth of lower jaw oblique, with the points directed more or less outward of backward; upper teeth erect, triangular or unecolate, with a single cusp. No nictitating membrane; spiracles wide behind the eye; gill-openings narrow; scales not leaf-shaped, nor edimaculate, each with a strong median keel and two or more lateral keels, each of these ending in a spine. In *Centrophorus*, the nearest related genus, there is no midrib to the scales, which are nearly smooth. In *Centroscymnus* the scales are smooth with a depression at the base. Small sharks, living in deep water.
(*zame*, shark, in Japanese.)

26. ZAMEUS SQUAMULOSUS (Günther).

Centrophorus squamulosus GÜNTHER, Deep Sea Fish, Challenger, 1887, p. 5, pl. 11, fig. B; Enoshima.

Snout much produced, mouth nearly midway between first gill-opening and end of snout; labial fold extends a little way along margins of mouth; upper lip fringed; distance between nostrils two-fifths of length of preoral portion of snout. Scales tricuspid, with a median keel, and so minute as to give a velvety appearance to skin. First dorsal small, its base (without spine) shorter than that of second, nearly one-sixth of distance between two fins; spines very small, scarcely projecting beyond skin; pectoral short, with lower angle rounded, not produced; extremity of ventral fins below end of second dorsal. Uniform deep black. Length, 27 inches. Off Inosima, Japan, Station 32 (Challenger) in 345 fathoms. (Günther.)

Coasts of Japan, in rather deep water. Known only from Sagami Bay, about Enoshima (misspelled Inosima by Günther) and Misaki, where our specimen was taken.

(*squamulosus*, with small scales.)

27. ETMOPTERUS Rafinesque.

Etmopterus RAFINESQUE, Caratteri di Alcuni Generi, 1810, p. 14 (*aculeatus*).

Spinax CUVIER, Règne Animal, 1st ed., 1817, p. 129 (*acanthias* and *spinax*).

Spinax MÜLLER and HENLE, Plagiostomen, 1838, p. 86 (*spinax*).

Acanthidium LOWE, Proc. Zool. Soc. London, 1839, p. 91 (*pussillum*).

Mouth little arched. Teeth of lower jaw with the point so much turned aside that the inner margin of the tooth forms the cutting edge; upper teeth erect, each with a long, pointed cusp and 1 or 2 smaller ones on each side; spiracles wide.

Small sharks of the warm seas, living in deep water, and nearly black in color.

(*ἔτμαγεν*, an aorist from *τέμνω*, to cut; *πτερόν*, fin, the original type having frayed fins.)

29. ETMOPTERUS LUCIFER Jordan and Snyder.

BOZUZAME (PRIEST SHARK).

Etmopterus lucifer JORDAN and SNYDER, Proc. U. S. Nat. Mus., XXV, 1902, p. 79 (Misaki).

Head $4\frac{3}{4}$ in length; depth about 7; snout about $2\frac{3}{4}$ in head; eye 5 in head; 2 in snout; $2\frac{4}{11}$ in width of snout; $2\frac{9}{11}$ in space from tip of snout to mouth; space between spiracles $2\frac{1}{2}$ in width of snout.

Body moderately elongate, rather robust, with slender caudal peduncle; scales forming longitudinal striae above, abruptly and sharply separated on sides from lower surface, which is evenly rough with fine shagreen.

Head large, thick, rather short; snout short, thick, more convex below than above, also with many pores; eyes moderate, lateral, anterior margin midway between tip of snout and spiracle; skin about eyes, more or less loose, free, upper eyelid overlapping and forming a pit in front; nostrils very large, lateral; mouth opening below posterior portion of eye, broad; lips rather thin; teeth small, compressed each of those in upper jaw with two sharp, basal cusps; spiracle

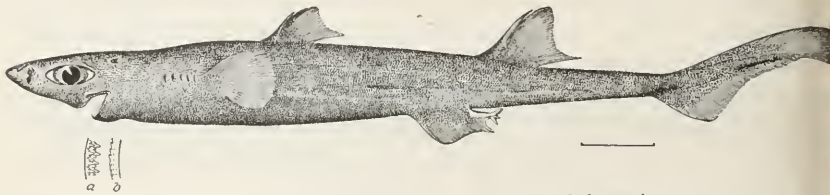


FIG. 5.—ETMOPTERUS LUCIFER. a, upper jaw; b, lower jaw.

large, nearer eye than first gill-opening, space between $1\frac{1}{4}$ in snout. Gill-openings in front of base of pectorals, rather short.

Dorsal fins each with a spine, base of first a little before tip of pectoral, short, sharp, pointed, projecting little above skin; second dorsal spine not as high as fin, much larger, longer than first, the greater portion exposed, and nearly a third greater than snout; ventrals moderate, entirely in front of second dorsal; caudal elongate, lower lobe little produced.

Color in spirits, dark grayish-brown, lower margin of caudal together with marginal portions of all other fins, very pale brown.

Length, 12 inches.

Type No. 6863, Ichthyological Collections, Leland Stanford Junior University. Locality, Misaki. From the collection of Capt. Alva Owston.

Some 30 others of the same species were obtained off Misaki on long lines handled by Mr. Kumakichi Aoki, assistant to Professor Mitsukur.

The pale areas on the side of the belly cover a glandular substance said to be luminous in life.

(*lux*, light; *fero*, to bear; the thickened skin of the belly said to be translucent.)

28. CENTROCYLLIUM Müller and Henle.

Centrocyllium MÜLLER and HENLE, Systematische Beschreibung der Plagiostomen, 1838, p. 191 (*fabricii*).

Teeth equal in both jaws, very small, straight, pointed, each with 1 or 2 smaller cusps on each side at base; mouth crescent-shaped, with a straight, oblique groove at its angle; spiracles moderate; gill-openings rather narrow; dorsal fins small, each with a strong spine; the second dorsal entirely behind the ventrals.

(*κέντρον*, spine; *σκυλλίον*, *Scyllium*, an allied genus, from *σκόλλω*, to rend or tear to pieces.)

30. CENTROCYLLIUM RITTERI Jordan and Fowler, new species.

Head $5\frac{1}{2}$ in length; snout about $3\frac{3}{4}$ in head; interorbital space 2; width of mouth 2; eye about 5; space between spiracles $2\frac{1}{3}$; pectoral about 2.

Body elongate; head very broad and depressed, flattened above; snout short, very broad, flattened above, rounded; eye large, near snout; nostrils large, inferior, midway between tip of snout and eye;



FIG. 6.—CENTROCYLLIUM RITTERI.

mouth distant from tip of snout a space equal to a trifle more than interorbital width; teeth very sharp, tricuspid, alike both jaws; lips rather thin, a labial fold at corners of mouth; interorbital space broad, greater than space between spiracles. Spiracles large, superior, behind eyes.

Body covered with small, single prickles, scattered, though not present on lower surface of snout, small on lower abdominal surface. Head with many pores, especially on lower surface of snout.

First dorsal spine smaller than second, slightly more than half height of fin; second dorsal spine long, curved, but not quite to tip of fin; origin of first dorsal nearer that of second than the tip of snout, inserted well behind pectoral; second dorsal nearer first dorsal than tip of caudal, tip of fin anteriorly not extending for more than half the space between its base and origin of upper caudal lobe; pectoral fins broad, short, about equal to width of snout in front of eyes; ventrals small and entirely in front of second dorsal; caudal moderate, less than space between two dorsal spines. Caudal peduncle long, rather slender, thick, flattened above and below. Lateral line with pores, rather far apart, running superiorly in front and along sides.

Color, uniform dark gray-brown, blackish below, in front, fins all more or less broadly edged with whitish. Length $16\frac{1}{2}$ inches.

Type No. 7185, Ichthyological Collections, Leland Stanford Junior University Museum. Locality, Misaki.

This species is known to us from 2 examples obtained at Misaki. It differs from *Centroscyllum fabricii*, the only other species of the genus, in having the caudal peduncle much longer and more slender; and in the shorter pectorals, which do not reach to below the first dorsal.

(It is named for Dr. William Emerson Ritter, of the University of California, in recognition of his excellent work on the Tunicates and Enteropneustans of the Pacific Ocean.)

Family XIV. DALATIIDÆ.

SCYMNOID SHARKS.

Sharks with no anal fin and with two dorsal fins, each without spine; gill-openings small, entirely in advance of pectorals; mouth but little arched; a long, deep, straight, oblique groove on each side; spiracles present. Oviparous, the eggs without horny case (at least in *Somniosus*). Vertebrae cyclospindylous. The absence of dorsal spine chiefly distinguishes this family from the *Squalidæ*, of which these are somewhat degenerate allies. Sharks mostly of the North Atlantic, some of them reaching a large size.

a. DALATIINÆ: First dorsal well behind ventrals; upper teeth small, pointed, lower much larger, triangular *Dalatias*, 29.

aa. SOMNIOSINÆ: First dorsal much in advance of ventrals.

b. Upper teeth narrow; lower quadrate with a horizontal edge ending in a point directed outward; body very robust, fins very small, dorsals about equal; skin moderately rough..... *Somniosus*, 30.

29. DALATIAS Rafinesque.

Dalatias RAFINESQUE, Caratteri di Alcuni Generi, 1810, p. 13 (*sparophagus*; description very incorrect).

Scymnus CUVIER, Règne Animal, 1st ed., 1817, p. 130 (*lichia*; preoccupied in insects).

Sepanorhinus BONAPARTE, Cat. Pesci. Europ., 1836, p. 16 (*lichia*).

Mouth transverse, a deep straight groove at each angle. Teeth in jaws close set, the upper small, pointed; the lower much larger, dilated, erect, triangular, not very numerous. Skin uniformly covered with minute scales. Two short dorsal fins, without spine, the first at a considerable distance from the ventrals; no anal fin. No membrana nictitans. Spiracles wide. Gill-openings narrow. (Günther.)

(δαλός, torch, the name unexplained.)

31. DALATIAS LICHA (Bonnaterre).

YOROIZAME (ARMOR SHARK).

Squalus licha^a BONNATERRE, Encycl. Ichth., 1788, p. 12 (after La Liche ou Gatto, Proussonet, Mem. Ac. Sci., 1788, p. 677; "Le Cap Bréton," in southern France).

Seymourhinus licha GARMAN, Deep Sea Fishes, 1899, p. 31.

Squalus americanus GMELIN, Syst. Nat., 1788, p. 1503 (after Broussonet, "Cap Bréton" being assumed to be in Nova Scotia).

Acanthorhinus americanus BLAINVILLE, Fauna Française, 1828, p. 63, pl. xv, fig. 2.

Squalus nicvensis RISSO, Ichth. Nice, 1810, p. 43, pl. iv, fig. 6; Nice.

Dalatius sparophagus RAFINESQUE, Caratteri di Alcuni Generi, 1810, p. 13; Palermo (description very incorrect, but certainly referring to this species).

Seymour licha CUVIER, Règne Animal, 1st ed., 1817.—DUMÉRIL Elasmobranches, 1870, p. 452; Mediterranean.—GÜNTHER, Cat. Fish, VIII, 1870, p. 426; Nice; Madeira (and of writers generally).

Dalatius licha GRAY, Chondropt., 1851, p. 75.

Snout rather projecting, anterior edge of mouth before front of eye; teeth of upper jaw narrow, lanceolate, close-set; lower teeth triangular, margins somewhat convex and slightly serrate. Skin covered with a shagreen of fine, sharp, close-set spinous scales. First dorsal inserted nearer pectorals than ventrals by a distance equal to length of pectoral; second dorsal a little before posterior end of base of ventrals; distance from second dorsal to beginning of caudal, $2\frac{1}{2}$ in distance between dorsals. Color black. Length 650 mm. ($25\frac{1}{2}$ inches).

This incomplete description is from a stuffed specimen^b in the Imperial Museum in Tokyo. The specimen, being hastily compared with Müller and Henle's figure, showed no evident difference, though its relations may appear on close examination.

Mediterranean Sea and neighboring waters, and, as above recorded, once taken in Japan.

(*licha*, the meaning of the name unexplained.)

30. SOMNIOSUS Le Sueur.

Somniosus LE SUEUR, Jour. Ac. Nat. Sci. Phila., 1818, 1, p. 222 (*brevipinna* = *microcephalus*).

Leiodon WOOD, Proc. Bost. Soc. Nat. Hist., 11, 1847, p. 174 (*echinatum* = *microcephalus*).

Laenargus MÜLLER and HENLE, Plagiostomen, 1838, p. 93 (*borealis* = *microcephalus*).

Rhinoseymnus GILL, Proc. Ac. Nat. Sci. Phila., 1864, p. 264 (*rostratus*).

Body thick and clumsy; mouth transverse, little arched, with a deep, straight groove running backward from its angle; nostrils near the extremity of the snout; jaw feeble; teeth in upper jaw small, narrow, conical; lower teeth numerous, in two or more series, the point so

^a The name *licha*, of the same date as *americanus*, is much less inappropriate.

^b Ishikawa, Prel. Cat., p. 61, as *Seymour licha*.

much turned aside that the inner margin forms a cutting edge, which is entire: spiracles moderate; no nictitating membrane; gill-openings narrow; fins all very small, the ventrals between the dorsal fins; skin uniformly covered with minute tubercles. Tail short, much bent upward. Eggs large, soft, globular, without shell, dropped in the ooze on the sea bottom. Species of the northern seas.

(*somniosus*, sleepy.)

32. SOMNIOSUS MICROCEPHALUS Bloch and Schneider.

Squalus microcephalus BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 135, northern seas.

Somniosus microcephalus JORDAN and EVERMANN, Fish North and Middle Amer., I, 1896, p. 57.

Somniosus brevipinna LE SUEUR, Jour. Ac. Nat. Sci. Phila., I, 1818, p. 122; Massachusetts.

Scymnus brevipinna STORER, Fishes Mass., 1867, p. 235.

Squalus borealis SCORESBY, Arct. Reg., I, 1820, p. 538, pl. xv, figs. 3 and 4; Arctic Ocean.

Lamargus borealis GÜNTHER, Cat. Fish., VIII, 1870, p. 426.

Squalus glacialis FABER, Fische Isl., 1829, p. 23; Iceland.

Squalus norvegicus BLAINVILLE, Faune Française, 1828, p. 61; Norway.

Liodon echinatum WOOD, Proc. Bost. Soc. Nat. Hist., II, 1847, p. 174. Massachusetts.

Body robust, rapidly tapering behind; greatest depth little more than one-fifth length; head somewhat less; mouth moderate, upper jaw with 5 rows of small, sharp teeth, which are incurved, lancet-shaped; lower jaw with 2 rows of broad, quadrangular teeth, divided in their centers by perpendicular ridge, directed outward, about 26 teeth on each side; fins small, first dorsal about as large as ventrals, larger than second dorsal; pectorals short, caudal short, bluntish. Length about 25 feet. Arctic seas south to Cape Cod, Oregon, France, and Japan.

A huge, clumsy shark, not rare northward; an enemy to the whales, biting out large masses of flesh from their bodies.

The only Japanese record is that of a large example, seen by Jordan and Snyder in the market of Tokyo, in June, 1900. Specimens from the Pacific have never been compared with those from the Atlantic, and may belong to different species.

(*μικρός*, small; *κεφαλή*, head.)

Family XV. PRISTIOPHORIDÆ.

SAW SHARKS.

Body elongate, covered with fine, smoothish scales, forming shagreen; snout produced in a long, flat blade, with sharp teeth on each side projecting at right angles, these of unequal lengths; a pair of barbels on

lower part of snout near its middle; teeth small, close-set, each with a sharp cusp on a broad base; nostrils inferior, with conspicuous valves; eyes large, no nictitating membrane; spiracles large; pectorals rather large, distant from head; first dorsal in front of ventrals; second dorsal large; no dorsal spine; no anal fin; gill-openings moderate, all before pectoral; lower caudal lobe narrow. Species few; found from Japan to Australia, resembling the saw fishes (*Pristididae*) of the New World, but smaller in size and different in details of structure.

31. PRISTIOPHORUS Müller and Henle.

Pristiophorus MÜLLER and HENLE, Plagiostomen, 1838, p. 97 (*cirratus*).

Characters of the genus included above.

(*πρίστis*, saw; *φορέω*, to bear.)

33. PRISTIOPHORUS JAPONICUS Günther.

NOKOGIRIZAME (SAW SHARK); HOKABUKA (HALBERD SHARK);
DAIGIRIZAME (SAW SHARK).

Pristiophorus cirratus SCHLEGEL, Fauna Japonica, Poiss., 1847, p. 105, pl. cxxxvii; Nagasaki.—RICHARDSON, Ich. China, 1846, p. 317.—BLEEKER, Nieuwe Nalezing, Ichth. Jap., 1854, p. 128; Nagasaki (not of Latham, 1794).

Pristiophorus japonicus GÜNTHER, Cat. Fish, VIII, 1870, p. 43; Japan.—ISUKAWA, Prel. Cat., 1897, p. 61; Sagami Bay.

Head a trifle less than 3 in body; tip of snout to eye $3\frac{3}{4}$ in head; greatest width of head $4\frac{2}{3}$ in its length; interorbital space $8\frac{2}{3}$ in head; spiracle $2\frac{2}{3}$ in interorbital space; eye $1\frac{2}{3}$; pectoral 3 in head; height of first dorsal $4\frac{1}{6}$; caudal $2\frac{1}{3}$.

Body elongate, moderately thick. Head small, except for elongate depressed snout, or saw, greatly depressed and flattened, both above and below; saw rather broad, thin, becoming narrow at tip, truncately rounded; in each margin of saw a series of sharp teeth of uneven size, the larger with one, two, or three smaller between; on lower marginal surface of snout a single series of small, backwardly hooked teeth, each at some distance apart; in lower surface of saw, near edges, a pair of flattened tentacles about equal in length to width of head in front of eyes; teeth on edge of saw become smaller posteriorly and extend halfway in space between eye and first gill-opening; mouth broadly obtuse below posterior part and behind eye; teeth small, pointed, in many rows in jaws; nostrils are a trifle closer together than corners of mouth, nearer latter than tentacles, or about in last third of space between; interorbital space more or less flattened, though there are slight supraocular ridges; eye elongate, lateral, placed less than its diameter posterior to nostrils. Spiracles very large, half the eye, placed directly behind its posterior margin. Gill-openings moderate, in front of base of pectoral.

Entire body finely roughened.

Origin of first dorsal nearer tip of caudal than tip of saw, nearer origin of ventral than that of pectoral, nearer posterior margin of eye than second dorsal; two dorsals are similar, of about equal size, second with posterior part of its base midway between first dorsal and tip of caudal; pectorals large, broad, blunt, rounded, nearer origin of second dorsal than tip of saw; ventrals behind first dorsal and nearer origin of second dorsal than that of pectorals; caudal not very broad, upper lobe much broader than lower, whole fin a little more than space between dorsals. Caudal peduncle rather long, thick, flattened above and below, its least depth one and one-half in interorbital space. A lateral keel along each side of tail from ventrals to caudal inferiorly. No pores in lateral line.

Color, pale gray-brown above; below, whitish.

Length, $40\frac{1}{4}$ inches.

This description from a large example from Aomori.

Coasts of Japan; our specimens from Aomori and Nagasaki, the latter received from Mr. Yahiro. A specimen is in the museum of Aomori, taken at Ajigasawa on the Japanese Sea.

The teeth are placed somewhat differently from those represented in Schlegel's figure, but the species is doubtless the same.

Family XVI. SQUATINIDÆ.

ANGEL SHARKS.

Ray-like sharks. Body depressed and flat, the snout obtuse, the mouth anterior; teeth conical, pointed, distant; pectoral fins very large, expanded in the plane of the body, but not adherent to the side of the head, being deeply notched at the base; ventral fins very large; dorsal fins 2, small, subequal, on the tail behind the ventrals; no anal fin; caudal small; gill-openings wide, partly inferior, partly hidden by the base of the pectoral; spiracles wide, crescent-shaped behind the eyes; nostrils on the front margin of the snout, with skinny flaps; males with small prehensile appendages; vertebrae tectospondylous. A single genus among living forms, with but one species certainly known; a small shark of singular appearance, found in most warm seas. In appearance, as in structure, this family is strictly intermediate between the sharks and the rays. Its nearest living allies are probably the *Dalatiidæ*.

32. SQUATINA Duméril.

ANGEL FISHES.

Squatina DUMÉRIL, Zool. Analyt., 1806, p. 102 (*angelus*=*squatina*).

Rhina RAFINESQUE, Caratteri Alcuni Nuovi Generi, 1810, p. 14 (*squatina*).

Rhina KLEIN, in AUGUSTE DUMÉRIL, Elasmobranches, 1870, p. 464 (*squatina*).

Characters of the genus included above.

(*squatina*, the ancient name, akin to the English words "skate" and "squat.")

34. SQUATINA JAPONICA Bleeker.

TEGAIZAME (CANOPY-SHARK); KASUZAME (CHAFF SHARK);
KOROZAME.

Squatina vulgaris SCHLEGEL, Fauna Japonica, Poiss., 1850, p. 305, pl. cxxxvi;
Nagasaki (not of Risso).

Squatina japonica BLEEKER, Act. Soc. Sci. Indo. Neerl., 1857, III, Japan, IV, p.
40; Nagasaki.

Rhina squatina ISHIKAWA, Prel. Cat., 1897, p. 61, Tokyo (not of Linnæus).

Head 5 in length; space between spiracles $1\frac{1}{3}$ in head; interorbital space, $2\frac{1}{4}$; eye $3\frac{2}{3}$ in interorbital space.

Body broad, flattened, width of disk equal to one and five-eighths total length. Head very broad, flattened, its length a trifle more than two-thirds its width; snout very broad, short, obtuse, projecting very slightly beyond mandible; eyes small, a little closer together than spiracles, directed upward; snout well separated from mouth below by a deep furrow; jaws with about three rows of sharp, pointed teeth, upper projecting slightly beyond mandible; lips rather broad, a flap at the corner of mouth; inferior margin of head with a narrow, thin flap; nostrils closer together than eyes, on edge of snout in front; interorbital space broad, concave, this concavity extending to posterior part of head. Spiracles less than eye, and about diameter of latter distant. Gill-openings very large, septa with broad dermal laminae crowded together before base of pectoral.

Above rough, especially along edges of dorsal and caudal; down middle of back a series of small, sharp tubercles; a number of small tubercles over eye between nostrils above; lower surface of body perfectly smooth, with exception of anterior borders of pectorals and ventrals and lower surface of tail.

Dorsals small, of about equal size, first just behind tips of ventrals, second about midway between origin of first and origin of upper caudal lobe. Pectorals with length of base about one-half of length of anterior margin, the latter not equal to breadth of head; ventrals from their origin to tip behind, shorter than anterior edge of pectoral; caudal about half head; tail broad at first, then tapering, its width in front not equal to space between outer edges of spiracles.

Color in alcohol gray-brown above, marked with very numerous, small, dark spots, so that lighter color between forms a reticulated network; toward edges of fins spots become smaller and crowded; dorsals and caudal with a few, indistinct, dark spots; lower surface of body creamy; outer edges of pectorals, deep gray-brown, blackish posteriorly, also some brown spots about bases of former, on breast, throat, a large blotch before the vent, and two streaks down tail.

This description is from specimens obtained at Kobe and Nagasaki, where it is abundant.

Coasts of Japan, common southward.

Duméril unites the Japanese species with the European *Squatina aculeata*, while Dr. Günther unites both with *Squatina squatina*. The several species of this genus, if really distinct, have yet to be defined.

Order IV. BATOIDEI.

THE RAYS.

Gill-openings inferior, slit-like, 5 in number; spiracles present; no anal fin; dorsal fins, if present, inserted on the tail; body typically disk-like, broad, and flat, the margin of the disk being formed by the expanded pectorals; tail comparatively slender, the caudal fin small or wanting. Vertebrae cyclospondylous. With the exception of the *Rajidae*, most or all of the rays are ovoviviparous.

(βᾶτος, a ray; εἶδος, likeness.)

a. SARCURA. Tail comparatively thick, with 2 dorsals and a caudal fin; no serrated caudal spine.

b. Snout not saw-like.

c. Electric organs absent; skin not perfectly smooth.

d. Species ovoviviparous; young developed within body of parent; disk passing gradually into long, stout tail; pectorals not extending to snout.

RHINOBATIDÆ, XVII.

dd. Species oviparous; eggs deposited in quadrangular, leathery egg cases, with a projection at each corner; disk abruptly contracted at base of tail; pectorals extending to snout.....RAJIDÆ, XVIII.

cc. Electric organs present; a structure composed of honeycomb-like tubes between pectoral fins and head; skin perfectly smooth. NARCOBATIDÆ, XIX.

aa. MASTICURA. Tail comparatively slender; dorsal fin single or wanting; back of tail usually with a serrated spine.

e. Pectoral fins uninterrupted, confluent around snout; teeth small.

DASYATIDÆ, XX.

ee. Pectoral fins interrupted, one portion forming detached appendages on the snout ("cephalic fins").

f. Teeth very large, flat, tessellated, few in number...MYLIOBATIDÆ, XXI.

ff. Teeth numerous, very small, flat or tubercular; size of body enormous; cephalic fins conspicuous, resembling horns.....MOBULIDÆ, XXII.

Family XVII. RHINOBATIDÆ.

GUITAR-FISHES.

Shark-like rays. Trunk gradually passing into the long and strong tail, which is provided with 2 well-developed dorsal fins, a caudal fin and a conspicuous dermal fold on each side; disk not very broad, the rayed portion of the pectoral fins not being continued to the snout; no conspicuous spines, the skin being nearly smooth, or with warty tubercles; no electric organs. Warm seas; distinguished from the *Rajidæ*

chiefly by the fact that the eggs are hatched within the body. The typical species are also much more elongated in form.

- a. First dorsal opposite to ventrals; caudal with lower lobe well developed.
 - b. Snout short and rounded, not much longer than interorbital width... *Rhina*, 33.
 - bb. Snout narrow, produced and pointed, its length much greater than interorbital width..... *Rhynchobatus*, 34.
- aa. First dorsal much behind ventrals; anterior nasal valves not confluent; disk subtriangular or rhombic; snout more or less produced; skin covered with fine shagreen, usually with somewhat larger spines on the back of tail.

Rhinobatus, 35.

33. RHINA Bloch and Schneider.

Rhina BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 352 (*ancylostomus*; not of Aristotle and Klein, who, before Linnaeus, used the name for *Squatina*).
Rhynchobatis GILL, Am. Lyc. Nat. Hist. N. Y., 1861, p. 408 (*ancylostomus*).

Body depressed, the snout very broad and obtuse, its length not much greater than interorbital width, its anterior outline semicircular; back with large tubercles. Pectoral fins with the anterior margin free, not extending to the head. Gill-openings narrow, inferior, below the base of the pectoral. Spiracles wide behind the eye. No nictitating membrane. Nostrils inferior; oblique, wide slits. Teeth, obtuse, granular, the dental surfaces of the jaws undulate. First dorsal opposite ventrals; lower caudal lobe well developed.

(*ρίση*, a shark.)

35. RHINA ANCYLOSTOMA Bloch and Schneider.

Rhina ancylostomus BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 352, pl. LXXII; Coromandel.—RICHARDSON, Ichth. Chin., 1846, p. 195; Canton, and of numerous authors.
Rhynchobatis ancylostomus GILL, Am. Lyc. Nat. Hist., N. Y., 1861, p. 408.—DUMÉRIL, Elasmobranches, 1870, p. 482 (after Bleeker).
Rhynchobatus ancylostomus GÜNTHER, Cat. Fish, VIII, 1870, p. 440; Madras, China, Seychelles, Pinang.—DAY, Fishes of British India, I, 1889, p. 41.

Snout very broad, obtuse, with semicircular outline; large, compressed tubercles form longitudinal ridges, one on each side of upper part of head, one on median line of trunk; an incomplete series of smaller tubercles round front margin of eye and below spiracle; two short series of small tubercles on each side of trunk may be regarded as continuations of those on head; teeth 77-75, twenty-two vertical rows in center of upper and twenty-seven in center of lower jaw, surface deeply undulated, with one large median and a smaller lateral elevation on the lower jaw, and with corresponding emarginations in upper; the teeth are largest on summit of each elevation, and all are obtusely rounded with several longitudinal ridges across each. Color dull brown, lighter beneath; body and sometimes fins, covered with whitish spots; occasionally some tortuous black lines. (Günther, Day.)

East Indies; a single specimen was obtained at Kinkwazan, an island off Matsushima Bay, in September, 1900, by Professor Mitsukuri. (*ἀγκυλός*, undulate; *στόμα*, mouth.)

34. RHYNCHOBATUS Müller and Henle.

Rhynchobatus MÜLLER and HENLE, Plagiostomen, 1838, p. 111 (*lavis*.)

This genus differs from *Rhina* chiefly in the form of the snout, which is produced and pointed as usual in *Rhinobatus*. The tubercles on the back are arranged much as in *Rhina*, but are very small.

(*ῥινγχός*, snout; *βάτος*, skate.)

36. RHYNCHOBATUS DJIDDENSIS (Forskål).

TONGARI (SHARP-POINTED RAY); KOTAINOZU; SAKATAZAME; KASUKA; SUKINOSAKI (PLOW-POINT); SAKAFUTE; SUKINOSAZAKI.

Raja djiddensis FORSKÅL, Descr. Anim., II, 1775, p. 15, figs. 1, 2; Djidda, Red Sea.

Rhynchobatus djiddensis GÜNTHER, Cat. Fish, VIII, 1870, p. 441; Red Sea, Zanzibar, Seychelles, Sumatra, India.

Rhinobatus lavis BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 354, pl. LXXI; Coromandel.—SCHLEGEL, Fauna Japonica, Poiss., 1850, p. 306, pl. CXXXIX; Nagasaki, in open sea.

Rhynchobatus lavis DUMÉRIL, Elasmobranches, 1870, p. 484; Malabar, Pondicherry.

Rhynchobatus duhameli BLAINVILLE, Fauna Française, 1828, p. 48 (after Duhamel).

Snout elongated, distance between mouth and end of snout equals one-fourth to one-fifth of entire length, excluding caudal fin, shortest in adults; eyes rather large; teeth oval, wider than broad, with a horizontal cusp across center of each, 40-42-40-42, twenty to twenty-five vertical rows across the middle of jaws, and dental plate with a central and a smaller lateral elevation; corresponding emarginations exist in upper jaw. Spiracle close behind eye. Scales minute, of irregular shapes and sizes, keeled; a number of tubercles, directed backward, exist in rows in some parts of body; a supraorbital row extends from anterior margin of orbit round its upper edge to above spiracle; a second passes from a central point between termination of last two and proceeds along back to base of first dorsal, tubercles on it much farther apart than in other lines; from slightly behind beginning of dorsal line of spines, a short, diverging row on either side, also a row on shoulder, and two or three spines on scapula. Second dorsal begins opposite extremity of first dorsal; smaller than latter fin; its shape the same. Lateral keel begins a little above termination of ventrals. In color, immature specimens dull-gray above, whitish, sometimes tinged with red beneath; a dark or black band on the upper eyelid, and a dark spot beneath on either side of snout; also usually, but not invariably, a black spot at root of pectoral, which may have several small white ones around it; body, and sometimes pectoral fin, spotted

with whitish, or light gray; iris golden; adult of a dull gray above and lighter on abdomen. (Day).

East Indies, north to Japan; seen by Jordan and Snyder at Onomichi, Hiroshima, Tsuruga, and Hakata.

A large ray, measuring 4 feet.

We have half of the head and a portion of the disk of a large example from Tsuruga. There is a small black spot on each side of the snout at tip; two blackish spots over the eye, and another at base of pectoral, with a couple of light spots near it.

(Named for Djidda in Arabia.)

35. RHINOBATUS Bloch and Schneider.

Rhinobatus BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 353 (*rhinobatus*).

Leibatus RAFINESQUE, Caratteri Alcuni Generi, 1810, p. 16 (*panduratus*).

Syrrhina MÜLLER and HENLE, Plagiostomen, 1838, p. 113 (*columna*).

Glaucostegus BONAPARTE, Catalogo Metodico, 1846, p. 14 (*rhinobatus*).

Body depressed, gradually passing into the tail. Cranial cartilage produced into a long rostral process, the space between the process and the pectoral fin being filled by membrane; spiracles wide, behind the eye; nostrils oblique, wide; anterior valves not confluent; teeth obtuse, with an indistinct, transverse ridge. Dorsal fins without spine; both far behind the ventral fins; caudal fin without lower lobe. Claspers slender and pointed. Species numerous in warm seas, varying considerably as to the form of the snout; those with the snout shortened and the nasal valves broader, constituting the subgenus *Leibatus*, (*Syrrhina*), to which the Japanese species belong.

(*ρίβνη*, a shark; *βάτος*, a skate.)

a. *LEIBATUS*. Anterior nasal valve continued toward median line.

b. Anterior nasal valve slightly continued toward median line by a short fold, far from meeting its fellow of other side; snout produced; dorsal tubercles obsolete; color uniform brown; young with brown spots.....*schlegeli*, 37.

bb. Anterior nasal valve continued toward median line, nearly meeting its fellow of other side; snout moderately produced; back with a median series of very small tubercles; back with dark rings.....*polyophthalmus*, 38.

37. RHINOBATUS SCHLEGEL Müller and Henle.

SAKATAZAME (SKATE-SHARK).

Rhinobatus schlegeli MÜLLER and HENLE, Plagiostomen, 1838, p. 123, pl. XLII; Nagasaki.—SCHLEGEL, Fauna Japonica, 1850, p. 207; Nagasaki.—RICHARDSON, Ichth., China, 1846, p. 95; Nagasaki.—BLEEKER, Act. Sci. Neerl., III, 1857, Japan, p. 41.—GÜNTHER, Cat. Fish, VIII, 1870, p. 445; Japan, Formosa.—DUMÉRIL, Elasmobranches, 1870, p. 497.—ISHIKAWA, Prel. Cat., 1897, p. 30; Boshu.—STEINDACHNER, Reise Aurora, 1898, p. 225; Kobe.—JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 337; Tokyo.

Tip of snout to spiracle $4\frac{3}{4}$ in length; width of disk $3\frac{2}{3}$ in body; space between spiracles $4\frac{1}{2}$ in space between tip of snout and spiracle; inter-

orbital space $3\frac{1}{2}$; width across body at origin of ventrals $1\frac{3}{5}$; width of mouth $3\frac{2}{3}$; space between nostrils 7 in snout; eye 7.

Body elongate and greatly depressed. Head and disk broadly expanded, width of latter about two-thirds its length; snout triangular, long, narrow, its tip narrowly rounded; eyes rather small; mouth small, below posterior margin of eye, almost straight across; teeth small, pavement-like; nostrils large, each inclined obliquely toward mouth, and space between two-thirds length of either; interorbital space flat, a supraocular ridge at each side above eye. Spiracles large, and very near posterior margin of eye. Gill-opening small.

Body very finely roughened on upper surface, more or less smooth below, with a very obsolete trace of a median keel down back of slightly enlarged denticles.

Dorsals rather large, second only a trifle smaller than first; first dorsal nearer second than origin of ventral; second dorsal nearer first than end of tail; pectorals very broad, forming greatest width of disk at its posterior third; origin of ventrals nearly midway between front of eye and origin of second dorsal. Caudal broad, depressed, its length two in snout. Sides of tail each with a strong, lateral keel below.

Color in alcohol, light brown above, below whitish; young specimens are marked with little bunches of blackish brown spots.

Length, $27\frac{1}{4}$ inches.

Described from a male specimen.

Coasts of Japan; not uncommon. This species was seen at Tokyo, Wakanoura, Onomichi, Hakata, and Nagasaki. We have specimens from Hiroshima, Hakata, Nagasaki, and Wakanoura; also one from Tokyo, taken by K. Otaki. In this latter specimen, the lower surface of the snout is dark brown.

(Named for Professor Schlegel.)

38. RHINOBATUS POLYOPHTHALMUS Bleeker.

Rhinobatus polyopthalmus BLEEKER, Nieuwe Nalezing, 1854, Japan, p. 129; Nagasaki; Nat. Tyd. Ned., Ind., VI, 1854, p. 423; Act. Soc. Sci. Indo. Neerl., III, 1857, Japan, IV, pl. iv.

Rhinobatus columnae STEINDACHNER, Reise Aurora, 1898, p. 225; Kobe (not of Bonaparte).

Head $4\frac{1}{2}$ in length; snout $6\frac{1}{3}$ in head; eye 5 in snout; width of disk $2\frac{3}{4}$ in its length. Snout acute, processes of rostrum not distinct; nares more than their length, distant, continued below till narrowly separate; nasal flap fringed; lips without sulcation above, continuous below; mouth scarcely undulated, remote from margin of disk. Spiracle close to eye. Orbital ridge armed in front with some spines; lower surface of rostrum smooth; scales very small; 40 small spines down center of back in front of first dorsal. Dorsals subequal, scarcely emarginate, much higher than length of their bases, and

about double their length distant; pectoral broadly rounded; ventrals subrhomboid anteriorly, and obtusely rounded, acute behind; above, yellowish-green, with oblong and rounded rings of olive-violet, frequently interrupted with numerous spots; below, whitish.

Nagasaki. (Bleeker.)

Length, 312 mm.

Coasts of Japan. This species was seen by the senior author at Wakanoura, Hiroshima, Hakata, and Nagasaki. It may be identical, as Duméril indicates, with *R. annulatus* Smith, from the Cape of Good Hope, but this should not be admitted without comparison of specimens. According to Steindachner, it is the young of the East Indian *Rhinobatus columnæ* Bonaparte.

(πολύς, many; ὀφθαλμός, eye.)

Family XVIII. RAJIDÆ.

SKATES.

Disk broad, rhombic, the skin more or less roughened with spines or prickles; tail stout, rather long, with a longitudinal fold on each side; usually 2 dorsal fins and sometimes a caudal fin present, all on the tail; pectoral fins extending to the snout; ventrals large; no serrated spine on the tail; no electric organs. Oviparous, the eggs being laid in large, leathery egg cases, 4-angled, with 2 long, tubular "horns" at each end. Found in all cool seas, some of the species in deep water.

- a. Caudal fin well developed; ventral fins separate; pectoral fins confluent around snout.....*Discobatus*, 36.
 aa. Caudal fin rudimentary or absent; pectorals not confluent around the snout; ventrals deeply notched.....*Raja*, 37.

36. DISCOBATUS Garman.

Platyrhina MÜLLER and HENLE, Plagiostomen, 1838, p. 125 (*sinensis*, name pre-occupied).

Discobatus GARMAN, Proc. U. S. Nat. Mus., 1880, p. 522 (*sinensis*).

Disk rhombic, the snout rounded in front; tail very distinct, with a fold on either side, and with two dorsals and a well-developed caudal. Body rough, with spines above. Pectoral fins united in front, forming fore part of snout. Ventral fins separate.

39. DISCOBATUS SINENSIS (Bloch and Schneider).

UCHIWAZAME (FAN-FISH).

Raie chinoise LACÉPÈDE, Hist. Nat. Poiss., I, pp. 34, 157, pl. II, fig. 2 (from a Chinese painting).

Rhina sinensis BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 352 (after Lacépède).

Platyrhina sinensis MÜLLER and HENLE, Plagiostomen, 1838, p. 125, pl. XLIII; Nagasaki (on a figure of Burger).—SCHLEGEL, Fauna Japonica, 1850, p. 307 (no description).—DUMÉRI, Elasmobranches, 1870, p. 576; Cochin China.—GÜNTHER, Cat. Fish., VIII, 1870, p. 471; China,

Snout $7\frac{3}{4}$ in head; space between spiracles $1\frac{3}{4}$ in snout; space between nostrils $4\frac{1}{2}$ in snout; eye 7 in snout.

Disk very broad, much broader than long. Head greatly flattened; snout confluent with pectorals; eyes small; mouth nearly straight, and not quite as wide as space between outer margins of eyes; teeth numerous, small, and flattened, or molar-like; nostrils large, oblique toward mouth, and either equal to space between; interorbital space flattened, even a trifle concave, and a supraoral ridge on each side, somewhat broad; spiracles directly behind eye, and rather round and deep. Gill-openings small.

Upper surface of body very rough with small prickles; a median series of small bucklers from behind the head to first dorsal, and between the latter and second dorsal; several small bucklers over eye in front, and over the spiracles; several bucklers on each side of the body near the base of pectoral; lower surface of the body very finely roughened.

Dorsals small and posterior on tail, alike in shape, and posterior a little larger; origin of first dorsal nearer that of ventrals than tip of caudal; second dorsal a short distance from first, its origin a little nearer tip of ventral than tip of caudal; pectorals very broad, and with snout form a very blunt angle in front; space between ventrals below greater than snout; caudal equal to snout and eye. Sides of tail below, with a fold on each side, running from ventrals to caudal. Caudal peduncle very short.

Color in alcohol muddy brown above, white below; bucklers over eyes, and spiracles, together with those on sides, and the first four of the median row, cream white.

Length $20\frac{3}{8}$ inches.

This description from an example taken at Hiroshima.

Coasts of Japan and China; not rare. We have specimens obtained at Wakanoura and Hiroshima.

* (*sinensis*, Chinese.)

37. RAJA Linnæus.

Raja LINNÆUS, Syst. Nat., 10th ed., 1758, p. 231 (*batis*).

Dipturus RAFINESQUE, Caratteri Alconi Generi, 1810, p. 16 (*batis*).

Platopterus RAFINESQUE, Analyse de la Nature, 1815, p. 93 (*batis*).

Dasybatus BLAINVILLE, Journ. Phys., 1816, p. 260 (*communis*).

Propterygia OTTO, Nova Acta Acad. Cæs. Leop. Nat. Curios, 1824, p. 111

(*hyposticta*; monstrous example, with fins not adnate to head).

Læviraja BONAPARTE, Fauna Italica, XXV, 1839, p. 130 (*oxyrhynchus*).

Craptera MÜLLER and HENLE, Plagiostomen, 1838, p. 155 (*agassizi*; species without caudal fin).

Batis BONAPARTE, Cat. Metod., 1846, p. 12 (*radula*; no description).

Malacorhinus GARMAN, Bull. Mus. Comp. Zool., XI, 1881, p. 236 (*plutonia*; species with imperfect rostral cartilage; probably recognizable as a valid genus when the species are better known).

Raja various authors, change of spelling.

This genus, as here understood, comprises all those *Rajidae* which have the pectoral fins not continued around the snout, the ventrals deeply notched, and the caudal fin little developed, or wanting. The tail is very distinct from the disk, and is provided with 2-rayed dorsal fins. The skin of the body is usually more or less spinous; the dentition differs in the two sexes, and the male is usually provided with a differentiated patch of spines on each pectoral. Species numerous, mostly of the northern seas.

(*raja* or *raia*, a ray, or skate.)

- . Snout not produced.
- b. Dorsal fins united; a single row of spines on back of tail; everywhere roughened above; no spines on supraorbital ridge..... *isotrachys*, 40.
- bb. Dorsal fins well separated; skin above mouth smooth.
- c. Angle of disk posterior to middle of its length; several rows of spines on back of tail (only 1 row in young); spines on supraorbital ridge.
- d. Teeth in 30 rows; size large..... *fusca*, 41.
- dd. Teeth in 45 rows; size moderate..... *meerderroorti*, 42.
- bb. Angle of disk about opposite center of its length, and its anterior margin broadly convex; 5 irregular rows of spines on back of tail; teeth in 45 rows. *kenojei*, 43.
- aa. Snout very long, produced, tapering to a narrow point; teeth in 38 rows. *tenyu*, 44.

40. RAJA ISOTRACHYS Günther.

Raja isotrachys GÜNTHER, Deep Sea Fishes, Challenger, 1887, p. 7, pl. 11; south of Japan.

Snout rather produced, anterior margins meeting at nearly a right angle; distance between outer margins of nostrils equals their distance from end of snout; teeth small, each with a point directed backward toward interior of buccal cavity. Body and tail entirely covered on upper surface with minute asperities, each with a stellate base; no spines on superciliary margin; a single small spine in middle of back; a series of rather strong spines (eighteen) along the median line of tail, none on sides. Outer pectoral angle rounded, margins of fin would meet at a right angle. Upper parts uniform, brownish-gray; lower parts smooth, brownish-black. A female taken at Station 235 in 365 fathoms. (Günther.)

This species we only know from Günther's description. The plate represents the dorsals as joined at base.

South of Japan, in deep water; one female known, 22½ inches long. (ἰσόος, equally; τραχύς, rough.)

41. RAJA FUSCA Garman.

Raja fusca GARMAN, Proc. U. S. Nat. Mus., 1885, p. 42; Japan.

(Type, No. 26542, Mus. Comp. Zool.; taken from the egg case.)

A very young specimen of some large skate, resembling *Raja meerderroorti*, taken from the egg case, is thus described by Mr. Garman:

Length, 4¾ inches; width, 2; length of pectorals, 1½ inches.

Disk three-fourths as long as wide. Snout moderately prominent. General outline similar to that of *Raja ocellata*. Tail from vent equals the length of the disk including the ventrals; depressed, rather broad at the dorsals, behind which it extends in a long point that probably is much reduced in comparative length in the adult. Teeth in 30 series. Eyes moderate; interorbital space nearly half their distance from the end of the snout. Mouth broad, with a slight forward curve. A pair of large spines in front of each eye; a single spine above each spiracle; one behind the head on the anterior end of the vertebral column, sometimes a second behind this on the shoulder girdle, and a median row on the tail, beginning behind the vent and reaching the second dorsal. Dorsals separated by two spines. Excepting these spines, the back is smooth.

Light reddish brown; a black ring, half as wide as the mouth, incloses a light colored space near the shoulder girdle on each pectoral.

The large size of this fetus renders it probable that it belongs to a species distinct from *Raja meerdervoorti* and perhaps allied to *Raja ocellata*.

(*fuscus*, dusky.)

42. RAJA MEERDERVOORTI Bleeker.

Raja meerdervoortii ^a BLEEKER, Act. Sci. Ind. Neerl., VIII, 1860, p. 66; Japan.—
JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 337; Tokyo.

Snout $7\frac{3}{5}$ in head; interorbital space $1\frac{2}{5}$ in snout; width of mouth $1\frac{2}{5}$; length of first dorsal, $1\frac{5}{6}$; eye $3\frac{1}{2}$ in interorbital space.

Body broad, disk much wider than long, its anterior margin undulated. Head small; snout slightly produced, pointed; eyes small, interorbital space greater than distance of eye from margin of disk; mouth rather small, undulated, about as far from tip of snout as latter is from eye; nostrils large, their distance from corners of mouth two and two-thirds in space between latter and tip of snout; internasal space one and one-fifth width of mouth; teeth rather small, sharply pointed, in about 45 rows in upper jaw; upper lip free in middle; nostrils very large, broadly separated at corners of mouth, with which they are confluent, and with a large flap, posterior margin of which is broadly fringed; interorbital space broad, concave, supraoral ridges not particularly elevated. Spiracles much smaller than the eye and directly posterior. Gill-slits small.

Above, roughened on snout in front, along anterior undulated margins of disk; a patch of thorns on each side of pectorals, on their outer third; several spines or tubercles on each supraorbital ridge; several in front of eye; a couple on middle of back in front, and three rows

^a Disk rhomboid, its anterior borders undulate, a little broader than long; snout very sharp, greater than internasal space, length from mouth half more than width of latter; median teeth in male, pointed. Back smooth, with a single, conical, curved spine on its median region; several spines before, and within the eyes; the outer spines on the anterior region in 3 to 5 series. Tail a little shorter than the disk; claspers (in the type 21 cm. long) very large. Olive-green above, orange along the edge of disk; pale ocelli of varying size more or less evident; pores on the lower side of head bordered with black. (Bleeker).

upper surface of tail; also a supero-lateral row of small spines; with these exceptions, smooth; lower surface of body perfectly smooth, except end of snout.

First dorsal larger than second, from which it is well separated, intervening space equal to one-fifth length of base of first; second

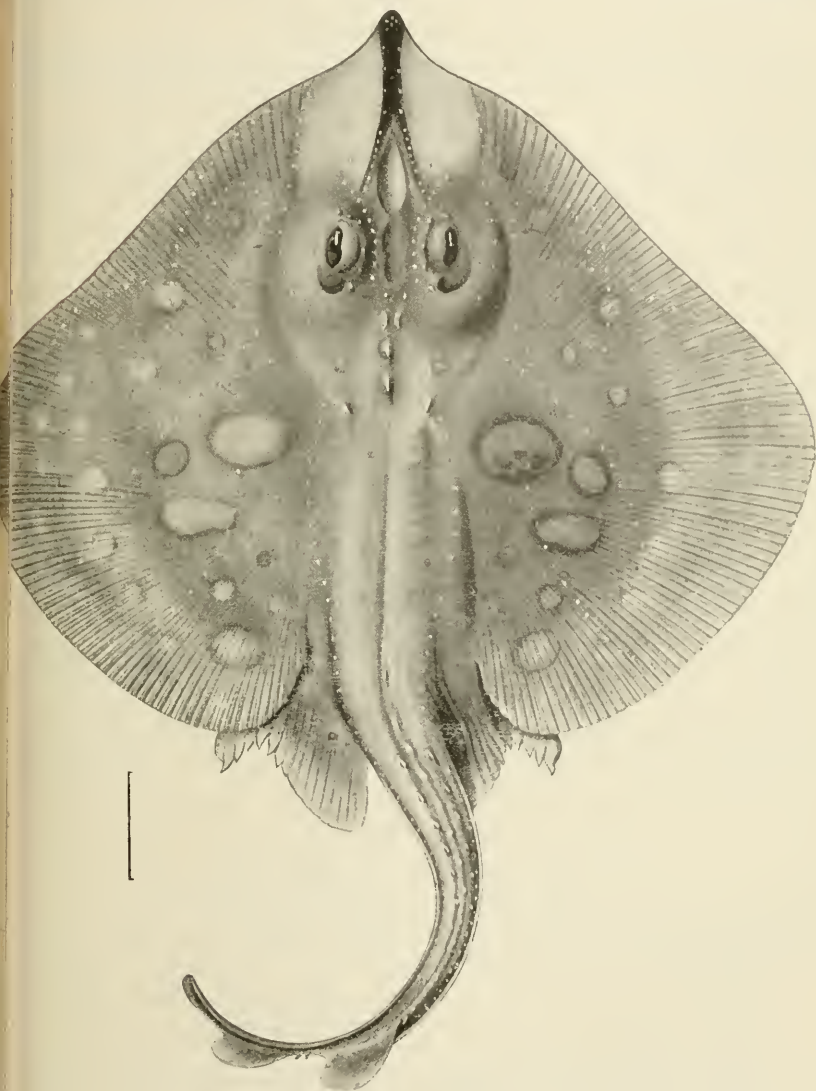


FIG. 7.—*RAJA MEERDERVOORTI*.

Dorsal and caudal joined, only separation a deep notch; angle of pectoral obtuse; ventrals four-fifths length of claspers; claspers more than half of tail, when measured above from posterior base of ventrals; a narrow lateral fold along each side of tail.

Color in alcohol, brown above, clouded with darker, and with many

light blotches on pectorals; at middle of base of pectorals, two large, round, light spots; behind these, also farther apart, two round blackish spots; edges of disk, ventrals, and tail light brown; lower surface of body whitish, more or less soiled with dusky, and pores with blackish dots.

Length $14\frac{3}{4}$ inches.

Described from a young male from Nagasaki.

A large male from Kobe differs in having the colors more or less uniform, the spots obsolete. Its lower surface is greatly soiled with pale brown.

Our adult females, all larger than any of the males, differ principally in their greater width. They also have the eyes closer together, the space between always less than their distance from the margin of the disk. They are more or less uniform in color like our adult male from Kobe. One from Tokyo is very dark, or soiled, below. The mouth is nearly straight.

In a smaller specimen than any yet mentioned the spots and markings above become more distinct, especially the two large spots at the base of the pectorals. However, there are still three rows of tubercles on the upper surface of the tail.

In our still smaller and youngest specimens there is great variation. In most of the males the distance between eyes is less than distance from the margin of the disk. The lower black spots on the pectoral above disappear, and the light spots at the base of the same fin vary from narrow-rimmed ocelli to deep blackish blotches. The tail is seldom with more than a single median row of tubercles above.

Coasts of Japan, very abundant. Our specimens from Tokyo, Nagasaki, Kobe, Wakanoura, and Hakodate. It is possible that more than one species is included in our series.

(Named for J. L. C. Pompe van Meerdervoort, who collected for Dr. Bleeker.)

43. RAJA KENOJEI Müller and Henle.

GANGI-EI (SEA-WALL RAY); KENOEI, KASUBE, SEBITA (FLAT-BACK); IGA-EI (SPINY RAY); RENTE-EI.

Raja kenjei MÜLLER and HENLE, Plagiostomen, 1838, p. 149, pl. XLViii; Nagasaki.—SCHLEGEL, Fauna Japonica, 1850, p. 308; Nagasaki.—RICHARDSON, Ichth. Chin., 1846, p. 197; Canton.—BLEEKER, Act. Soc. Sci. Ind. Neerl., III, 1858, Japan, IV, p. 42; Japan, VI, 1859, p. 65.—DUMÉRIL, Elasmobranches, 1870, p. 557; Nagasaki.—GÜNTHER, Cat. Fish, VIII, 1870, p. 463; Japan.—NYSTROM, Kongl. Svensk. Vet. Ak., 1887, p. 51; Nagasaki.—ISHIKAWA, Prel. Cat., 1897, p. 60; Tokyo.—JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 337.

Raja japonica^a NYSTROM, Kongl., Svensk. Vet. Ak., 1887, p. 52; Nagasaki.

^a*Raja japonica* is characterized thus by Nystrom:

“Distance from middle of forehead between eyes to tip of snout less than half breadth of head at same point; distance between outer angles of nostrils somewhat

Interorbital space $1\frac{1}{2}$ in snout; width of mouth $1\frac{2}{5}$; length of first dorsal, a little more than $\frac{1}{2}$; caudal $2\frac{3}{4}$; eye $3\frac{1}{2}$ in interorbital space.

Body rhomboid, very broad, width of the disk much greater than its length. Head small; snout very little produced, though ending in a small point; anterior margin of disk full, slightly undulated, and eyes nearer to it than their space between; mouth large, slightly undulate; teeth in about 45 rows in upper jaw, small, rounded; nostrils very large, broadly separated, but not equal to width of mouth at its corners, with which it is also confluent; nasal flaps large, posterior margin fringed; length of nostril to corner of mouth equal to two and one-half in space between latter and tip of snout; interorbital space concave, though flattened in middle, and supraorbital ridges little elevated. Spiracles rather large, a little smaller than eye, oblique, directly posterior. Gill openings very small.

Body almost perfectly smooth, with exception of some roughness on snout, several small tubercles on supraoral ridges, one in center of back in front, and 5 irregular rows of thorns on back of tail.

Dorsals separated, distance between about one-sixth base of first; second dorsal confluent with small caudal, only separation a deep notch, and equal to first dorsal in size; angle of pectoral would fall at about middle of length of disk; ventrals moderate.

Color in spirits, brown above, whitish beneath; upper surface marked with small, blackish spots; at bases of pectorals, two large, blackish rings above, below which, though farther apart, also two indistinct, imperfect rings, and still posterior on last rays, a small, black spot; nine indistinct, blackish cross-bands on upper surface of tail; lower surface of body whitish, soiled with brown, pores with grayish borders.

Length $17\frac{1}{2}$ inches.

Coasts of Japan, rather common. We have specimens from Misaki, Tokyo, Wakanoura, Kobe, Tsuruga, and Nagasaki. As this species is mature at about the length of the specimen described, the rays "de taille enorme" noticed by Schlegel must belong to *Raja tenu* or some other species. In our young specimens the spots on the back form more or less distinct ocelli, and the mottlings above are distinct, frequently with a number of light spots. The lower surface is white, but the outer third of the pectorals broadly bordered with pale brown, which in the adult is paler.

(*keno-ei*, the Japanese name.)

less than their distance from tip of snout; snout somewhat rounded; mouth with 40 rows of teeth; interorbital space concave. A few small tubercles about eyes; rest of body smooth, except for a large tubercle behind eye and a row of larger or smaller ones along middle of back. Color dark brown, with larger and smaller yellowish spots. Described from a specimen $2\frac{1}{2}$ cm. long, taken at Nagasaki."

44. RAJA TENGU Jordan and Fowler, new species.

TENGU-EI (LONG-NOSED RAY).

Interorbital space 3 in snout; width of mouth $2\frac{2}{3}$; length of first dorsal $4\frac{1}{4}$; caudal 6; eye $4\frac{1}{2}$ in interorbital space.

Body very broad, width of disk much greater than its length. Head large; snout greatly produced, tapering to a sharp point; eyes small rather far apart, though farther from margin of disk than this interval; mouth large, slightly curved or arched, with 38 rows of large teeth on jaws; upper lip not free in middle; nostrils very large, broadly separated at corners of mouth, with which they are confluent, and with

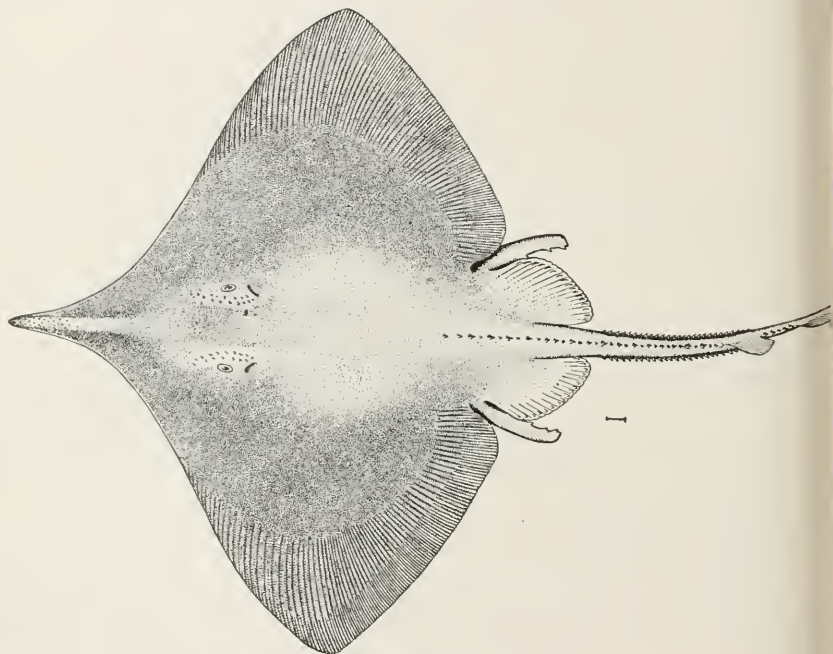


FIG. 8.—RAJA TENGU.

large flap, the posterior margin of which is broadly fringed; space between anterior part of nostril and corners of mouth 5, in space between former and tip of snout; interorbital space broad, concave; the supraoral ridges large, broad and convex. Spiracles smaller than the eye, oblique, directly posterior. Gill-slits small.

Snout roughened above; a number of small spines in front of and over eye, several on back behind head; a single row of spines down middle of tail above, a row on each side of same, and all rest of upper surface perfectly smooth; lower surface of body, except ventrals and tail, roughened, especially on snout.

First dorsal a little larger than second, from which it is well separated, intervening space equal to two-thirds length of second dorsal

second dorsal and caudal separated by a notch; angle of pectoral obtuse; ventrals small.

Color in spirits brown, more or less finely mottled with lighter, and lower surface like upper; pores below blackish.

Length 44 inches.

Type No. 7138, Ichthyological collections, Leland Stanford Junior University Museum. Locality, Matsushima Bay.

Cotypes are in U. S. National Museum, from station No. 3770, Matsushima, where they were dredged by the U. S. Fish Commission steamer *Albatross*.

The type is a young female, but is easily distinguished from other species by the elongate snout, which is, however, not so long as that of the adult; distance between eyes less than their distance from the margin of the disk; a pair of stout spines in front of each eye, a single one behind each, and a single one on the middle of the back, in front; middle of the tail with a single row above, and all the rest of the body, both above and below, smooth. Color more or less deeper brown above, marbled with darker; below, brownish; the pores on the under surface of the head, bordered with blackish. Length $8\frac{1}{2}$ inches.

Coasts of Japan, especially northward; rather common. It was obtained at Aomori, Hakodate, and Matsushima.

(Named from *Tengu* or *Tegu*, in Japanese mythology, a comical being with a very long nose, which he is fabled to thrust into the business of other people.)

Family XIX. NARCOBATIDÆ.

ELECTRIC RAYS.

Trunk broad and thick, covered with perfectly smooth skin. Tail comparatively short and thick, with rayed caudal fin, and commonly 2 rayed dorsal fins, the first of which is over or behind the ventrals; a longitudinal fold on each side of the tail; anterior or nasal valves confluent into a quadrangular lobe; a large electric organ, composed of many hexagonal tubes between the pectoral fins and the head. Rays of moderate or large size, noted for their power of giving electric shocks; found in most warm seas. According to Fritsch the torpedoes pass through three distinct phases of development—a shark-like, a ray-like, and finally a torpedo-like stage. The very young have long, external gills.

a. Dorsal fin single; spiracles close behind eye; tail with a fold on each side.

Astrape, 38.

38. ASTRAPE Müller and Henle.

Astrape MÜLLER and HENLE, *Plagiostomei*, 1838, p. 130 (*capensis*).

Dorsal fin single. Disk rounded, not emarginate in front; snout short, not keeled; spiracles with entire edges, near the eyes; mouth narrow, protractile, surrounded by a circular fold of skin, joined to the

nasal valve by a cartilaginous frenum; teeth flattened, quadrangular at base, not occupying the whole cleft of mouth. Skin smooth.

(*ἀστράπη*, lightning.)

45. ASTRAPE JAPONICA Schlegel.

SHIBIREI (SHOCKED RAY).

Astrape japonica^a SCHLEGEL, Fauna Japonica, 1850; p. 307, pl. cxi.; Nagasaki.

Astrape dipterygia ISHIKAWA, Prel. Cat., 1897, p. 60; Tokyo, Sagami Bay, Ajiro in Izu (probably not of Schneider).

Disk round and equal to tail, which is broad, compressed, and tapering. Head very small; snout short, equal to space between spiracles; eyes very small; 4 in space between spiracles; nostrils large, rather close together, median flap only separated slightly by a thick frenum; mouth not very broad, about one-half width between spiracles, and jaws with flattened pavement-like teeth; interorbital space nearly flat. Spiracles larger than eye, and with their edges elevated.

Body perfectly smooth, but with many pores, especially along outer portions of pectorals.

First dorsal, when depressed, reaching base of caudal, and equal to half its length; length of base of ventral is equal to width of caudal at base; tail greatly depressed, broad, and along sides, a rather narrow, lateral fold.

Color in alcohol, brown above; caudal, dorsal, and middle of tail, deep brown; lower surface with greater portion soiled with pale brown, remaining portions whitish.

Length, 7 inches.

This description from a male from Wakanoura.

Coasts of Southern Japan, not common. Our single example is from Wakanoura.

Family XX. DASYPATIDÆ.

STING RAYS.

Disk usually more or less broad than long; the pectoral fins uninterruptedly confluent in front, forming the tip of the snout; tail variously formed, usually whiplike, sometimes short and stout, sometimes bearing a single dorsal or caudal fin, but never with two dorsals; usually one or more vertical folds of skin on tail, rarely a lateral fold. Tail generally armed with a large, sharp, retrorsely serrate spine on its upper surface toward the base; 2 or 3 spines occasionally present. Ventral fins not emarginate. Skin smooth, or variously prickly or spinous, roughest in the adult; no differentiated spines on the pectorals in the males, the sexes being similar. Mouth rather small; teeth

^a*Narcine timlei*, a related species, is ascribed to Japan by Günther, following Richardson. There is no evidence that it has ever been taken in Japan. Perhaps *Astrape* has been mistaken for it.

small, paved, usually more or less pointed or tubercular. Nostrils close together; nasal valves forming a rectangular flap, which is joined to the upper jaw by a narrow frenum. Spiracles large, placed close behind the eyes. Skull not elevated, the eyes and spiracles superior. Species ovoviviparous. Found in most warm seas, some of them in the fresh waters of the northern parts of South America. The large, jagged spine on the muscular tail is capable of inflicting a severe and even dangerous wound.

- a. UROLOPHINE. Tail stout, provided with a rayed caudal fin; no dorsal fin; disk roundish; caudal spine strong..... *Urolophus*, 39.
- aa. DASYATINE. Tail slender, without caudal fin; pelvis without sword-shaped process. (Marine species.)
 - b. Tail whiplike, longer than disk, which is rhomboid, or roundish; caudal spine strong..... *Dasyatis*, 40.
 - bb. Tail very short, shorter than the very broad, transversely rhombic disk; caudal spine weak, often wanting; no trace of dorsal fin..... *Pteroplatea*, 41.

39. UROLOPHUS Müller and Henle.

Leiobatus^a BLAINVILLE, Jour. Phys., LXXXIII, 1816, p. 262 (*cruciatus*; not *Leiobatus*, Rafinesque, 1810).
Leiobatis BLAINVILLE, Faune Française, 1828, p. 43 (no type named).
Urolophus MÜLLER and HENLE, Plagiostomen, 1838, p. 173 (*aurantiacus*=*cruciatus*).
Urotrygon GILL, Proc. Ac. Nat. Sci. Phila., 1863, p. 173 (*mundus*).

Disk oval or rhombic, the length and breadth not very unequal; snout rounded or the tip exerted; skin smooth or more or less prickly. Tail rather short, little if any longer than the disk, muscular, provided with a distinct rayed caudal fin; no dorsal fin. Upper part of the tail with a strong, serrated spine. Warm seas. Sting rays of small size, the most vigorous and most dangerous of the group, mostly confined to tropical America.

(οὐρά, tail; λόφος, crest.)

46. UROLOPHUS FUSCUS Garman.

JUNORUI.

Urolophus fuscus GARMAN, Proc. U. S. Nat. Mus., 1885, p. 41; East Coast of Japan (Type No. 7058, U. S. Nat. Mus.).
Urolophus tullbergi NYSTROM, Kongl. Svensk. Vet. Akad., 1887, p. 53; Nagasaki (Coll. Dr. W. Tullberg).—JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 338; Tokyo.

Disk round, angles of pectorals about opposite first two-fifths its length. Head small, snout produced only in a short point; anterior edge of disk broadly convex; eyes rather small, 5 in snout and $3\frac{1}{2}$ in interorbital space; nostrils large, confluent with mouth only separated in middle by a thick frenum; mouth small, $1\frac{1}{2}$ in interorbital space;

^aIn the Faune Française, 1828, Blainville changes "*batus*" in this and all similar names to "*batis*," thus *Leiobatis*, *Aëtobatis*. In this form the name *Leiobatis* has priority over *Urolophus*, but being not a new name, but a mere variant in spelling, it is perhaps not necessary to adopt it as the name of this genus.

jaws with flattened, pavement-like teeth; interorbital space concave supraocular ridges little elevated. Spiracles large, much greater than eye.

Body perfectly smooth, with many pores.

Base of ventral about equal to snout; caudal rather broad, rounded lower lobe beginning before upper, and width of fin $2\frac{3}{4}$ in snout; tail depressed, its width at base 2 in snout, armed with a strong, compressed spine with serrate edges.

Color in alcohol, light brown above, pores with blackish borders caudal fin, a blotch below each eye and upper surface of tail blackish-lower surface whitish, except lower surface of tail, which is blackish-edges of ventrals and of disk broadly edged with blackish or brownish.

Length, $14\frac{3}{4}$ inches.

This description from a female from Tokyo.

Southern Japan, generally common. Our specimens are from Tokyo, Kobe, Hiroshima, Hakata, and Wakanoura.

(*fuscus*, brown, dusky.)

40. DASYATIS Rafinesque.

STING RAYS.

Dasybatus KLEIN, missus, 1742 (pre-Linnæan).

Dasyatis RAFINESQUE, Caratteri di Alcuni Nuovi Generi, 1810, p. 16 (*ujus* = *pastinaca*).

Urovis RAFINESQUE, Indice d'Ittiol. Sicil., 1810, p. 61 (*ujus*).

Trigonobatus BLAINVILLE, Jour. Phys., 1816, p. 261 (*vulgaris*).

Trygon ADANSON, in Cuvier, Règne Animal, 1st ed., 1817, p. 136 (*pastinaca*).

Hemistrygon MÜLLER and HENLE, Mag. Nat. Hist., 1837, p. 90 (*bennetti*).

Himantura MÜLLER and HENLE, Wiegmann's Archiv., 1837, p. 400 (*uarnak*).

Pastinaca SWAINSON, Classn. Anim., 1839, p. 319 (*oliracea*).

Anacanthus EHRENBERG, in Swainson, Classn. Anim., 1839, p. 319 (*orbicularis*).

Pastinaca DE KAY, N. Y. Fauna, Fishes, 1842, p. 373 (*pastinaca*).

Dasybatis GARMAN, in Jordan and Gilbert, Synopsis, 1883, p. 65 (*pastinaca*; corrected orthography).

Disk oval, flat, with rounded angles. Tail very long and slender, whip-like, without fin, but often with 1 or 2 vertical, membranous folds; a strong serrated spine toward the base of the tail. Skin more or less spinous or prickly, rarely smooth. Teeth small, paved; a few papille usually present in the mouth behind the lower jaw. Species about 30. Sting rays of large size, abundant in warm seas. Many of the spinous species are nearly or quite smooth when young, becoming rough with age. Some of the species are yet imperfectly known and much of the synonymy is uncertain.

(*δαρούς*, shaggy or rough; *βάτις*, a skate; abbreviated from *Dasybatis*.)

a. DASYATIS: Tail with cutaneous folds.

b. Snout not long and produced.

- c. Two appendages at bottom of mouth inside; tail $\frac{1}{2}$ larger than disk; under side dusky gray, without red in life.....*kuhlii*, 47.
 cc. Three appendages at bottom of mouth inside; under side, pale orange red in life.....*akajei*, 48.
 bb. Snout long and produced, so that greatest width of disk would be about opposite to middle of its length.....*zungoi*, 49.
 aa. HIMANTERA: Tail without cutaneous folds; three times length of disk.....*gerrardi*, 50.

47. DASYATIS KUHLLI (Müller and Henle).

Trygon kuhl MÜLLER and HENLE, Plagiostomen, 1838, p. 164, pl. CI; Vanicoro, New Guinea (drawing from a specimen from Nagasaki).—SCHLEGEL, Fauna Japonica, 1850, p. 308; Nagasaki.—BLEEKER, Verh. Bat. Gen. Plag., XXIV, 1852, p. 73.—DUMÉRIL, Elasmobranches, 1870, p. 603; Amboina, Java, Vanicoro, New Guinea.—GÜXTHER, Cat. Fish, VIII, 1870, p. 479; Zanzibar.

The margins of snout form an obtuse angle; only two appendages at bottom of mouth, behind teeth. Body entirely smooth, or with a series of spines, pointing backward along the median line of back to caudal spine. Tail with a distinct cutaneous fold above and below, about one-half larger than disk.

Coasts of Japan and southward, not common, readily known from *D. akajei* by the grayish, not reddish, coloration of the lower side. Our specimens from Hakodate, Tokyo, Misaki, Wakanoura, Onomichi, and Hiroshima.

(Named for the naturalist, M. Kuhl.)

48. DASYATIS AKAJEI (Müller and Henle).

AKA-EI (RED SKATE).

Trygon akajei MÜLLER and HENLE, Plagiostomen, 1838, p. 165, pl. LIII, Nagasaki.—SCHLEGEL, Fauna Japonica, 1850, p. 308; Nagasaki.—BLEEKER, Act. Soc. Sci. Indo.-Neerl., III, 1857, Japan, IV, p. 44.—DUMÉRIL, Elasmobranches, 1870, p. 604; Nagasaki.

Disk broadly oval; widest part about second fifth of its length. Head moderate, snout produced into a short, though very blunt point, and anterior edge of disk very broadly convex; eyes small, elevated a little, and 5 in interorbital space; nostrils large, confluent except for the thick, cartilaginous frenum; mouth small, more than one-half snout; teeth flattened, pavement-like; lower lip with narrow folds; interorbital space broad, flat. Spiracles not quite twice eye.

Body smooth, except a patch of asperities between and posterior to each eye, and a median series on back, developing posteriorly, into large thorny spines to caudal spine; end of tail rough; rest of body perfectly smooth.

Base of ventral less than interorbital space; tail much larger than disk, tapering rapidly till very slender, its width at base more than half interorbital space; spine on upper part of tail inserted a little before first third of its length, longer than snout, and serrate on both

edges on outer half; a small keel on tail above, behind spine, and a long one runs along lower surface.

Color in alcohol dark, dusky brown above, becoming lighter on outer and marginal portions of disk; lower surface of body a creamy white; a creamy buff bar in front of and below eye, also another about spiracles, above and at corners; sides of tail whitish, also edges of claspers. The belly is more or less bright orange red in life.

Length, 27 $\frac{1}{2}$ inches.

Here described from an adult male from Tokyo.

Young specimens are perfectly smooth above, without any asperities or thorns, the colors more pronounced, the outer half of the tail black, and the lower surface of the body more or less tinged with creamy or light buff.

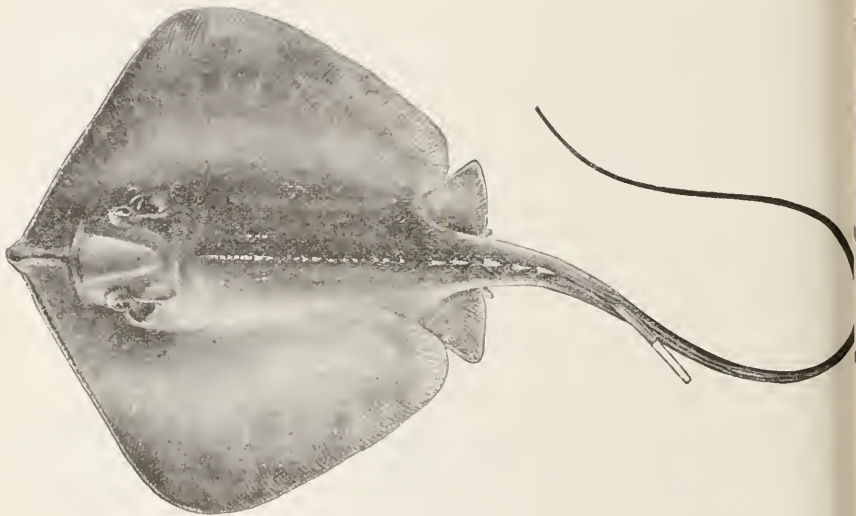


FIG. 9.—*DASYATIS AKAJEL*.

Coasts of Japan, very common southward in sandy bays. Our specimens from Matsushima, Tokyo, Misaki, Wakanoura, Onomichi, Hiroshima, Tsuruga, Hakata, Kawatana, and Nagasaki.

(*aka-ci*, red skate, in Japanese.)

49. *DASYATIS ZUGEI* (Muller and Henle).

ZUG-EL.

Trygon zugei MÜLLER and HENLE, Plagiostomen, 1838, p. 165, pl. LIII; Nagasaki.—SCHLEGEL, Fauna Japonica, 1850, p. 309; Nagasaki.—CANTOR, Malayan Fishes, 1850, p. 426.—BLEEKER, Verh. Bat. Gen., XXIV, 1852, Plagiost., p. 68; Macao, Pondicherry.—DUMÉRIL, Elasmobranches, 1870, p. 606.—GÜNTHER, Cat. Fish. VIII, 1870, p. 481; Japan, Pinang, Madras.

Disk as deep as broad; its greatest width about opposite middle of its length. Head large, with produced, pointed snout; snout about

$2\frac{3}{4}$ in disk, and anterior margins of disk, concave; eyes very small, slightly elevated, and about equal to $5\frac{1}{2}$ in interorbital space; nostrils large, confluent, except for thick cartilaginous frenum, and with edges of flap fringed; mouth small, about $1\frac{1}{3}$ in space between nostrils, and $4\frac{2}{5}$ in snout; teeth in somewhat roughened, pavement-like patches in jaws; interorbital space concave in middle, elevated a little on both sides, and equal to 3 in snout. Spiracles very large, rounded, and equal to $2\frac{1}{2}$ eye diameters. Gill-openings moderately small.

Body entirely smooth, with exception of upper surface of tail behind spine, where it is roughened.

Base of ventral about $1\frac{2}{5}$ in interorbital space; tail very long and slender, greatly exceeding length of disk; width of tail at base, $2\frac{1}{4}$ in interorbital space; spines on upper part of tail, less than interorbital space, sharp, slender, serrate on both of outer edges, and inserted about first fifth the length of tail; rather low keels on tail, one above short, and behind spine, the lower much longer.

Color in alcohol, brown above, more or less uniform, and below, whitish.

Length, $29\frac{1}{2}$ inches.

This description from a specimen from Kobe.

In a young specimen, with two caudal spines, the eyes are larger, the tail is smooth and with keels long, and the color darker above, and more or less mottled indistinctly.

Coasts of Japan and southward, known by the long snout. Our specimens from Tokyo, Kobe, Wakanoura, Onomichi, and Hiroshima. (*zug-ei*, the Japanese name.)

50. DASYATIS GERRARDI (Gray).

Trygon gerrardi GRAY, Chondropt., 1851, p. 116; India.—GÜNTHER, Cat. Fish, VIII, 1870, p. 474; Japan, East Indies.

Trygon macrurus BLEEKER, Verh. Bat. Gen., XXIV, 1852, Plag., p. 74; Java, Sumatra.—DUMÉRIL, Elasmobranches, 1870, p. 588 (after Bleeker).

Disk broader than long. Snout rather obtuse, margins forming an obtuse angle. One or more large tubercles in center of back, round which, or in front of which, generally smaller tubercles are grouped, forming a small patch or short band, and not extending beyond central portion of disk. Tail without cutaneous fold, exceedingly long and slender, about thrice as long as disk, without tubercles at base. Color brown, with round, yellowish spots, limited to posterior parts in young examples, which have tail ornamented with alternate brown and yellow rings. (Günther.)

India, East Indies, and a half-grown specimen recorded from Japan by Dr. Günther. We have seen no Japanese specimens. A related

species *D. nudus* (Günther), known by the smooth skin, is listed by Bleeker as from Japan, but no locality is given.

Duméril finds 2 buccal papillae.

(Named for M. Gerrard.)

41. PTEROPLATEA Müller and Henle.

Pteroplatea MÜLLER and HENLE, Plagiostomen, 1838, p. 168 (*altavela*).

Disk much broader than long, its anterior margins meeting in a very obtuse angle, its outer angles more or less acute, the form, therefore, transversely rhombic. Tail very short and slender, shorter than the disk, without fin, armed with a very small, serrated spine, which is often wanting. Skin smooth, or very nearly so. Size rather large. Warm seas. The species are closely related.

(πτερόρον, fin; πλατύς, broad; an ancient name of *Pteroplatea altavela*.)

51. PTEROPLATEA JAPONICA (Schlegel).

TSUBAKUROEI (SWALLOW RAY); YOKOSAEI (CROSS-WISE RAY).

Pteroplatea japonica SCHLEGEL, Fauna Japonica, Poiss., 1850, p. 309, pl. CXL4; Nagasaki.—BLEEKER, Act. Soc. Sci. Indo. Neerl., III, 1857, Japan, IV, p. 45.—DUMÉRIL, Elasmobranches, 1870, p. 614.

Dasyatis micrura var. *japonicus* GRAY, Chondropt., 1851, p. 122; Japan, Canton.

Pteroplatea hirundo, ISHIKAWA, Prel. Cat. 1897, p. 60; Tokyo, Boshu; (not of Lowe).

Disk very broad, its length only a little more than half its width; its greatest width would fall about opposite last fourth of its length. Head very broad, and flattened; snout only a small, blunt point, and its length equal to two-thirds interorbital space; anterior margin of disk broadly convex; eyes small, somewhat elevated, 7 in interorbital space; nostrils large, well separated, with large flaps; mouth moderate, equal to its length from tip of snout, undulate; teeth in broad, pavement-like patches in jaws; interorbital space very broad, flattened. Spiracles directly behind eye, much larger than the same. Gill-openings moderate.

Body entirely smooth.

Base of ventral $1\frac{3}{4}$ in interorbital space; tail very small, short, its length about twice interorbital width; a small, weak spine on upper surface of tail at its first third.

Color in alcohol, olivaceous brown above, marked with very fine, numerous, darker punctuations, tail whitish with eight dark rings about as broad as interspaces; lower surface of body whitish.

Length, $9\frac{1}{4}$ inches.

Here described from a female from Wakanoura.

Coasts of Japan, rather common. It was taken at Tokyo, Wakanoura, Hiroshima, Hakata, Kawatana, and Nagasaki.

Family XXI. MYLIOBATIDÆ.

EAGLE RAYS.

Disk broad; the pectoral fins not continued to the end of the snout, ceasing on the sides of the head and reappearing in front of the snout as 1 or 2 fleshy protuberances (cephalic fins), which are supported by fin rays. Tail very long and slender, whip like, with a small dorsal fin near its root, behind which is usually a strong, coarsely serrated spine. Nasal valves forming a rectangular flap, the posterior margin free, attached by a frenum to the upper jaw. Skull less depressed than usual among rays, its surface raised so that the eyes and spiracles are lateral in position. Teeth hexangular, large, flat tessellated, the middle ones usually broader than the others. Ovoviviparous. Skin smooth; no differentiated spines on the pectorals in the males, the sexes being similar. Ventrals not serrated. Large sting rays; inhabiting warm seas, feeding chiefly on mollusks, which they crush with their large, grinding teeth.

Teeth in several series, the middle series very broad.

Muzzle entire *Myliobatis*, 42

42. MYLIOBATUS Duméril.

Myliobatis DUMÉRIL in Cuvier, Règne Animal, 1st ed., II, 1817, p. 137 (*aquila*).
Holorhinus GILL, Proc. Ac. Nat. Sci. Phila., 1862, p. 331 (*vespertilio=californicus*).

Disk broad, the outer angles acute. Cephalic fins, forming a soft, convex appendage in front of snout. Jaws about equal. Median fin very broad, much broader than long in the adult, proportionally narrower in the young. Several series of narrower teeth on each side of the median series; teeth changing considerably with age. Free margin of the nasal valve not deeply emarginate. Tail very long and slender, with a small dorsal fin, and one or more serrated spines. Skin smooth, or nearly so. Size large. In all warm seas.

(μύλος, grinder; βᾶτις, ray.)

Disk two-thirds as long as broad *tobijei*, 52.

Disk twice as broad as long *nieuhofti*, 53.

52. MYLIOBATUS TOBIJEI Bleeker.

TOBI-EI (KITE RAY, OR FLYING RAY).

Myliobatis aquila SCHLEGEL, Fauna Japonica, 1847, p. 310, pl. cxlii; Nagasaki (not of Linnaeus).

Myliobatis tobijei BLEEKER, Verh. Bat. Gen., XXVI, 1854, Nieuwe Nalez. Japan, p. 130, Nagasaki.—DUMÉRIL, Elasmobranches, 1870, p. 640 (after Bleeker).

Myliobatus cornuta GÜNTHER, Cat. Fish, VIII, 1870, p. 490; Japan.—ISHIKAWA, Prel. Cat 1897 p. 60, Matsushima.

Head 3 in body (from tip of snout to base of ventrals behind); snout 1 in head, eye 6 in interorbital space; spiracles 2½; width of mouth 2½.

Disk very broad, length of body from tip of snout to tip of ventral a little more than $1\frac{1}{2}$ in its greatest width. Head thick, depressed and rounded above; snout flexible, inferior, flattened, and rounded; eyes small, lateral, at some distance in advance of spiracles; nostrils large, rather close together, separated by thick, cartilaginous and fleshy frenum, which is coarsely papillose or warty; lips and nasal flaps very thick and fleshy; teeth in pavement-like plates; interorbital space broad, fontanelle hollow in middle, and on each side of this a little elevated and flattened. Spiracles large, oblique. Gill-openings moderate.

Body smooth.

Dorsal fin small, its base a little less than length of spiracle, inserted behind ventrals; caudal very long, filamentous; upper surface of tail with a compressed, pointed spine with serrated edges a little less in length than space between spiracles; ventrals long and free, bases rather narrow.

Color in alcohol, dusky brown above, with many rather large, whitish spots, distinct posteriorly; lower surface chalky white; tail blackish.

Total length, $54\frac{1}{2}$ inches; without tail, about 10 inches.

Description from a male taken at Tokyo.

Coasts of southern Japan, not uncommon. Our specimens from Hakodate, Tokyo, Onomichi, Hiroshima, Hakata, and Nagasaki. Some of these have the dermal thickening, or horn, over the eye, said to characterize *M. cornuta*, and others are without it. This is evidently not a specific character.

(*tobi-ei*, Flying Ray in Japanese.)

53. MYLIOBATIS NIEUHOFI (Bloch and Schneider).

Raja nieuhofii BLOCH and SCHNEIDER, Syst. Ichth., 1801, p. 364; Indian Sea (after Zee-Vleermuis of Nienhof, in Willughby, Appendix, p. 6, pl. x, fig. 3).

Myliobatis nieuhofii CUVIER, Règne Anim., 1st ed., 1817, p. 138.—MÜLLER and HENLE, Plagiostomen, 1838, p. 177.—DUMÉRIL, Elasmobranches, 1870, p. 638; Pondicherry.—GÜNTHER, Cat. Fish, VIII, 1870, p. 491; Pinang, Moluccas, Japan.

Raja fasciata SILLW., Gen. Zool., III, 1804, p. 286, pl. CXLIII (after Schneider).

Body smooth, disk about twice as broad as long. Fleshy prolongation of snout, short; no horn on orbit. Dorsal situated at beginning of base of tail, opposite end of insertion of ventrals, no spines posterior to it; tail about three times as long as disk. Color, olive superiorly, tinged externally with a reddish hue, and a dark, outer margin to disk; young have about seven blue bands across disk and two more between or close to eyes; as fish increases in size first bands on head disappear, and finally those on body. (Günther, Day.)

Indian Ocean and archipelago; a half-grown specimen in the British

Museum, said to be from Japan (coll. Jamrach). The record is very doubtful, but the species, if occurring in Japan, may be recognized by the anterior position of the dorsal fin, nearly over the root of the ventrals and by the very broad disk. It was not seen by us.

(Named for Dr. Jean Nicuhof, of Batavia, died in 1671, once governor of Ceylon, author of *Voyages par mer et par terre à differens lieux des Indes Orientales*, with 20 plates of fishes.

Family XXII. MOBULIDÆ.

SEA DEVILS.

Rays of enormous size, with the disk broader than long, and the pectoral fins not continued on the sides of the head, the anterior or cephalic portion being separate, developed as 2 long horn-like or ear-like appendages. Mouth wide, terminal or inferior. Teeth very small, flat or tubercular, in many series; those of the upper jaw sometimes wanting. Eyes lateral. Nostrils widely separated, their valves united, forming a flap as wide as the cleft of the mouth. Tail long and slender, whip-like, with a single dorsal fin at its base, and with or without a serrated spine. Ventral fins not emarginate. Skin more or less rough. Males without differentiated spines on the pectorals, the sexes similar. Ovoviviparous. Largest of all rays and among the largest of all fishes; the species few, found in the tropical seas.

7. Teeth in both jaws; mouth inferior *Mobula*, 43

43. MOBULA " Rafinesque.

- Mobula* RAFINESQUE, Indice d'Ittiol. Sicil., 1810, p. 61 (*auriculata*=*edentula*).
- Apterurus* RAFINESQUE, Indice d'Ittiol. Sicil., 1810, p. 62 (*fabroni*=*edentulus*).
- Cephalopterus* DUMÉRIl, in Risso Ichthyol., Nice, 1810, p. 14 (*giorna*=*edentula*; not of Geoffroy St. Hilaire, 1809, a genus of birds).
- Dicerobatus* BLAINVILLE, Jour. de Phys., 1816, p. 262 (*mobular*=*edentula*).
- Cephaloptera* (DUMÉRIl) CUVIER, Règne Animal, 1st ed., II, 1817, p. 138 (*giorna*).
- Ptercephala* SWAINSON, Nat. Hist. Fishes, II, 1839, p. 321 (*giorna*).

Head free from pectoral fin, truncated in front, with the cephalic fin on each side developed as a straight, horn-like appendage, pointing forward. Nostrils widely separated. Mouth inferior, wide. Teeth in both jaws very small, flat, or tubercular, in many series. Tail very slender, with a dorsal fin between the ventrals; the serrated spine present or absent. Species about 5, in tropical seas, reaching an enormous size and therefore not well known.

(*Mobular* is a name said to be used for the European species, *Mobula edentula* (Brünnich), "le diable des Caraïbes," in the Azores.)

^aThe name *Aodon*, accepted for this genus by Jordan and Evermann, was originally based on a shark of the Red Sea, *Aodon massasa*, said to have microscopic, serrated teeth, and very large pectoral fins. It may belong to the *Scylorhinida*.

54. *MOBULA JAPONICA* (Müller and Henle).

ITOMAKI-EI (SPOOL RAY).

Cephaloptera japonica MÜLLER and HENLE, Plagiostomen, 1836, p. 185; Nagasaki.—SCHLEGEL, Fauna Japonica, 1850, p. 310; Nagasaki.—DUMÉRIL, Elasmobranches, 1870, p. 659 (after Müller and Henle).

Dicorobatis japonica GÜNTHER, Cat. Fish, VIII, 1870, p. 496 (after Müller and Henle).

Teeth very minute, obtuse tubercles, extending laterally to the angles of the mouth. Back rough. Tail nearly thrice as long as

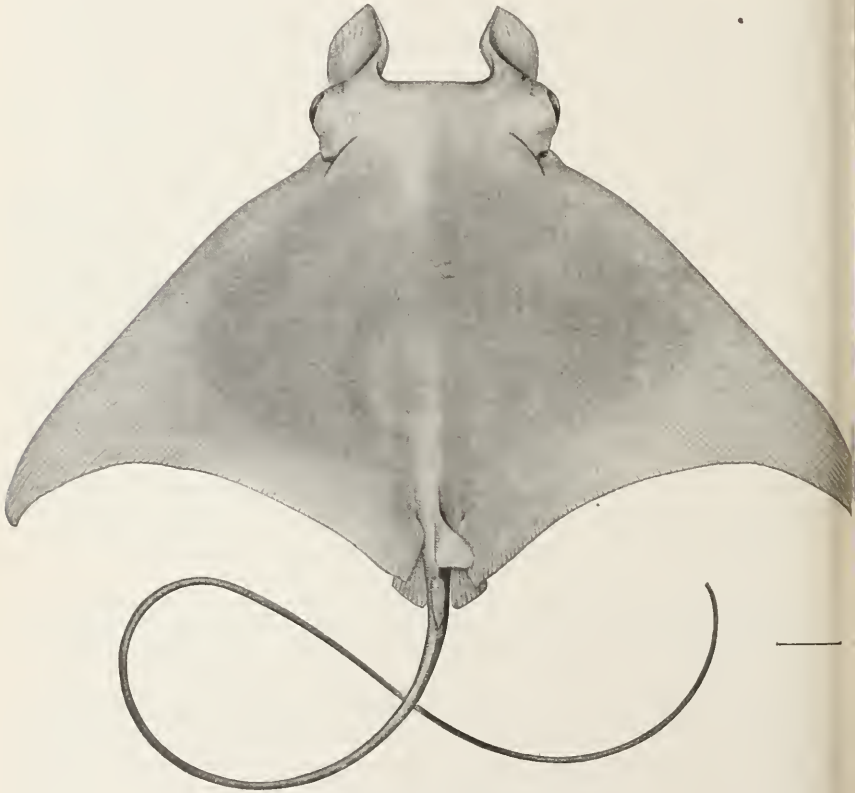


FIG. 10.—*MOBULA JAPONICA* (from a fetus).

body. On each side of tail, a series of small, white tubercles. (Günther, after Müller and Henle.)

Coasts of Japan, occasionally taken. A fetus, $2\frac{1}{4}$ inches long, was obtained by us from Kumakichi Aoki of Misaki. Two mounted specimens are in the museum at Hakodate, both from Volcano Bay. The largest is 8 feet across, the tail about twice the length of disk, which is a little more than twice as broad as long.

Subclass HOLOCEPHALI.

CHIMÆRAS.

Skeleton cartilaginous. Gill cavity with four clefts within, but having one external opening only, 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; a cartilaginous hook, with a brush of teeth at the tip (frontal holder) on the forehead of the adult 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, among existing fishes; many extinct forms belong to it, and the group is perhaps not less ancient than that of the sharks.

(ὄλος, solid; κεφαλή, head.)

Order V. CHIMÆROIDEI.

CHIMÆROIDS.

Characters of the order, included above. The group includes three existing families, Rhinochimæridæ (Bassalian), Chimæridæ, and Callo-rhynchidæ (Antarctic). The two families found in Japan are thus defined by Mr. Garman:

a. Proboscis long and pointed; lateral canal system subtubular; notochord with rings; cerebral hemispheres distant from both olfactory and optic lobes.

RHINOCHIMÆRIDÆ, XXIII.

aa. Proboscis absent; lateral canal system, sulcate; notochord with ring-like segments; cerebral hemispheres fused with the olfactory lobes, and distant from the optic lobes.....CHIMÆRIDÆ, XXIV.

Family XXIII. RHINOCHIMÆRIDÆ.

Snout very long, with a cartilaginous midrib, and foliaceous lateral expansions of the skin at the base. Two dorsal fins, the anterior one with an immense triangular spine, finely serrated on its lateral edges. Tail very elongate, with filamentous tip. Frontal region in the adult male with a "frontal holder," as in Chimæra. Ventral claspers small and simple, gill-openings separated by a wide isthmus. Lateral canal system subtubular; notochord with rings; cerebral hemispheres distant from both olfactory and optic lobes. Two genera—*Harriotta* in the deep waters below the Gulf Stream, and *Rhinochimæra* in similar situations in Japan. *Harriotta* has teeth much like those of *Chimæra*. *Rhinochimæra* is the most primitive of existing Chimæroids.

44. RHINOCHEMÆRA Garman.

Rhinocheimæra GARMAN, Proc. N. Eng. Zool. Club, 1901, II, p. 75 (*pacifica*).

Teeth without tritons or dental lamina, much like the horny covers of the jaws of tortoises or birds. Snout stronger and more compressed than in *Harriotta*. Japan, in deep seas.

(*ὄϊν*, snout: *χιμαίρα*, chimæra.)

55. RHINOCHEMÆRA PACIFICA (Mitsukuri).

Harriotta pacifica MITSUKURI, Zool. Mag., June, 1895, pl. xvi; Kurihama, near Misaki.

Rhinocheimæra pacifica GARMAN, Proc. N. Eng. Zool. Club, 1901, p. 75 (specimen bought in Japan).

No detailed description of this species has yet been given. Mitsukuri's paper reads as follows:

The reader's attention is called to Plate XVI, giving the figures of individuals of the Chimæroid group. The lower figure is copied, somewhat reduced, from the April number of the American Naturalist, and represents the new chimæroid *Harriotta raleighana*, which Messrs. Goode and Bean discovered among the collection made by the *Albatross*. Its habitat is said to be the coasts of Virginia, Maryland, and Delaware, 707-1080 fathoms.

The upper figure represents a chimæroid which has been for some years in the possession of the Zoological Museum of the Science College in the Imperial University of Tokyo. The specimen (male) was bought in the Tokyo market and is marked as from *Kurihama, province of Sagami*. There can be no doubt that fishermen of that village caught it in the deep water (200 fathoms or more) contiguous to Misaki. Its unique characters had not been noted by us.

Unfortunately, I am not yet in possession of the original description of *Harriotta raleighana* by Messrs. Goode and Bean; but the short description, the extremely elongate muzzle, and the feeble claspers, as well as a comparison of the two figures, leave no doubt in my own mind that the individuals figured belong to the same genus.

There can be very little question that they belong to different species. (1) The general shape of the body, (2) the shape and size of the pectoral and ventral fins, (3) the point to which these fins reach when back, (4) the shape and disposition of the dorsal fins, (5) distribution of lateral-line sense system, all seem to point to the specific distinction of Atlantic and Pacific specimens. The name of *Harriotta pacifica* will be appropriate to the Japanese species.

I hope to return to the subject and to give fuller notes at no distant date. The occurrence of this interesting genus in both the Pacific and Atlantic oceans is, however, an interesting fact well worthy of being placed on record as speedily as possible.

Of this species a few specimens have been obtained by Professor Mitsukuri in deep water off Misaki. These the senior author has examined, but has not minutely described.

Family XXIV. CHIMÆRIDÆ.

CHIMÆRAS.

Body elongate, rather robust anteriorly, tapering posteriorly. Head compressed, without proboscis, 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 laminae

(tritors) above and 2 below. No spiracles. Pectorals free, placed low; ventral fins abdominal, many rayed, provided in the male with elaspers, the male also with "frontal holders" on the forehead. 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, the canal system, sulcate. Notochord with ring-like segments. Cerebral hemispheres fused with the olfactory lobes, and distant from the optic lobes. (Garman.)

Three free gills and 2 half gills, 1 on each side; isthmus moderate; gill-rakers small. Oviparous, the egg cases long, elliptical, with silky filaments. Fishes of singular appearance, found only in the seas of the cold regions.

45. CHIMÆRA Linnæus.

ELEPHANT FISHES.

Chimæra LINNÆUS, Syst. Nat., 10th ed., 1758, p. 236 (*monstrosa*).

Hydrolagus GILL, Proc. Ac. Nat. Sci. Phila., 1862, p. 331 (*collicii*).

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 or trifid elaspers in the male, the form partly dependent on age or season; male also with rough appendages at the base of the 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, often more or less produced in a filament at tip. Skin smooth. Fishes of singular appearance; mostly of the northern seas; not valued for food.

(*Χίμαιρα*, chimæra, a fabulous monster, with the head of a lion, body of a goat, and tail of a serpent.)

56. CHIMÆRA PHANTASMA Jordan and Snyder.

GINZAME (SILVER SHARK).

Chimæra monstrosa SCHLEGEL, Fauna Japonica, Poiss., 1850, p. 300, pl. cxxxii; Nagasaki (not of Linnæus).

Chimæra phantasma JORDAN and SNYDER, Proc. U. S. Nat. Mus., 1900, p. 338; Tokyo.

Body very elongate, tapering from head into the long, filamentous tail. Head deep, oblong, its width about three-fifths its length, its

depth less than length; snout very deep, blunt, rounded, short, soft; eyes oblong, large, high, a little anterior, their length 3 in head (measured from surrounding cartilages); hook on tip of head in front of snout, depressible in sockets, and with its lower rounded extremity beneath, beset with many sharp spines, directed backward; mouth small, inferior, with thick lips; teeth of 10 laminae in upper jaw, forming a serrate cutting edge in front, and posteriorly broad, oblique, molar-like teeth are found; in mandible, 16 laminae, forming a serrate cutting edge in front, laminae becoming broad posteriorly and with a concave space in front at symphysis; no broad, posterior, molar-like teeth on mandible, edges of jaws elevated and enameled; nostrils large, close together, confluent with corners of mouth; space between eyes narrow, less than their diameter. Gill-openings small, in front of and below base of pectoral; isthmus broad, with a fold of skin across.

First dorsal arising directly behind head, armed with a long, curved, compressed, pointed spine, much longer than fin, when depressed, 7 times length of pupil, triangular in cross section, keeled in front, with a serrate edge, posterior edge, from its separation from the soft part of fin, grooved in middle, and with each of edges finely serrate; first dorsal is depressible in a deep groove; second dorsal long, even, of uniform height to base of upper caudal lobe; upper caudal lobe not so high as second dorsal, shorter than lower lobe, sinking on fin anterior to it; pectorals very long, broad at base, pointed, not reaching tips of elaspers; ventrals inserted behind tip of dorsal spine, broad, rounded, about equal to length of head; lateral line running around eye above and below, over the top of head, joined behind eyes and along sides superiorly.

Color in alcohol, brown above, white below, and washed with silvery; fins with their outer portions blackish.

Total length, $29\frac{3}{8}$ inches; without caudal filament, $19\frac{3}{8}$ inches.

This description is from a male taken in Sagami Bay. It differs from two other specimens from the same locality, and from the original type, in having the anal and caudal lobe below, confluent, and forming a single fin.

This species is not rare in rather deep water along the coast of Japan. We have secured three specimens from Misaki, besides the original type found by Mr. Otaki in the market of Tokyo.

(φαντάσμα, a vision.)

SUPPLEMENTARY NOTE.

In a recent letter (January, 1903) Dr. K. Kishinouye notes the discovery of the East Indian shark, *Stegostoma tigrinum* (Gmelin), on the coast of Japan, near Tokyo. It belongs near the *Hemiscylliidae*, being remarkable for the very long tail, half the length. Body with brown spots or bands.

SUMMARY.

Class ELASMOBRANCHII.

Subclass SELACHI.

Order I. NOTIDANI.

Family I. HEXANCHIDÆ.

1. *Heptanchias* Rafinesque.

1. *deani* Jordan and Snyder; *Aburazame*; Misaki.

Family II. CHLAMYDOSELACHIDÆ.

2. *Chlamydoselachus* Garman.

2. *anguineus* Garman; *Rabuka*, *Kagurazame*; Misaki.

Order II. ASTEROSPONDYLI.

Family III. HETERODONTIDÆ.

3. *Heterodontus* Blainville.

3. *japonicus* (Duméril); Misaki, Tokyo, Wakanoura, Kobe, Hakata, Nagasaki.

Family IV. SCYLIORHINIDÆ.

4. *Halaelurus* Gill.

4. *burgeri* (Müller and Henle); Nagasaki.

5. *Cephaloscyllium* Gill.

5. *umbroale* Jordan and Fowler; *Nanukazame*, *Oseibuka*; Nagasaki.

Family V. HEMISCYLLIDÆ.

6. *Chiloscyllium* Müller and Henle.

6. *indicum* (Gmelin); Keerun in Formosa.

7. *Orectolobus* Bonaparte.

7. *barbatus* (Gmelin); Nagasaki, Hakata.

7a. *Stegostoma* Müller and Henle.

7a. *Tigrinum* (Gmelin); not seen.

Family VI. CARCHARIDÆ.

8. *Mustelus* Cuvier.

8. *manazo* Bleeker; *Hoshizame*; Hakodate, Aomori, Matsushima, Tokyo, Misaki, Kobe, Onomichi, Hiroshima, Hakata.

9. *Triakis* Müller and Henle.

9. *scyllium* Müller and Henle; *Korozame*; Tokyo, Tsuruga, Onomichi, Hakata.

10. *Galeus* Rafinesque (*Galeorhinus* Blainville).

10. *japonicus* (Müller and Henle); *Yerakufuka*; Nagasaki, Onomichi, Hiroshima.

11. *Galeocerdo* Müller and Henle.

11. *tigrinus* Müller and Henle; Nagasaki.

12. *Prionace* Cantor.12. *glauca* Linnaeus; Misaki.13. *Carcharias* Rafinesque (*Carcharhinus* Blainville).13. *japonicus* (Schlegel); *Mejiro*, *Wanizame*; Hakodate, Tokyo, Wakanoura, Kawatana, Nagasaki.14. *Scoliodon* Müller and Henle.14. *laticaudus* (Müller and Henle); not seen.15. *acutus* (Rüppell); not seen.16. *walbechmi* (Bleeker); Nagasaki, Kawatana.

Family VII. SPHYRNIDÆ.

15. *Sphyrna* Rafinesque.17. *zygæna* (Linnaeus); *Shimokuzame*, *Kasebuzame*; Misaki, Wakanoura, Nagasaki.

Family VIII. ALOPIIDÆ.

16. *Alopias* Rafinesque.18. *vulpes* (Gmelin); *Onogazame*, *Nadebuka*, *Nezamezame*; Tokyo, Yokohama, Nagasaki.

Family IX. MITSUKURINIDÆ.

17. *Mitsukurina* Jordan.19. *owstoni* Jordan; Misaki.

Family X. LAMNIDÆ.

18. *Isuropsis* Gill.20. *glauca* (Müller and Henle); *Aozame*, *Morozame*; Matsushima, Nagasaki.19. *Lamna* Cuvier.21. *cornubica* (Gmelin); not seen.20. *Carcharodon* A. Smith.22. *carcharias* (Linnaeus); Misaki.

Family XI. CETORHINIDÆ.

21. *Cetorhinus* Blainville.23. *maximus* (Gunner); *Ubazame*, *Tenguzame*, *Bakazame*, *Zozame*; not seen, but reported on good authority.

Family XII. RHINEODONTIDÆ.

22. *Rhineodon* A. Smith.24. *typicus* Smith (*pentalineatus* Kishinouye); not seen.

Order III. TECTOSPONDYLII.

Family XIII. SQUALIDÆ.

23. *Squalus* Linnaeus.25. *mitsukurii* Jordan and Snyder; Aomori, Misaki, Awa, Kagorhima, Boshu.

24. *Lepidorhinus* Bonaparte26. *foliaceus* (Günther); Misaki.25. *Deania* Jordan and Snyder.27. *eglantina* Jordan and Snyder; Totomi Bay.26. *Zameus* Jordan and Fowler.28. *squamulosus* (Günther); Misaki.27. *Etmopterus* Rafinesque.29. *lucifer* Jordan and Snyder; *Bozuzame*; Misaki.28. *Centroscyllum* Müller and Henle.30. *ritteri* Jordan and Fowler; Misaki.

Family XIV. DALATIIDÆ.

29. *Dalatias* Rafinesque.31. *licha* (Bonnaterre); *Yoroizame*; Misaki.30. *Somniosus* Le Sueur.32. *microcephalus* (Bloch and Schneider); Tokyo.

Family XV. PRISTIOPHORIDÆ.

31. *Pristiophorus* Müller and Henle.33. *japonicus* Günther; *Nokogirizame*, *Hokobuka*, *Daigirizame*, Aomori, Nagasaki.

Family XVI. SQUATINIDÆ.

32. *Squatina* Duméril.34. *japonica* Bleeker; *Tenguzame*, *Kasuzame*, *Korozame*; Nagasaki, Kobe.

Order IV. BATOIDEI.

Family XVII. RHINOBATIDÆ.

33. *Rhina* Bloch and Schneider.35. *ancylostomus* Bloch and Schneider; Kinkwazan, Matsushima Bay.34. *Rhynchobatus* Müller and Henle.36. *djiddensis* (Forskål); *Tongari*, *Kotainoza*, *Kasuka*, *Shinosaki*, *Sakafute*; Onomichi, Hiroshima, Hakata, Tsuruga.35. *Rhinobatus* Bloch and Schneider.37. *schlegeli* Müller and Henle; *Sakatazame*; Tokyo, Wakanoura, Onomichi, Hakata, Nagasaki.38. *polyophthalmus* Bleeker; Wakanoura, Hiroshima, Hakata, Nagasaki.

Family XVIII. RAJIDÆ.

36. *Discobatus* Garman.39. *sinensis* (Bloch and Schneider); *Uchivazame*; Hiroshima, Wakanoura.

37. *Raja* Linnaeus.

40. *isotrachys* Günther; not seen.
 41. *fusca* Garman; not seen.
 42. *meerdervoorti* Bleeker; *Sebita*; Tokyo, Nagasaki, Kobe, Wakanoura, Hakodate.
 43. *kenojei* Schlegel; *Kenoji*, *Genjiei*, *Kasube*, *Igaï*, *Rentiei*; Misaki, Tokyo, Wakanoura, Kobe, Tsuruga, Nagasaki.
 44. *tengu* Jordan and Fowler; *Tenguji*; Aomori, Hakodate, Matsushima.

Family XIX. NARCOBATIDÆ.

38. *Astrape* Müller and Henle.

45. *japonica* Schlegel; *Shibireci*; Wakanoura.

Family XX. DASYATIDÆ.

39. *Urolophus* Müller and Henle.

46. *fuscus* Garman; *Junoruci*; Tokyo, Kobe, Hiroshima, Hakata, Wakanoura.
 40. *Dasyatis* Rafinesque.
 47. *kuhlî* (Müller and Henle); Tokyo, Misaki, Hakodate, Wakanoura, Onomichi, Hiroshima.
 48. *akajei* (Müller and Henle); *Akajî*; Matsushima, Tokyo, Misaki, Wakanoura, Onomichi, Hiroshima, Tsuruga, Hakata, Kawatana, Nagasaki.
 49. *zugji* (Müller and Henle); *Zugji*; Tokyo, Kobe, Wakanoura, Onomichi, Hiroshima.
 50. *gerrardi* (Gray); not seen.

41. *Pteroplatea* Müller and Henle.

51. *japonica* (Schlegel); *Tsubakuraji*, *Yokosaji*; Tokyo, Wakanoura, Hiroshima, Hakata, Kawatana, Nagasaki.

Family XXI. MYLIOBATIDÆ.

42. *Myliobatis* Duméril.

52. *tobiji* Bleeker; *Tobiji*; Hakodate, Tokyo, Onomichi, Hiroshima, Hakata, Nagasaki.
 53. *nienhofi* (Bloch and Schneider); not seen.

Family XXII. MOBULIDÆ.

43. *Mobula* Rafinesque.

54. *japonica* (Müller and Henle); *Itomakiei*; Misaki, Volcano Bay.

Subclass HOLOCEPHALI.

Order V. CHIMÆROIDÆ.

Family XXIII. RHINOCHEMÆRIDÆ.

44. *Rhinoclimax* Garman.

55. *pacifica* (Mitsukuri); Kurihama, Misaki.

Family XXIV. CHIMÆRIDÆ.

45. *Chimæra* Linnaeus.

56. *phantasma* Jordan and Snyder; *Ginzam*; Sagami Bay, Tokyo.