

A DESCRIPTION OF THE DEEP-SEA FISH CAUGHT BY  
THE R.I.M.S. SHIP "INVESTIGATOR" SINCE THE YEAR 1900,  
WITH SUPPOSED EVIDENCE OF MUTATION IN *MALTHOPSIS*.

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Four years ago Colonel Alcock drew my attention to the fact that a number of unknown fish had been obtained of late years by the "Investigator." The description of these had been delayed until the results of the German exploratory vessel "Valdivia," which operated in deep waters round India, had been published.

Colonel Alcock's catalogue of the deep-sea fish taken by the "Investigator" was published ten years ago. Since then a few new forms have been described from time to time. Dr. Annandale has asked me to include these descriptions and to mention the more interesting of the known forms obtained since the compilation of the catalogue, some of which have not been previously recorded from Indian seas. The previous descriptions have been given *verbatim* so that the whole may form an appendix to the catalogue published in 1899. Five genera and nineteen species are described here for the first time.

Systematic work cannot always be pursued with unbroken facility. There are among the collection four small communities of the genus *Malthopsis*. These include a number of types which although distinct, cannot I think be treated as separate species in the ordinary sense of the word, for it is hardly possible to suppose that these types arose in separate areas and subsequently came together again so as to exhibit the remarkable distribution obtained. This question is dealt with separately at the end of the systematic part of the paper.

I. SYSTEMATIC PART.

Subclass ELASMOBRANCHII.

Order PLAGIOSTOMI.

Suborder Selachii.

Family SCYLLIDÆ.

*Scylliorhinus indicus*, Brauer.

*Wissen. Ergebn. Deutsch. Tiefsee-Exped. "Valdivia,"* Bd. xv, part i, p. 8, pl. xiv (1906).

One specimen 30 cm. in length from 604 fathoms in the Gulf of Oman, Station 339. Registered No. 1144.

Suborder **Batoidei.**Family **RAIIDÆ.***Raia andamanica*, sp. nov.

*Illustr. Zool.* "Investigator," Fishes, pl. xlvi, fig. 2 (1909).

*Raia*, sp. nov., *Annandale, Mem. Ind. Mus.*, ii, part 1, p. 3.

The breadth of the disk is slightly greater than the length measured to the end of the pelvic fin in the proportion of 19 to 17. The tail is long, the distance between the tip of the tail and the centre of the vent is much greater than the distance between the snout and the vent in the proportion of 3 to 2.

The snout projects very slightly. The antero-lateral borders, which are markedly sinuous, meet at less than a right angle. The lateral and posterior angles are both evenly rounded, but the lateral angle is less broadly rounded than the posterior. The greatest diameter of the eye is slightly greater than the smallest interorbital distance, and is a quarter of the length of the snout measured from the centre of the upper jaw. The spiracle is close behind the eye; its greatest diameter is about half that of the eye. The mouth is nearly a transverse line, being very slightly curved; its length is one-third that of the snout. The anterior limit of the nostril is removed from the corner of the mouth by a distance equal to the breadth of the mouth. There are 54 rows of teeth in the upper jaw, 40 in the lower. The teeth are on an oval base; the front ones are worn flat, the back ones have a low pointed cusp.

The dorsal fins are small, the anterior being somewhat larger than the posterior; they are close to the end of the tail and are separated by a distance less than the length of the base of either. The caudal fin is only represented by a narrow fold of skin on the lower side.

There is a continuous row of eight large thorns on the supraorbital ridge; the first of these is in front of the eye, the last behind it.

There are about 15 large spines over the rostral cartilage which does not extend quite to the end of the disk.

There is a single series of large spines in the mid dorsal line extending from a short distance behind the level of the spiracles, to the tail, where the series becomes less regular. Besides this, most of the upper surface except the postero-lateral margins of the pectoral fins is covered with small denticles.

The sides and top of the tail are spiny, the spines being larger on the upper surface.

The entire lower surface is smooth and naked except the distal half of the tail, which bears a few very small spines.

Colour, a uniform slaty grey above and below.

A small male 21 cm. in length from 279 fathoms in the Andaman Sea, Station 332. Registered No. F  $\frac{1129}{1}$ .

*Raia reversa*, Lloyd.

*Ann. Mag. Nat. Hist.* (7), vol. xviii, p. 310 (1906); and *Illustr. Zool. "Investigator,"* Fishes, pls. xxxix and xli (1908).

The greatest breadth of the disk is equal to the length from the snout to the root of the tail.

The cloaca is slightly nearer the end of the snout than the end of the tail.

The interorbital space is  $\frac{1}{4}$  the length of the snout measured from an eye or the middle of the mouth.

The anterior borders of the pectoral fins are sinuous and together form an angle of about  $80^{\circ}$ .

The snout is prominent.

The lateral angle of the pectoral fins is rounded.

The spiracle is large; its greatest diameter equals that of the eye.

The skin over the skull, but not over the snout, is covered with fine denticles.

The anterior half or more of the pectoral fins is covered with small denticles.

There are two series of larger spines on the pectoral fins, one series of about twenty opposite the shoulder-girdle (male characteristic probably) and another of about fifteen opposite the eye.

There is one large white stellate spine in front of the eye and two or three smaller ones behind.

There are four or five similar spines in the mid-dorsal line.

On the dorsum of the tail are three regular rows of large spines, those of the middle row being about half as numerous as those of the lateral rows.

The sides of the tail are spiny.

The lower surface of both disk and tail is smooth and devoid of spines.

The two dorsal fins are equal in length and are in contact at their bases; the caudal fin is a minute fold.

The mouth is transverse in its outer part and curved in the middle; its breadth is exactly half the length of the snout.

There are forty-two rows of teeth across both upper and lower jaw.

The teeth in the middle of the series are long and curved; their bases are heart-shaped.

Colours in the fresh state:—The upper surface of the disk is pure white, passing into dark grey at the margin of the pectoral fins. The upper surface of the pelvic fins and claspers is grey. The iris is black, but the pupil had a white milky appearance: the anatomical cause of this was unfortunately not made out in the fresh state. The entire lower surface is purplish black. In consistency the whole body is soft and flabby; when taken from the trawl it was rolled up in a cylindrical posture.

The single specimen (a male), measuring 60 cm. in its greatest length and 33 cm. in its greatest breadth, was taken from 820 fathoms in the Arabian Sea off the Baluchistan coast. Station 367..

The most characteristic features of this species are the soft, flabby consistency in the fresh state and the remarkable coloration, which suggested the name *R. reversa*. Registered No. F 1381

In the same haul was obtained a black pillow-shaped egg with four hollow horns at the corners; this measures  $2\frac{1}{2}$  by  $1\frac{1}{2}$  inches. The horns are not equal in length: those of one pair are  $2\frac{1}{2}$  inches long and are separated by a straight border; those of the other pair are  $1\frac{1}{2}$  inches long and are separated by a tongue-shaped projection of the border, which constitutes a smaller fifth horn.

*Raia philipi*, Lloyd.

*Ann. Mag. Nat. Hist.* (7), vol. xviii, p. 309 (1906); *Illustr. Zool. "Investigator,"* Fishes, pls. xl and xli (1908).

The greatest breadth of the disk is equal to the greatest length, including the ventral fins.

The ends of the snout and tail are equidistant from the cloacal orifice. The snout is slender and prominent. The interorbital space is  $3\frac{2}{3}$  in the length of the snout, measured from an eye or the middle of the mouth.

The anterior borders of the pectoral fins, which are somewhat sinuous, together form an angle of about  $85^\circ$

The lateral angles are rounded. The spiracle is large, its greatest diameter equals that of the eye.

Numerous small spinules occur on the upper surface of the tip of the snout and close to the antero-lateral margin in its posterior half only.

The superciliary ridge bears four spines in front and three behind.

There are five mid-dorsal spines in the branchial region.

Between the ocellus and the margin of the pectoral fin is a group of lanceolate denticles pointing inwards (probably characteristic of the male).

The whole lower surface of the snout is covered with fine denticles.

On the dorsum of the tail are three somewhat irregular rows of spines. The tail is naked below, the sides of the tail are spiny.

The mouth is widely but distinctly V-shaped; in width it is  $1\frac{7}{8}$  in the length of the snout.

There are eighty rows of teeth in the upper jaw and sixty in the lower. Teeth low and triangular, on a rhomboidal base.

The edges of the nasal valves are deeply fimbriated and are united across the middle line by a distinct fold of skin, which is separated from the upper jaw by a deep curved groove.

The dorsal fins are equal in length; the distance between them is greater than the length of either. Caudal fin small.

Colour uniform brown above, with a dark ocellus at the base of each pectoral fin, surrounded by a paler ring. Uniform white below; the tail shows dark mottling on its lower surface.

One small male specimen, measuring 36 cm. in its greatest length and 23 cm. in its greatest breadth, was taken from 130 fathoms in the Gulf of Aden. Station 360. Registered No. 1383.

There are now six species of the genus *Raia* in the collection, each of which is represented by a single specimen. Four of these are from depths of over 200 fathoms. Two are from more shallow water. Of these two *R. powelli* is from 67 fathoms in the Gulf of Martaban, the other, *R. philipi*, is from 130 fathoms in the Gulf of Aden. These two resemble one another more closely than any of the others. There is in the Indian Museum another specimen of the genus which was brought ashore by fishermen at Travancore from water which must have been less than 10 fathoms in depth. This specimen closely resembles *R. powelli*<sup>1</sup> but in some ways it also resembles *R. philipi*. It is possible that the three specimens are in a wide sense of one species which occurs rarely in the shallow waters around India and shows local variation. The specimens from Martaban and Travancore are both females, while the specimen from Aden is a male. It has been suggested to me that the differences exhibited may be of a sexual nature. At present it does not seem advisable to describe the specimen from Travancore as a new species, nor is it safe to infer without evidence that *R. philipi* is the male form of *R. powelli*. The measurements of the three specimens will be given in detail:—

Name of specimen	..	..	..	<i>Raia powelli.</i>	<i>Raia, sp.</i>	<i>Raia philipi.</i>
Locality	..	..	..	G. of Martaban.	Trivandrum.	G. of Aden.
Depth	..	..	..	67 fathoms.	10 fathoms (?).	130 fathoms.
Sex	..	..	..	Female.	Female.	Male.
Total length	..	..	..	318 mm.	475 mm.	350 mm.
Breadth	..	..	..	191 "	315 "	220 "
Snout to pelvic fin	..	..	..	187 "	290 "	220 "
Vent to snout	..	..	..	150 "	235 "	174 "
Width of mouth	..	..	..	26 "	46 "	32 "
Corner of mouth to front end of nostril	..	..	..	17 "	25 "	16 "
Length of snout from centre of upper jaw	..	..	..	54 "	78 "	60 "
Greatest diameter of eye	..	..	..	9 "	12 "	11 "
Spiracle	..	..	..	9 "	17 "	11 "
Interorbital distance	..	..	..	13 "	22 "	16 "
Position of greatest breadth—						
A, from snout	..	..	..	93 "	147 "	135 "
B, from end of pelvic fin	..	..	..	94 "	143 "	85 "
Number of teeth—						
Upper jaw	..	..	..	55 "	75 "	80 "
Lower jaw	..	..	..	55 "	75 "	60 "
Reg. No...	..	..	..	235	2708	1383
				I	I	I

As regards the form of the disk *R. powelli* and the Travancore specimen resemble one another exactly, and differ widely from *R. philipi*, in which the greatest breadth is much further back. As regards the shape of the mouth the Travancore specimen is intermediate between the other two (text-fig. 1), while as regards the relative

<sup>1</sup> See Annandale, *Mem. Ind. Mus.*, vol. ii, No. 1, p. 16.

proportions of eye and spiracle it differs from the others, which resemble one another in this respect. All three specimens are of the same colour and have the same characteristic ocellus at the base of the pectoral fin.

The shape of the teeth is alike in the three specimens; the same may be said of the form and disposition of the dorsal and caudal fins.

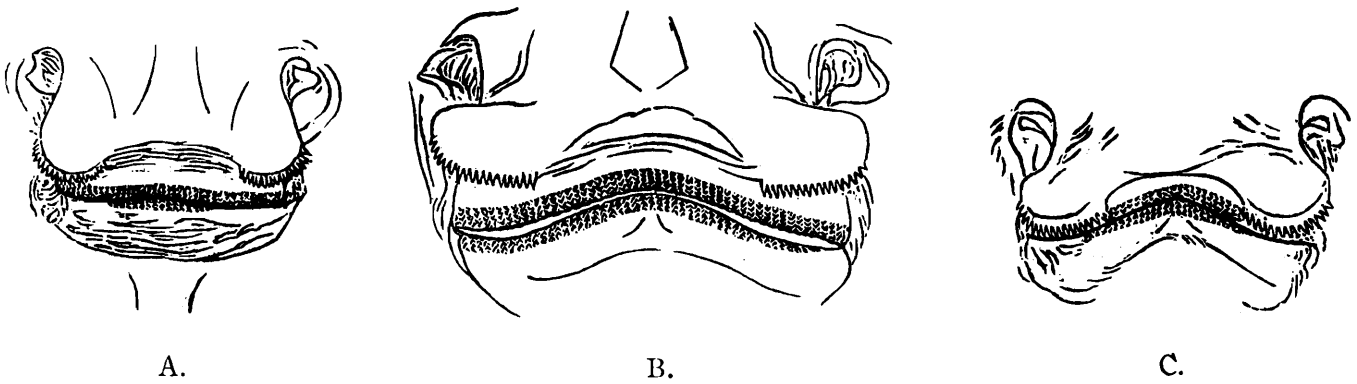


FIG. 1.—Mouths of *Raia*: A. = *R. powelli*; B. = *Raia* sp.; C. = *R. philipi*.

#### Family TORPEDINIDÆ.

##### *Narcine mollis*, Lloyd.

Lloyd, *Rec. Ind. Mus.*, vol. i, p. 8 (1907); Annandale, *Mem. Ind. Mus.*, vol. ii, no. 1, p. 43, pl. iiii, figs. 3, 3a.

*Illustr. Zool. "Investigator,"* Fishes, pl. xlvi, figs. 1, 1a (1909).

The vent is slightly nearer the anterior margin of the snout than the tip of the tail. The disk is evenly rounded, it is slightly broader than long. The margin of the flap formed by the confluent nasal valves is most prominent at the sides, unlike *N. timlei*, the other Indian species. The whole quadrangular space which lies between the two nasal clefts is nearly as long as it is broad. In *N. timlei* this space is three times as broad as it is long.

The anterior dorsal is slightly smaller than the posterior; it commences just behind the ventrals. The dorsal and caudal fins have blunt pointed ends and the folds of skin along the sides of the tail are obvious, but not prominent. The dorsal and ventral parts of the caudal fin are confluent.

The teeth are in 10 to 12 rows in both jaws; the front row has only 3 or 4 teeth; behind this the number gradually increases in succeeding rows up to about 16. The teeth of the front rows have triangular, flat surfaces; behind, the teeth bear a sharp median cusp.

The spiracle is immediately behind the eye and is the same size as the eye.

The electric organs seem well developed. The fish gave no perceptible shock to the hand and died soon after capture.

Round the margin of the disk, and along the sides of the tail, and over the snout, are the openings of mucous pores symmetrically arranged.

Consistency and general appearance distinctly bathybial. Colour dark brown above, greyish brown below.

Habitat.—Gulf of Aden; 130 fathoms. Station 360. Registered Nos. F 1456-7.

*Benthobatis moresbyi*, Alcock.

*Ann. Mag. Nat. Hist.* (7), vol. v, p. 145 (1898); *Cat. Indian Deep-Sea Fish*, p. 18 (Calcutta, 1899); *Illustr. Zool. "Investigator,"* Fishes, pl. xxvi (1899).

One small specimen from 585 fathoms, off the south coast of Arabia. Station 358. Registered No. F 1315.

### Order TELEOSTEI.

#### Suborder Malacopterygii.

#### Family ALEPOCEPHALIDÆ.

#### Genus PLATYTROCTEGEN, nov.

Resembling the genus *Platytrectes* (Günther), but differing from it in possessing small but well-developed pelvic fins. The deep folds of skin which in *Platytrectes* form the dorsal and ventral contours of the body are not empty as in that genus but are occupied by a thick layer of connective tissue. The scales are not keeled.

*Platytrecten mirus*, sp. nov.

B. 6, D. 23, A. 23, P. 28, V 5.

The greatest depth of the body is one-third of the total length without the caudal. The length of the head is slightly more than a quarter of the total without the caudal. The diameter of the eye is slightly less than one-third the length of the head. The length of the snout is equal to half the diameter of the eye.

Minute teeth occur in a single row on the premaxillaries, maxillaries and dentaries; there are a few small teeth on the vomer. The palatines are toothless.

The innermost of the four gills is half the length of the others. Filaments and rakers are about a third of the diameter of the eye, the gill-rakers of the first arch are longer than the others.

A small tubular papilla with an apical pore rises from the skin a short distance behind the operculum on a level with the centre of the eye.

The upper surface of the head, which is triangular and nearly flat, is bounded on either side by straight supraorbital ridges, converging in front. The supraorbital ridge, the infraorbital and pre-opercular bones each support a muciferous canal opening at intervals.

The lower ends of the clavicles, which together form a remarkable bony spine, are in contact up to their apices.

The gill-cover of the left side overlaps that of the right side at its lower end, where it contains an extra or seventh small branchiostegal ray, not represented on the right side.

Colour black.

One specimen measuring 13 cm. from the Bay of Bengal. Station 371, 500 fathoms. Registered No.  $\frac{2382}{1}$ .

This genus must be closely related to *Platytroctes*. It is most interesting that the two genera should be separated by such a major character as a pair of pelvic fins and yet resemble one another so closely in minor details. The similarity of their outward appearance is most remarkable.

The genus *Platytroctes* contains the species *P. apus*, Günther, and *P. procerus*, Brauer. The "Investigator" has obtained a single specimen of *P. apus* from near the Laccadive Isles. I have had the opportunity of comparing this with *Platytroctegen*. The main difference lies in the pelvic fins of the latter. With this is necessarily associated the fact that the contours of the body are not formed by empty skin as in *Platytroctes*, for pelvic fins could not be supported on a fold of empty skin. In *Platytroctes* the highest and lowest quarter of the body will transmit light, for the component layers of skin are in contact with one another internally. In our specimen of *P. apus* only those scales which cover the empty folds of skin are keeled. The scales covering the middle or thick part of the body are not keeled.

The specimen of *Platytroctes apus* obtained by the "Investigator" has a tubular papilla behind the operculum similar to that possessed by *Platytroctegen*. In both the system of muciferous canals on the head is as alike as though they were of the same species. Similarity in other features is equally great and yet the differences are very decided. Apart from the pelvic fins the following are the chief differences:—

1. The triangular cranium is depressed in the middle line in *Platytroctes apus*,—nearly flat in *Platytroctegen*.
2. The scales are keeled like those of a reptile in *Platytroctes apus*,—smooth in the other. In our specimen of *P. apus* only the upper and lower scales are keeled.
3. The remarkable clavicular spine is bifid at the tip in *Platytroctes*,—simple in the other.
4. The dorsal and anal fins are longer in *Platytroctegen*.

*P. procerus* is also furnished with the postopercular papilla. It is likely that the first example of *P. apus* which was taken by the "Challenger" in the Atlantic Ocean also possessed a similar organ which became detached or was otherwise overlooked.

*Alepocephalus microlepis*, sp. nov.

*Illustr. Zool.* "Investigator," Fishes, plate xlv, fig. 4 (1909).

B. 6, D. 20-22, A. 30-33, V 5-6, P. 10, L.l. 125, L.tr. 30-35.

The head is slightly less than a third of the total without the caudal. The maximum height—which is at the base of the pectoral fin—is a sixth of the total. The vent is nearer to the gill-opening than to the base of the caudal fin. The ventrals are much nearer to the vent than to the gill-opening. The anal fin, being much longer

than the dorsal, commences anteriorly to it. The tenth ventral spine is opposite the first dorsal.

The diameter of the eye, which is equal to the length of the snout, is  $3\frac{1}{4}$  in the total length of the head. The posterior end of the maxilla just reaches a vertical through the anterior border of the eye. The gill-covers are large and widely open; they contain six branchiostegals and are covered with soft brownish black skin, like the cranium and snout. The gill-rakers are numerous, long, lanceolate and acute. Pseudobranch small. The teeth are well-developed in the premaxillæ and dentaries, a few small teeth on palatines and three or four minute teeth on vomer.

In the mid-line of the back in continuation with the dorsal fin nearly up to the head is an empty fold of skin bearing scales as in *Aulastomatomorpha*. Scales throughout are very small and nearly circular. Stomach siphonal. Eight pyloric cæca.

The chief peculiarities are the small and numerous scales and the extension of the ventral fin well beyond the level of the dorsal. Both of these features are associated in the genera *Conocara* and *Aulastomatomorpha*. On the whole the species resembles *A. niger* (Günth.) more than any other species. Colour black.

Five specimens, the longest 20 cm. in length. Stations 273, 336 and 297. Arabian Sea, 850, 700 and 600 fathoms. Registered Nos.  $231-2$ ,  $2315$ ,  $2321$ .

*Alepocephalus longiceps*, sp. nov.

*Illustr. Zool. "Investigator,"* Fishes, plate xlv, fig. 2 (1909).

B. 6, D. 20, A. 23, P. 10, V. 6, L.1. 52, L.tr. 5-1-6.

The length of the head is considerably more than a third of the total without the caudal. The greatest height of the body—which is at the level of the pectoral fins—is  $6\frac{1}{2}$  in the total without the caudal. The vent is nearer the gill-opening than the end of the tail. The attachment of the ventrals is somewhat nearer to the vent than to the gill-opening. The dorsal and anal fins are opposite to one another. The diameter of the eye is a fifth of the length of the head. The snout is long and pointed; its length is equal to the postocular length of the head. The upper jaw projects considerably beyond the lower as much as a distance equal to half the diameter of the eye. It is nearly horizontal when closed. The mouth is capable of wide extension. When closed the whole of the maxilla is in front of a vertical through the anterior border of the eye. The ends of the maxilla are very conspicuous and hang down slightly below the level of the lower jaw.

The gill-covers are voluminous and widely open below; one partially overlaps the other. They contain six branchiostegal rays, and are covered with soft black skin. The skin on the top of the head and snout is thin. The gill-rakers are numerous, long, lanceolate and acute. The gill-filaments are short and delicate. Pseudobranchs present but small.

The teeth on the premaxillary and dentary are very minute; on palatines and vomer present but minute. Stomach siphonal. Seven rudimentary cæca.

One specimen, 9 cm. in length. Bay of Bengal, 693 fathoms. Station 330. Registered No.  $\frac{2374}{1}$ .

*Alepocephalus macrops*, sp. nov.

*Illustr. Zool.* "Investigator," Fishes, plate xlv, fig. 3 (1909).

B. 6, D. 17, A. 20, V 8, P. 8, L.1. 50, L.tr. 6-1-9 at v. fin.

The length of the head is as much as two-fifths of the total without the caudal.

The maximum height—which is just in front of the pectoral fins—is one-fifth of the length without the caudal.

The vent is equidistant from the base of the caudal and the nearest point of the opercular margin. The attachment of the ventrals is half-way between the vent and the nearest point of the opercular margin. The diameter of the eye is a third of the length of the head and is more than the length of the snout. The eyes are separated by less than their diameter. The snout is  $3\frac{3}{4}$  in the length of the head. The mouth is nearly horizontal. The posterior end of the maxilla reaches nearly as far back as a vertical through the centre of the eye. The upper jaw slightly overlaps the lower. Teeth are conspicuous and occur on the premaxillæ, dentaries, palatines and vomers. The gill-cover is voluminous and widely open below; it is covered like the rest of the head with soft black skin. The gill-rakers are numerous, long, lanceolate and acute, the pseudobranch is present but small. The scales are rather large, their length and breadth are equal.

The dorsal and anal fins are approximately of the same length and lie opposite to one another. Stomach siphonal. There are seventeen pyloric cæca of moderate length.

Colour in spirits.—Head jet black, body brownish black, fins black with a bluish tinge.

One specimen, 11 cm. in length. Bay of Bengal off Arakan coast, 419 fathoms. Registered No.  $\frac{1094}{1}$ .

*Aulastomatomorpha phosphorops*, Alcock.

*Ann. Mag. Nat. Hist.* (6), vol. vi, p. 307 (1890).

A second specimen has been obtained from the Bay of Bengal off the Arakan coast, 1,100 fathoms. The type specimen was from the Arabian Sea, 1,000 fathoms. Registered No.  $\frac{1093}{1}$ .

*Aulastomatomorpha cæruleiceps*, Lloyd.

*Ann. Mag. Nat. Hist.* (7), vol. xviii, p. 308 (1906); *Illustr. Zool.* "Investigator," Fishes, plate xlii, fig. 3 (1908).

B. 5, D. 18, A. 40, P. 7, V 6.

Closely resembles *A. phosphorops*, from which it differs in the following particulars:—

1. The premaxillary teeth are fewer in number and are relatively larger; they are arranged in two sets, an anterior closely set group of eight or nine, and a posterior group of three with wide intervals between.

2. The interorbital space is wider than half the diameter of the eye.

3. The head is covered with a firm smooth skin just as in *A. phosphorops*, but in the new species the colour of this skin is a dark slaty blue. The colour of the rest of the body is brownish black. The bases of the fins have a blue tinge. The blue colour is partially preserved in spirit.

4. The total height is only  $\frac{1}{8}$  of the total length excluding the caudal fin.

One specimen, 18 cm. long, from 1,005 fathoms in the Gulf of Oman. Station 354. Registered No. 1384.

*Narcetes affinis*, Lloyd.

*Ann. Mag. Nat. Hist.* (7), vol. xviii, p. 308 (1906); *Illustr. Zool. "Investigator,"* Fishes, plate xlii, figs. 1, 1a (1908).

B. 7, A. 14, D. 17, V 10, P. 13, L.1. 73, L.tr. 9-1-13.

Resembles *N. pluriserialis* (Garman), and differs from *N. erimelas* (Alcock) in the following particulars:—

1. There are seven branchiostegal rays.

2. The first ray of the anal fin is vertically below the eighth ray of the dorsal.

3. There is one enlarged tooth on either side of the vomer.

In all its proportions this species resembles *N. pluriserialis* very closely.

It differs from *N. pluriserialis* in the following respects:—

The teeth in the maxillæ are in two series, an outer series of small teeth and an inner series of larger ones.

There are only seventy-three scales in the lateral line.

The scales of the lateral line are large, measuring as much as  $\frac{1}{4}$  inch in length.

The total length of the single specimen is 14 inches.

In the middle and hinder parts of the fish, one inch of the lateral line contains six scales, but in the front these scales overlap one another to a much further extent, so that one inch contains eight or nine scales.

In the anterior half of each scale of the lateral line is the wide opening of its tube; the margin of this opening is completed in front by a semicircular notch in the hinder edge of the scale which lies next in front.

Colour almost black; head and lining of gill jet-black.

One specimen, 14 inches long, from 1,005 fathoms in the Gulf of Oman. Station 354.

It is notable that *N. pluriserialis* (Garm.), which this species resembles in many ways, came from 1,010 fathoms in the Gulf of Panama. Registered No. 1385.

## Family STOMIATIDÆ.

*Triplophos hemingi* (MacArdle).

*Photichthys hemingi*, MacArdle, *Ann. Mag. Nat. Hist.* (7), vol. viii, page 521 (1901); *Illustr. Zool.* "Investigator," Fishes, plate xxxvi, fig. 2 (1905).

B. 14, D. 10, A. 61, P. 11, V 9.

"Body black, covered with large deciduous scales. The length of the head is about one-seventh the length of the body without the caudal, and a little greater than the height of the body. The eyes are situated very near the anterior profile, about a diameter apart from one another, and are one-sixth the length of the head. There is a double row of small needle-like teeth in the upper jaw, and a single row of similar but smaller teeth in the mandible. A few small teeth in the palatines and vomer, but the latter has no fang. The surfaces of the mesopterygoids minutely denticulate. Gill-openings very wide. Four gills with short laminae and long setose gill-rakers on the first three arches. The dorsal fin is situated above the space between the ventral and anal fins. The latter is extremely long and terminates about an eye-length from the caudal. The pectoral and ventral fins are nearly in the same plane, and the latter are almost midway between the former and the beginning of the anal fin. On the two specimens, one of which is very much damaged and the other by no means perfect, no adipose dorsal fin can be made out. The back is scaly and is not rugose. The luminous organs, which show up a dull opaque white against the dark background, may be grouped as follows:—

- (1) One between the bases of all the branchiostegal rays.
- (2) Sixteen between the symphysis of the jaw and the pectoral fins.
- (3) Eight between the pectoral and the ventral fins.
- (4) Five between the ventral and the anal fins.
- (5) Thirty-five or thirty-six distributed along the bases of the anal rays.  
The last four groups may be taken as forming the lowest lateral row.
- (6) and (7) A second and a third lateral row join about the ventral fins, and run as a single row of spots to near the caudal fin.
- (8) A fourth row, not so distinct as the others, runs from behind the head to near the termination of the anal fin.

There are two glands on the head, one at the anterior angle of, and the other behind, the orbit.

Length 6—8 inches. Two specimens from the Bay of Bengal, 475 and 859—880 fathoms.

This fish bears several points of resemblance to *Gonostoma maderense* (Johnson, *Proc. Zool. Soc.*, 1890, p. 458), notably in the absence of fangs on the vomer and of an adipose dorsal fin; but in other respects it appears like a true *Photichthys*. It differs from *G. maderense* in having scales on the back and none on the cheek, and in having but a single row of teeth in the anterior portion of the lower jaw. It is quite

possible, too, that the small adipose fin may have got rubbed off in the 'Investigator' specimens." (MacArdle.)

Since the above description was drawn up by the late Captain A. F. MacArdle other specimens have been obtained. There is no doubt that the adipose fin is wanting in the species.

The illustration of this species was published simultaneously with the report on the deep-sea fish of the "Valdivia" Expedition, among which is the new genus *Triplophos*, Brauer. The resemblance between *Triplophos elongatum*, Brauer, and *Photichthys hemingi*, MacArdle, is manifest, consequently I have changed the name of the latter to *Triplophos hemingi*. The presence of two teeth on the palatines of this species is a distinction from *T. elongatum*.

Four specimens from the Bay of Bengal. Stations 165, 235, 277, 327. All have two teeth of moderate size set close together on each palatine.

One specimen (No.  $\frac{928}{1}$ ) has a tooth on the left side of the vomer. Registered Nos. 13707,  $\frac{928}{1}$ ,  $\frac{1134}{1}$ ,  $\frac{2376}{1}$ .

#### Suborder **Haplomi.**

#### Family SCOPELIDÆ.

*Myctophum (Lampanyctus) gemmifer* (Goode and Bean).

*Mem. Mus. Comp. Zool. Harvard*, vol. xxii, p. 80, fig. 88 (1896).

One specimen 11 cms. in length from Station 184 in the Arabian Sea, 947 fathoms. This species has been previously recorded only from the Atlantic Ocean. Registered No.  $\frac{1155}{1}$ .

*Sternoptyx diaphana*, Hermann.

*Der Naturforscher*, 1781, vol. xvi, p. 8, and vol. xvii, p. 249.

Three specimens from the Bay of Bengal. Station 309, 765 fathoms. Registered Nos.  $\frac{1025-27}{1}$ .

*Cyclothone acclinedens*, Garman.

*Mem. Mus. Comp. Zool. Harvard*, No. xxvi, vol. xxiv, p. 247, pl. J (1899).

One specimen, Bay of Bengal. Station 315, 705 fathoms. Registered No.  $\frac{2392}{1}$ .

#### Suborder **Apodes.**

#### Family NEMICHTHYDÆ.

*Venefica proboscidea*, Vaillant.

One specimen from the Gulf of Manaar, 888 fathoms, Station 307, agrees very closely with this species. In the original description the tail was said to be three-fifths of the total. In this specimen the vent is eleven inches from the nose and

nineteen inches from the tail. The proportions of the head are exactly as in Vaillant's specimen, which was taken from 2,200 metres off Morocco. Registered No.  $\frac{2376}{1}$ .

*Serrivomer sector*, Garman.

*Mem. Mus. Comp. Zool. Harvard*, No. xxvi, vol. xxiv, p. 320 (1899).

This specimen agrees exactly with Garman's detailed description, but it also agrees with the shorter description of *S. beanii* (Gill and Ryder).

Brauer records *Serrivomer sector* as having been taken by the "Valdivia" from the Indian Ocean, and remarks the similarity between *S. sector* and *S. beanii*. Arabian Sea, off Travancore. Station 306, 930 fathoms. Registered No.  $\frac{1023}{1}$ .

#### Family ANGUILLIDÆ.

*Coloconger raniceps*, Alcock.

*Ann. Mag. Nat. Hist.* (6), vol. iv, p. 456, (1889); *Illustr. Zool.* "Investigator," Fishes, pl. vii, fig. 4 (1892).

Among many specimens of this species are three from Stations 323 and 333 which are of unusual size, being over 30 cm. in length. They are black in colour but otherwise resemble the smaller specimens of the species, which are greyish brown. The generative organs of these three specimens are conspicuously ripe. They are probably the sexually mature form of the species which, as in certain other eels, is different in appearance from the immature form. Registered No.  $\frac{1090-2}{1}$ .

#### Family SYNAPHOBRANCHIDÆ.

*Synaphobranchus pinnatus*, var. *brevidorsalis*, var. nov.

*Illustr. Zool.* "Investigator," Fishes, plate xlvi, fig. 1 (1909).

This variety closely resembles *S. pinnatus* in all but one character, namely, the length of the dorsal fin. In this it resembles *S. brevidorsalis*.

In describing the position of the dorsal fin the same words may be used as in the description of *S. brevidorsalis*: "The dorsal fin commences so far behind the vent that the distance between its origin from the vent equals the length of the head." (Günther.)

In its general proportions and in the mosaic-like arrangement of the elongated scales the specimen resembles *S. pinnatus* and differs from *brevidorsalis*.

There are three specimens of *S. pinnatus* from separate stations in the Arabian Sea. In all of these the dorsal fin arises about a head-length and a third behind the gill-opening; in this specimen it arises rather more than two head-lengths behind that point.

One specimen, 70 cm. in length, from the Arabian Sea, Station 338, 839 fathoms. Registered No. 1141.

Suborder **Heteromi.**

Family NOTACANTHIDÆ.

*Notacanthus indicus*, sp. nov.

*Illustr. Zool. "Investigator,"* Fishes, plate xlv, fig. 8 (1909).

B. 12, D. xi, A. 14-105, V. iii 7, P. 12.

The length of the head is three-fifths of the distance between the snout and vent. The head is  $4\frac{1}{4}$  in the total length. The depth of the body at the ventrals and pectorals is  $7\frac{1}{2}$  in the total length.

The snout is pointed, laterally compressed, and half as long again as the eye. The diameter of the eye is  $6\frac{1}{2}$  in the length of the head. The corner of the mouth lies just behind a vertical through the anterior border of the eye. Just above the corner of the mouth is a stout curved spine lying horizontally with the concavity downwards. The nostrils lie in front of the middle of the eye and are slightly nearer the eye than the end of the snout. The gill-covers are very large and form more than half the length of the head: widely open behind and above, they are united below for less than half their length.

The lateral line is conspicuous; it commences a short distance in front of the upper angle of the gill-opening. Behind the head it occupies the highest quarter of the body but descends gradually until it occupies the middle line of the tail. There are eleven spines in the dorsal fin, they become gradually longer from the first to the tenth; the eleventh is a small spine. The distance of the first spine from the end of snout is very nearly as long as the distance of the eleventh from the end of the tail. The vent lies under the third dorsal spine. The first ventral spine lies immediately behind the vent. The last ventral spine lies under the last dorsal. The ventral spines increase in length from before backwards.

The ventral fins contain three short spines and seven soft rays; they are partially joined together at the base. The pectorals reach to the base of the ventrals and are nearly as long as the postocular part of the head. They contain twelve soft rays. The scales are cycloid, small, and cover the whole body and head.

The premaxillæ on either side bear twenty-five curved teeth arranged with great regularity. The lower jaw contains forty-two teeth on either side. They are not so curved nor are they arranged with such regularity as the premaxillary teeth. There are forty-two similar teeth on the palatines, they evidently oppose the teeth of the lower jaw. Stomach siphonal. Four large pyloric cæca.

One specimen, 20 cm. in length. Colour dark brown. Arabian Sea, 512 fathoms, Station 305. Registered No. 1019.

Suborder **Percesoces.**

## Family CHIASMODONTIDÆ.

## Genus KALI, nov

A genus allied to *Chiasmodus* (Johnson), differing from it in the reduction of the operculum, in the character of the teeth, the presence of a double row of pores in the lateral line, and in possessing pyloric cæca.

The body is scaleless and covered with thin, loose, black skin. There are two separate dorsal fins, the anterior slightly shorter than the posterior which is equal and opposite to the anal. The ventrals are thoracic but slightly behind the level of the pectorals. The mouth is very wide. The opercular bones are much reduced so that the angle of the lower jaw forms the posterior limit of the head. The teeth are few and very large, with arrow-headed points; they are arranged in two series, those of the inner series being much the larger. The vomer is toothless; the palatine bears a few large teeth. Upper pharyngeal teeth are present. All the teeth are depressible inwards. The gill-aperture is very wide. There are four long slender gills with very short filaments. There are no pseudobranchiæ. The stomach is cæcal and very large. There are two pyloric cæca. Air-bladder present.

*Kali indica*, sp. nov.

*Illustr. Zool. "Investigator,"* Fishes, plate xlv, fig. 5 (1909).

B. 6, D. xiii 22, A. 23, P. 12, V i 15.

The head is a quarter of the total length without the caudal. The greatest depth, which is just in front of the attachment of the pectorals, is a fifth of the total. The length of the snout is equal to the interorbital breadth and half as long again as the diameter of the eye, which is a fifth of the length of the head. The mouth is very large and extends far behind the eye. The upper and lower jaws meet only at their articulations and in front; they curve upwards and downwards in the middle of their length. Because of this curve the teeth can stand erect. When the mouth is closed, the upper and lower jaws are separated in the middle of their length by a distance greater than the diameter of the eye. There is a deep bony depression on the top of the head limited by two ridges which converge and meet in the middle of the upper surface of the snout. On either side of these ridges are two deep depressions in the bone (the loose skin has become detached from the head in the single specimen). The openings of the gill-cavities are very large. The gill-coverings are completed below by a thin membrane which is so voluminous that in the dead specimen it is not rendered tense until the angles of the jaw have been separated laterally from one another by a distance equal to the length of the head. The gill-arches are very long and slender and are freely exposed. Their filaments are short, being equal to half the diameter of the eye. The teeth are alike in both jaws; they consist of an outer series of ten teeth increasing in size from behind forward—the largest being slightly less in

length than the diameter of the eye, and of an inner series of three much larger teeth the middle one of which is situated beneath the eye and is as long as the snout. All teeth are completely depressible except the foremost of the outer row which are only partially so. There are five long depressible teeth on each palatine. There are well-developed upper pharyngeal teeth. The vomers are toothless.

The vent is half-way between the snout and the root of the tail. The pectoral fins are nearly as long as the head. The ventrals arise below and behind the pectorals and are about half their length. The second dorsal and the anal fins commence at the level of the vent. The two dorsal fins are separated by a distance equal to the diameter of the eye. In the specimen the skin of the anterior half of the body alone is present. In this region the lateral line consists of a double series of circular white spots. There are eighteen pairs of these from the highest point of the gill-opening to the level of the vent. The stomach is cæcal and very large. It is empty and contracted but its walls are very thick, much folded and covered with tortuous blood-vessels. There are two pyloric cæca ascending on the left side of the stomach. An air-bladder is present.

Judging from the character of the jaws, teeth, gills and stomach, we may assume that this genus has, like *Chiasmodus*, the habit of swallowing large fish.

One specimen, 17 cm. in length. Bay of Bengal, Station 312, 1,343 fathoms. Registered No. 1054.

#### Genus *DYSALOTUS*, MacGilchrist.

A genus allied to *Chiasmodus*, Johnson, differing from it in possessing four series of teeth in the jaws, and scales which are provided with thorn-like spines. It possesses a pseudobranch and pyloric cæca.

#### *Dysalotus alcocki*, MacGilchrist.

*Ann. Mag. Nat. Hist.* (7), vol. xv (1905), p. 268; *Illustr. Zool. "Investigator,"* Fishes, pl. xxxvii (1905).

B. 7, D. viii 27, A. 27, P. ii, V i 5.

"The body is elongate and compressed; its height contained nearly eight times in the total length, without the caudal. The head is large, low, and long, contained about  $3\frac{1}{2}$  times in the same standard length.

The snout is very long and depressed, about 3 times the diameter of the eye and more than  $\frac{1}{3}$  the length of the head. The eyes are lateral, wide apart, small, and deep-set. The interorbital space is more than twice the diameter of the eye, nearly flat from side to side, and traversed by two anteriorly converging ridges which enclose a V-shaped space. The nostrils are slightly nearer to the eye than to the tip of the snout.

The mouth is very deeply cleft, reaching beyond the eyes. The lower jaw projects beyond the upper; no barbel. The mucous system of the head is well-developed.

The body is naked except the posterior half or so, which is furnished with (minute) spiny scales arranged for the most part in rows parallel to the lateral line; the spinules have a backward inclination.

The lateral line is single, uninterrupted, very broad, and conspicuous; it runs from the upper angle of the gill-opening to the base of the caudal, curved slightly downwards, and contains a row of about 41 distinct pores.

Two separate dorsal fins: the first begins slightly posterior to the vertical through the base of the pectoral, and contains 8 slender spines; the second begins a couple of millimetres behind the first, is much the longer, and contains 27 rays. The anal is equal, opposite and similar to the second dorsal. Caudal symmetrically forked. Pectorals long (about half the length of the head) and slender, in position nearer the ventral than the dorsal line; all rays branched. Ventrals (I, 5) short (not so long as snout), inserted below the pectorals, but connected only by ligament with the clavicular arch.

Vent about 8 mm. in front of where the anal fin begins. No anal papilla; small urogenital papilla behind the vent.

The jaws are distensible, with four series of setiform teeth similar in both jaws; those of the inner rows longest; all movable and turned inwards. No vomerine teeth; a single row of small teeth—depressible backwards—on each palatine. Tongue free. Gill-openings very wide, with membranes joined only quite anteriorly. Seven branchiostegals. Gills four; last gill-cleft a foramen merely. Branchial arches weak and gill-rakers represented by small fixed and fairly numerous teeth similar to those of the mouth. Pseudobranchiæ are present.

An air-bladder is present, but without an open duct. The pyloric cæca were densely matted together and entangled with parasitic worms; there were about nine cæca. Beside these the hepatic duct opened into the gut. Vertebræ 39 (15 abdominal and 24 caudal). Abdomen extends well behind the vent into the tail. The stomach is elongate, cæcal in shape, and empty; its inner surface presented large coarse, longitudinal rugæ. Liver small.

The colour in life was violet-black. A single specimen about  $9\frac{1}{2}$  inches long; was caught in the trawl at Station 315, Bay of Bengal, near the Andamans, 705 fathoms." (MacGilchrist.) Registered No.  $\frac{1053}{1}$ .

I think that the word "minute" which is applied to the spiny scales should be omitted. These structures are the most remarkable peculiarity of the genus. They are arranged in four irregular rows parallel to the lateral line in the posterior part of the body. Each spine arises from the centre of a circular disc which may measure over a millimetre in diameter; the spines are slender, transparent and upright, and curve slightly with the concavity directed backwards. Some of them project from the disc by as much as a millimetre.

The parasitic worms referred to have been since identified by Prof. von Linstow as immature examples of a species of *Ascaris*.

#### Family TETRAGONURIDÆ.

##### Genus MULICHTHYS, nov.

Resembles *Tetragonurus*, the only other genus of the family, in the form of the body and general arrangement of the fins and in possessing œsophageal sacs lined by

papillæ. Differs from *Tetragonurus* in that the soft dorsal and anal fins are continued nearly as far backwards as the caudal, the anal fin being preceded by three spines; in having only three branchiostegal rays; in being devoid of gill-raker-like knobs below the pseudobranchiæ.

The pectoral arch (text-fig. 2) is suspended from the skull; the coracoid is foraminiate; there is no mesocoracoid; there are four metapterygials, the highest is nearly suppressed, the next two articulate with the scapula, the lowest and largest touches both scapula and coracoid. One or two of the uppermost rays of the pectoral fin articulate with the scapula; the postclavicle is well-developed, its lower end is close to but does not touch the hinder end of the pelvis.

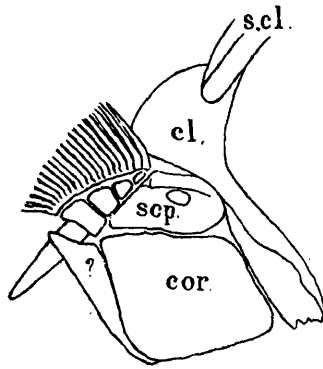


FIG. 2.—Shoulder-girdle of *Mulichthys*.

The eye rests upon a concave lamina of bone which projects inward from the suborbital. The maxilla does not make up any part of the margin of the jaw. The premaxilla and the dentary bear a single row of minute peg-like teeth which are set close together in the gum, but scarcely project beyond it and combine to form a weak cutting edge. There are a few small teeth on the vomer and palatines.

There are four gill-arches and a wide slit behind the fourth.

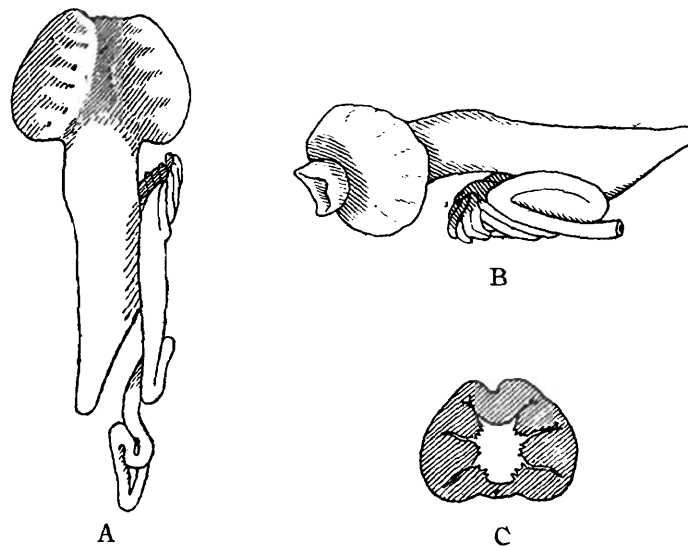


FIG. 3.—Viscera of *Mulichthys*: A, from above; B, from left side. C, transverse section of gizzard.

The pseudobranch is very well developed, consisting of twenty distinct folds. The œsophagus is dilated laterally, forming a kind of gizzard which is lined by a hard papillated membrane (text-fig. 3). There are numerous well-developed pyloric cæca. There is no air-bladder.

*Mulichthys squamiceps*, sp. nov.

*Illustr. Zool.* "Investigator," Fishes, plate xlvii, fig. 4 (1909).

B. 3, D. x 20, A. iii 20, P. 19, V i 5, L.1. 53, L.tr. 15.

The head is slightly less than a third of the total without the caudal. The greatest depth of the body equals the length of the head. The diameter of the eye is one-third of the length of the head. In length the snout is two-thirds of the diameter of the eye; it is smoothly conical and somewhat pointed. The lower jaw falls short of the snout. The nostrils lie just below a horizontal line drawn through the upper border of the eye and half-way between the eye and snout. The vent is equidistant from the snout and the base of the tail. The body and head, including the cheeks and snout, must have been covered with scales which have since fallen off, judging from their areas of attachment; it is probable that the scales were approximately rhomboidal in shape. There are indications of two lateral lines as portrayed in the figure. (The scale areas have been represented somewhat conventionally in the figure.) The colour of the whole fish is chocolate-brown. It is probable that this fish is, like *Tetragonurus*, an inhabitant of the intermediate depths of the ocean.

One specimen, 11 cm. in length, taken in a trawl from the Arabian Sea, 512 fathoms, Station 305. Registered No. 1020.

## Family STROMATEIDÆ.

*Psenes nigrescens*, sp. nov.

*Illustr. Zool.* "Investigator," Fishes, plate xlvii, fig. 6 (1909).

B. 6, D. ix 22-25, A. iii 21-23, V i 5, P. 21.

A small compressed fish with a blunt, rounded snout. The greatest height is slightly more than half the length without the caudal. The length of the head is  $2\frac{3}{4}$  in the length without the caudal. The snout is about half the diameter of the eye. The diameter of the eye is a third of the length of the head. The length and depth of the head are about equal. The length of the upper jaw is equal to the diameter of the eye. The angle of the lower jaw reaches nearly as far back as a vertical through the centre of the eye. The pectoral fins are as long as the head behind the centre of the eye. The ventral fins arise vertically below the base of the pectorals and reach as far back as the first anal spine. The opercular margin above the pectoral fin shows two blunt points separated by a wide and open notch. The lateral line forms a wide curve. Scales cycloid. Colour dark greyish brown. Fins black, except the caudal, which has a little pigment and the pectorals, which have none. A single row of small teeth in both jaws. None on palatine or vomer. Many specimens were obtained in the trawl from 950 fathoms. Their stomachs contained *Sagitta* or some allied Chætognathous genus in large numbers, so they were not caught at the bottom. Judging from their uniform dark grey colour they were probably from the intermediate depths. Andaman Sea, Station 310. Registered Nos. 1028-49.

Suborder **Anacanthini.**

## Family MACRURIDÆ.

*Macrurus (Cælorhynchus) acipenserinus* (Gilbert and Cramer).*Cælocephalus acipenserinus*, *Proc. U. S. N. M.*, vol. xix, page 422.

One specimen of this species, which has been recorded previously only from near the Hawaiian Isles. Bay of Bengal off Dondra Head, 620 fathoms, Station 321. Registered No. 1097.

Suborder **Acanthopterygii.**Division *PERCIFORMES.*

## Family ACROPOMATIDÆ.

*Synagrops splendens*, sp. nov.*Illustr. Zool. "Investigator,"* Fishes, plate xlvii, fig. 5 (1909).

B. 7, D. ix-i-10, A. iii 8, P. 17, V i 5, L.1. 53, L. tr. 3-1-9.

The greatest depth, which is at the anterior end of the first dorsal, is  $3\frac{1}{4}$  in the length without the caudal.

The length of the head is nearly half the total without the caudal, the proportion being 11 : 24.

The eye is large, it is a quarter the length of the head and is longer than the longest part of the interorbital space.

The mouth is oblique, the posterior end of the maxilla nearly reaches to a vertical through the centre of the eye.

The length of the snout is slightly less than the diameter of the eye. The lower jaw projects beyond the upper. The symphysis of the lower jaw is very prominent. The nostrils are in front of the upper half of the eye and are much nearer the eye than the end of the snout. The anterior of the two nostrils is the smaller and is placed at a lower level than the other. The posterior margin of the operculum has two thin flexible points, the upper one being the smaller. The lower is formed by a prolongation of the suboperculum and is supported by a third somewhat stronger point, which is the true posterior angle of the opercular bone. The preoperculum has a double border but is not serrated.

There is a well-marked pseudobranch. The gill-rakers are numerous and flattened but not acutely pointed.

There are small villiform teeth on the premaxillæ, palatines and vomer. The teeth of the lower jaw are larger than those of the upper. There is a pair of large canine teeth in the upper jaw and a pair at the symphysis of the lower jaw.

The deciduous scales are very large and stout, they overlap one another by about three-quarters of their diameter, they are ctenoid, but some of the scales, especially those below the eye, have inconspicuous serrations or none at all.

The first dorsal fin commences behind the level of the pectoral fin and in front of the level of the opercular angle.

The first dorsal spine is half the length of the third which is the highest of all. The two dorsal fins are almost in contact. The pectoral fin reaches nearly as far back as the level of the first anal spine. The ventral fin arises at the same level as the pectoral but is only half its length. The vent lies between the ventral fins at the level of the opercular angle. There are three anal spines; the first, which is very short, is opposite the middle of the posterior dorsal fin.

The caudal fin is deeply cleft and is as long as the postocular part of the head.

The lateral line is distinct; it is curved and occupies the upper part of the body; it is separated from the mid-dorsal line by three rows of scales.

Seven pyloric cæca of moderate length. Colour in spirits reddish brown above. Scales very bright and silvery with a fine blue iridescence.

One specimen, 15 cm. in length, from the Gulf of Oman, 230 fathoms, Station 341. Registered No. 1164

This species differs from *S. philippinensis* in possessing three anal spines. The preopercle and spine of the ventral fins are not serrated and the scales are ctenoid.

#### Divison ZEORHOMBI

#### Family PLEURONECTIDÆ.

#### *Samaris ivornata*, sp. nov.

*Illustr. Zool.* "Investigator," Fishes, plate xlvii, figs. 7, 7a (1909).

B. 6, D. 61, A. 48, P. 5, V 5, C. 16.

The breadth of the body is  $2\frac{1}{2}$  in the length without the caudal. The length of the head is  $4\frac{1}{8}$  in the length without the caudal. The length of the snout is a little less than half the diameter of the eye. The eye is  $3\frac{1}{2}$  in the length of the head.

The eyes are close together but not in contact; the right is very slightly in advance of the left. The pupil is semilunar, being reduced by a flap which descends from the upper margin of the iris. The anterior nostril on the coloured side is tubular, the posterior is simple.

The mouth is oblique, the right and left maxillæ are equally developed and are of the same length as the eye. The teeth are villiform and are arranged in a compressed band; they are alike on both sides of the jaw. The arrangement is nearly the same as in *S. cristata* but differs in being compressed into one broad band instead of being arranged in distinct rows. There are no teeth on the vomer and palatines.

The right pectoral fin contains five rays and is longer than the head. There is no pectoral fin on the blind side. There are two ventral fins each with five rays. The right is pigmented and is one-third longer than the left which is unpigmented. The caudal fin is about one-fifth of the total length. The rays of the dorsal and anal fins become longer posteriorly. They are sharply marked off from the caudal fin. The dorsal fin commences well in front of the eye in one specimen; the first ray arises

close to the upper lip. There is no prolongation of the first dorsal rays. This constitutes the great distinction between this species and *S. cristata*.

The lateral line is straight, rising slightly in the anterior part of the body.

The gill-rakers are short tubercles.

Colour of the upper surface.—Chestnut-brown with diffused blotches of sepia and dark grey; white below.

Fins black.

Scales ctenoid on both sides; the cilia are much less marked on those of the lower side.

Three specimens, the longest measuring 13 cm., from 130 fathoms in the Gulf of Aden, Station 360. Registered Nos.  $2401-3$ .

This species so closely resembles *S. cristata* that it was thought that the absence of the crest might be due to the fact that these specimens were of the opposite sex to those on which *S. cristata* was defined. Examination of the immature generative organs show, however, that both sexes are represented among the three specimens.

*Læops nigrescens*, Lloyd.

*Rec. Ind. Mus.*, vol. i, pt. i, p. 9 (1907); *Illustr. Zool. "Investigator,"* Fishes, pl. xliii, fig. 2 (1908).

D. 95, A. 82, C. 17, P.d. & 5. 13, V.d. & s. 6.

This species is closely allied to *L. guentheri* and *L. parviceps*. It differs from these in the following respects:—

It is bathybial in appearance. The pectoral fins are longer than the head. The head is  $\frac{1}{4}$ th the length without the caudal fin; the height without the fins is  $2\frac{2}{3}$  in the total length. The pectoral fins are better developed on the left side; the length of the left pectoral is longer than the entire head in most specimens; it is never less than the length of the head. The left pectoral fin is much longer than the right, in some specimens nearly twice as long. The ventral fins are about equal: the left is in a line with the anal. The caudal fin is pointed, its length is 6 in the total. The length of the dorsal and anal fin rays are about equal and are about  $2\frac{1}{2}$  in the body height. The lateral line forms a strong pectoral curve; the scales are small and deciduous. The snout is half the major diameter of the eye, the lower eye is in advance of the upper; the eyes are separated by a prominent ridge.

The major diameter of the eye is one-third the length of the head.

Teeth on the blind side only.

Vomer prominent, devoid of teeth.

Six specimens, the longest  $6\frac{3}{4}$  inches in length.

Colour.—Left side dark sepia, with irregular patches of a darker sooty tone, fins nearly black. The colour resembles that of *Læops macropthalmatus* from 100 fathoms and differs widely from that of *L. guentheri* and *L. parviceps* from shallow water.

Habitat.—Gulf of Aden, 130 fathoms, Station 360. Registered Nos.  $1201-6$ .

Division *SCLEROPAREI*Family *SCORPÆNIDÆ*.*Minous longipinnis*, sp. nov.

*Illustr. Zool.* "Investigator," Fishes, plate xlvi, fig. 3 (1909).

B. 7, D. x 12, A. ii 10, P. i 10, V i 5.

Resembles *M. inermis* but differs from it in the following respects:—

- (1) The snout is longer than the eye; proportion 3 : 2.
- (2) The posterior end of the maxilla does not reach a vertical through the anterior border of the eye.
- (3) The pectoral fin is considerably longer than the head and reaches to the base of the caudal.
- (4) The spines on the head are in the same position as in *M. inermis*, but they are relatively stronger.
- (5) The ventrals reach beyond the origin of the anal.
- (6) Colour.—Upper half dark grey fading to light grey below. Edges of fins black. Pectoral and pelvic fins almost black.

The upper side of pelvic fins and the inner side of the pectoral fins have elongated white spots.

Two specimens, the longest 10 cm. in length, from the Gulf of Oman, 230 fathoms, Station 341. Registered Nos. 1158-9.

*Gymnapistus affinis*, sp. nov.

*Illustr. Zool.* "Investigator," Fishes, plate xlvi, fig. 2 (1909).

B. 6, D. iii 8, A. iii 7, V i 5, P. 15.

The head is somewhat longer than the greatest depth of the body and is slightly less than a third of the total length. The diameter of the eye is a third of the length of the head. The interorbital space is less than the diameter of the eye. The mouth is nearly horizontal. The lower jaw projects somewhat beyond the upper. The end of the maxilla is slightly behind a vertical through the centre of the eye. The length of the snout is three-quarters of the diameter of the eye. The nostrils are on a level with the lower border of the eye. The anterior or lower nostril is on a tubular papilla. The preorbital bone bears a strong spine which is as long as the snout and projects horizontally outwards and backwards. At its base is a much shorter spine directed forwards. In a line with this spine the preopercle also bears a strong spine projecting backwards. Below this are four other spines. The base of the preorbital and preopercular spines are connected by a blunt ridge; the operculum bears three or four obscure spines. The first spine of the dorsal fin is on a level with the posterior border of the eye. The third and fourth spines are separated by a greater interval

than the others. The first spine is half the length of the second, the third is the longest of all. The first anal spine is opposite the eleventh dorsal.

The pectoral fins reach well beyond the vent and are as long as the head. The attachment of the pelvic fins is below that of the pectorals. The pelvic fins are two-thirds the length of the pectorals. The caudal fin is rounded; it is one-fifth of the total length. The lowest five rays of the pectoral fins are separate.

The body is covered with minute imbricate scales. The lateral line is nearly straight; it descends somewhat in the region of the tail.

The gill-rakers are short and obtuse.

The stomach is cæcal, with four short pyloric cæca. There are minute villiform teeth in both jaws and on the vomer and palatines.

Colour in spirits greyish brown above, lighter below. The dorsal, pectoral and caudal fins have obscure grey spots. There is a greyish blot behind the angle of the opercle. There are two irregular rows of spots above the lateral line.

Several specimens, the longest 9 cm. long, from Station 329 in the Gulf of Martaban, 46 fathoms. Registered Nos. 1172-1178.

A species closely allied to *G. niger*.

#### Family CLYCOPTERIDÆ.

##### Genus LIPAROIDES, nov.

A small tadpole-like fish which shows its relation to the family in possessing a sub-orbital stay to the preoperculum and a broad attachment of the pectoral fins. It differs from the other bathybial genera of the family in possessing a diphyercal tail and small pelvic fins which are not modified into a sucker. There is one continuous dorsal fin, but the anterior rays differ from the posterior. The dorsal and anal fins are separated from the caudal by a wide space. The line of attachment of the pectoral fin rays is about as long as the longest ray. The rays diminish in length from above downwards. The pelvic fins are small and are situated close together near the middle line between the lowest ray of the pectorals. The vent is situated about the middle of the body length. The gill-openings are wide, extending from the upper angle of the operculum to the lower end of the attachment of the pectoral fins. Branchiostegals seven. Three-and-a-half gills; no slit behind the fourth arch. A small pseudobranch.

Teeth in two or three irregular series in both jaws and on the vomer and palatines. Skin soft, grey and devoid of scales. Large mucous glands open on the head. Eyes are most probably functionless.

*Liparoides beauchampi*, sp. nov.

*Illustr. Zool. "Investigator,"* Fishes, plate xlv, fig. 3 (1909).

B. 7, D. vi 16, A. 12, P. 23, V. 4, C. 15.

The head is rather less than half the total length without the caudal, the proportion being five to eleven. The greatest breadth of the head is equal to two-thirds of

its length. The greatest depth, which is at the occiput, is slightly less than the greatest breadth. The vent is half-way between the snout and the root of the tail.



FIG. 4.—*Liparoides beauchampi*, sp. nov., ventral surface.

The first dorsal ray arises at the level of the upper end of the gill-openings. The first six rays are short, delicate and flexible but not articulate. The posterior sixteen rays are longer, stouter and articulate. The dorsal and anal fins are separated from the caudal by an interval which is equal to a quarter of the length of the head. The twenty-three pectoral rays are attached along a line opposite the lower half of the gill-openings. The uppermost and longest rays are equal to the post-orbital part of the head. The pelvic rays are about half that length. The caudal fin is about one-fifth of the total. One specimen measuring 55 mm. from 643 fathoms in the Bay of Bengal, Station 372. In the fresh state the fish seems to be blind, both orbits being covered by opaque skin, but on the right side the eye-ball could be seen through the skin, though not on the left. On dissection it was found that the right orbit contained a well-developed eye but that the left contained a small rudiment. The specimen did not appear to be damaged in any way.

Named after Commander W G. Beauchamp, R.I.M., Commanding Officer of the "Investigator." Registered No.  $\frac{2377}{1}$ .

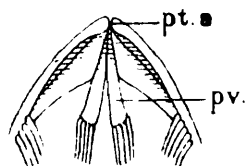


FIG. 5.—Limb girdles of *L. beauchampi*.  
pv. = pelvic.  
pt. = pectoral.

The pectoral and pelvic fins of this specimen so closely resembled those of *Paraliparis latifrons* as figured by Garman (*Memoirs Mus. Comp. Zool. Harvard*, xxvi, pls. xxvii and xxviii), that it was first thought that the pelvic fins must be merely the lowest detached rays of the pectoral arch as in that species, and not true pelvic fins. Dissection, however, showed that well-developed pelvic bones were present, the anterior ends of which were in contact with the lower ends of the pectoral arch, and the four pelvic filaments were clearly attached to these pelvic bones (text-fig. 5). It is probable that the four detached rays of *Paraliparis* were originally pelvic rays which acquired a secondary attachment to the pectoral arch during the reduction of the pelvis to its rudimentary condition.

#### Family TRIGLIDÆ.

##### *Peristethus adeni*, Lloyd.

*Rec. Ind. Mus.*, vol. i, part i, p. 8 (1907); *Illustr. Zool.* "Investigator," Fishes, pl. xliii, figs. 1, 1a (1908).

B. 7, a.D. 7, p.D. 14, V 5, P. 12 2, L.l. 24, L.tr. 4, A. 14.

The length of the preorbital process is equal to one-third of the distance between its extremity and the anterior border of the orbit. The preocular ridge has a prominent, finely serrated border; it ends behind in a sharp spine, which is nearly as long as the eye. The inner borders of the preorbital processes are parallel, their outer

borders, if prolonged, would meet in front at an angle of  $40^\circ$ . The preorbital processes therefore appear to converge. The length of each labial tentacle is equal to the width of the mouth.

The osseous plates between the ventral fins are unusually thick. The greatest length of each anterior ventral plate is equal to the greatest breadth of both combined. The greatest length of the posterior ventral plates is half that of the anterior ones. The greatest length, in both cases, is to one side of the middle line. A quadrangular portion of the posterior plates fits into a corresponding hiatus in the anterior plates. Throughout the length of the body, on either side, there are four rows of plates, each with a large spine shaped somewhat like a rose-thorn, their points curving backwards. The lowest row is much less conspicuous than the others.

There are large postorbital, occipital, post-temporal, and two opercular spines, a small upper and a large lower one, on either side. There is one small median spine, an orbit's length in front of the orbits.

The greatest height is one-fifth the total length. Total length of the single specimen  $6\frac{1}{2}$  inches; greatest length of the head 3 inches.

Colour.—Reddish yellow, pectorals grey; dorsals tipped with black.

Habitat.—Gulf of Aden, 130 fathoms, Station 360. Registered No. 1443.

#### Division JUGULARES.

#### Family ZOARCIDÆ.

#### *Diplacanthopoma squamiceps*, Lloyd.

*Rec. Ind. Mus.*, vol. i, part i, p. 10 (1907); *Illustr. Zool.* "Investigator," Fishes, pl. xlii, fig. (1908).

Corresponds with the generic definition in the following respects:—the form and arrangement of the fins, of the teeth and the gills, in the number of the branchiostegals (8), in the absence of pseudobranchiæ and pyloric cæca, in the obscurity of the lateral line, and in the presence of radiating spines on the opercles. It differs from all known species in this important respect:—there are scales on the head as far forward as the posterior limit of the eyes and on the opercles and sides of the head as far forward as a line dropped vertically from the posterior border of the eyes. The head is much depressed and the eyes are close together and look upwards to a great extent, being separated by less than their diameter; this gives the head a very different appearance from that of the other three known Indian species of the genus, in all of which the eyes are separated by about  $1\frac{3}{4}$  times their diameter.

There are deep mucus pits on the head and in a semicircle below the orbits.

There are no pseudobranchiæ, but in the position of these organs there are two very short and slender filaments which are vestiges of this organ. I find that the type specimens of *D. riversandersoni* and *D. raniceps* have precisely similar vestiges. This seems to be a strong argument for including this new species under the genus *Diplacanthopoma*.

The length of the head is  $3\frac{1}{2}$  in the total without the caudal fin.

The greatest height is one-sixth the length without the caudal fin.

The length of the eyes is a little less than the length of the snout.

There are 19 rays in the pectoral fins.

The filaments composing the ventral fins are composed of two rays.

The male has a well-developed penis.

Two specimens, a male and a female, both about five inches long.

Habitat.—Off the S.-E. coast of Arabia, 540 fathoms, Station 361. Registered Nos.  $\frac{1321-2}{1}$ .

*Barathronus diaphanus*, Brauer.

*Wissen. Ergebn. Deutsch. Tiefsee-Exped.* "Valdivia," Bd. xv, part i, p. 305 (1906).

One specimen from Station 310, in the Andaman Sea, 960 fathoms. The "Valdivia" obtained this species from the Indian Ocean near the Chagos group in 2,919 metres. Registered No.  $\frac{1050}{1}$ .

Suborder **Pediculati**.

Family LOPHIIDÆ.

*Lophius triradiatus*, sp. nov.

*Illustr. Zool.* "Investigator," Fishes, plates xlv, figs. 5, 5a (1909).

B. 6, D. iii 8, A. 7, C. 8, P. 15, V i 5.

The disk is elliptical, its length measured from the symphysis of the lower jaw to the base of the pectoral fins is half the total with the caudal. The height of the disk is half its length. The greatest breadth of the disk is rather more than half its length. The margins of the disk are scantily fringed. The diameter of the eye is equal to the interorbital space in the middle of its length and slightly less than the snout. The interorbital space is twice as broad behind as it is in front. The first two dorsal spines are on the snout: they are relatively small, the first, which is the longer, being about a third the length of the disk; it curves forward—it has been shown as straight in the figure, but bears no tassel (? incomplete); the second is a straight bristle, slightly shorter than the first. The third spine, which is about as long as the second, but somewhat stouter than either of the others, arises from the central and highest point of the disk. There is no trace of any other spines, subcutaneous or otherwise, between this and the soft dorsal.

The bony spines are relatively large, prominent and upright, two on each supra-orbital margin, two behind each eye, a small pair on either side of the snout. The humeral spine is feebly trifold.

The pectoral fins are a fifth of the total length. The caudal is a third of the total. The ventrals are nearly as long as the pectoral, but for two-thirds of the length they are fastened down to the body by a triangular fold of skin.

Depressible teeth in both jaws in three irregular series. Three or four teeth situated transversely in each vomer and the same number in each palatine.

Colour in spirits uniform grey above and below; lighter near the jaws. Three gill-arches without rakers; pseudobranchs present.

One specimen, 55 mm. in length, from the Laccadive Sea, Station 259, depth 300 fathoms. Registered No.  $\frac{878}{1}$ .

Family CERATIIDÆ.

Genus LOPHODOLOS, nov.

A genus which resembles *Dolopichthys* and differs from the other genera of the family in possessing paired cephalic spines and a jointed bait-bearing filament which is directed backwards, and in being covered loosely with soft black skin entirely devoid of scales and ossicles.

It differs from *Dolopichthys* in that the snout is short and the mouth nearly vertical, and in the position of the dorsal filament, which is attached to the back of the neck and not to the snout. The cephalic spines are disposed as in *Dolopichthys*. There are no ventral fins; the eye is very small; there are six branchiostegal rays and three gill-arches of which only the second and third bear filaments.

*Lophodolos indicus*, sp. nov.

*Illustr. Zool. "Investigator,"* Fishes, plate xlv, fig. 7 (1909).

B. 6, D. 7, A. 6, P. 16, C. 11.

The length and depth of the head are about equal and are slightly less than half the total length without the caudal, the proportion being 4:9. The eye is very small and the snout is considerably shorter than the postocular portion of the head, the proportion being 2:3. The angle of the mouth is slightly in front of a vertical through the eye. The mouth is more nearly vertical than horizontal. There is a deep longitudinal groove on the cranium from the snout to the occiput. The cephalic spines are long and project upwards, outwards and slightly backwards. The nasal spines are much shorter and project directly upwards. The spines at the angle of the jaw seem to project downwards, outwards and forwards, but this part of the specimen is somewhat damaged. The spines on the mentum project directly forwards when the mouth is closed. They are curved, the concavity being below.

The depth of the body at the anterior end of the dorsal fin is about half that of the head. The whole is covered with a soft skin which is easily detached but not fragile.

The dorsal filament arises behind the occiput half-way between the snout and the fourth ray of the posterior dorsal fin. It is naturally directed backwards and reaches just beyond the base of the caudal fin. The proximal quarter is thick, the distal three-quarters is filamentous. The thick part has a backwardly directed joint close to its insertion. The bait is hard but is covered with short, shreddy filaments. Its

distal half is of a light colour. The gill-openings are of a moderate size and are situated just below the pectoral fins.

The branchiostegal rays are six in number arranged in an upper and lower set of three each, with a wide space between. There are three free gill-arches but the first bears no filaments. There is a fourth gill-arch incorporated in the pharynx wall which bears filaments on its outer side. There are no gill-rakers and no pseudo-branch.

The upper jaw bears an irregular series of small teeth, the lower jaw a similar series of larger teeth. The teeth are depressible inwards. There are seven large pterygoid teeth on either side close to the opening of the gullet. Colour black throughout.

One specimen, 65 mm. long, from 888 fathoms, off the Travancore coast, Station 307. Registered No.  $\frac{1024}{1}$ .

*Melanocætus*, sp.

*Illustr. Zool.* "Investigator," Fishes, plate xlv, fig. 4 (1909).

There is a small specimen of this genus which differs from other known species in several important respects. Although the specimen is complete, it is somewhat distorted and it is difficult to be sure of the appearance it would present during life. Its most striking peculiarity is the apparent absence of the anal fin; dissection shows that there were four rays in the position of this fin which were apparently subcutaneous, lying parallel with the lowest ray of the caudal fin. Of the presence of these rays there is no doubt, but one cannot be sure how far they would be erected during life. Another peculiarity is the form of the abdomen, which is much compressed and extends backwards beneath the caudal fin, encroaching on the space which is occupied by the anal fin in other species of the genus. The teeth are of unusual length; there are about fifteen on either side in the upper jaw and twelve in the lower jaw. The longest tooth is more than half the length of the lower jaw. The vomer forms a prominent transverse ridge bearing a long median tooth accompanied by four others, two on either side. The proportions cannot be given with certainty as the eye and pectoral fin on one side are considerably higher than on the other; this is evidently the result of artificial distortion.

One specimen measuring 20 mm. from the Arabian Sea, 947 fathoms, Station 184. Registered No.  $\frac{2373}{1}$ .

Family MALTHIDÆ.

*Dibranchus nudiventer*, sp. nov.

*Illustr. Zool.* "Investigator," Fishes, plate xlv, fig. 2. (1909).

Resembling *D. nasutus*, Alcock, but differing in that the lower surface of the disk and tail is devoid of spines.

The distance between the snout and the gill-opening is hardly greater than the distance between the gill-opening and the root of the tail, and is equal to the greatest

breadth of the disk. The snout projects beyond the mouth, though, to a somewhat less extent than in *D. nasutus*. The nasal tentacle, however, is exactly as in that species; it "ends in a pair of fleshy balls with a pair of filaments above and between them."

The diameter of the eye is about  $\frac{1}{4}$ th of the length of the disk. The eyes are rather more than a diameter apart. The caudal and pectoral fins are about equal in length and are one-fifth of the total length.

Up to this point the description is almost the same as that of *D. nasutus*. The only difference is in the dermal armature. The upper surface is covered with sharp spines on a stellate base. They are larger and less numerous than in *D. nasutus*. The ventral surface of the tail and disk is covered with smooth skin entirely devoid of spines except for three minute spines near the bases of the pelvic fins.

Colour dark grey. One specimen, 75 mm. in length, from the Bay of Bengal, off Arakan, 1,100 fathoms, Station 326. Registered No. 1127.

*Matthopsis triangularis*, sp. nov.

*Illustr. Zool.* "Investigator," Fishes, plate xlv, figs. 1, 1a (1909).

B. 5, D. 5, V. 2-3, C. 9.

The greatest breadth measured between the subopercular spines is slightly less than the greatest length excluding the caudal fin (proportion 9 to 10). The anterolateral borders of the disk are straight and together form a right angle. The nasal spine is nearly vertical and is slightly more than half the diameter of the eye in length. The caudal and pectoral fins are of the same length and are longer than the pelvic fins in the proportion of 3 to 2. The caudal fin is slightly less than a fifth of the total length. There are seven large ossicles between the base of the ventral fins and the vent. One of these is large and central and is surrounded by the six others which are in contact with it. There is a pair of plates between the bases of the pelvic fins and five plates in front of them. The upper surface is covered with stellate ossicles except on either side of the middle line where there is an area of naked skin. This is bounded externally by an oblique row of ossicles which converge in the direction of the root of the tail. The subopercular spines are as large as the nasal spine and bear four transparent spinelets.

There are two gills; teeth are present on the vomer and palatines as in other species of the genus.

Two specimens from 279 fathoms in the Andaman Sea, Station 332. Registered Nos. 1121, 1125.

Family ANTENNARIIDÆ.

*Chaunax apus*, sp. nov.

*Illustr. Zool.* "Investigator," Fishes, plate xlv, fig. 6 (1909).

Resembling *Chaunax pictus* (Lowe) in every respect except that the pelvic fins and the nasal tentacle are represented by minute rudiments. Colour as in *C. pictus*.

There are numerous specimens of *C. pictus* among the collection made by the "Investigator." In all of these the pelvic fin and nasal tentacles though small do not vary much. Text-figure 6 shows the difference between the pelvic fins of equal-sized specimens of *C. apus* and *C. pictus*.

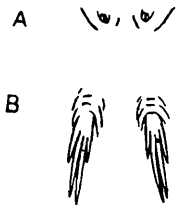


FIG. 6.—Pelvic fins of—  
A, *Chaunax apus*, sp.nov.  
B, *C. pictus* (Lowe).

One specimen, 11 cm. in length, colour reddish yellow. Bay of Bengal off Akyab, 530 fathoms, Station 379. Registered No.  $\frac{2404}{1}$ .

## II. SUPPOSED EVIDENCE OF MUTATION IN *MALTHOPSIS*.

Among the collection made by the "Investigator" are four small communities of pediculate fish of the genus *Malthopsis*, from separate but not far distant stations in the Andaman Sea.

It has been the custom in the Indian Museum to regard these four communities as of one species—*M. lutea*—although the individuals are so variable that if certain of them had been found alone in separate localities they would have been regarded without doubt as distinct species. However, they have been looked upon as one species, partly because each group was taken at one cast of the trawl in similar circumstances, every individual being of the same remarkable yellowish pink colour; but the fact that individuals of a particular and constant type occurred in the first three communities obtained, was probably the chief reason for regarding the whole collection as one species. This particular type predominated in the first community and it was described and figured as the type of the species. It was at first thought that the great variation shown by some members of the first community was due to the fact that they were immature. It was subsequently made clear, when the other communities were obtained, that the characters which were at first thought to be due to immaturity, occurred in some adult forms. There are twenty-one specimens in all and it will be shown that there are five distinct types among them not linked by intermediate forms. The four communities will be designated by the letters A, B, C and D, the five types by the letters v, w, x, y and z. The types are distributed in the following way; the figures indicate the numbers of individuals of each type:—

Community A contains	2 v,	2 w,	x.
„ B	„	v,	6 w.
„ C	„	v,	w, 2 y.
„ D	„	3 w,	2 z.

Type v occurs in three of the communities, while w occurs in all four. A specimen of type v was figured as *M. lutea*, for this type predominated in community A, which was the first to be obtained, and from which the genus and species were defined.

Two years ago I drew up a description of the type z under the name *Malthopsis triangularis*. There is no doubt that this type, of which there are two specimens, is remarkably different from the type v. The description is published here (*antea*) for the first time, though it seems that the other types w, x and y have almost as good a claim to specific rank.

DESCRIPTION OF THE TYPES.

In their gross structure the twenty-one specimens resemble one another and conform to the original description of the genus; they differ from one another in two respects, firstly, in the breadth of the disk; secondly, in the form and arrangement of the dermal ossicles. The variation in the breadth can be studied by measurement. The length of each specimen was measured from the snout to the base of the tail fin.

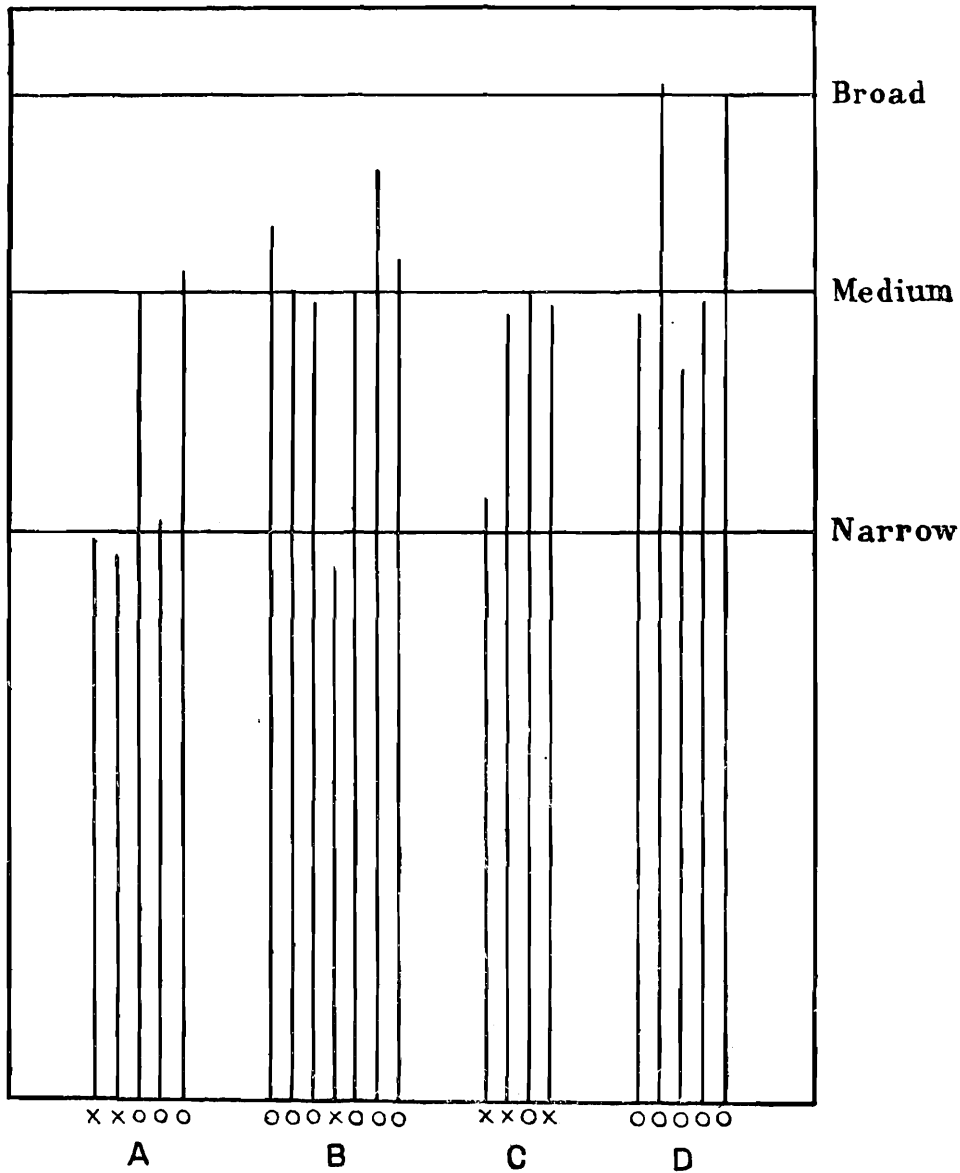


FIG. 7.—Proportion of breadth to length in 21 specimens of *Malthopsis* of communities A, B, C and D: O = orderly, x = disorderly.

The greatest breadth of the body was recorded as the distance between the most prominent parts of the subopercular spines. Measurements were taken to the nearest half-millimetre. The measurements are shown in the table at p. 176. The breadths are also displayed as percentages of the lengths by lines of proportionate length in text-fig. 7. This diagram shows that as regards breadth the specimens fall into three groups, the members of which may be spoken of as narrow, medium

and broad. If some hundreds of specimens had been available for measurement, there is no doubt that these three groups would have been bridged by intermediate forms, but they are so distinct that it seems certain that specimens approximating to the three types would be in excess however many specimens were measured.

#### *The Dermal Ossicles.*

Owing to the smallness in numbers some doubt may possibly be felt as to whether the above threefold division is justified. An examination of the dermal ossicles, however, shows a result which may be stated without doubt. As regards the arrangement of these ossicles the twenty-one specimens fall into two groups, which are perfectly distinct from one another. There are two distinct types in the arrangement of the ossicles, which will be spoken of as the "type of order" and the "type of disorder."

Each specimen possesses three particular spines,—a median nasal spine and two subopercular spines, one at each posterior angle of the disk. It was first noticed that whereas the nasal spine did not vary much in size or form among the whole group, the subopercular spines varied to a remarkable extent. The nasal spine is simple and conical, it was measured in each case by placing one end of the callipers in the little tentacular pit which undermines the spine, the other on the tip of the spine. The measurement so obtained was compared with the diameter of the eye. It was found that in every case the length of the spine was about half that diameter. Though constant in length this spine varies considerably in its position, being nearly upright in some while in others it is directed forwards.

The subopercular spines, however, vary to an extraordinary extent in size and form. They were studied in the following way:—The right spine of each specimen was placed beneath the microscope, magnified 50 times and its outline drawn with the camera lucida. The resulting figures reduced in size are shown on plate 1. It was found that these spines were in one of two conditions; they were either small, relative to the size of the fish, and covered irregularly with short projections, or they were large and armed with four long transparent spinelets disposed in a particular order constantly occupying the positions indicated by the terms antero-superior, antero-inferior, postero-superior, postero-inferior. The antero-superior spinelet is much the largest and is directed forwards; it is marked 1 in the figures. The postero-superior spinelet is generally curved upwards like a cow's horn; it is marked 2 in the figures, which do not show the curvature satisfactorily. Thirteen of the specimens in the collection possess these relatively large tetrafid subopercular spines, while the other eight have relatively small and irregular spines.

It has been mentioned that as regards the dermal ossicles, there are two distinct types in the collection, the orderly and the disorderly type. The presence of a large tetrafid subopercular spine is an important part of the orderly character. In every specimen possessing a small irregular subopercular spine the dermal ossicles of both dorsal and ventral surfaces are distributed in a disorderly manner. In every

specimen in which this spine is large and tetrafid the ossicles are arranged in a definite pattern. The full characters may be defined in the following way:—

Character.	Dermal order.	Dermal disorder.
1st part—Subopercular spine.	Relatively large and tetrafid.	Relatively small and irregular.
2nd part—Ventral surface of disk.	The space between the pelvic fin and the vent is occupied by seven large plates, a central one surrounded by the six others. The plates are in contact.	The space between the pelvic fins and vent is covered with about thirty minute plates which are widely separated from one another by naked skin.
3rd part—Dorsal surface of disk.	On the dorsal surface is a median row of four or five large plates. On either side of the median row is an area of naked skin which is bounded externally by an oblique row of plates converging in the direction of the base of the tail.	There is no area of naked skin on either side of the median row; the whole dorsum is covered irregularly with plates.

Thus the character may be divided into three parts. Of these the first is nearly constant, the second is constant, but the third is less constant. The aberration shown by those individuals which are not quite true to type is always in the direction of the opposite character. For example, we shall see in dealing with the types and individuals, that among those which possess small irregular subopercular spines some show a slight tendency in the direction of the tetrafid type.

The contrast between the ventral surfaces of the two opposite types is most striking to the eye and is clearly visible in the photograph. It may be described at greater length. In the orderly type besides the seven plates already mentioned there is a pair of large plates between the bases of the pelvic fins. In front of these are six other plates, a large central one surrounded by five others. In the disorderly type these plates are represented by numerous small platelets distant from one another and arranged irregularly. Beneath the lower jaw of all the specimens is a semilunar area covered with little pits containing minute tentacles. In the orderly type this area is marked off from the rest of the disk by a row of four large plates, which are in contact with one another. In the other type these plates are absent; in one or two cases, however, they are represented by four minute platelets widely separated by naked skin, which are only visible with the aid of a lens.

Although there are two types of dermal armature, the orderly and disorderly, we have seen that there are three types of disk, a narrow, a medium and a broad. The characters occur independently of one another so that six types of fish are possible—

- |                          |                                |
|--------------------------|--------------------------------|
| 1. Orderly and narrow    | Type x.                        |
| 2. Orderly and medium    | „ w.                           |
| 3. Orderly and broad     | „ z ( <i>M triangularis</i> ). |
| 4. Disorderly and narrow | „ v ( <i>M lutea</i> ).        |

5. Disorderly and medium Type y.  
 6. Disorderly and broad.

Of these six possible types no less than five are present in the collection. The only one not represented is the broad disorderly type.

#### DESCRIPTION OF TYPES AND INDIVIDUALS.

The types z and v are most unlike one another and will be described first.

*Type v (disorderly and narrow)*—

This is the species *M. lutea* in the strict sense. It occurs in three of the communities and will be found in the plate under the designation A 1, 2; B 4; C 1. The four specimens resemble one another very closely. A 1 shows a tendency, however, towards the opposite type in one respect. The ventral surface in front of the pelvic fins, although covered with many platelets, shows one plate which is larger than the others and is surrounded by five others. Behind the ventral fins, however, the arrangement is quite disorderly. B 4 also shows a similar tendency. The subopercular spines of A 2 and B 4 show some approach to the tetrafid type which is part of the orderly character. B 1 and C 1, although occurring in different communities, show obscure pigmented rings on the upper surface, such as happens to come out well in the photograph of C 4, on the right side of middle line.

*Type z (orderly and broad)*—

This type has been described as *M. triangularis*. There are two specimens, D 2 and 5, occurring in the same community. The plate shows clearly that in the ordinary acceptance of the word these two individuals are of a different species from *M. lutea*.

*Type x (orderly and narrow)*—

This is represented by the single small specimen A 4, one of the most interesting fish in the collection. It can be seen that the disk is of exactly the same shape as that of *M. lutea*, while the plates are arranged as in *M. triangularis*. Although it is much smaller than any of the five specimens of type v, its subopercular spine is actually larger than in some of the members of that type, and is perfectly tetrafid.

Although this fish is probably immature, there is no more reason for supposing that it would lose the orderly arrangement of its ossicles and retain its shape and so grow into a *M. lutea* than there is for supposing that it would retain the pattern and lose its shape and become *M. triangularis*.

*Type y (medium and disorderly)*—

This is represented by two individuals, C 2 and C 4, occurring in the same community. The shape of the disk is not quite the same, though both have departed from the narrow type. As regards the upper surface of the disk they approach the orderly type. On either side of the mid-dorsal row of plates is an area of skin covered with a few small scattered platelets. The postero-lateral spines also show a slight tendency towards the tetrafid type, that is, in the direction of the orderly

character. The plates of the ventral surface, however, show no sign of order. In both specimens there is a pigmented ring on either side of the mid-dorsal line; this is very plain in C 4. These rings also occur in the type v; they therefore seem to be a constant part of the disorderly character.

*Type w (medium and orderly)—*

Fish of this kind occur in every community—A 3, 5; B 1, 2, 3, 5, 6, 7; C 3; D 1, 3, 4. There is some variation in the breadth of the disk. B 5 approaches the broad type, and D 3 approaches the narrow type in this respect. The separation of the groups according to the shape of the disk is therefore not quite distinct, and yet one cannot believe that if a large collection were available they would be evenly distributed about a single mean as regards their breadth. Moreover, after considering the diagram (text-fig. 7) it can scarcely be doubted that there would be three means.

*Measurements in millimetres.*

Community.	Specimen.	Length.	Breadth.	B. L.	Nasal spine.	Eye.	S. E.
A							
Depth 200 fms.	A 1. 13014	49	25	51	4	8	50
Lat. 11° 31' 40" N.	A 2. 13015	50	25	50	4	8	50
Long. 92° 46' 40" E.	A 3. 13018	29	21.5	74	2.5	5	50
Green mud, 56 F.	A 4. 13016	27.5	14.5	53	2.5	4.5	55
Year 1890	A 5. 13020	27	20.5	76	2.5	5	50
B							
Depth 405 fms.	B 1. 134	35	28	80	3.5	6	57
Lat. 13° 27' 00" N.	B 2. 132	40	29.5	74	4	7	57
Long. 93° 14' 30" E.	B 3. 135	36.5	26.5	73	4	7	57
Green mud, 48 F.	B 4. 129	58.5	28.5	49	4.5	9	50
Year 1896	B 6. 130	39	29	74	4	7	57
	B 5. 131	38	32.5	85	3.5	6	57
	B 7. 133	37	28.5	77	4	7	57
C							
Depth 185 fms.	C 1. 286	65	36	55	5	10	50
Lat. 13° 17' 15" N.	C 2. 290	43	31	72	3.5	7	50
Long. 93° 10' 25" E.	C 3. 289	27	20	74	2.5	5	50
Sand, 53 F.	C 4. 288	39	28.5	73	3.5	6	57
Year 1897							
D							
Depth 279 fms.	D 1. 1123	40	29	72	4	7.5	53
Lat. 10° 21' 00" N.	D 2. 1121	42	39	93	4.5	8	56
Long. 92° 46' 15" E.	D 3. 1124	36	24	67	3.5	7	50
Green mud, 40 F.	D 4. 1122	34.5	26	75	4	7	57
Year 1904	D 5. 1125	37	34	92	4	7	57

The relation between the length of the nasal spine and the diameter of the eye is not expressed exactly by the above measurements which merely show that the spine is about half the diameter of the eye in every specimen. It was not possible to employ a smaller unit of measurement than half a millimetre with any confidence.

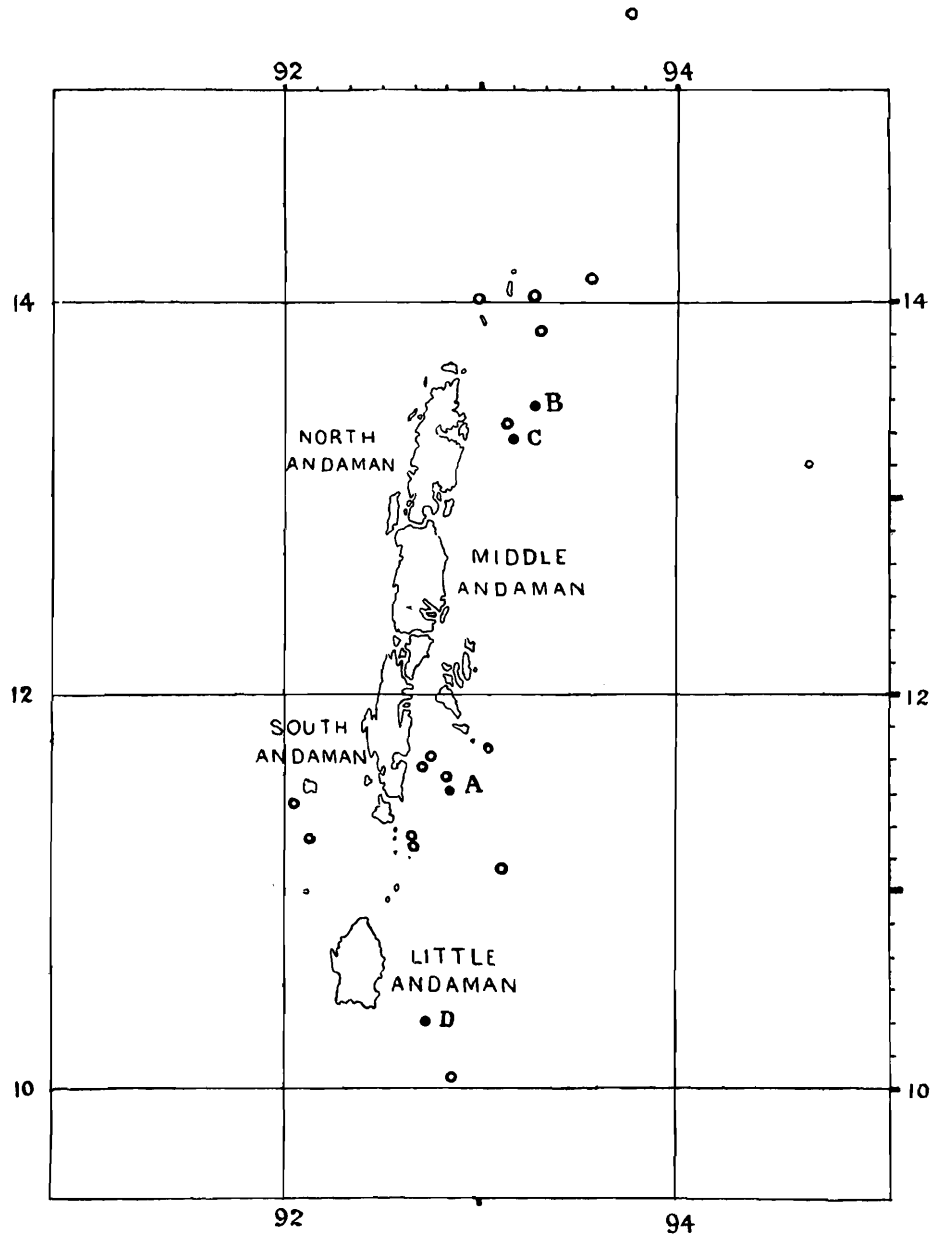


FIG. 8.—Map of Andaman Islands showing position of the four stations at which specimens of *Malthopsis* were obtained.

This list does not include all specimens that were caught. At Station A ten specimens were taken; some of these have passed out of the Indian Museum. It would be of great interest to know if any of these cannot be placed naturally in one of the five types. The specimens at present are in the following Institutions: the

British Museum, Oxford University Museum, Cambridge University Museum, United States National Museum and the Aberdeen University Museum.

Before considering the theoretical aspects of the case the following facts must be emphasised:—

1. The "Investigator" has trawled 380 times in the deep waters of the Arabian Sea and the Bay of Bengal. Twenty-one of these Stations were in water between 100 and 500 fathoms, in the neighbourhood of the Andaman Isles,— that is to say, in situations where we should expect to obtain *Malthopsis*.

2. Only four of the twenty-one Stations have yielded *Malthopsis*. Some of the localities are separated by considerable distances though all are in the neighbourhood of the Andamans. The position of the Stations is given on the map (text-fig. 8).

3. The smallest number of specimens obtained at one Station is four (community C); the largest number is ten (community A). The genus is therefore not rare at the Stations at which it was obtained, but it is not generally common in the moderate depths of the Andaman Sea, for not a single specimen was obtained at the seventeen other Stations, nor has it ever been obtained elsewhere by the "Investigator."

4. The physical conditions under which the four communities live must be remarkably similar.

5. The genus *Malthopsis* is not confined to Indian seas. A number of species have been described by Garman from the Pacific Ocean. These, however, must represent a separate branch of the genus, for they do not possess the characteristic nasal spine. The species *Malthopsis mitrigar* (Gilbert and Cramer) from near the Hawaiian Isles possesses this spine. It would be most interesting to know how it resembles or differs from any of the five types described here as regards the arrangement of its ossicles.

#### THEORETICAL CONSIDERATIONS.

It is fortunate that this case can be illustrated by photography so that it lies open to the consideration of all, for such wide and definite variation as these communities exhibit is rarely met with.

In regard to the change which may take place in organisms, it has been written "There are two factors: namely, the nature of the organism, and the nature of the conditions. The former seems to be much the more important; for nearly similar variations sometimes arise under, as far as we can judge, dissimilar conditions; and, on the other hand, dissimilar variations arise under conditions which appear to be nearly uniform" (*Origin of Species*, page 6, 6th Ed.). There are two reasons given here for the statement that the nature of the organism is much the more important factor in producing change. The present case forcibly illustrates both reasons. At any one of the four localities where, presumably, the conditions are uniform, different varieties seem to have arisen, and at any two localities where, presumably, the conditions might differ, similar varieties have arisen.

Therefore, as regards *Malthopsis* it may be said that the nature of the organism is much the more important if not the only factor in the change that is occurring.

If these five types are separate species in the ordinary sense of the word, they must, according to some theorists, have primarily arisen each in a separate locality, in adaptation to some peculiarity of that locality by natural selection from among a population exhibiting minute variations, and subsequently come together to exhibit the remarkable intermingled distribution obtained. This seems highly improbable.

It seems more likely that the type v, the true *Malthopsis lutea*, is an established species, which during a long period of stability has become widely distributed in moderate depths of the seas around India. One specimen of this type was taken by the "Valdivia" off the east coast of Africa. It is especially common at certain points in the Andaman Sea. Among the offspring which the members of the species are producing are some which differ widely from their parents as regards their shape and dermal ossicles, the differences being of particular kinds. Offspring showing the same kind of differences from their parents are being produced in widely separate localities. Judging from the fact that the type w occurs in each of the four communities, it may be assumed that it is a hardy and progressive form which is fast becoming established as a new species.

This is put forward as an explanation of the manner in which change is supposed to be taking place. As to the cause of the change nothing can be said from the evidence, except that it seems to be inherent in the organism and quite independent of the conditions of environment.

In many ways the phenomenon calls to mind that observed by De Vries in the plant *Enothera*, a phenomenon which that author terms "Mutation." This term defines the manner in which evolution is believed to occur; by using it one allows exceptions to the rule that a parent and its offspring must be of the same species. So far as I can understand it, the Theory of Mutation does not deal with the causes which lead to the appearance of these exceptions, but emphasises the fact that the nature of the organism is a much more important factor in their production than the external conditions.

An important part of the Theory of Mutations is the idea of characters as definite units; an idea which seems to rest on the surest evidence. These fish illustrate this and moreover show how some of the character units are related to one another.

It has been shown that there are two types of subopercular spine among the collection, and that a particular type of spine is always associated with a particular arrangement of the dermal plate; that there are certain types in the form of the disk which are quite independent of the character of the derma, for one specimen (A 4) has preserved the narrow form but acquired the orderly character of the derma completely, while others (C 2, C 4) have lost the narrowness but retained the disorderly derma. It has also been shown that the nasal spine is quite independent of the subopercular spine, for all the specimens, whatever the form of their subopercular spines, possess nasal spines approximately of the same size and form. This is the opposite of what we might expect, for the nasal spine is a character peculiar to one branch of the genus *Malthopsis*, while the subopercular spine in various forms is

characteristic of other pediculate fish such as *Halicmetus*, *Dibranchus* and *Lophius*.<sup>1</sup> An essential character may therefore be more liable to change than a trivial one.

It sometimes happens that two animal forms resemble one another very closely as regards their specific characters though differing in some weightier generic character. Such a phenomenon is well known and is usually ascribed to "convergence,"—a term of uncertain value.

It does not, however, necessarily follow that because two forms differ in a fundamental character, while resembling one another in certain specific characters, that these latter have been acquired independently in the two cases; nor does it follow that the two forms must have been long separated in their descent.

The case of *Platytroctegen* and *Platytroctes*, the case of *Chaunax pictus* and *C. apus (antea)*, provide excellent illustrations of this principle.

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<sup>1</sup> I assume that the "humeral" spine of *Lophius* is the same structure under another name, for it is based on the opercular bones, and has the same multifid form.