

Studies on Some Japanese Fishes of the Family Gempylidae

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THOUGH THE FISHES of the family Gempylidae have long been of interest to ichthyologists and though considerable literature concerning this family has accumulated, the group still is far from being satisfactorily understood.

Since the publication of "Gempylidae of Japan" by Dr. Toshiji Kamohara in 1938, some additional facts have come to light, and several discrepancies have been found to exist between his descriptions and our specimens. The present paper, supplementing Kamohara's, treats seven species of the family, referred to the genera *Neopinnula*, *Epinnula*, *Mimasea*, *Gempylus*, *Rexea*, *Nealotus*, and *Promethichthys*. The specimens thus far examined were all taken by deep-sea trawlers off the Pacific coast of Japan at a depth of about 100 fathoms, and all are deposited in the Department of Fisheries, Faculty of Agriculture, Kyoto University. *Neopinnula*, described as a new genus, is based on *Epinnula orientalis* Gilchrist and von Bonde.

The family Gempylidae is closely related to the Scombridae and is apparently an offshoot from that family, divergent in the direction of the Lepidopidae and Trichiuridae. This family is distinguished, from the Scombridae at least, by having the dentition strong, the body usually elongated, and the ventral fin small, often reduced to a single spine, or even absent in adults.

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The few species comprising this family live in the high seas and are widely distributed in warm regions throughout the world.

The measurements of various parts of the body were made in the same way as those made by the senior author in his study on the scorpaenoid fishes of Japan (Matsubara, 1943: 6-7). We have carefully observed the gill rakers stained by alizarin red and cleared by potassium hydroxide.

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NEOEPINNULA new genus

The genus *Epinnula* was established by Poey (1854: 369) for the accommodation of his new species *E. magistralis*, which he obtained at Havana, Cuba. In 1924 another new species, *E. orientalis*, was added to this genus by Gilchrist and von Bonde (1924: 15, pl. 4, fig. 1) on the basis of a specimen taken from Natal, South Africa. On careful examination of specimens of these two species, we found some remarkable differences, on the basis of which we erect a new genus *Neopinnula*, with *N. orientalis* (Gilchrist and von Bonde) as genotype.

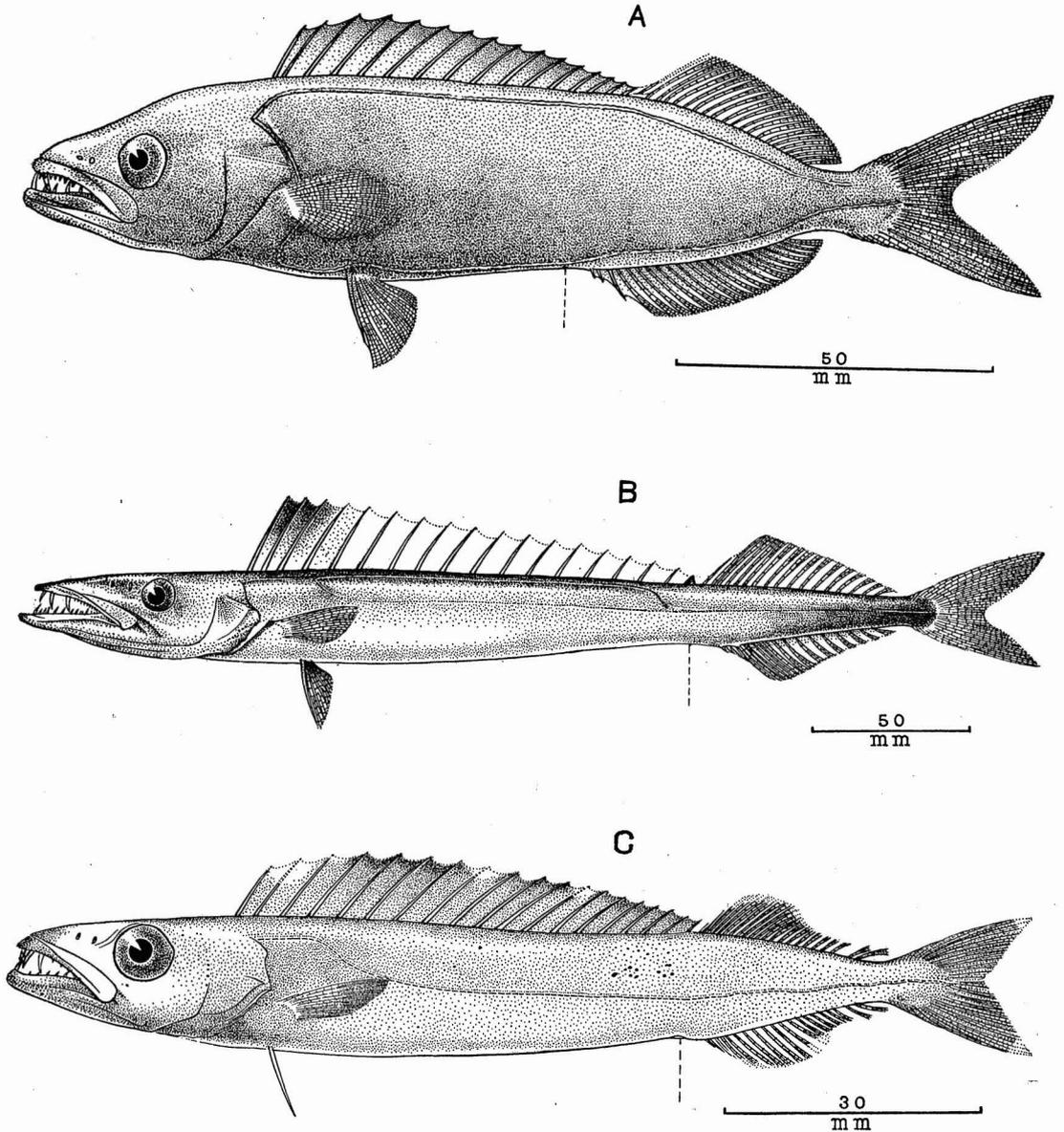


FIG. 1. Three species of Gempylidae. A, *Neopinnula orientalis* (No. 4258); B, *Mimasea taeniosoma* (No. 4114); C, *Promethichthys prometheus* (No. 4101). Drawn by Ryokai Ito.

Body rather stout, fusiform, and compressed, covered with minute imbricated scales. Several fangs, some depressible, on upper jaw near tip of snout. Vomer and palatines toothed. Two lateral lines, originating together above upper angle of gill opening. Dorsal fin inserted behind upper angle of gill opening; dorsals barely connected; spines

rather feeble and flexible. Ventrals I, 5. No finlets. Tail not keeled. Gill raker at angle of first arch (Fig. 2A₃) T-shaped; its inner surface armed with minute spines. Lining of buccal and branchial cavities and peritoneum black.

This genus differs from *Epinnula* as indicated in the key.

KEY TO THE GENERA OF JAPANESE GEMPYLIDAE

- 1a. Caudal peduncle with a keel on each side; scales of body unique, each large scale being surrounded by a network of small pored tubular scales; lateral line greatly undulated, reaching nearly to both back and belly.....
.....*Lepidocybium* (= *Xenogramma*; *Lepidosarda*)
- 1b. Caudal peduncle without lateral keel; scales not surrounded by a network of small-pored tubular scales; lateral line not greatly undulated.
- 2a. Abdomen keeled; skin spinigerous; lateral line obscure. Ventrals I, 5.....*Ruvettus*
- 2b. Abdomen not keeled; skin smooth; lateral line well-developed.
- 3a. Ventrals well-developed, their rays I, 5; no detached finlets.
- 4a. Body fusiform (depth about one fourth standard length); palatines toothed; lower lateral line running near lower contour of body; snout (Fig. 5C) not projecting beyond anterior extremities of premaxillaries.
- 5a. Vomer with 1 to 3 teeth on each side; the 2 lateral lines originating together at upper angle of gill opening; dorsal fin inserted behind upper end of gill opening; dorsal spines feeble and flexible; inner surface of gill raker at angle of first arch (Fig. 2A₃) armed with 2 rows of minute spines; lining of buccal and branchial cavities black.....*Neopinnula*
- 5b. Vomer edentulous; the 2 lateral lines bifurcating below membrane between fifth and sixth dorsal spines; dorsal fin inserted above posterior margin of preopercle; dorsal spines rather strong and pungent; inner surface of gill raker at angle of first arch not armed with spines; lining of buccal and branchial cavities pale.....*Epinnula*
- 4b. Body elongate (depth about one tenth standard length); palatines edentulous; lower lateral line running along middle of body; snout (Fig. 5A) projecting far beyond anterior extremities of premaxillaries.....*Mimasea*
- 3b. Ventrals greatly reduced or absent; detached finlets always present.
- 6a. Body greatly elongate (depth contained more than 12 times in standard length); detached finlets 5 to 7; ventrals minute, their rays I, 4 to I, 5, the soft rays hardly visible without aid of a lens; maxillary largely hidden under infraorbital membrane; gill raker at angle small, triangular; snout (Fig. 5B) projecting far beyond tips of premaxillaries. Two lateral lines, both originating above angle of gill opening.....*Gempylus*
- 6b. Body moderately elongate (depth contained less than 9 times in standard length); detached finlets usually 2; ventrals absent or each represented by a single spine; maxillary wholly exposed; gill raker at angle T-shaped; snout (Figs. 5 D-E) projecting little or not at all beyond tips of premaxillaries.
- 7a. Two lateral lines; ventral fins absent in adult.....*Rexea*
- 7b. One lateral line; ventral fins usually present.
- 8a. A dagger-shaped spine followed by a minute free spine behind vent; lateral line straight; each pore in lateral line with short upper oblique branch only; scales nonimbricate.....*Nealotus*
- 8b. No free spines behind vent; lateral line abruptly curved downward anteriorly; each pore in lateral line behind the anterior curved part bearing short upper and lower oblique branches; scales imbricate.....*Promethichthys*

Neopinnula orientalis
(Gilchrist and von Bonde)

Figs. 1A, 2A, 5C

Epinnula orientalis Gilchrist and von Bonde, 1924: 15, pl. 4, fig. 1; Barnard, 1927: 790; Kamohara, 1936a: 18; 1938a: 48, pl. 3, fig. 4; 1938b: 20; 1940: 95, fig. 44; 1942: 108; Smith, 1949: 311, fig. 865.

MATERIAL DESCRIBED: No. 1970 (the numbers refer to Matsubara's Fish Collection, in which each specimen bears a separate number), 143 mm. in standard length (176.5 mm. in total length), off Owase, Kumano-Nada, January 4-9, 1936; Nos. 4258 and 4259, 129 and 179 mm. (159 and 219 mm.), off Owase, Kumano-Nada, January, 1937; No. 4430, 154.5 mm. (185 mm.), off Owase, Kumano-Nada, April, 1937; No. 5490, 122.5 mm. (151 mm.), off Choshi, Chiba Prefecture, November 20-26, 1937; No. 6235, 121.5 mm. (151 mm.), off Heta, Suruga Bay, March 26, 1939.

Since the publication of Gilchrist and von Bonde's description and figure of this rare fish in 1924, there was no record other than from South Africa until 1936, when Kamohara described it from the vicinity of Kochi, Japan. It is apparently known only from these two localities.

D. XVI, I, 19-20; A. III, 19-20; P. 13-14; V. I, 5; Br. 7. Head 3.21 to 3.44 in body length; depth 3.92 to 4.21. Snout 2.64 to 2.92 in head; eye 4.75 to 6.12; interorbital space 3.63 to 4.06; upper jaw 2.01 to 2.26; depth of caudal peduncle 4.00 to 4.75; pectoral 1.87 to 2.53; ventral 2.38 to 3.25; longest (4th) dorsal spine 3.30 to 4.00; longest (3rd) soft dorsal ray 2.74 to 4.22; caudal 1.17 to 1.41.

Body fusiform, rather stout and strongly compressed; depth about equal to length of head behind anterior nostril. Jaws rather ob-

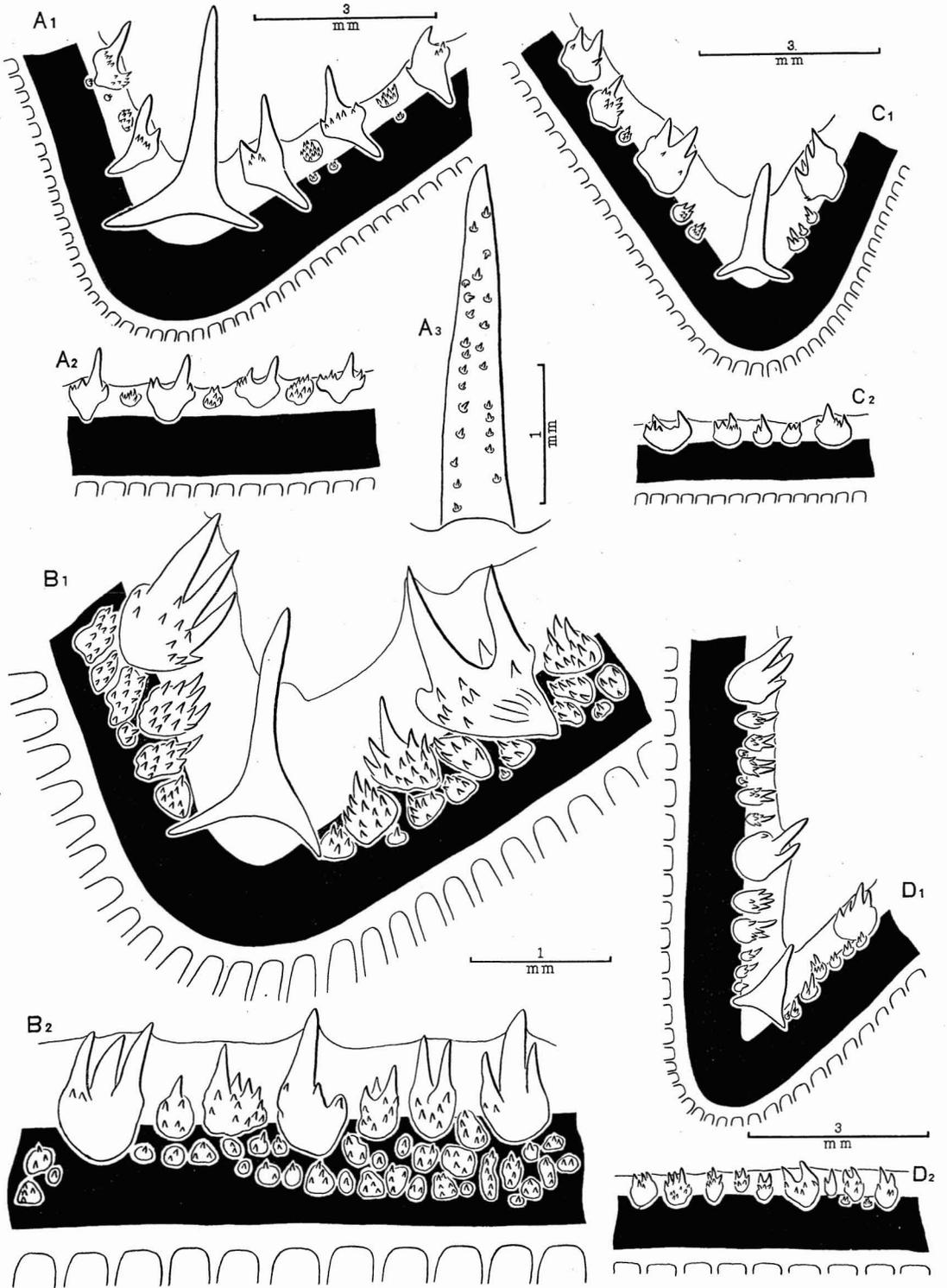
tuse, lower projecting beyond upper when mouth is closed. Mouth large, maxillary exposed, about 3 times as broad as least infra-orbital width, extending to below anterior edge of pupil or approximately to below middle of eye. Three or 4 fangs on upper jaw near tip of snout, of which 2 or 3 are immovable and the others depressible; lateral teeth on jaws conical and widely spaced, those of lower jaw much larger than those of upper; a pair of canines near the symphysis of lower jaw, exposed outside the closed mouth; 1 to 3 teeth on each posterior extremity of lateral edges of vomer; a single series of small conical teeth on palatines. Interorbital flattish in small specimens, but slightly convex in larger ones, always much wider than eye.

Upper lateral line gently elevated upward and backward to below base of second or third dorsal spine, then passing directly backward near dorsal base and ending below upper anterior end of base of caudal fin; lower one running downward and slightly backward to immediately below lower edge of base of pectoral, then turning downward and slightly forward, and finally extending near lower contour of body to base of middle caudal ray. Head and body, except maxillaries, lower lip, throat, and branchiostegal membrane, wholly covered with small scales.

Base of spinous part of dorsal about twice as long as that of soft part; soft dorsal about as large as anal fin, which is preceded by 3 small spines. Pectoral slightly longer than ventral, extending to below sixth dorsal spine; ventral inserted a little behind middle of pectoral.

Gill rakers distinctive (Fig. 2A): small, mostly hidden under the skin; each usually with a single cusp and a vertically elongated basal plate, and armed with many small spines; gill raker at angle T-shaped with more

FIG. 2. Outer face of first gill arch in four species of Gempylidae. Bony part of gill arch is black. A₁, A₂, and A₃, *Neopinnula orientalis*, showing, respectively, right side of region of angle, middle part of lower branch, and inner side of a raker at angle (No. 4259); B₁ and B₂, *Promethichthys prometheus*, showing, respectively, right side of region of angle and middle part of lower branch (No. 4101); C₁ and C₂, *Mimasea taeniosoma*, showing, respectively, left side of region of angle and middle part of lower branch (No. 4114); D₁ and D₂, *Gempylus serpens*, showing, respectively, left side of region of angle and middle part of lower branch (No. 57). Drawn by authors.



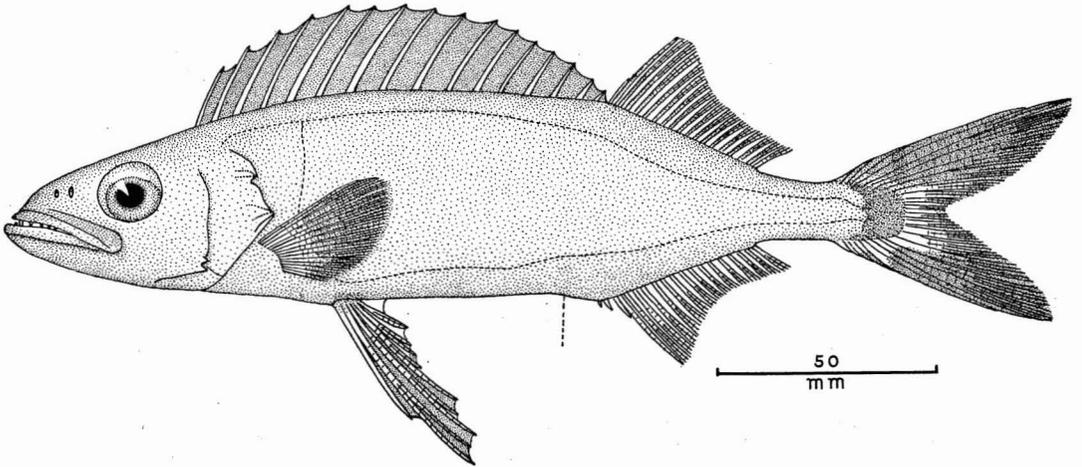


FIG. 3. *Epinnula magistralis* (No. 13961). Drawn by senior author.

than two thirds of length exposed and inner surface armed with 2 longitudinal series of minute spines (Fig. 2A₃).

Color in formalin uniformly bluish brown, not paler below; fins pale except for the blackish spinous dorsal; lining of buccal and branchial cavities black.

REMARKS: Our six specimens agree fairly well with the figure and brief descriptions by Kamohara. In our specimens, however, the ventral origin lies slightly behind the middle of the pectoral, as in those of Kamohara; not behind the tip of the pectoral, as indicated in the original description and figure. We, therefore, identify our fish with some doubt.

EPINNULA Poey

Epinnula Poey (1854: 369—type *E. magistralis* Poey).

Body rather stout, fusiform, and compressed; covered with minute imbricated scales. Several fangs, some depressible, on upper jaw near tip of snout. Vomer edentulous, but palatines with a series of small teeth. Lateral line bifurcating beneath anterior part of spinous dorsal. Dorsal fin inserted before upper angle of gill opening; dorsals barely connected; spines rather stout and inflexible. Ventrals I, 5. No finlets. Tail not keeled. Gill raker at angle of first gill arch T-shaped, with

inner surface smooth. Lining of buccal and branchial cavities pale, but peritoneum black.

Epinnula magistralis Poey

Figs. 3-4

Epinnula magistralis Poey, 1854: 369, pl. 32, figs. 3-4; Günther, 1860: 349; Goode and Bean, 1895: 198, pl. 57, fig. 211; Jordan and Evermann, 1896: 880; Kamohara, 1938a: 48, pl. 3, fig. 3; 1938b: 20; 1940: 93, fig. 43.

MATERIAL DESCRIBED: No. 13961 (Matsubara's Fish Collection), 188 mm. in standard length (242 mm. in total length), off Owase, Kumano-Nada, October 2, 1950.

This species was originally described from a specimen obtained at Havana in September, 1853. There has since been obtained a single specimen from the Caribbean Sea in 1885 (Goode and Bean) and two from Japan (Tosa Bay and Kumano-Nada) in 1938 (Kamohara). Until recently, therefore, this fish has been supposed to be confined to the West Indies. The Japanese specimens, however, differ markedly from the descriptions of Atlantic fish in the length of the ventral fin and in certain numerical characters.

D. XVI, I, 18; A. III, 16; P. 15; V. I, 5; Br. 7. Head 3.13 in body length; depth 3.91; width 9.35; distance from tip of snout to

origin of dorsal fin 4.01. Snout 2.88 in head; eye 4.29; fleshy interorbital space 3.65; bony interorbital 4.96; upper jaw 2.35; depth of the caudal peduncle 4.80; pectoral 1.87; ventral 1.25; longest (5th) dorsal spine 2.51; longest (2nd) soft dorsal ray 2.75; longest (1st) anal ray 2.83; caudal 1.06.

Body rather stout, fusiform, and strongly compressed; depth about equal to length of head behind anterior nostril; width about equal to one third the length of head. Upper profile of head slightly elevated before anterior nostril, then nearly straight to insertion of dorsal fin. Snout not projecting beyond premaxillaries. Muzzle bluntly conical; lower jaw projecting beyond tip of snout a distance about one third as long as pupil. Mouth large; maxillary not hidden under infraorbital membrane, extending a little behind anterior border of pupil, the width about twice the least infraorbital width. Two fangs on each side of upper jaw near tip of snout, anterior one of right side depressible, the others immovable; lateral teeth on jaws conical and widely separated; those of lower jaw larger than those of upper; a pair of canine-like teeth near symphysis of lower jaw, exposed outside closed mouth; vomer evidently edentulous; a single longitudinal series of small conical teeth on palatines. Eye round, not entering upper profile of head, about two thirds as long as snout; infraorbital less than half as wide as pupil. Interorbital about 1.2 times as broad as eye; with 4 low longitudinal ridges; space between inner pair of ridges very slightly concave; outer part of outer ridges more or less elevated. Angle of preopercle armed with 2 small but rather pungent spines; opercle strengthened by 2 obscure ridges, not ending in spines.

Lateral line inserted above upper end of gill opening, running backward to point of bifurcation beneath the membrane between fifth and sixth dorsal spines; upper branch running directly backward close to and parallel dorsal contour of body and ending at base of middle caudal ray; lower branch

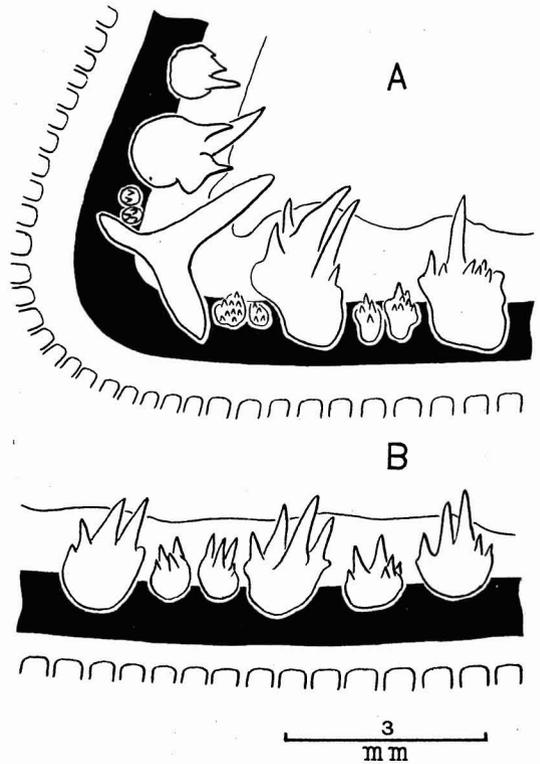


FIG. 4. Outer face of first gill arch in *Epinnula magistralis* Poey. A, region near angle on right side; B, middle part of lower branch on right side. Drawn by authors.

running directly downward to behind middle part of base of pectoral fin, then passing downward and slightly backward to above origin of ventral, and finally extending along lower contour of body to base of caudal fin. Head and body—except lips, lower jaw, anterior half of maxillary, and branchiostegal membrane—wholly covered with small imbricated scales.

Base of spinous part of dorsal fin about 2.5 times as long as that of soft part; soft dorsal about as long as anal fin and preceded by a weak spine; anal opposite soft dorsal, preceded by 3 spines, the first inserted under base of first soft dorsal ray; margins of soft dorsal and anal shallowly but widely concave. Pectoral rather short, about two thirds as long as ventral, extending to below eighth dorsal spine. Ventral inserted below middle of pectoral, very long, about as long as head

behind anterior nostril and extending nearly to vent; ventral spine also very long, about as long as pectoral. Caudal deeply forked.

Gill rakers (Fig. 4) small, mostly hidden under the skin, each usually armed with 3 or 4 sharp cusps and provided with a broad, roundish, never vertically elongated basal plate armed with 1 to 5 small accessory spines; 1 or 2 small accessory rakers, armed with small spines, interpolated between some larger rakers; raker at angle of first gill arch T-shaped, with about one third of its entire length exposed; its inner surface not armed with minute spines.

Color of body when fresh, before preservation, light grayish blue, not paler below; head more or less darker. Interradial membranes of spinous dorsal and those of ventral fin before third soft ray jet-black; basal part of caudal fin dark blue; caudal fin jet-black except for the whitish 8 shorter rays near axis of body; pectoral and rays of soft dorsal spotted with black; anal pale. Buccal and branchial cavities pale, but peritoneum black.

REMARKS: Our single specimen differs from the descriptions of Atlantic specimens in having a larger number of dorsal rays (XVI, I, 18, instead of XV, I, 16), a larger number of anal soft rays (16 instead of 13), and a shorter snout (1.5 times instead of twice the diameter of eye), and in having the longer ventral fin about 1.5 times as long as the pectoral, reaching nearly to the vent rather than being about two thirds as long as the pectoral, and far removed from the vent when the fin is laid back. These discrepancies, however, appear to be attributable largely to the difference in size of the specimens, inasmuch as ours is merely 242 mm. instead of 980 mm. long.

Our specimen agrees well with Kamohara's description (1938a: 48, pl. 3, fig. 3) except in having slightly fewer anal soft rays (16 instead of 17) and a somewhat longer ventral fin (the fin 1.25 instead of 1.6 to 1.7 in length of head).

Apart from the generic differences afore-

mentioned, this species may be distinguished from *Neopinnula orientalis* in having much larger eyes, fewer anal soft rays (16 or 17 instead of 19 or 20), and a longer ventral fin (in our single specimen of this species, 188 mm. in standard length, the ventral measures 1.25 in the head length, whereas in 2 specimens of *N. orientalis*, Nos. 13960 and 4259, 177 and 179 mm. long, this fin measures 3.17 and 3.25, respectively).

E. magistralis appears to be a pelagic species. Its stout body, strong dorsal spines, and colorless buccal and branchial chambers favor this interpretation, which is strongly supported by the fact that it has well-developed ventral fins—at least as indicated by the immature specimen examined by us.

MIMASEA Kamohara

Mimasea Kamohara (1936b: 929—type *M. taeniosoma* Kamohara).

This monotypic genus is closely related to *Neopinnula* and *Epinnula*, with which it agrees in having well-developed ventrals and in lacking detached finlets. It resembles *Gempylus* in form of body and structure of the snout, which is rather sharply pointed, terminates in a large conical cartilaginous process, and projects far beyond the anterior extremities of premaxillaries (Fig. 5A). In other genera of this group the premaxillaries terminate at the anterior extremity of the snout. Thus, the present genus is intermediate between *Neopinnula* and *Epinnula* on the one hand and *Gempylus* on the other. *Gempylus* is apparently the most specialized of these genera. The species of *Gempylus* have greatly elongated bodies and ventral fins of greatly reduced size, represented by one spine and four or five weak soft rays.

Mimasea taeniosoma Kamohara Figs. 1B, 2C, 5A

Mimasea taeniosoma Kamohara, 1936b: 929, fig. 1; 1938a: 47, pl. 3, fig. 3; 1938b: 20; 1940: 96, fig. 45.

MATERIAL DESCRIBED: No. 4114, 280 mm. in standard length (322.5 mm. in total length), off Owase, Kumano-Nada, January, 1937.

This rare species, the genotype of *Mimasea*, was based on three specimens taken near Kochi City. Later, two other specimens, since lost, were taken by him at the same locality. Our single specimen differs in some features from Kamohara's rather brief description.

D. XVIII, 16; A. I, 16; P. 13; V. I, 5; Br. 8. Head 3.83 in body length; depth 9.82. Snout 2.09 in head; eye 6.96; interorbital 6.96 (bony width 7.86); upper jaw 2.15; depth of caudal peduncle 8.17; pectoral 2.70; ventral 3.32; longest (2nd) dorsal spine 2.61; longest (3rd) anal ray 3.95; caudal 1.74.

Body greatly elongated and strongly compressed, at its middle about half as wide as deep. Snout (Fig. 5A) rather sharply conical; lower jaw also sharply pointed, projecting beyond tip of snout a distance equal to half diameter of eye. Mouth large; maxillary not hidden under infraorbital membrane, extending to below front edge of eye, the width at the extremity a little greater than the least infraorbital width. Three fangs on each side of upper jaw near tip of snout, second one on right side and first and third on left side depressible, the others immovable; a pair of canines near symphysis of lower jaw; lateral teeth on jaws conical, those on lower jaw much larger and more widely spaced than those on upper jaw; no teeth on vomer or palatines. Interorbital shallowly concave, its least width equal to diameter of eye.

Lateral line inserted above angle of gill opening, bifurcating slightly behind vertical from base of fourth dorsal spine; lower branch abruptly curved backward and downward from bifurcation, to run along middle of body to base of middle caudal ray; upper branch coursing directly backward near dorsal to below a point slightly before penultimate dorsal spine, where it suddenly curves downward and ends immediately before reaching lower branch (Fig. 1B). Posterior part of body covered with minute scales, which occupy an

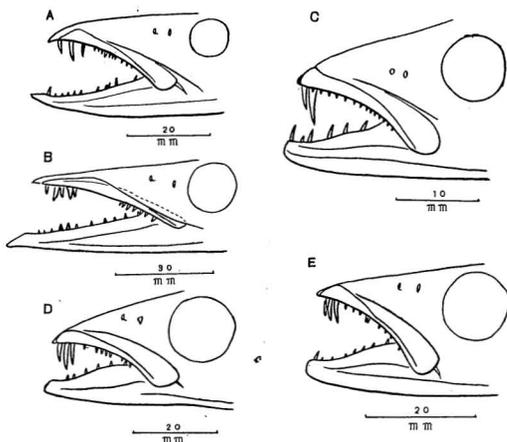


FIG. 5. Anterior portion of head of five species of Gempylidae, showing form of snout and extension of anterior extremity of premaxillary. A, *Mimasea taeniosoma*; B, *Gempylus serpens*; C, *Neopinnula orientalis*; D, *Rexea solandri*; E, *Promethichthys prometheus*. Drawn by authors.

area of rather indefinite extent, extending from base of caudal forward to slightly beyond vertical from base of last dorsal spine.

Dorsal inserted above upper angle of gill opening; dorsal spines becoming progressively shorter posteriorly; last spine separated from soft dorsal, which is about as large as anal. Anal inserted below base of fourth dorsal ray; preceded by a single spine. Pectoral extending to below base of sixth dorsal spine. Ventral slightly shorter than pectoral; inserted somewhat behind base of pectoral. Caudal deeply forked, with subequal lobes.

Gill rakers (Fig. 2C) small, largely hidden under the skin; each usually with 3 to 4 cusps and armed with several spines, except the one at the angle, which is also small and is T-shaped, with only the distal part exposed; 1 or 2 small accessory rakers frequently interpolated.

Color in formalin dark brown, paler below; spinous dorsal blackish between first and fourth spines; other fins pale.

REMARKS: Our single specimen, the basis of the description and figures, differs from Kamohara's accounts of *Mimasea taeniosoma* in having somewhat fewer soft dorsal and pectoral rays (dorsal soft rays 17 to 18 and

pectoral rays 14, according to the original description) and longer ventrals (3.8 to 3.9 in head in the type). Probably each of these differences will be found to be included within the range of fluctuation when a larger number of specimens has been examined.

GEMPYLUS Cuvier

Gempylus Cuvier (1829: 200—type *G. serpens* Cuvier).

As one of the characteristics of the monotypic genus *Gempylus*, earlier authors (Jordan and Evermann, 1896: 884; Barnard, 1927: 789; Fowler, 1936: 636; Smith, 1949: 310) have mentioned "lateral line single." In his description of *Gempylus serpens*, however, Fowler (1936: 637) wrote: "Lateral line double, begins opposite base of first dorsal spine; upper branch extends high along back to a point opposite anterior elongated dorsal rays, where it suddenly becomes incomplete; lower branch complete to caudal base." In our single specimen referable to this species the lateral line is also double, but the upper branch ends at the base of the last dorsal spine.

In their definitions of the genus, Jordan and Evermann (1896: 884) and Fowler (1936: 636) mentioned the ventrals as having a spine and five soft rays. In our single specimen, however, the ventrals are composed of a spine and four soft rays, as described by Fowler (1936: 636) for the species. Cuvier (1829: 200), Goode and Bean (1895: 202), Barnard (1927: 789), and Longley and Hildebrand (1941: 73) indicated that the ventral is reduced to a single spine, but it seems very probable that they overlooked the soft rays, which are so minute that they can hardly be seen without the aid of a lens (Fig. 6B).

Gempylus differs from the other genera of this family in the form of the gill raker at the angle of the arch: it is very small and triangular and only its tip is exposed, instead of being T-shaped and moderately or greatly exposed (Fig. 2D). The maxillary (Fig. 6A)

is largely hidden under the infraorbital membrane, as in the trichiurids.

The sharply pointed snout terminates in a large conical cartilaginous process, which projects far beyond the premaxillaries (Fig. 5B).

The present genus seems to us to be a highly specalized offshoot of a line of genera which is represented in Japanese waters by *Neoepinnula*, *Epinnula*, and *Mimasea*.

Gempylus serpens Cuvier

Fig. 2D, 5B, 6

Gempylus serpens Cuvier, 1829: 200—based on *Serpens marinus* Sloane, 1707, "Voy. Jamaica," 1: 26, pl. 1, fig. 2; Cuvier, in Cuvier and Valenciennes (1831: 207); Günther, 1860: 352; 1873-75: 106, pl. 68, fig. B; Goode and Bean, 1895: 202, fig.; Jordan and Evermann, 1896: 884; Jordan, Tanaka, and Snyder, 1913: 122; Jordan and Jordan, 1922: 305; Barnard, 1927: 789; Fowler, 1928: 135; 1936: 636; 1938: 277; Howell Rivero, 1938: 185; Kamohara, 1940: 98, fig. 46; Longley and Hildebrand, 1941: 72; Fowler, 1944: 75, 295, 422, 463, 499, pl. 2, upper fig.; Smith, 1949: 311, fig. 864.

Lemnisoma thyrstitoides Lesson, 1830: 160; Jordan and Evermann, 1905: 179; Jordan and Seale, 1906: 228.

Gempylus thyrstitoides Fowler, 1938: 253.

Gempylus coluber Cuvier, in Cuvier and Valenciennes, 1831: 211, pl. 221; Günther, 1860: 353; Franz, 1910: 57.

MATERIAL DESCRIBED: No. 57, 488 mm. (552.5 mm.), Tokyo market, from Sagami Bay.

The only previous definite record of this rare fish from Japan is that of Franz.

D. XXVIII, I, 12+6; A. II, I, 11+6; P. 14; V. I, 4; Br. 7. Head 5.10 in body length; depth 15.75. Snout 2.20 in head; eye 5.64; interorbital 8.00 (bony width 8.80); upper jaw 1.92; depth of caudal peduncle 7.66; pectoral 2.00; ventral 22.80; longest (5th) dorsal spine 3.57; longest (2nd) soft dorsal

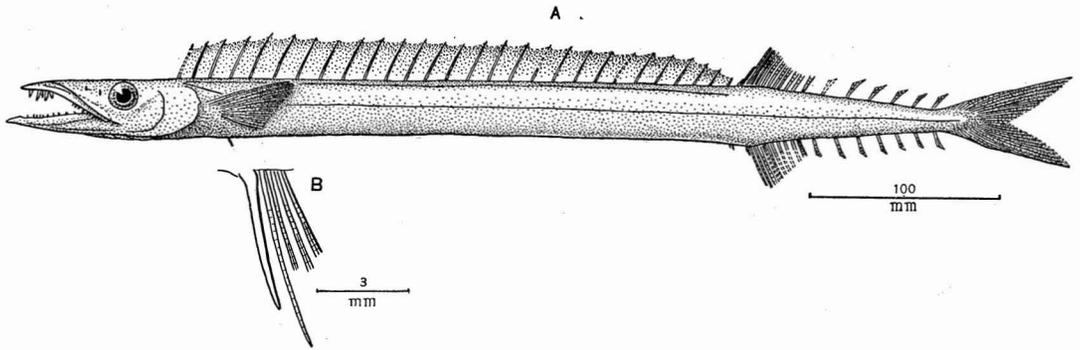


FIG. 6. *Gempylus serpens*. A, lateral view; B, ventral fin enlarged. Drawn by authors.

ray 3.57; longest (2nd) anal ray 4.26; caudal 1.57.

Body greatly elongated, strongly compressed, at its middle somewhat less than half as wide as deep. Snout (Fig. 5B) conical, acutely pointed, projecting far beyond premaxillaries; lower jaw also sharply pointed, extending far beyond tip of snout when mouth is closed, the distance between tip of snout and that of lower jaw about 2.30 in eye. Mouth large; maxillary largely hidden under the infraorbital membrane, extending to a little beyond anterior edge of eye, its width about equal to least infraorbital space. Five fangs on upper jaw near tip of snout, 3 on left side and 2 on right; the anteriormost on each side and the hindmost on the left side depressible; lateral teeth of jaws large, conical, and widely spaced; palatine teeth small and weak, uniserial; face of vomer rather rough, but evidently edentulous. Interorbital flat-tish, much narrower than eye.

Two lateral lines both inserted below base of first dorsal spine; upper line running high to abrupt end below base of last dorsal spine; lower line descending gently backward and downward to tip of pectoral, then running along middle of body to base of caudal fin. Small scales scattered on basal part of caudal fin.

Origin of dorsal midway between eye and insertion of pectoral; base of spinous part of dorsal about 1.90 in body length; soft dorsal about as long as anal, inserted slightly in

advance of first anal soft ray. Anal preceded by 2 minute isolated spines. Pectoral extending to below base of seventh dorsal spine. Ventral minute, inserted a little behind base of pectoral, with first soft ray much longer than either spine or other soft rays.

Gill rakers (Fig. 2D) small, mostly hidden under the skin; several much smaller ones set in a single series between the larger ones; both larger and smaller ones usually with a large basal plate and several small cusps.

Color in formalin uniformly dark brown, except for several small black spots scattered above base of pectoral. Fins all dark brown, with the margins somewhat darker.

REMARKS: The single specimen, the basis of our description and figures, agrees well with the published descriptions, except as noted under the genus and in having 28 instead of 29 to 32 dorsal spines and a slightly larger eye (5.64 in head instead of 5.8 to 7.0).

REXEA Waite

Rexea Waite (1911 [January 18]: 49—type *R. furcifera* Waite = *Gempylus solandri* Cuvier).
Jordanidia Snyder (1911 [May 6]: 527—type *J. raptor* Snyder).

According to Whitley (1929: 120) the genus *Rexea* was first proposed by Waite on January 18, 1911, not June 24, 1911, as stated by Jordan (1920: 541). The genus *Jordanidia* Snyder was proposed on May 26, 1911, and, therefore, must give precedence to the earlier name of Waite.

Rexea solandri (Cuvier)

Figs. 5D, 7-9

Gempylus solandri Cuvier, in Cuvier and Valenciennes, 1831: 215.*Thyrsites solandri* Günther, 1860: 352.*Jordanidia solandri* McCulloch, 1915: 150; 1934: 81, pl. 34, fig. 300a.*Rexea solandri* Whitley, 1929: 120, pl. 33, fig. 2; McCulloch, 1929: 269.*Thyrsites prometheoides* Bleeker, 1856: 42; Günther, 1860: 352; Tortonese, 1939: 154.*Jordanidia prometheoides* Schmidt, 1931: 41, fig. 5; Kamohara, 1938a: 50; 1938b: 20, fig. 8; 1940: 102, fig. 49.*Rexea furcifera* Waite, 1911 (January 18): 49.*Jordanidia raptorica* Snyder, 1911 (May 26): 527; 1912: 410, pl. 52, fig. 2; Jordan, Tanaka, and Snyder, 1913: 124; Kamohara, 1932: 148; 1934: 1199.

MATERIAL DESCRIBED: Nos. 1935, 1964, 1978, and 2124 (Matsubara's Collection), 101-242 mm. in standard length (119.5-290.5 mm. in total length), off Owase, Kumano-Nada, January 4-9, 1936; Nos. 2185 and 2186, 269 and 141 mm. (321 and 167 mm.), off Owase, December 25, 1935; Nos. 4100, 4102 to 4105, and 4260, 125-178 mm. (144-206 mm.), off Owase, January, 1939; No. 6234, 259 mm. (308.5 mm.), off Heta, Suruga Bay, March 26, 1939; No. 6785, 332.5 mm. (394 mm.), off Heta, November 22-24, 1938; Nos. 1185 and 1635, 100.5 and 168 mm. (115.5 and 200 mm.), Ensyu-Nada; Nos. 11934 and 11935, 162 and 139 mm. (196 and 169 mm.), off Kochi City, January, 1950.

D. XVII-XVIII, I, 15-16+2; A. I, 14-16+2; P. 13 or 14; V. I or absent; Br. 7. Head 3.02 to 3.42 in body length; depth 3.81 to 7.35. Snout 2.42 to 2.60 in head; eye 3.97 to 4.76; interorbital 4.22 to 5.17 (bony width 5.80 to 6.80); upper jaw 2.13 to 2.44; depth of caudal peduncle 6.12 to 7.55; pectoral 1.97 to 3.14; longest (4th) dorsal spine 3.31 to 4.09; longest (3rd) dorsal ray 3.09 to 4.15; longest (3rd) anal ray 3.24 to 4.30; caudal 1.42 to 2.00.

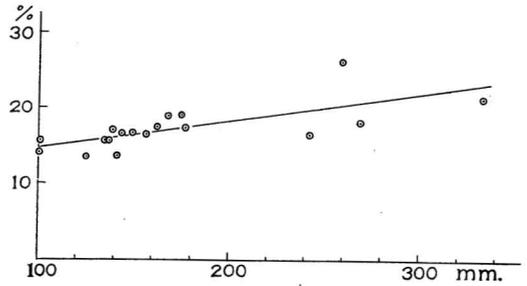


FIG. 7. Showing variation, with size, in depth of body in *Rexea solandri*. Proportional measurements (expressed in hundredths of standard length) are plotted against the standard length (mm.). Drawn by authors.

The 18 specimens vary greatly in proportions, especially in depth of body (Fig. 7), which gradually increases proportionally with size of the fish (standard length from 100.5 to 332.5 mm.). Body moderately elongated, deepest at the middle. In a specimen 259 mm. in standard length, however, the body is much higher than in the others (its depth is 263 thousandths of the standard length). Jaws conical; snout not projecting beyond the premaxillaries (Fig. 5D). Mouth large; maxillary not hidden under the infraorbital membrane, the extremity reaching slightly beyond anterior edge of eye or opposite anterior edge of pupil, its greatest width about twice the least infraorbital width. Fangs on upper jaw near tip of snout variable in number (Fig. 8); young fish smaller than 180 mm. in standard length typically having more than 3, usually 5 or 6, of which 3 are immovable and the others depressible; larger fish all bearing 3 immovable fangs; lateral teeth on jaws conical and widely spaced; a pair of canine-like teeth near the symphysis of lower jaw. Vomer edentulous; a single series of small teeth on palatines. Interorbital broadly and shallowly concave.

Lateral line inserted above upper angle of gill opening, bifurcating at or slightly before the vertical from base of fifth dorsal spine; upper line ending below middle of base of soft dorsal, lower one sometimes irregularly undulated on posterior part of body. Small

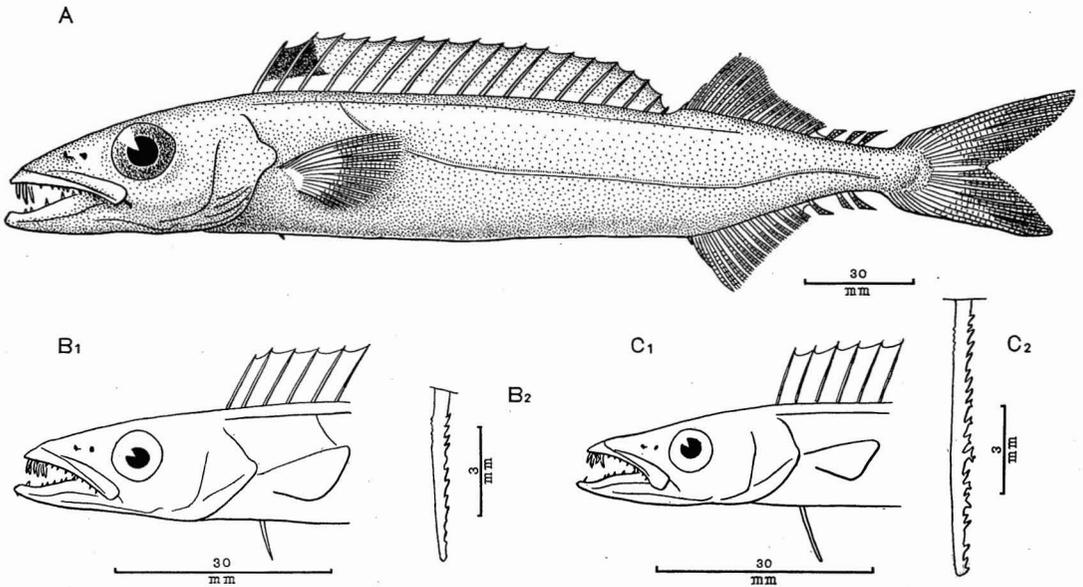


FIG. 8. *Rexea solandri*, showing variation, with size, in ventral fins and in number of fangs on upper jaw near tip of snout. A, No. 2124, measuring 242 mm. in standard length; B, No. 1935, 101 mm. long; C, No. 1936, much mutilated, smaller than preceding one. B₂ and C₂ showing ventral spines. Drawn by authors.

thin scales on posterior part of body only.

Soft dorsal and anal opposite, each preceded by a single spine and with last ray more or less remote from preceding one, but connected with it by a thin membrane. Pectorals extending to below base of sixth or seventh dorsal spine. Caudal deeply emarginated, with upper lobe the longer. Ventral fin absent or represented by a single spine; in specimens smaller than 242 mm. in standard length, spine always lying under middle of base of pectoral, as stated in original descriptions of *Gempylus solandri* and *Thyrsites prometheoides*. Spine with rather rough serrations along posterior margin and several much smaller ones along anterior edge near base (Fig. 8); variable in length and sometimes entirely hidden under skin, even in young specimens, but generally longer in younger ones, becoming shorter with growth of fish, finally becoming hidden under skin; entirely absent in specimens longer than 242 mm., as indicated in original description of *Jordanidia raptorica*.

Gill raker at angle of arch T-shaped, very

long, and about two thirds exposed. Other rakers rather hidden under skin, each having large basal plate and several small cusps. In 2 smaller specimens, 100.5 and 101 mm. long, basal plate of each raker unarmed. Rarely, a minute accessory raker present between large ones (Fig. 9A). In larger specimens basal plates armed with many small spines and usually 2 or more armed accessory rakers interpolated (Fig. 9B-C).

Body in life bluish gray, paler below, with strong silvery luster. A large black blotch always present at anterior part of spinous dorsal.

REMARKS: In 1931, Schmidt demonstrated that *Jordanidia raptorica* Snyder is a synonym of *Thyrsites prometheoides* Bleeker, and more recently Kamohara (1938a: 50; 1938b: 20; 1940: 103) has confirmed Schmidt's opinion. We further conclude that the two species just mentioned are referable to *Gempylus solandri* Cuvier, described from New Zealand. As has already been mentioned, the body is slender and the ventral is represented by a single spine in the younger specimens, but the relative depth of the body gradually increases and

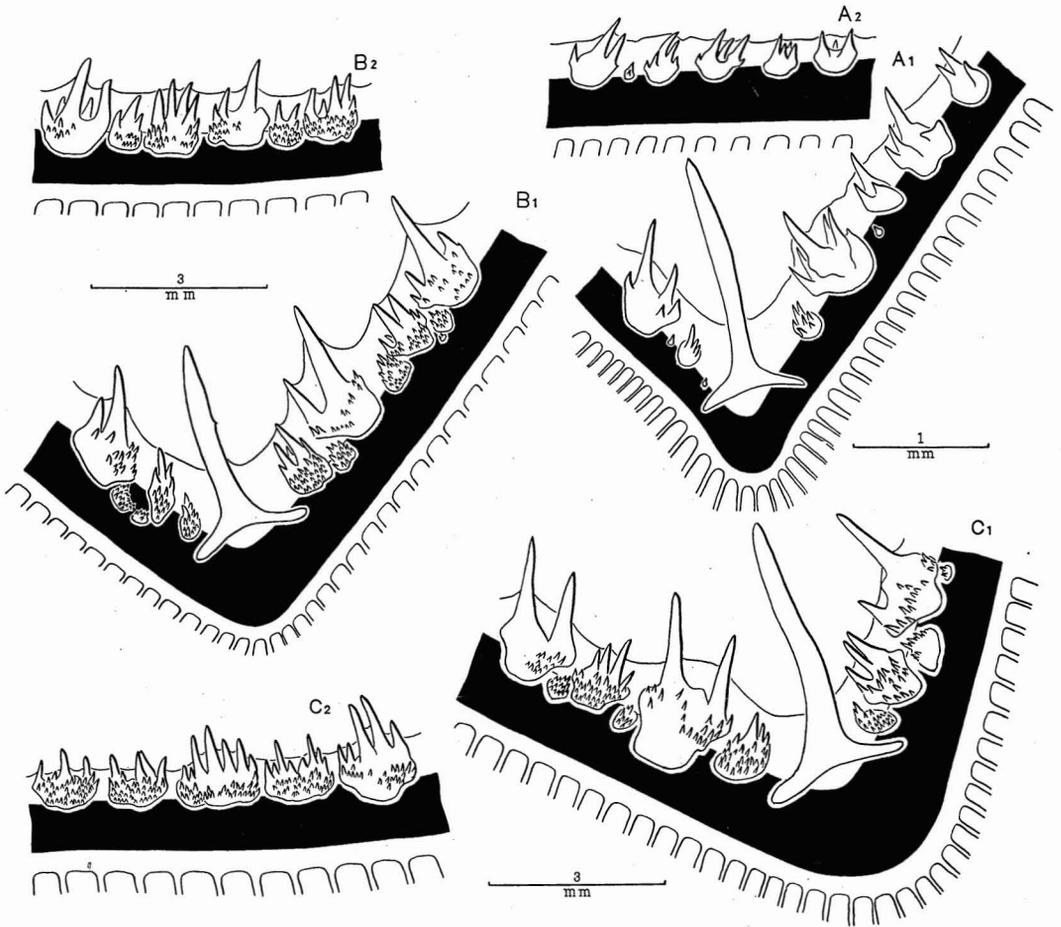


FIG. 9. Outer face of first gill arch in *Rexea solandri*, showing size variation of gill raker at angle of arch and o. rakers at middle part of lower branch. (Bony part of gill arch is black.) A₁ and A₂, right side, No. 1185, 100.5 mm. in standard length, provided with long ventral spine; B₁ and B₂, right side, No. 2124, 242 mm. in standard length, the largest one bearing ventral spine; C₁ and C₂, left side, No. 2185, measuring 269 mm. in standard length, lacking the ventral spine. Drawn by authors.

the spine becomes shorter with the growth of the fish, finally being hidden entirely under the skin. *Gempylus solandri* and *Thyrssites prometheoides* are described as having the body either moderately deep or rather slender (according to Günther, 1860: 352, the depth in total length is $5\frac{1}{3}$ in the former and $7\frac{1}{3}$ to $7\frac{1}{4}$ in the latter) and as having a single ventral spine, as in our younger specimens, whereas *Jordanidia raptor* is said to have the body moderately deep (depth 5.0 in body length) and the ventral spine entirely lacking, as in our larger specimens. Whitley's (1929: pl. 33, fig. 2) illustration of *Rexea solandri* shows the

body very deep (depth about 4.4) and the ventral absent, whereas McCulloch's (1934: pl. 34, fig. 300a) figure of *Jordanidia solandri* shows the body rather slender (depth about 5.4 in body length) and the ventral spine present.

McCulloch (1915: 151) distinguished *Jordanidia solandri* from *J. raptor* by its smaller eye and broader interorbital. However, in comparing our specimens with the description of *Rexea furcifera* Waite (1911: 49), which has been understood by Australian ichthyologists to be a synonym of *Rexea solandri* or *Jordanidia solandri*, we fail to confirm these

supposed differences (diameter of eye 4.8 and interorbital space 4.6 in head in *R. furcifera*).

In his description of *R. furcifera*, Waite mentioned "Ventral IV," but we think this is probably a misprint for "Ventral I."

Finally, we searchingly examined the descriptions of these four nominal species by various authorities and compared the other important characters as described with our specimens without finding any characteristics that would enable us to separate these species.

NEALOTUS Johnson

Nealotus Johnson (1865: 434—type *N. tripes* Johnson).

In general physiognomy, this genus closely resembles *Promethichthys* Gill but appears to differ in having a dagger-shaped spine behind the vent, followed by a minute spine; a straight lateral line; rather large nonimbricate scales; and a single short (dorsal) branch running upward and backward from each pore in the lateral line (Fig. 10A). *Promethichthys* lacks the isolated free spines behind the vent; its lateral line descends sharply downward and backward on the anterior curved part of the body (Fig. 1C); its scales are definitely imbricated and cover the whole body and head except for the snout, jaws, throat, and interorbital space; and each pore in its lateral line has short upper and lower branches running obliquely backward, except on the anterior curved part, where the pores have only an upper branch, as in *Nealotus* (Fig. 10B-C).

Nealotus tripes Johnson

Figs. 10A, 11, 12

Nealotus tripes Johnson, 1865: 434; Günther, 1887: 35; Goode and Bean, 1895: 199; Jordan and Evermann, 1896: 881; Smith and Pope, 1906: 465, fig. 1; Jordan, Tanaka, and Snyder, 1913: 123, fig. 89; Jordan and Hubbs, 1925: 221; Norman, 1930: 351, fig. 41; Fowler, 1936: 634; Kamohara, 1940: 99, fig. 47.

MATERIAL DESCRIBED: No. 13957, 199 mm. in standard length (237 mm. in total length),

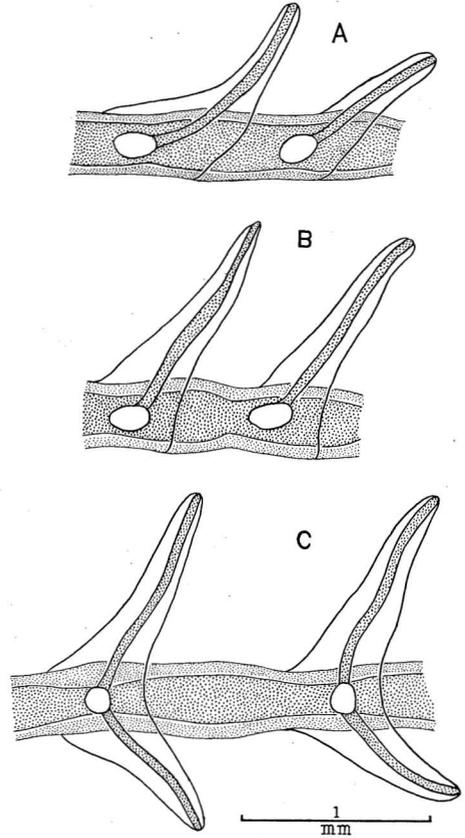


FIG. 10. Lateral line in two species of Gempylidae. A, anterior part in *Nealotus tripes*; B, curved part in *Promethichthys prometheus*; C, anterior section behind curved portion in *P. prometheus*. Drawn by authors.

off Owase, Kumano-Nada, October 2, 1950.

Originally described from one specimen taken at Madeira, this species has since been reported as follows: one specimen each from between the Bahamas and Madeira (Günther), from near Hamashima, Japan (Smith and Pope), and from near Misaki, Japan (Jordan and Hubbs); and two specimens from off the west coast of middle Africa (Norman).

D. XX, I, 17+2; A. II, I, 16+2; P. 12; V. I; Br. 7. Head 3.56 in body length; depth 6.63; width 12.75. Snout 2.43 in head; eye 5.00; interorbital 5.18 (bony width 5.65); upper jaw 2.03; depth of caudal peduncle 5.53; pectoral 1.75; ventral 12.15; longest (5th) dorsal spine 3.63; longest (4th) dorsal soft ray 3.27; dagger-shaped spine behind

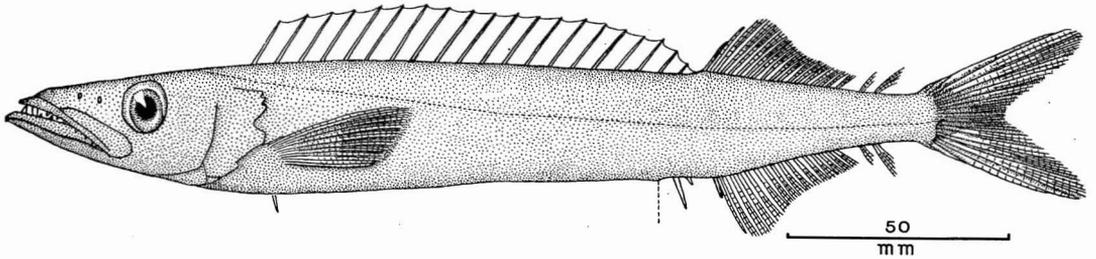


FIG. 11. *Neolotus tripes* (No. 13957). Drawn by senior author.

vent 8.22; longest (2nd or 3rd) anal soft ray 3.75; caudal 1.41.

Body very elongate and compressed, width anteriorly about half the depth. Upper profile of head nearly straight from tip of snout to insertion of dorsal fin. Snout slightly more than twice as long as eye, not projecting beyond premaxillaries. Jaws bluntly conical; lower jaw projecting beyond tip of snout a distance equal to one third diameter of eye. Mouth large; maxillary exposed, extending to below front edge of pupil, about 4 times as broad as least infraorbital width. Three fangs on each side of upper jaw near tip of snout, second one on right side and first and third on left depressible, but others immovable; a pair of canines near symphysis of lower jaw, entirely exposed immediately in front of closed mouth; lateral teeth on jaws conical and widely spaced, those on lower jaw rather larger than those on upper. Vomer edentulous; a single series of small teeth on palatines. Eye round, nearly entering upper profile of head, slightly less than half as long as snout; infraorbital very narrow, its least width about half that of pupil; interorbital space slightly narrower than eye, with 4 low longitudinal ridges; space between inner pair of ridges shallowly concave. Angle and lower edge of preopercle armed with several vestigial spines, invisible without aid of a lens. Border of opercle shallowly notched between 2 obtuse projections.

Lateral line single, inserted slightly before perpendicular through preopercular margin and running straight backward and slightly downward to base of caudal fin; each pore in

lateral line bearing a short branch, enclosed in a broad sheath and running backward and upward. Scales rather large, nonimbricate, scattered here and there on surface of head and body.

Dorsal fin inserted midway between tip of opercle and upper end of gill opening, much nearer insertion of pectoral than posterior border of eye; base of spinous dorsal a little more than 3 times as long as base of soft dorsal and about one-half length of body, excluding caudal fin; soft dorsal about as long as anal, preceded by a single spine and inserted slightly in advance of first anal soft ray. A flat dagger-shaped spine, little more than half as long as eye, located slightly behind vent; a small spine, hardly visible with naked eye, behind dagger-shaped spine. Soft anal inserted under third ray of soft dorsal and preceded by a spine; finlets 2 in dorsal and in anal. Pectoral rather long, extending to slightly beyond vertical from base of seventh dorsal spine; lower pectoral rays not especially shortened. Ventral reduced to a single smooth spine, about as long as pupil, inserted below middle of base of pectoral fin. Caudal deeply emarginated, with subequal lobes.

Gill raker at angle of arch T-shaped, very long, with somewhat more than half its entire length exposed; other rakers with a large roundish basal plate, armed with 3 or 4 sharp cusps and, usually, 1 to 3 small accessory spines; a minute accessory raker, armed with 1 to 3 small spines, interpolated between pairs of larger ones (Fig. 12).

In fresh state prior to preservation, head and body jet-black; pectoral and basal part

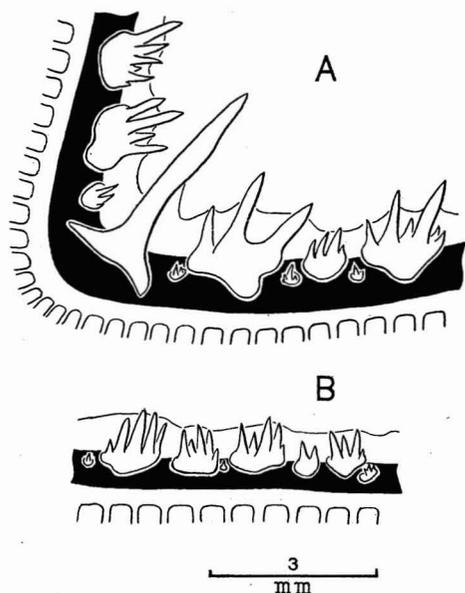


FIG. 12. Outer side of first gill arch in *Nealotus tripes*. A, region near angle on right side; B, middle portion of lower branch on right side. Drawn by authors.

and membranes of caudal dark brown; other fins entirely pale. After preservation, head and body somewhat paler. Buccal and branchial cavities and peritoneum jet-black.

REMARKS: In our specimen a minute spine can be seen with the aid of a lens immediately behind the dagger-shaped spine in front of the anal fin. This spine has hitherto been overlooked. A spine preceding the soft dorsal and the anal has been misinterpreted as a soft ray by most earlier authors. Our specimen differs from the type description of this species in having a deeper body, a longer snout, and fewer dorsal and anal soft rays (the type was described as having depth $9\frac{1}{2}$ in total length, eye $1\frac{1}{3}$ in snout, dorsal XXI, 19+2, and anal 18+2). Günther's specimen was only 33 mm. long and naturally differs in many points from our adult female. Our specimen is the size of Smith and Pope's specimen but has smaller eyes and fewer dorsal and anal soft rays (eye 1.6 in snout and 4.3 in head, dorsal XXI, 19+2 and anal I, 18+3 in the latter). In general our specimen

agrees well with Norman's description, except in having a deeper body, a larger head, and smaller eyes (depth 8 to $8\frac{1}{2}$ in length of body, head nearly 4 in length of body, and eye $4\frac{1}{4}$ to $4\frac{1}{2}$ in length of head, according to Norman).

Not having examined specimens of this species, Tanaka and Kamohara both synonymized it with *Promethichthys prometheus* without giving any sound basis for their action. This species is sharply distinguished from *Promethichthys prometheus*, not only in the generic characters indicated above and in the key, but also by having a greater number of spines in the first dorsal (20 or 21 instead of 18), by the more posterior position of the ventral spine (inserted below middle of base of pectoral fin instead of ahead of anterior end thereof), and by detailed characters of the gill rakers on the first arch (the bony part of the gill arch is armed with minute accessory rakers interpolated between pairs of larger ones, instead of being rather thickly covered with many small accessory rakers, and the raker at the angle is very long, with somewhat more than half, instead of about one third, of its entire length exposed).

PROMETHICHTHYS Gill

Promethichthys Gill (1893: 115, 123—type *Prometheus atlanticus* Lowe = *Gempylus prometheus* Cuvier).

Promethichthys prometheus (Cuvier)

Figs. 1C, 2B, 5E, 10B-C

MATERIAL DESCRIBED: No. 4101, 185 mm. in standard length (211.5 mm. in total length), off Owase, Kumano-Nada, January, 1937; No. 1551, 261.5 mm. (311 mm.), Ensyu-Nada; Nos. 11932 and 11933, 215.5 and 197 mm. (258.5 and 235 mm.), off Kochi City, January, 1950.

Fangs on upper jaw near tip of snout 4 to 6, of which 3 are immovable and the others depressible. Scales small and definitely imbricate, evident over entire body and head except on snout, jaws, throat, and interorbital.

Lateral line with a row of larger scales, extending far beyond base of middle caudal ray. Ventrals (Fig. 1C) always represented by a single spine, becoming shorter with the growth of the fish (in the smallest one, measuring 211.5 mm., the spine being 1.23 times as long as eye, and anterior edge armed with a row of minute and blunt spines).

Gill rakers moderately large but mostly hidden under skin (as in other species of this group), each tricuspid and armed with several small spines, except for one at angle, which is T-shaped and about one third exposed; bony part of gill arch rather thickly covered with small accessory circular rakers, which are densely covered with small prickles (Fig. 2B).

REFERENCES

(Asterisks mark those to which we did not have access.)

- BARNARD, K. H. 1927. A monograph of the marine fishes of South Africa. Part II. *South African Mus., Ann.* 21 (2): 419-1065, 20 pls.
- *BLEEKER, P. 1856. Beschrijvingen van nieuwe en weining bekende Vischsoorten van Amboina, versameld op eene Reis door den Molukschen Archipel, gedaan in het Gevolg van den Gouverneur-Generaal Duymaer van Twist in September en October, 1855. *Soc. Sci. Indo-Nederl., Acta* 1: 1-80.
- *CUVIER, G. 1829. *Le règne animal distribué d'après son organisation . . .* [2nd ed.] Vol. 2, 532 pp. Paris.
- and A. VALENCIENNES. 1831. *Histoire naturelle des poissons*. Vol. 8. 509 pp. [pp. 1-470 by Cuvier]. Paris.
- FOWLER, H. W. 1928. *The fishes of Oceania*. iii+486 pp., 49 pls. Bernice P. Bishop Mus., Mem. 10. Honolulu.
- 1936. The marine fishes of West Africa. *Amer. Mus. Nat. Hist., Bul.* 70 (2): 606-1493.
- 1938. The fishes of the George Vanderbilt South Pacific Expedition, 1937. *Acad. Nat. Sci. Phila., Monog.* 2: i-v, 1-349, 12 pls.
- 1944. Results of the Fifth George Vanderbilt Expedition (1941). (Bahamas, Caribbean Sea, Panama, Galápagos Archipelago and Mexican Pacific Islands). *Acad. Nat. Sci. Phila., Monog.* 6: i-viii, 1-583, 265 figs., 20 pls.
- FRANZ, V. 1910. Die japanische Knochenfische der Sammlungen Haberer und Doflein. In Beiträge zur Naturgeschichte Ostasiens. *Bayer Akad. der Wiss., Abhandl., Suppl.* IV, 1: 1-135, 7 figs., 11 pls.
- GILCHRIST, J. D. F., and C. VON BONDE. 1924. Deep-sea fishes procured by the S. S. "Pickle" (Part II). *Fisberies and Mar. Biol. Survey Rpt.* 3, Spec. Rpt. 7 (1922): 1-24, 6 pls.
- *GILL, T. 1893. A comparison of antipodal faunas. *Natl. Acad. Sci. [Wash.], Mem.* 6: 91-124.
- GOODE, G. B., and T. H. BEAN. 1895. *Oceanic ichthyology*. xxxv+553 pp., 123 pls. U. S. Natl. Mus., Spec. Bul. Washington.
- GÜNTHER, A. 1860. *Catalogue of the fishes in the British Museum* 2. xxi+548 pp. Brit. Mus. Nat. Hist. London.
- 1873-75. Andrew Garrett's Fische der Südsee 1. *Mus. Godeffroy, Jour.* 2: i-iv, 1-128, 83 pls.
- 1887. Report on the deep-sea fishes collected by H. M. S. "Challenger" during the years 1873-76. *Report on the Scientific Results of the Voyage of H. M. S. "Challenger."* Zoology 22 (57): 1-268, 66 pls.
- HOWELL RIVERO, L. 1938. List of the fishes, types of Poey, in the Museum of Comparative Zoology. *Harvard Univ., Mus. Compar. Zool. Bul.* 82 (3): 169-227.
- JOHNSON, J. Y. 1865. Description of a new genus of trichiurid fishes obtained at Madeira [*Nealotus tripes*] with remarks on the genus *Dicrotus* Günther, and on some allied genera of Trichiuridae. *Zool. Soc. London, Proc.* 1865: 434-437.
- JORDAN, D. S. 1920. The genera of fishes.

- Part IV. *Stanford Univ., Pubs., Univ. Ser.* 411-576.
- and B. W. EVERMANN. 1896. Fishes of North and Middle America, Pt. 1. *U. S. Natl. Mus., Bul.* 47: ix+1240 pp.
- and ——— 1905. The aquatic resources of the Hawaiian Islands. Pt. 1. The shore fishes. *U. S. Fish Comm., Bul.* 23 (1) (1903): xxviii+574 pp., 65+73 pls.
- and A. SEALE. 1906. The fishes of Samoa. *U. S. Bur. Fisheries, Bul.* 25 (1905): 173-455, i-xxx, 21 pls.
- S. TANAKA, and J. O. SNYDER. 1913. A catalogue of the fishes of Japan. *Tokyo Imp. Univ., Col. Sci., Jour.* 33 (1): 1-497.
- and E. K. JORDAN. 1922. A list of the fishes of Hawaii, with notes and descriptions of new species. *Carnegie Mus., Mem.* 10 (1): 1-92, 4 pls.
- and C. L. HUBBS. 1925. Record of fishes obtained by David Starr Jordan in Japan, 1922. *Carnegie Mus., Mem.* 10 (2): 93-346, 1 fig., 8 pls.
- KAMOYARA, T. 1932. Supplementary notes on the fishes collected in the vicinity of Kochi City, Shikoku (II). *Zool. Mag.* 44 (522): 147-151. [In Japanese]
- 1934. On the deep-sea fishes taken off Prov. Tosa. *Bot. and Zool.* 2 (7): 1196-1202. [In Japanese]
- 1936a. Supplementary notes on the fishes collected in the vicinity of Kochi City, Shikoku (VIII). *Zool. Mag.* 48 (1): 17-22. [In Japanese]
- 1936b. Supplementary notes on the fishes collected in the vicinity of Kochi City, Shikoku (X). *Zool. Mag.* 48 (11): 929-935. [In Japanese]
- 1938a. Gempylidae of Japan. *Annot. Zool. Jap.* 17 (1): 45-50, 1 pl.
- 1938b. *On the offshore bottom-fishes of Prov. Tosa, Shikoku, Japan.* 86 pp. Maruzen Co. Ltd., Tokyo.
- 1940. Scombroidei. *Fauna Nipponica* 15-2 (5) viii+225 pp. Sanseido Co. Ltd., Tokyo. [In Japanese]
- 1942. Some rare deep-sea fishes from Prov. Tosa, Japan. *Biogeog. Soc. Japan, Bul.* 12 (7): 105-114.
- *LESSON, R. P. 1830. *Poissons in Voyage autour du monde—sur la Corvette . . . "La Coquille," pendant . . . 1822-25 undes Capitaine L. I. Duperrey, 1830:* 66-238, 38 pls.
- LONGLEY, W. H., and S. F. HILDEBRAND. 1941. Systematic catalogue of the fishes of Tortugas, Florida, with observations on color, habits and local distribution. *Carnegie Inst. Wash., Pub.* 535: i-xiii, 1-331, 34 pls.
- MATSUBARA, K. 1943. Studies on the scorpaenoid fishes of Japan. *Sigenkagaku Kenkyusbo, Trans.* 1-2: 1-486, 4 pls., 156 figs.
- MCCULLOCH, A. R. 1915. Report on some fishes obtained by the F. I. S. "Endeavour" on the coast of Queensland, New South Wales, Victoria, Tasmania, South and South-western Australia. *Biological Results of the Fishing Experiments Carried on by the F. I. S. "Endeavour," 1904-14,* 3 (3): 97-170, 25 pls.
- 1929. A check-list of the fishes recorded from Australia. *Austral. Mus., Mem.* 5 (2): 145-329.
- 1934. *The fishes and fish-like animals of New South Wales.* (3rd ed., with supplement by Gilbert P. Whitley.) xxvi+104 pp., 43 pls. Royal Zoological Society of New South Wales, Sydney.
- MUNRO, I. S. R. 1949. The rare gempylid fish, *Lepidocybium flavo-brunneum* (Smith). *Roy. Soc. Queensland, Proc.* 60 (3): 31-41, 1 pl.
- NORMAN, J. R. 1930. Oceanic fishes and flat-fishes collected in 1925-1927. *Discovery Rpt.* 2: 261-370, 47 figs., 1 pl.
- *POEY, F. 1854. Nuevo género de peces Escombrideos, *Epinnula magistralis* Poey. Fasc. 1 in *Memorias sobre la historia natural de la isla de Cuba . . .* Vol. 1. 441 pp. Habana.
- SCHMIDT, P. J. 1931. Fishes of Japan, collected in 1901. *Pacific Comm. Acad. Sci. USSR, Trans.* 2: i-ii, 1-185.

- SMITH, H. M., and T. E. B. POPE. 1906. List of fishes collected in Japan in 1903, with descriptions of new genera and species. *U. S. Natl. Mus., Proc.* 31 (1489): 459-499, 12 figs.
- SMITH, J. L. B. 1949. *The sea fishes of southern Africa*. xvi+550 pp., 105 pls. Central News Agency, Cape Town.
- SNYDER, J. O. 1911. Descriptions of new genera and species of fishes from Japan and the Riu Kiu Islands. *U. S. Natl. Mus., Proc.* 40 (1836): 525-549.
- 1912. Japanese shore fishes collected by the United States Bureau of Fisheries steamer "Albatross" Expedition of 1906. *U. S. Natl. Mus., Proc.* 42 (1909): 399-450, 11 pls.
- TANAKA, S. 1931. On the distribution of fishes in Japanese waters. *Tokyo Imp. Univ., Fac. Sci., Jour.* Ser. 4, Zool. 3 (1): 1-90, 3 pls.
- TORTONESE, E. 1939. Risultati ittologici del viaggio di circumnavigazione del globo della R. N. "Magenta" (1865-68). *Torino Univ., Mus. Zool. Anat. Compar., Bol.* Ser. 3, 47 (100): 1-245, 17 figs., 9 pls.
- WAITE, E. R. 1911. Additions to the fish fauna of New Zealand: No. II. *New Zealand Inst., Proc.* 43 (2): 49-51.
- WHITLEY, G. P. 1929. Studies in ichthyology. No. 3. *Austral. Mus. Rec.* 17 (3): 101-143, 5 pls.