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FAUNA OF THE CHILKA LAKE

OLIGOCHAETA.

(*Supplementary Report*).

By J. STEPHENSON, *D.Sc., Lt.-Col., I.M.S., Professor of Zoology, Government College, Lahore.*

(With 1 text-figure).

CONTENTS.

OLIGOCHAETA.

(*Supplementary Report*).

By J STEPHENSON.

A number of small worms, which proved to be of the above species, were kindly sent to me for examination a short time ago by Dr. Annandale. The species has hitherto been recorded, so far as I have been able to discover, by only two observers,—Ditlevsen, who found it in Denmark, and Moore, in the United States. The genus to which it belongs, however, has also been found in England, Japan, the Kermadec and Auckland Islands, and the Transvaal (I include the identical or closely allied *Rhizodrilus*), and thus is cosmopolitan. From a zoogeographical point of view therefore the present record is not of much importance. The worm is however interesting, inasmuch as the fusion of the originally paired genital apertures in the middle line has here been followed by the disappearance of the spermatheca of the right side.

Monopylephorus parvus, Ditlevsen.

Baikuda I., Chilka Lake, Ganjam Dist., Madras Pres.; among rotting water-weeds at edge of lake (*Annandale* and *Gravely*); 15—22-vii-1916. Numerous specimens.

Two short accounts of the anatomy of this worm have already been given (Ditlevsen, 3; Moore, 6). The following description is fairly complete, and adds a number of particulars, more especially with regard to the setae and genital apparatus.

The maximum length of the specimens was half an inch, or about 12 mm., and their thickness about ·35 mm. They were whitish or grey in colour (pink during life). The external segmentation was very well marked, the segments being divided by very distinct constrictions, and bulging out between these. The number of segments counted in a good-sized specimen was 64; there were no secondary annulations.

The prostomium is large, prominent, and triangular in shape with rounded tip.

The clitellum embraces about the posterior two-fifths of segment x, and the whole of xi and xii.

The setae are of two forms, single-pointed and double-pointed curved needles (crotchets); both kinds occur in both dorsal and ventral bundles. There are no hair-setae.

The double-pointed needles (fig. 1*a*) are 80μ in length,—those of the anterior bundles perhaps a trifle longer; in thickness they are about 3μ. The nodulus is somewhat distal to the middle of the shaft. The prongs are equal in length, or the outer may sometimes seem to be slightly the longer, and both are comparatively short; anteriorly, the rule is that the prongs are nearly equal in thickness, but the

relation varies, so that in some cases the outer prong is only two-thirds as thick as the inner, while towards the posterior end it may be only half as stout.

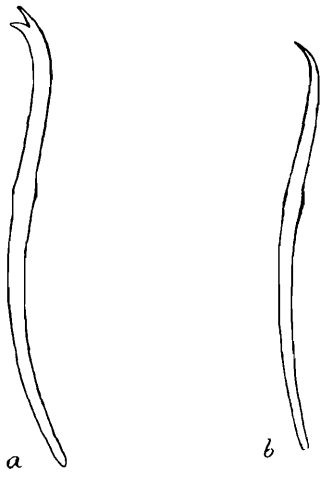

FIG. 1.—*Monopylephorus parvus*, Ditlevsen.

a. Double-pointed seta from an anterior dorsal bundle. × 760

b. Single-pointed seta from a ventral bundle behind the middle. × 760.

The single-pointed needles (fig. 1*b*) are about 70μ or a little more in length, and 3μ in thickness. They have the usual double curve, the distal curve however being more marked than the proximal. They end in a single sharp point; and the nodulus is slightly distal to the middle of the shaft.

A certain number of double-pointed setae are found in which the outer prong is small. Thus they present an intermediate character; and the single-pointed setae may be conceived as originating from the double-pointed by the diminution and ultimate loss of the outer prong.

The ventral setae begin in segment ii, and are absent in xi. They are usually three per bundle throughout the body, including the hinder end, but in the anterior segments four and five are met with. The bundles are composed of only double-pointed setae throughout the anterior half of the body; single-pointed setae are found behind the middle, and at first only occasionally; they are commoner at the hinder end, but even there are outnumbered by the double-pointed.

The dorsal setae begin in segment ii; the number per bundle is here also three, four, or five;—three in one or two of the most anterior segments, then four or five as far as the clitellum, and thenceforward three or four,—more usually three, at any rate in the hinder part of the body. In the most anterior segments only double-pointed setae are found; these soon begin to be replaced by the single-pointed, and the change is completed shortly behind the clitellum, or, in another specimen, by about the middle of the body. The dorsal thus differ from the ventral bundles in the much greater proportion of the single-pointed setae.

The alimentary tube is but little differentiated into distinct regions. Chloragogen cells begin in segment vi, and thereafter the characters of the canal remain much the same throughout the body. The pharynx is remarkable for the height of the epithelium on the roof; an area of columnar cells, with an abrupt margin, forms a plate-like or sucker-like projection into the cavity, and exactly resembles the structure called the "pharynx" in the Enchytraeidae. The "pharyngeal gland cells" are arranged in four cords which are applied dorsally and dorso-laterally to the pharynx, as described and figured for *M. limosus* by Nomura (7). Numerous similar cells are found on the body-wall, where they form considerable masses at the level of the hinder part of these cords, as well as for some distance behind this, as far as segment vi; a number are also seen on each side of the ventral nerve cord in the oesophageal region.

The body-cavity corpuscles have the characters described by Moore (6); a fairly large one is 10μ in diameter.

The dorsal vessel is ventro-laterally or laterally situated, on the left side of the alimentary tube, throughout the greater part of the body; it appears in a mount of the whole animal as a series of loops, the bend of each loop being at about the level of the lateral line of the body and the rest of the vessel below this level; it becomes altogether lateral in position about segment vii, and is only really dorsal at the anterior end of the body. Supra- and subintestinal vessels are absent. The parietal plexus is situated amongst the muscular fibres of the body-wall, well beneath the peritoneal layer. The valves in the larger vessels have been described in related species by previous authors (Goodrich, 4; Nomura, 7).

The Enchytraeid character of the nephridia in this genus is well known. The remarkable length of the upper lip of the funnel is not to be made out in preserved material.

The anterior lobes of the cerebral ganglion project forwards for some distance,—about 30μ,—in front of the main mass; there are practically no posterior projections.

The testes are situated in segment x, along with the cup-shaped funnels and a quantity of sperm-morulae. The vas deferens is at first, immediately behind the septum, 25μ in diameter, and without any covering of high peritoneal cells; but this uncovered portion is of very small extent, scarcely even as long as the width of the tube.

The second portion of the duct, or the part which is covered with elongated peritoneal cells, passes backwards for some distance ventrally in the segment, and then rises towards the dorsal body-wall. The investment of high cells ceases just before the tube reaches the highest point of its course. In this part of its extent the canal with its investment has a diameter of 90 to 120μ by 50μ; the central tube is about 35μ thick, the peritoneal covering accounting for the remainder. The cells composing the wall of the tube are columnar, about twice as high as broad, and furnished with long cilia; the peritoneal cells are apparently only one layer thick, and very much elongated,—sometimes as much as 40μ in length; where they appear to be more than one layer thick the section is probably oblique; their cytoplasm stains darkly and equably, and the nucleus is at about half the height of the cell.

The third portion of its course, which is free from the tall peritoneal investment, comprises the summit of the curve and the downward course of the canal until it joins the atrial chamber. Its total length is about 100μ, and its diameter at first 35 to 40μ, but it becomes narrower before joining the atrial chamber, measuring at its end 23μ; from the bend downwards it is heavily ciliated.

The atrial chamber is of an elongated pear-shape, the narrower end below; the lower ends of both converge to unite in the middle line, and forming there a narrow tube, discharge, as described by Moore, on the summit of a low papilla on the roof of the spermiducal chamber; the union of the atrial chambers takes place below the ventral nerve cord and ventral vessel. Each atrial chamber is 145μ long and 70μ in diameter at its thickest part; its upper end is at about half the height of the segment; it is lined by a very high non-ciliated columnar epithelial layer, so that the clear lumen in the middle is not more than about 20μ across. There are well-marked circu-

lar (inner) and longitudinal (outer) muscular investing layers; and the covering of peritoneal cells cannot be described as either tall or flat.

The spermiducal chamber is a median depression on the ventral surface, squarish in shape as seen in a transverse section of the animal, its depth and width about 40μ. It is lined by cubical epithelium.

A single sperm-sac, an anterior evagination of septum 9/10, is situated in segment ix; and a posterior sperm-sac, also single, extends backwards through several segments from septum 10/11.

The ovary and ovisac have the usual positions; but I did not see any trace of oviduct or ovarian funnel.

The spermatheca is single, in segment x. Its external opening is in the middle line in furrow 9/10; but the organ belongs to the left side. It lies near the ventral body-wall, and takes up nearly the whole of the segment in an antero-posterior direction. It may be described as a somewhat twisted cylinder, whose diameter reaches 80μ, narrowing towards the external aperture to form a short duct which bends downwards. The spermatozoa, which form an amorphous mass, not spermatophores, are contained in the most posterior (ental) part of the chamber. Here the epithelial lining is cubical; the middle portion of the organ, much larger than the former, but not separated from it by any distinct constriction, is lined by a columnar epithelium with the nuclei basal; the duct has a lining of approximately cubical cells.

Remarks. I subjoin a comparison of certain features of this worm with the specimens described under the above name by Ditlevsen and Moore.

Ditlevsen gives no indication of the habitat of his worm. Moore's was a littoral form; "it appears to prefer more gravelly shores and the neighbourhood of beach grass, among the roots of which it may be found. In a few cases larger numbers were found living gregariously between stones at half-tide on the south shore of Naushon." The related species *M. glaber* (Moore, 6) flourishes best in brackish water; enormous numbers were found where the saltness of the water was just barely perceptible to the taste. Dr. Annandale informs me that the salinity where the present specimens were found was certainly low, but the water was distinctly brackish. At the same place on the same date in 1914 the specific gravity was 1·0145 (corrected).

The segments in the specimens here described were not, as in Moore's worm, quadriannulate.

The differences in the setae are more important. According to Ditlevsen, while the hinder dorsal bundles contain single-pointed setae, all the ventral setae are bifid. Moore finds the tips "curiously variable," and single-pointed tips seem to have been very much the exception ("in some the tips are deeply bifid and the points long and acute; others, especially in the posterior dorsal bundles, have the upper or distal point more or less reduced, and still others have a more apical notch or are apparently entire"). In the present specimens all the dorsal setae behind the middle of the body, and some in front of this, are single-pointed, while single-pointed setae are not uncommon in the posterior ventral bundles also; intermediate forms are comparatively rare.

The abnormal position of the dorsal vessel is not mentioned by either author; it is shown lying against the side of the intestine in Moore's figure. It is said to be on the *right* side in *M. limosus* by Nomura (7).

Ditlevsen implies, and his figure shows, that the two male ducts do not unite before entering the spermiducal chamber; nor is there any reference to the widening to the duct which I have called the atrial chamber; this latter, however, is visible in the figure.

There can, I think, be little doubt that Moore's specimens are specifically identical with those here described; but I am inclined to agree with him that further information may necessitate a separation between Ditlevsen's worm and his own. As to the generic name that should be employed; Benham (1, 2), uniting *Rhizodrilus* and *Monopylephorus*, uses the former; Michaelsen (5), while accepting the union, prefers the name *Monopylephorus*; Nomura (7) gives reasons for retaining the two genera as distinct. A revision of all the forms described under these two names is, as Michaelsen says (*loc. cit.*), required, along with that of related genera; for the present the most convenient course seems to be to retain the name under which the worm has already twice been described.

A thorough revision would also probably indicate the homologies of the various parts of the male efferent apparatus with the successive segments of the tube in other genera. At present there is an extraordinary amount of confusion: Ditlevsen calls the whole tube, from the funnel to its termination in the median pit on the ventral surface, "Samenleiter" (=vas deferens); the pit itself, following Goodrich, he names "spermiducal chamber" (using the English words). Moore uses the term "sperm reservoir" for the portion of the duct which is covered by high peritoneal cells, "ejaculatory duct" for the short succeeding portion, and "median bursa" for the pit on the surface; the term "penis sac" is employed for the dilatation which I have called "atrial chamber." There is, however, no such dilatation of the "sperm reservoir" as would lead one to suppose that it is capable of acting as such, nor did I find spermatozoa in this portion of the duct; while the epithelium of the "penis sac" is so high that the passage would be altogether obliterated by the eversion or even by any considerable protrusion of the terminal portion of the apparatus; the utmost that could happen, apparently, would be some slight protrusion of the papilla on the roof of the "median bursa," sufficient, perhaps, to bring this level with the surface of the body. Nomura, in describing *M limosus*, uses the term "atrium" for the portion of the duct which is covered by high peritoneal cells, "atrial duct" for the short portion which succeeds, and "lateral horn of the spermiducal chamber" for what I have called the "atrial chamber." Michaelsen, in *M. africanus*, includes under the term "atrium" the atrial duct of Nomura; in this species there is apparently no separate "atrial chamber," the upper part of the deep "Kopulationstasche" (spermiducal chamber, median bursa) representing the united atrial chambers of such forms as *M. parvus*, *glaber*, *limosus*, etc.; but on other grounds (spermathecae in segment ix, presence of penial setae) it seems probable that *M. africanus* ought to be considered as belonging to another genus. Most authors seem to confine the term

"vas deferens" to that part of the duct in front of the covering of high peritoneal cells; in the present case the "vas deferens" would be almost, and in *Rhizodrilus kermadecensis* (Benham, 2), where the covering begins immediately behind the funnel, it would be altogether absent. Merely from a consideration of the present form, it would seem pretty obvious that the whole duct from funnel to atrial chamber corresponds to the "vas deferens" in the Tubificidae and Naididae generally; but, as I have said, comparative studies are necessary to settle the terminology. I hope the terms I have employed are sufficiently non-committal to obviate any further confusion.

REFERENCES TO LITERATURE.

(1) Benham, W. B.—Report on Oligochaeta of the Subantarctic Islands of New Zealand, 1909

(2) *ib.* Oligochaeta from the Kermadec Islands. *Trans. New Zealand Inst.*, vol. xlvii, 1914.

(3) Ditlevsen, A.—Studien an Oligochaeten. *Zeitsch. f. wiss. Zool.*, vol. lxxvii, 1904.

(4) Goodrich, E. S.—On the structure of *Vermiculus pilosus*. *Quart. Journ. Micr. Science*, n. s., vol. xxxvii, 1895.

(5) Michaelsen, W.—Oligochäten von tropischen und südlichsubtropischen Afrika. *Zoologica*, Heft 67 u. 68, 1912-1913.

(6) Moore, J. P.—Some marine Oligochaeta of New Zealand. *Proc. Acad. Sci. Philadelphia*, vol. lvii, pt. ii, 1905.

(7) Nomura, E.—On the aquatic Oligochaete *Monopylephorus limosus* (Hatai). *Journ. Coll. Sci. Tokyo*, vol. xxxv, 1915.

FAUNA OF THE CHILKA LAKE.

FISH.

PART III.

By B. L. CHAUDHURI, *D.Sc.* (*Edin.*), *F.R.S.E.*, *F.L.S*

(With 2 text-figures).

CONTENTS.

FISH. (*PART III*).

By B. L. CHAUDHURI.

This part contains a systematic treatment of the suborders Percesoces and Plectognathi of the order Teleostei. The total number of specimens examined and recorded is 373. They belong to twenty species. Of these one (*Sphyraena raghava*) is new to science. The twenty species fall into nine genera and seven families.

Suborder PERCESOCES.

Family SCOMBRESOCIDAE.

Genus **BELONE**, Cuvier

Belone strongylura, Van Hasselt.

1803. *Esox* sp. (*Kuddera A.*), Russell, *Fish Vizag.* II, p. 61, pl. clxxvi.
1823. *Belone strongylura*, Van Hasselt, *Alg. Konst. Letterbode*, p. 131.
1823. *Belone strongylura*, *Id.*, *Bull. Ferussac Zool.*, p. 374.
1830. *Belone caudimacula*, Cuvier, *Reg. Anim.*, p. 234.
1846. *Belone caudimacula*, Cuvier and Vallenciennes, *Hist. Nat. Poiss.*, XVIII, p. 452.
1846. *Belone caudimacula*, Richardson, *Rep. Brit. Assc. Adv. Sc.* (1845), p. 264.
1849. *Belone caudimacula*, Cantor, *Journ. Asiat. Soc. Bengal* (1849), p. 1228.
1851. *Belone caudimaculata*, Jerdon, *Madras Journ. Lit. Sc.*, p. 147.
1853. *Belone caudimacula*, Bleeker, *Verh. Bat. Gen.*, XXV, p. 72.
1865. *Belone caudimaculata*, Day, *Fish. Malabar*, p. 165.
1866. *Mastacembelus strongylurus*, Bleeker, *Ned. Tijdsch. Dierk.*, III, p. 220.
1866. *Belone strongylura*, Günther, *Cat. Fish Brit. Mus.*, VI, p. 246.
1866. *Belone caudimaculata*, *Id.*, *ibid.*, p. 245.
1872. *Mastacembelus strongylurus*, Bleeker, *Atl. Ich. Ind. Orient. Neerl.*, VI, p. 45, pl. cclvii, fig. 3.
1878. *Belone strongylurus*, Day, *Fish. Ind.*, p. 512, pl. cxviii, fig. 6.
1889. *Belone strongylura*, Day, *Faun. Brit. Ind. Fish.*, II, p. 421.
1910. *Belone strongylura*, Jenkins, *Rec. Ind. Mus.*, V, p. 131.
1913. *Belone strongylura*, Weber, *Fisch Siboga-Exped.*, p. 122.

There are ten specimens in the collection, the largest of which measures 410 mm. in length. It was collected at Parikud at the end of November, 1914. The rest vary from 224 mm. to 328 mm. in length and were collected at Satpara and Rambha Bay, mostly during the latter part of July, 1913. The species does not breed in the lake and appears to be only an occasional visitor to it.

Distribution:—Coasts and estuaries from Bengal to China; East Indian Archipelago and North Australia; in the river Brunai (Borneo) and in fresh water at Aleppee (Malay Peninsula).

Genus **HEMIRHAMPHUS**, Cuvier.

Hemirhamphus limbatus, Cuvier and Valenciennes.

1846. *Hemirhamphus limbatus*, Cuvier and Valenciennes, *Hist. Nat. Poiss.*, XIX, p. 44.
1849. *Hemirhamphus tridentifer*, Cantor, *Journ. Asiat. Soc. Bengal* (1849), p. 1231.
1859. *Hemirhamphus brachynotopterus*, Blyth, *Proc. Asiat. Soc. Bengal* (1858), p. 288.
1878. *Hemirhamphus limbatus*, Day, *Fish. Ind.*, p. 516, pl. cxix, fig. 3.
1889. *Hemirhamphus limbatus*, *Id.*, *Faun. Brit. Ind. Fish.*, II, p. 426.

There are eighty-eight specimens in the collection, many of which are quite young. They were obtained throughout the year and from all parts of the lake. The species is a permanent inhabitant and breeds in the lake at least twice in the year. In full-grown specimens the caudal fin is truncate in some and lunate in others; in most of the specimens the lower caudal lobe is the longer.

In Hamilton Buchanan's volume of manuscript drawings,[1] plate xcv is identified as a figure of *H. limbatus*, but it is not described anywhere by him.

The following statement gives the different localities whence the specimens were collected, and their number and size.

1 specimen	Off Balugaon	6-iii-14	measuring 10 mm.	
1 ,,	Between Barkuda Island and the mainland	16-vii-14	,,	33 ,,
6 specimens	Off Barkul	13-xi-12	,,	42 ,, to 105 mm.
3 ,,	Chiriya Island	17-xi-14	,,	10 ,, to 11 ,,
1 specimen	Between Guntasila and Breakfast Island	23-xi-14	,,	32 ,,
1 ,,	Off Guntasila	18-xi-14	,,	98 ,,
2 specimens	Off Kalidai	5-iii-14	,,	83 ,, and 95 mm.
2 ,,	,, ,,	21-ix-14	,,	4 ,, and 8 ,,
10 ,,	,, ,,	22-xi-14	,,	5 ,, to 10 mm.
17 ,,	Between Kalidai and Samalkuda	21-xi-14	,,	4 ,, to 40 ,,
8 ,,	Off Kalupara Ghat.	16-ix-14	,,	40 ,, to 62 ,,
1 specimen	Off Nalbano	18-ix-14	,,	83 ,,
2 specimens	Off Manikpatna (close to sand dunes opposite)	3-ix-14	,,	18 ,, and 61 mm.
8 specimens	Off Patsahanipur	6-iii-14	,,	10 ,, to 95 ,,
5 ,,	,, ,,	10-iii-14	,,	53 ,, to 165 ,,
3 ,,	Rambha Bay	Feb. 14	,,	24 mm., 85 mm. and 99 mm.
5 ,,	,, ,,	15-ii-14	,,	10 ,, to 15 mm.
11 ,,	,, ,,	23-ix-14	,,	7 ,, to 18 ,,
1 specimen	Off Sankuda	17-ii-14	,,	140 ,,

This is one of the most extensively used food-fishes of the lake.

Distribution:—Indian Ocean; sea of Penang; this is by far the most common species on the Coromandal coast of India and extends to Burma; it is also found, but more rarely, on the Malabar coast; it ascends tidal rivers and is sometimes captured in fresh waters.

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[1] Chaudhuri, *Mem. Ind. Mus.*, V, p. 444 (foot-note).

Family MUGILIDAE.

Genus **MUGIL**, Linnaeus.

Mugil cephalus, Linnaeus.

1758. *Mugil cephalus*, Linnaeus, *Syst. Nat.* Ed. X, p. 316.
1775. *Mugil Öûr*, Forskål, *Descrip. Anim.*, p. xiv, no. 109c.
1788. *Mugil cephalus*, Bonnaterre, *Tabl. Encyclop.*, p. 179, pl. lxxiii, fig. cccix.
1801. *Mugil cephalus* Lacepede, *Hist. Poiss.*, V, p. 384.
1835. *Mugil Öûr*, Ruppell, *Neu. Wirbel. Fisch.*, p. 131.
1836. *Mugil cephalotus*, Cuvier and Valenciennes, *Hist. Nat Poiss.*, XI, p. 110.
1841. *Mugil cephalotus*, Eydoux and Souleyet, *Voy. Bonite, Zool.*, I, p. 175, pl. iv, fig. 4.
1842. *Mugil cephalotus*, Cantor, *Ann. Mag. Nat. Hist.*, IX, p. 484.
1845. *Mugil japonicus*, Temminck and Schlegel, *Faun. Japon.*, p. 134, pl. lxxii, fig. 1.
1845. *Mugil cephalotus*, Bleeker, *Nat. Geneesk. Arch. Ned. Ind.*, II, p. 514.
1846. *Mugil macrolepidotus*, Richardson, *Rep. Brit. Assc. Adv. Sc.* (1845), p. 249.
1861. *Mugil cephalotus*, Günther, *Cat. Fish. Brit. Mus.*, III, p. 419.
1865. *Mugil cunnesius*, Day, *Fish. Malabar*, p. 136.
1868. *Mugil cephalotus*, Kner, *Reis. Oster. Novar. Fisch.*, p. 224.
1870. *Mugil oeur*, Klunzinger, *Verhand. zool. bot. Gesell. Wien*, XX, p. 829.
1878. *Mugil oeur*, Day, *Fish. Ind.*, p. 353, pl. lxxv, fig. 3.
1889. *Mugil oeur*, *Id.*, *Faun. Brit. Ind. Fish.*, II, p. 348, fig. 114.
1903. *Mugil cephalus*, Fowler, *Proc. Acad. Nat. Sc. Philadel.*, LV, p. 743.
1907. *Mugil cephalus*, Jordan and Seale, *Proc. Davenport Acad. Sc.*, X, p. 4.
1911. *Mugil oeur*, Jordan and Richardson, *Mem. Carnegie Mus.*, IV, p. 176.
1916. *Mugil cephalus*, Waite, *Trans. Proc. Roy. Soc. South Australia*, XL, p. 453.

As yet no characters separating this Indian species from the cosmopolitan *Mugil cephalus* have been pointed out ; it is identical with the Japanese species *M. öeûr*, *M. cephalotus* and *M. japonicus*.

There are seven specimens in the collection, the largest of which measures 309 mm. in length. It was secured at Nalbano on 25-xi-14 ; five specimens were obtained at Parikudh (21-31-vii-13), measuring 152 mm., 195 mm., 244 mm., 256 mm. and 261 mm. The remaining specimen was secured at the south end of the lake, its length being 208 mm.

The eyes of all the specimens appear slightly smaller than usual in the species. The species probably does not breed in the lake but is an occasional visitor to it.

Distribution :—The Pacific and the Atlantic coasts of America ; the Mediterranean sea ; coast of Madeira ; west coast of Africa ; Red sea ; Polynesia and Indian Ocean ; seas of China and Japan including estuaries and canals.

Mugil gymnocephalus, Swainson.

1803. *Mugil* sp. (*Bontah*), Russell, *Fish. Vizag.* II, p. 64, pl. clxxx.
1839. *Mugil gymnocephalus*, Swainson, Lardner's *Cab. Cyclop. Nat. Hist.* (*Fish. Amph. Rep.*), II, p. 234.
1857. *Mugil belanak*, Bleeker, *Nat. Tijdsch. Ned. Ind.*, XIII, p. 337.

Jordan and Seale, *Proc. Davenport Acad. Sc.* X, p. 4.

1861. *Mugil belanak*, Günther, *Cat. Fish. Brit. Mus.*, III, p. 427.
1878. *Mugil belanak*, Day, *Fish. Ind.*, p. 351, pl. lxxiv, fig. 5.
1889. *Mugil belanak*, *Id.*, *Faun. Brit. Ind.*, *Fish.*, II, p. 345.
1905. *Mugil belanak*, Fowler, *Proc. Acad. Nat. Sc. Philadel.*, LVII, p. 494, fig. 9.

Russell's figure and description of his *Bontah* (pl. clxxx), which he wrongly identified as *M. cephalus*, L., was adopted by Swainson in 1839 as representing his *M. gymnocephalus*. This name has, therefore, priority over the rest. Russell's name *Bontah* was adopted by Bleeker for his *Mugil bontah*[1], but the latter placed specimens of another species under that name.[2] Day was misled by Russell's adoption of the name *Mugil cephalus* for his *Bontah* into the belief that this species was identical with *Mugil öûr*, Forskål.

There is only one specimen in the collection. It measures 88 mm. in length and was obtained in the latter part of July, 1913. The fish is a casual visitor to the lake.

Distribution :—Seas of India ; coasts and rivers of the East Indian Archipelago ; Malay Archipelago.

Mugil cunnesius, Cuvier and Valenciennes.

1803. *Mugil* sp. (*Kunnesee*), Russel, *Fish. Vizag.* II, p. 65, pl. clxxxi.
1836. *Mugil cunnesius*, Cuvier and Valenciennes, *Hist. Nat. Poiss.*, XI, p. 114.
1837. *Mugil cunnesius*, Ruppell, *Neu. Wirbel. Fisch.*, p. 131.
1839. *Mugil squamipinnis*, Swainson, Lardner's *Cab. Cyclop Nat. Hist.* (*Fish. Amph Rep.*), II, p. 414.
1845. *Mugil cunnesius*, Bleeker, *Nat. Geneesk. Arch. Ned. Ind.*, II, p. 514.
1849. *Mugil cunnesius*, Cantor, *Journ. Asiat. Soc. Bengal*, p. 1082.
1858. *Mugil axillaris*, Bleeker, *Nat. Tijdsch. Ned. Ind.*, XVI, p. 280.
1861. *Mugil longimanus*, Günther, *Cat. Fish. Brit. Mus.*, III, p. 428.
1861. *Mugil cunnesius*, *Id.*, *ibid.*, p. 434.
1865. *Mugil engli*, Day, *Fish. Malabar*, p. 139.
1878. *Mugil cunnesius*, Day, *Fish. Ind.*, p. 349, pl. lxxiv, fig. 3.
1889. *Mugil cunnesius*, *Id.*, *Faun. Brit. Ind. Fish.*, II, p. 342.
1909. *Mugil cunnesius*, Jenkins, *Rec. Ind. Mus.*, III, p. 287.
1910. *Mugil cunnesius*, *Id.*, *ibid.*, V, p. 133.

There are one hundred and seventy-six specimens in the collection. Of these one hundred and seventy four are very young, measuring from 35 mm. to 70 mm., and the remaining two are adult : *viz.* one from Satpara measuring 118 mm. in length, and one from Barkul measuring 129 mm. in length. The young specimens were caught in prawn-traps and nets during the third week of September, 1914. This fish evidently breeds in the lake, probably from the beginning of the breaking up of the monsoons. Cantor noted the young to be numerous at all seasons at Penang. The fish is a permanent inhabitant of the lake, in the main area as well as in the outer channel, breeding freely in the main area, at least at the commencement of the rains if not at " all seasons."

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[1] Bleeker, *Verh. Bat. Genoot.*, XXV, p. 48 (1853).
[2] Bleeker, *Nat. Tijdsch. Ned. Ind.*, XIII, p. 336 (1857).

Distribution :—Abyssinia ; Red sea ; seas of India to the Malay Archipelago and beyond.

Mugil subviridis, Cuvier and Valenciennes.

1836. *Mugil subviridis*, Cuvier and Valenciennes, *Hist. Nat. Poiss.*, XI, p. 115.
1836. *Mugil dussumieri*, *Id.*, *ibid.*, p. 147,
1861. *Mugil subviridis*, Günther. *Cat. Fish. Brit. Mus.*, III, p. 423.
1865. *Mugil subviridis*, Day, *Fish. Malabar*, p. 138.
1878. *Mugil dussumieri*, Day, *Fish. Ind.*, p. 352, pl. lxxiv, fig. 4.
1878. *Mugil subviridis*, *Id.*, *ibid.*, p. 353.
1884. *Mugil dussumieri*, *Id.*, *Faun. Brit. Ind. Fish.*, II, p. 347.
1889. *Mugil subviridis*, *Id.*, *ibid.*, p. 348.

There are three specimens in the collection, two from Satpara measuring 143 mm. and 130 mm. in length, the latter being secured in March, 1914. The remaining specimen, measuring 85 mm was obtained at the mouth of Barkul Bay on the 18th September, 1917.

There is a manuscript figure (named *Mugil laevis* on the margin) in Hamilton Buchanan's drawings which represents this species.

This fish is found in the main area as well as in the outer channel and in all probability is a permanent inhabitant of the lake.

Distribution :—Seas of India, entering fresh water.

Mugil caeruleo-maculatus, Lacepede.

1798. *Mugil caeruleo-maculatus*, Lacépède, *Hist. Poiss.*, V, pp. 385, 389.
1836. *Mugil caeruleo-maculatus*, Cuvier and Valenciennes, *Hist. Nat. Poiss.*, XI, p. 128.
1860. *Mugil caeruleo-maculatus*, Bleeker, *Act. Soc. Sc. Indo-Neerl.*, VIII, *Sumatra* (IX), p. 5.
1861. *Mugil caeruleo-maculatus*, Günther, *Cat. Fish. Brit. Mus.*, III, p. 445.
1878. *Mugil caeruleo-maculatus*, Day, *Fish. Ind.*, p. 356.
1889. *Mugil caeruleo-maculatus*, *Id.*, *Faun. Brit. Ind. Fish.*, II, p. 351.
1913. *Mugil bleekeri* (in part), Weber, *Fisch. Siboga-Exp.*, p. 139.

There is only one specimen in the collection. It measures 106 mm. in length and was obtained from the outer channel near Satpara in October, 1914. The species is in all probability an occasional visitor to the lake.

Distribution :—Coasts of Mauritius; Bombay, through the seas of India to the Malay Archipelago.

Mugil jerdoni, Day.

1865. *Mugil sundanensis*, Day, *Fish. Malabar*, p. 138.
1878. *Mugil jerdoni*, Day, *Fish. Ind.*, p. 352.
1889. *Mugil jerdoni*, *Id.*, *Faun. Brit. Ind. Fish.*, II, p. 346.

There are only two specimens in the collection. They measure 105 mm. and 95 mm. in length. Both were secured at Rambha on 31-xii-14. The fish is probably a casual visitor to the lake and is found in the main area at least during the period of maximum salinity. It is a small-sized marine *Mugil* not growing bigger than six inches in length.

Distribution :—Seas of India.

Mugil speigleri, Bleeker.

1858. *Mugil speigleri*, Bleeker, *Act. Soc. Sc. Indo-Neerl.*, V, p. 2.
1860. *Mugil speigleri, Id., ibid.*, VIII, p. 58.
1861. *Mugil speigleri*, Günther, *Cat. Fish. Brit. Mus.*, III, p. 435.
1865. *Mugil suppositus*, Day, *Fish. Malabar*, p. 143.
1868. *Mugil axillaris*, Kner, *Reis. Oster. Novar. Fisch.*, p. 227, pl. ix, fig. 93.
1878. *Mugil speigleri*, Day, *Fish. Ind.*, p. 348, pl. lxxiv, fig. 1.
1889. *Mugil speigleri, Id., Faun. Brit. Ind. Fish.*, II, p. 342.

There are four specimens in the collection: one from Satpara collected in September, 1914 measuring 110 mm., and three from Rambha obtained at the end of the month of December, 1914 measuring from 117 mm. to 130 mm. This fish is found in the outer channel after the floods are over, and in the main area of the lake in winter.

Distribution :—Seas of India ; coasts of Java, Borneo and Halmaheira; Shanghai.

Genus LIZA, Jordan and Swain.[1]

Liza borneensis (Bleeker)

1851. *Mugil borneensis*, Bleeker, *Nat. Tijd. Ned. Ind.*, II, p. 201.
1853. *Mugil adjustus, Id., ibid.*, V, p. 503.
1861. *Mugil borneensis*, Günther, *Cat. Fish. Brit. Mus.*, III, p. 448.
1878. *Mugil borneensis*, Day, *Fish. Ind.*, p. 357, pl. lxxvi, fig, 1.
1889. *Mugil borneensis*, Day, *Faun. Brit. Ind. Fish.*, II, p. 353, fig. 115.

There is only one specimen in the collection. It is from Satpara and measures 122 mm. in length. The time of capture is not given. The species appears to be an occasional visitor to the outer channel.

Distribution :—Seas of India ; East Indian and Malay Archipelagoes.

Liza corsula (Hamilton Buchanan).

1822. *Mugil corsula*. Hamilton Buchanan, *Fish. Ganges*, pp. 222 and 381, pl. ix, fig. 97.
1836. *Mugil corsula*, Cuvier and Valenciennes, *Hist. Nat. Poiss* XI, p. 119.
1841. *Mugil corsula*, Eydoux and Souleyet, *Voy. Bonite, Zool.*, I, p. 172, pl. iv, fig. 2.
1853. *Mugil corsula*, Bleeker, *Verh. Bat. Gen.*, XXV, p. 101.
1860. *Mugil corsula, Id., Act. Soc. Sc. Indo-Neerl.*, VII, p. 82.
1861. *Mugil corsula*, Günther, *Cat. Fish. Brit. Mus.*, III, p. 460.
1878. *Mugil corsula*, Day. *Fish. Ind.*, p. 354, pl. lxxi, fig. 6.
1889. *Mugil corsula, Id., Faun. Brit. Ind. Fish.*, II, p. 340.
1910. *Mugil corsula*, Jenkins, *Rec. Ind. Mus.*, V, p. 140.

Only one young specimen, 40 mm. in length, is in the collection. It was caught on 16-ix-14 in the north-east portion of the lake about eight miles south-east of Kalupara Ghat, at a point where the depth of the water was eight feet. This specimen was mixed up with other young mullets and its presence was detected only on a minute examination of the specimens. It is remarkable that this species should be represented only by one very young specimen. Probably it entered the lake along with flood-water from the rivers during July, which, judging from the size

[1] *Proc. U. S. Nat. Mus.*, VII, p. 261 (1884), and *Proc. Acad. Nat. Sc. Philadelphia*, LV, p. 746 (1903).

of the specimen, was about the time when the mother-fish spawned. The species is, however, very common in the brackish and fresh waters of Orissa and individuals are often noticed even in *nayan jhuris* (road-side drains). This fish is proverbially clever in eluding capture and special traps are constructed to secure it. It is not improbable, therefore, that specimens in the lake escape capture. The presence of the species after the freshets is, however, well established, as this individual was captured at a considerable distance from the mouth of any river.

Distribution :—Estuaries and rivers of Bengal, Bihar and Orissa, United Provinces and Burma, found far above tidal influence in fresh water.

Liza troschelii (Bleeker).

1858. *Mugil troschelii*, Bleeker, *Nat. Tijdsch. Ned. Ind.*, XVI, p. 277.
1859. *Mugil troschelii*, *Id.*, *Act. Soc. Sc. Indo-Neerl.*, VIII, *Sumatra* (8), p. 80.
1861. *Mugil troschelii*, Günther, *Cat. Fish. Brit. Mus.*, III, p. 448.
1878. *Mugil troschelii*, Day, *Fish. Ind.*, p. 358.
1889. *Mugli troschelii*, *Id.*, *Faun. Brit. Ind. Fish.*, II, p. 355.
1911. *Liza troscheli*, Jordan and Richardson, *Mem. Carnegie Mus.*, IV, p. 176.
1913. *Mugil troschelii*, Weber, *Fisch. Siboga-Exped.*, p. 139.

There is only one specimen in the collection, 107 mm. in length. It was secured at Satpara; the time of capture is not stated. Probably the fish is only a casual visitor to the outer channel.

Distribution :—Seas of India; coasts of Ceylon, Java, Sumatra and Borneo.

Family POLYNEMIDAE.

Genus **ELEUTHERONEMA**, Bleeker.

Eleutheronema tetradactylum (Shaw).

1803. *Polynemus* sp. (*Maga Jelle*), Russell, *Fish. Vizag.* II, p. 67, pl. clxxxiii.
1804. *Polynemus tetradactylus*, Shaw, *Gen. Zool.*, V, p. 135.
1822. *Polynemus teria*, Hamilton Buchanan, *Fish. Ganges*, pp. 224 and 381.
1829. *Polynemus tetradactylus*, Cuvier and Valenciennes, *Hist. Nat. Poiss.*, III, p. 375, and VII, p. 514.
1839. *Polynemus tetradactylus*, M'Clelland, *Journ. Asiat. Soc. Bengal*, VIII, p. 206.
1839. *Polynemus salliah*, Cantor, *Journ. Roy. Asiat. Soc.*, V, p. 166.
1839. *Polynemus quadrifilis*, *Id.*, *ibid.*, p. 186.
1846. *Polynemus tetradactylus*, Richardson, *Rep. Brit. Assoc. Adv. Sc.* (1845), p. 218.
1849. *Polynemus tetradactylus*, Cantor, *Journ. Asiat. Soc. Bengal*, p. 1007.
1849. *Polynemus tetradactylus*, Bleeker, *Verh. Batav. Gen.*, XXIII, p. 57.
1860. *Polynemus tetradactylus*, Günther, *Cat. Fish. Brit. Mus.*, II, p. 329.
1878. *Polynemus tetradactylus*, Day, *Fish. Ind.*, p. 180.
1880. *Polynemus tetradactylus*, Klunzinger, *Sitzb. Akad. Wien*, LXXX, p. 373.
1889. *Polynemus tetradactylus*, Day, *Faun. Brit. Ind. Fish.*, II, 106.
1903. *Polydactylus rhadinus*, Jordan and Evermann, *Proc. U. S. Nat. Mus.*, XXV, p. 351, fig. 20.
1907. *Polynemus tetradactylus*, Lloyd, *Rec. Ind. Mus.*, I, p. 224.
1911. *Eleutheronema tetradactylum*, Jordan and Richardson, *Mem. Carnegie Mus.*, IV, p. 177, fig. 10.
1913. *Polynemus tetradactylus*, Weber, *Fisch. Siboga-Exped.*, LVII, p. 141.

There are eleven specimens in the collection, among which one from Rambha is fairly large, measuring 430 mm. in length. The species is found throughout the main area of the lake and is a permanent resident, probably breeding near the mouths of rivers before the rains. The following statement shows the different localities whence the specimens were obtained, and their number and size.

2 specimens	Off Balugaon	21-vii-13	130 mm. and 136 mm.
4 ,,	Barkul Bay	18-ix-14	77 mm., 86 mm., 97 mm. and 115 mm.
1 specimen	Off Barkul	———	121 mm.
3 specimens	8 miles S. E. of Kalupara Ghat	16-ix-14	68 ,, to 69 mm.
1 specimen	Rambha	19-xi-14	430 ,,

Distribution:—Seas of India; China; Indo-Australian Archipelago; North-Australia; this species ascends higher up the rivers than any other of the family.

Family SPHYRAENIDÆ.

Genus **SPHYRAENA**, Artedi.

Sphyraena raghava, sp. nov.

(Text-figures 20, 21.)

The body is elongated and round but a little compressed and is also slightly constricted near the end of the caudal peduncle. The dorsal profile is almost straight; the ventral profile is slightly convex to the anterior origin of the anal fin, posterior to which it runs up, narrowing down the depth of the fish to the constricted portion of the caudal peduncle.

The measurements in hundredths of the length without the caudal fin are as follows: the length of the head 31%, the height of the body 14·3%, the length of the snout 15·24%, the horizontal diameter of the eye 5·24%, the length of the maxillary 13%, the breadth of the interorbital space 4·7%, the length of the pectoral fin 10·95%, the length of the ventral fin 7·6%, and the least depth of the caudal peduncle 7·14%.

The distance between the occiput and the anterior origin of the first dorsal fin is equal to the length of the snout; the distance between the anterior origin of the first dorsal fin and the anterior origin of the second dorsal fin is equal to the distance between the anterior origin of the second dorsal fin and the commencement of the caudal fin rays on the superior side of that fin; the distance between the anterior origin of the second dorsal fin and the root of the caudal fin about its middle is equal to the length of the head. The depth of the body is contained seven times in the length without the caudal fin. The least height of the caudal peduncle is half the depth of the body and is contained two and two-thirds times in the length of the caudal peduncle.

The head is long and tapering and is as high as broad. The upper and the lower profiles of the head are straight and the end is pointed. The length of the head measured from the tip of the mandible is contained three and one-fifth times in the length without the caudal fin, and the height of the head, which is equal to the width of the

head and the post-orbital length of the head, is contained three and one-fourth times in the length of the head. The snout is contained twice in the length of the head. The lower jaw is longer than the upper by half the length of the longer diameter of the eye. On the upper side of the free pointed end of the lower jaw there is a fleshy cushion-like protuberance, which is continued over the tip down to the lower surface of the protruded end of that jaw. The anterior end of the upper jaw is truncated and thus fits behind the fleshy cushion on the upper side of the tip of the lower jaw. The skin on the superior side of the truncated end of the upper jaw is finely striated. The eye is large, lateral and ovate; the anterior end of the eye is wider, the vertical diameter being a little more than three-fourths of the horizontal diameter, which is contained six times in the length of the head. The lower margin of the orbit is lower than the middle of the depth of the head. The eyes have adipose eye-lids. The breadth of the interorbital space about the middle of the eyes is contained six and a half times in the length of the head. This space is slightly concave and there are two ridges running through the interorbital space from the end of the snout to the occiput, running more and more apart either way than in the middle of the eyes. The

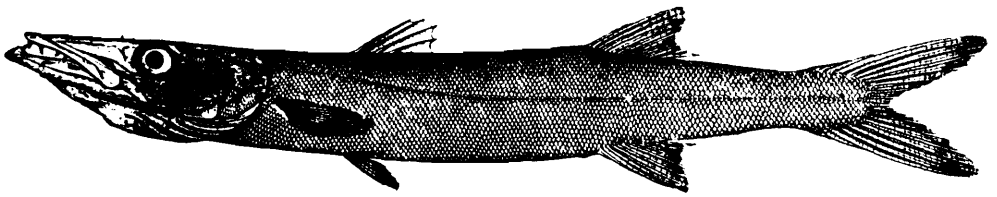

FIG. 20.—*Sphyraena raghava*, Chaudhuri × $\frac{1}{2}$.

two pairs of nostrils are close together, the posterior nostrils are lateral, are in the form of vertically inclined slits and are provided with skin flaps, which are one-third of the vertical diameter of the eye in advance of the anterior orbit; the anterior nostrils are superior in position and are closer together, with tubular openings and are in advance of the anterior orbit by half the horizontal diameter of the eye. The free posterior end of the maxillary is dilated and round and reaches below the posterior nostril of its side; there is a triangular process on the maxillary bone above the angle of the jaws which ends in a bony knob.

The teeth in the jaws are uniserial. At the symphysis of the mandible, just posterior to the fleshy tubercle, there is a pair of large fang-like teeth, placed side by side very close to each other, and inclined together at an acute angle and directed inwards. There is a large round and deep groove correspondingly above at the symphysis of the upper jaw for the lodgment of this pair of canine-like teeth when the mouth is shut. On each side of this pair of teeth, there is an empty round and smooth interval in the jaw on each ramus of the lower jaw, beyond which there are eight minute conical teeth in a single line placed close to one another; posterior to these small teeth there are seven or eight large conical teeth of various sizes quite wide apart from one another, the size of the one further inward being larger than the one

nearer to the symphysis. In the upper jaw, in the front part of the snout, on each side of the large groove at the symphysis already described, there are two large and long fang-like teeth on each side of the groove with a considerable empty interval between. On a higher level to these four fangs there are minute villiform teeth, forty-five in number, on each side on the edges of the premaxillary throughout its length, which continue to the angle of the jaws (as the maxillary bone does not take any part in the formation of the mouth). Further inward and at a lower level, but running parallel to the villiform teeth of the premaxillary, there are on each side a series of palatine teeth beginning behind and beyond the four anterior fang-like teeth. Of these palatine teeth on each side there are four large conical teeth wide apart from one another; posterior to these large conical teeth, but in the same line with them, there are five very small teeth on each side, not very close to one another (fig. 21).

The tongue is not free but is attached to the floor of the mouth about its middle;

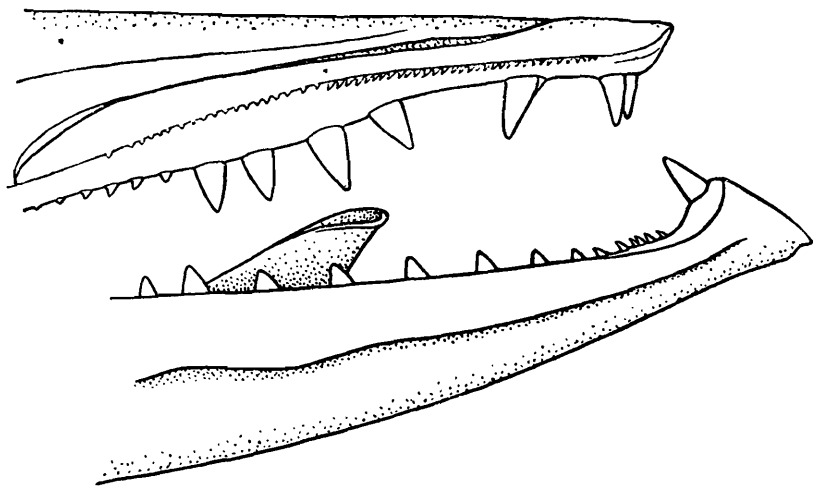

FIG. 21.—*Sphyraena raghava*, Chaudhuri. Teeth of palate, upper and lower jaw.

it is long, slender, and pointed; the upper surface of the tip of the tongue is finely asperous and there are very minute teeth on this surface arranged in longitudinal series.

There are seven branchiostegal rays and the gill openings are wide; the gill rakers are entirely absent and are only represented by the asperities opposite the gill filaments. The pseudo-branchiae are well developed and have about fifty-two filaments, most of which are longer than half the length of the gill filaments. The end of the isthmus is in the form of a hard bony knob. The edge of the operculum is round and is without any spinous process or point.

The dorsal fin has four spines, probably there was another which possibly might have been damaged beyond recognition; the second dorsal fin has one short and slender spine and nine soft rays; the pectoral fin has fourteen rays; the ventral fin has one strong spine and six rays; the anal fin has two spines and nine rays. The distance between the root of the pectoral fin and the anterior origin of the first dorsal

fin is less than the length of the pectoral fin by nearly one-fifth the length of the latter fin ; the insertion of the ventral fin is almost vertically below the anterior origin of the first dorsal fin ; the distance between the root of the ventral fin and the anterior margin of the anal fin is almost equal to the interval between the anterior roots of the two dorsal fins. The anal opening is in advance of the anterior root of the anal fin by half the length of the vertical diameter of the eye. The caudal fin is deeply divided, the length of the middle rays is contained three times in the length of the longest outer caudal rays ; the upper caudal lobe is slightly longer than the lower one.

The scales are small and the head is more or less covered with scales smaller than those on the body. The preorbital, the frontal, and the parietal regions are bare, but the suborbital, the temporal, the occipital, the preopercular and the opercular regions are thickly covered with minute scales. The number of vertical rows of scales on the cheek below the eye) is nine and the number of vertical rows on the opercle eighteen. The lateral line is complete ; it runs from the upper edge of the gill-opening to the middle point of the base of the caudal fin, consisting of rather large scales perforated by simple tubes ; from the upper corner of the opercular opening the lateral line continues straight along seven scales, then curving a little it slopes below the middle line which it meets traversing forty-three scales ; from this point it continues in a straight line to the root of the caudal fin terminating at the middle point ; the number of perforated scales in the lateral line is one hundred and forty-four. In the transverse lateral series there are eleven rows of scales between the first dorsal fin and the lateral line and twenty-five rows of scales between the lateral line vertically below the anterior origin of the first dorsal fin and the midventral line [*i.e.* lat. trans. at the first dorsal fin, is 11/25], between the second dorsal fin and the lateral line there are sixteen rows of scales, and between the lateral line at the point in the line directly below the anterior origin of the second dorsal fin and the midventral line there are fifteen rows of vertical scales [*i.e.* lat. trans. at the second dorsal fin, is 16/15]. The number of lateral rows of scales, between the anterior origin of the first dorsal fin and the ventral fin of the same side, is thirty-five.

The colour of the specimens in alcohol is brown above the lateral line, and dull silvery white below that line including the abdomen. The fins are pale brown and, except the ventral fins, the inner margins of the fins are tinted black. The tip of the lower jaw with the fleshy protuberance is coloured black. The upper margins of the rims of the eyes are also black. The roots of the dorsal fins, specially of the second dorsal, are coloured black. On the side of the body there are short and thick but faint oval patches, six or seven in number, along the middle line below the two dorsal fins. These faint marks are only visible in shaded light. The tip of the tongue and the top of the end of the upper jaw are dark.

The new species differs from all the known Indian species by possessing a very large number of scales in the lateral line as well as in the proportions of the different parts and in the position of the fins. The new fish has a longer head than *S. jellow*, *S. acutipinnis*, *S. commersonii* and *S. obtusata* ; it is of lesser height and has smaller

eyes than *S. obtusata*. In the number of scales in the lateral line it approaches *Sphyraena sphyraena* (L.), more commonly known as *Sphyraena vulgaris*, which has one hundred and fifty scales in the lateral line against one hundred and forty-four in the new species; the new species is a deeper fish than *S. sphyraena* and possesses larger eyes. From all the recently described species of the genus it differs considerably. From *S. africana*, Gilchrist,[1] it differs in the character of its teeth, in possessing a smaller eye and a shorter maxillary, in having the pectoral fin not ending below the origin of the spinous dorsal and not having the ventrals in advance of the origin of the first dorsal, besides other differences. *S. ensis*, Jordan and Gilbert,[2] has a longer head, a less deep body, a larger eye and longer maxillary. *S. goodingi*, Seale,[3] is much less deep, possesses short gill-rakers (gill-rakers are absent in the new species) and differs in the position of the fins. *S. pelleri*, Jenkins,[4] has longer eyes and is much less deep than the new species and differs in the number of rows of scales on the cheek. *S. putnamiae*, Jordan and Seale,[5] differs in the length of the maxillary and also in the character of the teeth, in the proportions of the fins and in colouration.

The new species differs from *S. pinguis*, Günther,[6] in the character of the tip of the lower jaw, in the position of the fins and in the number of scales in the lateral line. *S. snodgrassi*, Jenkins,[7] has a larger eye, longer maxillary and a smaller number of scales in the lateral line. *S. tome*, Fowler,[8] differs in the depth of the body, in the number of scales in the lateral and transverse lines, in the width of the head and in the depth of the caudal peduncle, etc. *S. waitii*,[9] Ogilby, differs in every particular except in the height of the body and the length of the head.

The type-specimen was collected at Satpara in the outer channel of the lake. The period of its capture is not noted. Evidently the species is an occasional visitor to the part of the lake that is nearest to the sea. The type is 210 mm. in length without the caudal fin and is entered in the register of the Zoological Survey of India under No. F. 9453/1.

Family OPHIOCEPHALIDAE.

Genus **OPHICEPHALUS**, Bloch.

Ophicephalus punctatus, Bloch.

1801. *Ophicephalus punctatus*, Bloch, *Ichth.*, X, p. 114, pl. cccIviii.
1803. *Ophiocephalus karrouvei*, Lacepede, *Hist. Poiss.*, III, p. 554.
1822. *Ophiocephalus lata*, Hamilton Buchanan, *Fish. Ganges*, pp. 63 and 367.
1831. *Ophicephalus punctatus*, Cuvier and Valenciennes, *Hist. Nat. Poiss.*, VII, p. 404.

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[1] Gilchrist, *Ann. South African Mus.*, VI, p. 256 (1908-10).
[2] Jordan and Gilbert, *Bull. U. S. Fish. Com.*, II, p. 106 (1882).
[3] Seale, *Occasional Papers Ber. Pau. Bishop Mus. Honolulu*, IV, p. 18 (1906).
[4] Jenkins, *Bull. U. S. Fish. Com.*, XIX, p. 387 (1899).
[5] Jordan and Seale, *Proc. Davenport Acad. Sc.*, X, p. 4, pl. xiii (1907).
[6] Günther, *Journ. Mus. Godeffroy*, II, p. 211 (1873).
[7] Jenkins, *Bull. U. S. Fish. Com.*, XIX, p. 387 (1899).
[8] Fowler *Proc. Acad. Nat. Sc. Philadelphia*, LV, p. 750, pl. xlvi (1903).
[9] Ogilby, *Ann. Queensland Mus.*, IX, p. 29 (1908).

1842. *Ophicephalus indicus*, M'Clelland, *Cal. Journ. Nat. Hist.*, II, p. 583.
1848. *Ophiocephalus punctatus*, Jerdon, *Madras Journ. Lit. Sc.*, p. 145.
1853. *Ophiocephalus punctatus*, Bleeker, *Verh. Bat. Gen.*, XXV, p. 95.
1861. *Ophiocephalus punctatus*, Günther, *Cat. Fish. Brit. Mus.*, III, p. 469.
1861. *Ophiocephalus affinis*, *Id.*, *ibid.*, p. 470.
1865. *Ophiocephalus punctatus*, Day, *Fish. Malabar*, p. 151.
1878. *Ophiocephalus punctatus*, *Id.*, *Fish. Ind.*, p. 367, pl. lxxviii fig. 1.
1889. *Ophiocephalus punctatus*, *Id.*, *Faun. Brit. Ind. Fish.*, II, p. 364.
1909. *Ophiocephalus punctatus*, Jenkins, *Rec. Ind. Mus.*, III, p. 287.
1910. *Ophiocephalus punctatus*, *Id.*, *ibid.*, V, p. 138.
1911. *Ophiocephalus punctatus*, Chaudhuri, *ibid.*, VI, p. 23.

There are two specimens in the collection ; one measuring 148 mm. in length is from Parikud. The other, 108 mm. in length, was secured in the month of September, 1914 at Barkul. In Parikud the fish was probably introduced through human agency. The presence of the fish in September near Barkul, when the water of this part of the lake is almost fresh, is easily accounted for.

Distribution :—Fresh waters of the East Indian continent and of Ceylon ; Yunnan.

Suborder PLECTOGNATHI.

Division *SCLERODERMI.*

Family TRIACANTHIDAE.

Genus **TRIACANTHUS**, Cuvier.

Triacanthus brevirostris, Temminck and Schlegel.

1754. *Balistes* sp., Gronovius, *Mus. Ichthyol.*, I, p. 52, pl. cxv.
1763. *Balistes bipes*, Gronovius, *Zoophyl.*, p. 53, pl. cccxciv.
1803. *Balistes* sp. (*Bowree and Abatoo*), Russell, *Fish. Vizag.*, I, p. 14, pl. xxi.
1830. *Balistes biaculeatus*, Bennett, *Fish. Ceylon*, p. 15, pl. xv.
1840. *Triacanthus biaculeatus*, Cantor, *Journ. Asiat. Soc. Bengal*, p. 1342.
1850. *Triacanthus brevirostris*, Temminck and Schlegel, *Faun. Japon. Pisces.*, p. 294, pl. cxxix, fig. 2.
1854. *Balistes bipes*, Gronovius and Gray, *Cat. Fish. Brit. Mus.*, p. 37.
1854. *Triacanthus brevirostris*, Hollard, *Ann. Sc. Nat.*, I, p. 45, pl. ii, fig. 1.
1865. *Triacanthus biaculeatus*, Day, *Fish. Malabar*, p. 260.
1870. *Triacanthus brevirostris*, Günther, *Cat. Fish. Brit. Mus.*, VIII, p. 210.
1878. *Triacanthus brevirostris*, Day, *Fish. Ind.*, p. 685, pl. clxxv, fig. 1.
1889. *Triacanthus brevirostris*, *Id.*, *Faun. Brit. Ind. Fish.*, II, p. 471, fig. 170.
1903. *Triacanthus brevirostris*, Regan, *Proc. Zool. Soc.*, I, pp. 181 and 183.
1910. *Triacanthus brevirostris*, Annandale and Jenkins, *Mem. Ind. Mus.*, III, pp. 8 and 11.
1910. *Triacanthus brevirostris*, Jenkins, *Rec. Ind. Mus.*, V., p. 136.
1912. *Triacanthus brevirostris*, *Id.*, *ibid.*, VII, p. 6.

The specific name "*bipes*" by Dr. Laurence Theodore Gronow is the earliest, reported to be written before 1777 and said to be published in 1780. The species was described by Gronow as early as 1754 (Mus. Ichthyol.[1]).

[1] "Catalogue of Fish collected and described by Laurence Theodore Gronow now in the British Museum." Published by order of the Trustees, in 1854 ; edited by J. E. Gray, pp. v-vii and 37.

There are fifty-seven specimens in the collection. This fish occurs very extensively all over the lake and breeds freely everywhere at least from February to September. Numerous young measuring 12 mm. and upwards were secured in March, June, July and September. Some of the young have black or grey blotches or stripes The following statement shows the different localities in the lake whence the specimens were obtained, and their number and size.

2 specimens	Off Balugaon	21-vii-13		28 mm. and 40 mm.
9 ,, ..	Off Barkul	13-xi-12		24 ,, to 56 ,,
3 ,,	Between Chiriya Island and Barkuda Island ..	17-xi-14 ..		255 ,, to 275 ,,
10 ,,	Between Domkuda and Samal Island	July, 1914		12 ,, to 23 ,,
3 ,,	Off Nalbano	Sept. 1914		24 ,, to 53 ,,
1 specimen	South East of Patsahanipur	6-iii-14		12 ,,
1 ,,	Rambha Bay ..	——		86 ,,
21 specimens	Off Samal Island	22-ix-13		11 ,, to 47 ,,
6 ,,	Seruanaddi near Barnikuda	4-ix-14 ..	..	17 ,, to 46 ,,
1 specimen ..	Seruanaddi ..	8-ix-14		46 mm.

This fish is eaten by the Uriyas among whom it commands a very extensive sale and is extremely cheap; it is very popular with the poorer classes of the people round the lake; even the skin, spines and bones separately find a ready market.

Distribution:—Seas of India, of the Malay Archipelago, China and Japan; also Australia.

Division *GYMNODONTES.*

Family TETRODONTIDAE.

Genus **TETRODON,** Linnaeus.

Tetrodon fluviatilis, Hamilton Buchanan.

1822. *Tetrodon fluviatilis*, Hamilton Buchanan, *Fish. Ganges*, pp. 6 and 362, pl. xxx, fig. 1.
1823. *Tetrodon nigroviridis*, Procé, *Bull. Soc. Philom.* (1822), p. 130.
1849. *Tetrodon simulans*, Cantor, *Journ. Asiat. Soc. Bengal*, p. 1356.
1860. *Arothron dorsovittatus*, Blyth, *ibid.*, XXIX, p. 173.
1865. *Crayracion fluviatilis*, Bleeker, *Atl. Ichthyol. Ind. Orient. Neerl.*, p. 68, pl. ccx, fig. 4.
1865. *Crayracion fluviatilis*, Day, *Fish. Malabar*, p. 256.
1870. *Tetrodon fluviatilis*, Günther, *Cat. Fish. Brit. Mus.*, VIII, p. 299.
1878. *Tetrodon fluviatilis*, Day, *Fish. Ind.*, p. 707, pl. clxxxiii, fig. 1.
1889. *Tetrodon fluviatilis*, *Id.*, *Faun. Brit. Ind. Fish.*, II, p. 496.
1902. *Tetrodon fluviatilis*, Regan, *Proc. Zool. Soc.*, 1902 (ii), p. 284.
1910. *Tetrodon fluviatilis*, Annandale and Jenkins, *Mem. Ind. Mus.*, III, pp. 8 and 15.

There are only three young specimens in the collection, one measuring 44 mm. in length caught off Nalbano in September, 1914 and two measuring 70 mm. and 72 mm. in length from Rambha Bay in February, 1914. The fish is probably a permanent inhabitant in the main area of the lake and breeds in it.

Distribution:—Seas and estuaries of India and the Malay Archipelago. This

species appears to be entirely littoral, estuarine and fluviatile. It ascends tidal rivers and has been reported as far up as Saraghat in the Ganges. In the Amherst District of Burma it is said to be found in hill streams.

Tetrodon oblongus (Bloch).

1785. *Tetraodon oblongus*, Bloch, *Ausl. Fisch.*, II, p. 6, pl. cxlvi, fig. 1.
1801. *Tetraodon oblongus*, Bloch and Schneider, *Syst. Ichthyol.*, p. 504.
1803. *Tetraodon* sp. (*Kappa*), Russell, *Fish. Vizag.*, I, p. 17, pl. xxiv.
1846. *Tetrodon alboplumbeus*, Richardson, *Voy. Sulph. Ichthyol.*, p. 121, pl. lviii, figs. 6 and 7.
1846. *Tetrodon alboplumbeus*, *Id.*, *Rept. Brit. Assoc. Adv. Sc.* (1845), p. 199.
1849. *Tetrodon oblongus*, Cantor, *Journ. Asiat. Soc. Bengal* (1849), p. 1362.
1860. *Gastrophysus microphthalmus*, Blyth, *Journ. Asiat. Soc. Bengal*, XXIX, p. 174.
1870. *Tetrodon oblongus*, Günther, *Cat. Fish. Brit. Mus.*, VIII, p. 278.
1878. *Tetrodon oblongus*, Day, *Fish. Ind.*, p. 702, pl. clxxx, fig. 2.
1889. *Tetrodon oblongus*, *Id.*, *Faun. Brit. Ind. Fish.*, II, p. 492.
1910. *Tetrodon oblongus*, Annandale and Jenkins, *Mem. Ind. Mus.*, III, pp. 8 and 14.

There is only one young specimen in the collection measuring 67 mm. in length ; locality and date of capture are not noted. Probably the fish is a chance visitor to the outer channel.

Distribution :—Seas of India ; Indian Ocean ; Malay Archipelago ; China, Japan and the South Sea.

Tetrodon patoca, Hamilton Buchanan.

1803. *Tetraodon* sp. (Kappa), Russell, *Fish. Vizag.*, p. 18, pl. xxv.
1822. *Tetrodon patoca*, Hamilton Buchanan, *Fish. Ganges*, pp. 7 and 363, pl. xviii, fig. 2.
1849. *Tetrodon dissutidens*, Cantor, *Journ. Asiat. Soc. Bengal* (1849), p. 1364.
1855. *Tetrodon patoca*, Duméril, *Rev. Zool.*, p. 280.
1865. *Leiodon patoca*, Bleeker, *Atl. Ichthyol. Ind. Orient. Neerl.* V, p. 76, pl. vi, fig. 2.
1870. *Tetrodon patoca*, Günther, *Cat. Fish. Brit. Mus.*, VIII, p. 288.
1878. *Tetrodon patoca*, Day, *Fish. Ind.*, p. 703, pl. clxxxii, fig. 4.
1889. *Tetrodon patoca*, *Id.*, *Faun. Brit. Ind. Fish.*, II, p. 492.
1910. *Tetrodon patoca*, Annandale and Jenkins, *Mem. Ind. Mus.*, III, p. 14.

There are three specimens in the collection all of which are young, measuring 12 mm., 13 mm. and 25 mm. in length. They were collected in the latter half of the mouth of March, 1913 and 1914 in Satpara Bay and near Satpara. Probably the fish comes as far as the outer channel and breeds in the neighbourhood in February and March, when the water is nearly as salt as the sea outside.

Distribution :—From Sind through the seas of India to China. The fish is very common along the Coromandel coast. The species is also common in the estuaries of the Ganges.

Tetrodon reticularis (Bloch and Schneider).

1785. *Tetraodon testudineus*, Bloch, *Ausl. Fisch.*, I, p. 123, pl. cxxxix.
1801. *Tetraodon testudineus*, Bloch and Schneider, *Syst. Ichthyol.*, p. 502.
1801. *Tetraodon reticularis*, *Id.*, *ibid.*, p. 506.
1803. *Tetraodon* sp. (*Bondaroo Kappa*), Russell, *Fish. Vizag.*, I, p. 19, pl. xxvii.
1804. *Tetrodon testudineus*, Shaw, *Gen. Zool.*, V, p. 444, pl. clxxviii.

1849. *Tetrodon testudineus*, Cantor, *Journ. Asiat. Soc. Bengal* (1849), p. 1358.
1865. *Crayracion testudineus*, Bleeker, *Atl. Ichthyol. Ind. Orient. Neerl.*, V, p. 71, pl. ccxii, fig. 3.
1865. *Crayracion testudineus*, Day, *Fish. Malabar*, p. 257.
1870. *Tetrodon reticularis*, Günther, *Cat. Fish. Brit. Mus.*, VIII, p. 296.
1878. *Tetrodon reticularis*, Day, *Fish. Ind.*, p 705, pl. clxxx, fig. 5.
1889. *Tetrodon reticularis*, *Id.*, *Faun. Brit. Ind. Fish.*, II, p. 494.
1910. *Tetrodon reticularis*, Annandale and Jenkins, *Mem. Ind. Mus.*, III, p. 8.

There are only two specimens in the collection, one measuring 145 mm. in length secured in March, 1914 near Satpara, and the other measuring 112 mm. in length obtained in the channel between Barnikuda and Satpara on 4-ix-14. Probably the fish is an occasional visitor to the outer channel when the salinity of the area is sufficiently high.

Distribution :—Seas of India, Malay Archipelago and New Guinea.