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LARVAL AND POST-LARVAL FISHES.

BY

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(*Assistant in the Department of Zoology, British Museum (Natural History)*).

WITH FIVE FIGURES IN THE TEXT AND PLATES I–X.

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LARVAL AND POST-LARVAL FISHES.

BY C. TATE REGAN, M.A.

(Assistant in the Department of Zoology, British Museum (Natural History)).

WITH FIVE TEXT-FIGURES AND TEN PLATES.

I.—ANTARCTIC AND SUBANTARCTIC FISHES.

1. NOTOLEPIS AND MYCTOPHUM.

THE pelagic fishes of the order Iniomi are represented by a very perfect post-larval example of the strictly Antarctic *Notolepis coatsii* and by a series illustrating the development of the more widely distributed *Myctophum antarcticum.* This ranges, when adult, throughout the Antarctic, Subantarctic, and South Temperate Zones, but the larval and post-larval specimens were all taken in the Subantarctic Zone, some to the south of New Zealand, others to the west of Tierra del Fuego.

Notolepis coatsii, Dollo. (Pl. I, figs. 4, 5).

A post-larval example, 70 mm. long, is very similar to one figured by Roule (Deux. Expéd. Antarct. Française, Poissons, pl. III). It was taken on Dec. 28th, 1912, at Station 269, 68° 37′ S., 166° 14′ W., surface. The adipose fin is continuous with the procurrent part of the caudal, and extends forward to the dorsal. The small pelvic fins are a little in advance of the vertical from the origin of the dorsal, and the anus is a short distance in front of them; from the anus a membranous fringe runs backwards to the anal fin.

FIG. 1.—*Notolepis coatsii.* Type, actual size.

Dr. W. S. Bruce has very kindly lent me the type in order that the accompanying figure might be drawn, but owing to the condition of the specimen (cf. Tr. R. Soc. Edinburgh, XLIX, 1913, p. 233) this figure is largely a restoration. The "Terra Nova" example agrees with the type in the number of myotomes (82) and fin-rays (8 dorsal and

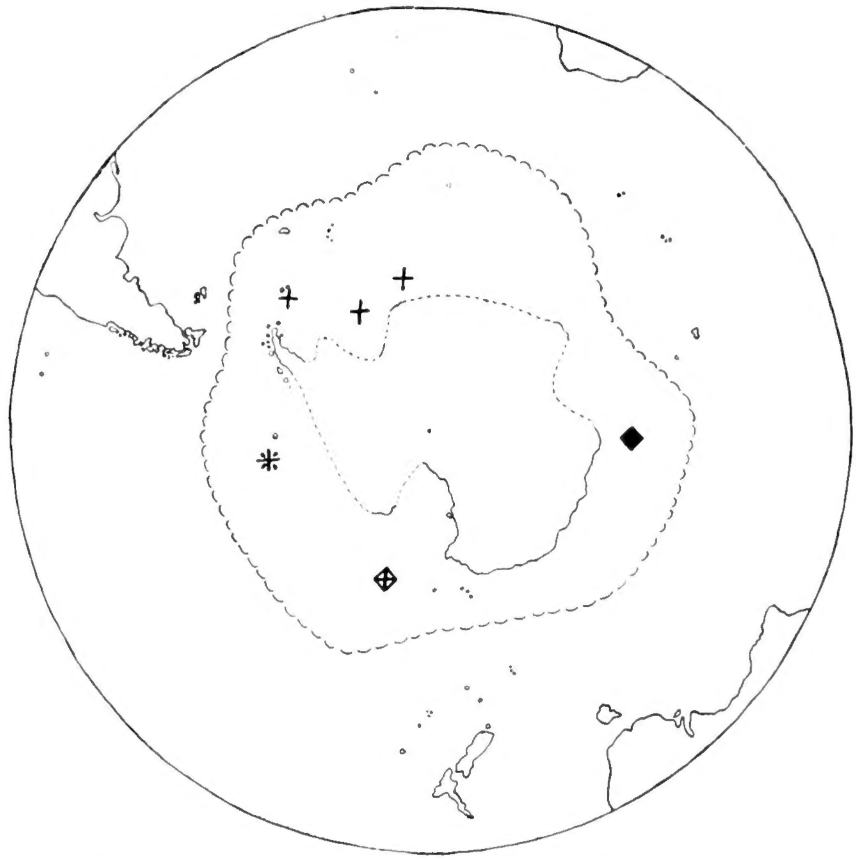

FIG. 2.—Distribution of *Notolepis coatsii.* All recorded captures are from the area bounded by the extreme limit of pack-ice, ⌒⌒⌒⌒⌒⌒⌒. Specimens taken by the "Terra Nova," ⊕; "Pourquoi Pas?" ✱; "Scotia," +; "Challenger," ◆.

28 anal); but in the type, which is 105 mm. long, the anus is further back, below the anterior part of the dorsal fin, and there is a separate adipose fin. On the other hand, in a specimen of 50 mm., the anus is further forward, only a short distance behind

the head, so that the migration of the anus backwards during the development of this species is established.

Moreover, it is evident that *Prymnothonus* is not a valid genus, but merely a larval form of *Notolepis*, *Paralepis*, etc.

The capture of this example in the Ross Sea completes the evidence that *Notolepis coatsii* is circumpolar, for it had previously been taken near Peter Island, at the South Orkneys and in the Weddell Sea, and near Wilkes Land.

Myctophum, sp.

Some specimens, very much damaged, taken on March 27th, 1912, at Station 238; 52° 11′ S., 167° 25′ E., 30 metres.

The largest, 13 mm. long, is very similar to the somewhat larger example of *M. punctatum*, Rafin. figured by Holt and Byrne (Fisheries Ireland Sci. Invest., 1910, VI, pl. I, fig. 1), but differs in that the anal papilla is separated by an interspace from the anal fin. I count 40 myotomes and 20 anal rays; the dorsal fin appears to have been bitten off.

Myctophum antarcticum, Günth. (Pl. I, figs. 1–3).

A number of examples of this circumpolar species, 10 to 18 mm. in length, were taken in the Subantarctic Zone at Stations—

235 .	52° 41′ S., 168° 15′ E.,	10 metres,	March 26th, 1912.
238 .	52° 11′ S., 167° 25′ E.,	30 ,,	March 27th, 1912.
240 .	51° 57′ S., 167° 38′ E.,	4 ,,	March 28th, 1912.
250, 251	54° 2′ S., 177° 0′ W.,	surface,	Dec. 20th, 1912.
252 .	54° 33′ S., 176° 55′ W.,	,,	Dec. 21st, 1912.
308 .	55° 29′ S., 78° 54′ W.,	4 metres,	April 9th, 1913.

In adult examples, 60 to 100 mm. in length, I count 13 to 15 dorsal and 18 to 22 anal rays, and 40 to 42 myotomes. I find the same numbers in the larger specimens (14 to 18 mm.) of the "Terra Nova" collection, which have the fin-rays developed, but differ from the adult fish in the following points:—

(1) There are no scales or photophores, except a single photophore on each side above the base of the pelvic fin.

(2) The dorsal and anal fins are lower, the caudal fin is less emarginate, the adipose fin is longer, and the paired fins are shorter.

(3) The fish is more elongate, and the snout is proportionately longer, the eye smaller and the maxillary shorter, not reaching the vertical from the posterior edge of the eye.

(4) There is a prominent anal papilla, and from it a membranous fringe runs forward to the base of the pelvic fins.

(5) There is a small sinus, subdivided by septa, persistent above the occipital

region of the head; this is an expansion of the anterior part of the dorsal fin-fold.

(6) Pigment is wanting, except for a median black spot on the parietal region and some pigmented areas on the tail. In specimens of 14 mm. (and less) there is a dark area above and another below on the caudal peduncle; in larger ones the dorsal area spreads forward on each side of the adipose fin, and the ventral one may disappear, or may be replaced by a median series of

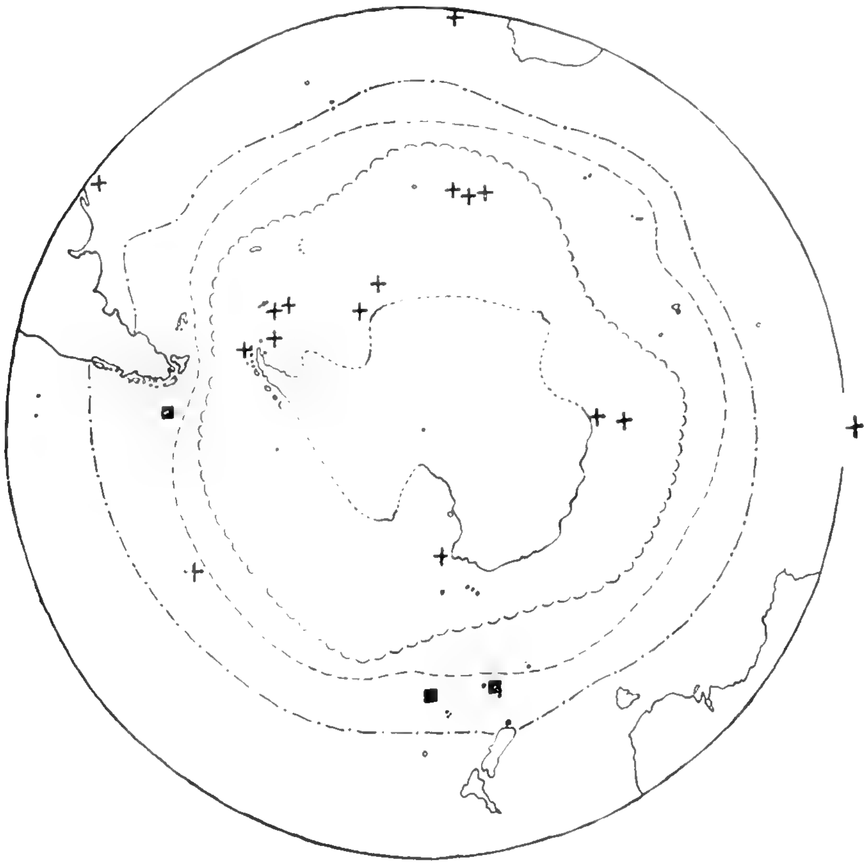

FIG. 3. Distribution of *Myctophum antarcticum*. Recorded captures of the adult are marked +; larval and post-larval stages taken by the "Terra Nova," ■. The map shows the extreme limit of pack-ice ⌒ ⌒ ⌒ ⌒ ⌒, and the mean annual surface isotherms of 6° C. – – – – – and 12° C. -·-·-

dark spots, probably the precursors of the infracaudal plates of the adult female.

Examples of 10 to 12 mm. are often more elongate, and have no photophores and no pelvic fins; the adipose fin extends forward to the dorsal; the dorsal fin is low, and its rays are undeveloped or just evident. The maxillary reaches only to below the anterior part or middle of the eye, which is relatively larger than in the specimens of 14 to 18 mm., whilst the snout is correspondingly shorter.

Myctophum antarcticum is very similar in form, proportions, position of the fins and number of rays, number of myotomes, etc., to the northern *M. glaciale*, Reinh., the principal differences between them residing in the number and arrangement of the photophores. Holt (P.Z.S. 1898, pp. 552–560, pls. XLVI, XLVII) has described young stages of the northern species, and it is interesting to note the resemblances and differences between these and corresponding stages of *M. antarcticum*. There is a general resemblance in the development of the two species, but *M. glaciale* at 8 mm. long corresponds to *M. antarcticum* of 10 to 12 mm. and at 11·5 mm. to *M. antarcticum* of 16 to 18 mm., whilst at 14·5 mm. *M. glaciale* has the general characters of the adult fish, except that the eye, although considerably larger than in smaller examples, is not yet proportionately as large as in the adult. Post-larval examples of *M. glaciale* differ from corresponding stages of *M. antarcticum* in that they are not noticeably elongate in form as compared with the adult, the abdomen is prominent, the dorsal sinus extends from head to dorsal fin, and the latter is much higher than in *M. antarcticum*.

Even if post-larval *M. glaciale* appear less elongate than the same stages of *M. antarcticum* to a great extent because the depth is increased by the large dorsal sinus and the protuberant abdomen, yet if these features be neglected, the southern species is at this early age noticeably more slender than the northern one. In both, the eyes at first grow at a slower rate than the fish as a whole, as is the rule in fishes generally, but later on grow faster than the rest of the fish, so that they are proportionately much larger in the adult than in the young. Holt's explanation—that this is due to the fact that the adults live at greater depths than the young—may be unreservedly accepted.

2. A NEW PARALIPARIS.

Paraliparis terrae-novae, sp. n. (Pl. I, fig. 6).

A young fish, 35 mm. long, was taken in McMurdo Sound on Jan. 16th, 1912, at Station 332, 77° 15′ S., 166° 0′ E., 0–550 metres. It is very similar in most respects to *P. antarcticus*, Regan, but differs notably in the fewer fin-rays (dorsal 55; anal 43) and in the form of the pectoral fin, which has no elongate lower rays. This is the second Antarctic species of this genus.

3. THE NOTOTHENIIFORM FISHES.

The "Terra Nova" collection includes young stages of *Pleuragramma*, *Pagetopsis* and *Chionodraco*, from the Ross Sea and McMurdo Sound. As I have already made a systematic revision of the Nototheniiformes and have given a general account of their distribution, it seemed worth while to try and complete this work by describing the eggs and young of the whole group, so far as possible, from the material in the British

Museum (Natural History), including some undescribed larvae from the "Discovery" collection.

Nototheniidae.

Notothenia (Pl. II, fig. 2).

A mass of eggs and a number of newly hatched larvae taken on Sept. 21st, 1910, at Roy Cove, Falkland Islands, by Mr. Rupert Vallentin, evidently belong to a species of *Notothenia*. The eggs have a diameter of about 1·5 mm., and the capsules adhere by facets to form a loose mass, just as in our northern *Cottus scorpius*. The newly hatched larvae have a length of about 6 mm., and in their general structure are very similar to *Cottus* larvae, for they have a short abdomen and a long tail, the mouth is well-developed, and the median fin extends from the head round the tail to the yolk-sac; the anus is placed a short distance behind the yolk-sac, instead of at its posterior edge, as in *Cottus*, nor can I see an oil-globule in the yolk.

Lönnberg has noted that in August *N. tessellata* and *N. sima* had the ovaries well developed, with eggs measuring 1 mm. or less; it is quite likely therefore that the eggs and larvae described above belong to one of these species or to another species of the *tessellata* group.

A second mass, also presented by Mr. Vallentin, is very similar to the first, but has the eggs somewhat larger (diameter 1·7 mm.); it was found under a stone at the Falklands on May 10th, 1910.

Of the Antarctic species of *Notothenia* Lönnberg has noted that *N. larseni* and *N. nudifrons* were nearly ripe on April 19, and that in *N. rossi* and *N. gibberifrons* the ovaries were very small in May, and in *N. coriiceps* in August.

Late larval and early post-larval stages of *Notothenia* have not yet been found. Two young examples of *N. macrocephala*, 40 mm. long, were taken by the "Challenger" in the tow-net on Jan. 8th, 1874, off Kerguelen. These are very different in appearance from the adult fish, as they are bright silvery, with the back bluish. From this coloration and from their method of capture it may be concluded that the young of this species swim at the surface and that its wide distribution may be connected with this. In *N. cyanobrancha*, which is restricted to Kerguelen, young examples of 40 mm. have the mottled coloration of the adult.

Trematomus.

In examples of *T. bernacchii* and *T. hansoni* taken by the "Southern Cross" and "Discovery" I find that the genital glands are much larger in April than in October. Females taken in April have well-developed ovaries with eggs 1 to 1·5 mm. in diameter. All the specimens that were preserved of those captured in traps during the winter are males, with testes nearly ripe; it may be that the females cease feeding at the approach of the breeding season. It is probable that spawning takes place about July, and that the eggs are not much, if any, larger than in *Notothenia*.

Pleuragramma antarcticum, Bouleng. (Pl. II, figs. 3–6).

Larval and post-larval examples were taken by the "Discovery" at Ross Island, at a depth of 6 to 10 fathoms.

Date of Capture.	Length.
December 14th, 1902	6–7 mm.
December 25th, 1902	8–10 mm.
February 8th, 1904	9–15 mm.
February 21st, 1902	15–19 mm.
April, 1903	15–25 mm.
May 23rd, 1902	24 mm.
August 13th, 1903	15–25 mm.
September 18th, 1903	20–25 mm.

The "Terra Nova" also secured specimens from the Ross Sea and the coast of Victoria Land:

Station.	Date.	Locality.	Length.
Near 186	December 31st, 1910	Ross Sea, 190 fathoms	30–35 mm.
325	August 8th, 1911	Cape Evans, 10 metres	16–18 mm.
326	January 9th, 1912	Terra Nova Bay, 10 metres	10 mm.
337	January 22nd, 1912	Cape Bird, 80 metres	10 mm.
325	April 30th, 1912	Cape Evans, 10 metres	22–25 mm.

From these data it seems probable that *Pleuragramma* may breed in the early Antarctic summer, that the eggs may hatch out about the beginning of December, that the newly hatched larvae may be 6 mm. long or a little less, that by the winter they may reach a length of 15 to 25 mm., and when a year old may be as much as 35 mm. long. Larval and post-larval examples have been taken not far from the coast and at depths not exceeding 80 metres. Young fish (30 to 35 mm.) in the Ross Sea at a depth of 190 fathoms, and adults from the Ross Sea, 158 fathoms, from near the Balleny Islands, 254 fathoms, in addition to examples found frozen on the ice barrier and others taken from seals' stomachs.

Larvae of 6–7 mm. are very similar to those of *Notothenia* from the Falklands. Figures (Pl. II) are given of examples 6, 11·5, 13·5 and 25 mm. long. It will be noted that the permanent caudal rays are making their appearance in the larva of 11 mm., and that in the larger ones they have assumed their final position. The differentiation of the dorsal and anal rays proceeds from behind forwards, and the full number is not developed until a length of 30 mm. is reached. Pectoral fins are present from the first, but the pelvics are rudimentary in fish of 25 to 35 mm. and are absent in smaller ones. The pigmentation at the bases of the vertical fins and on the dorsal surface of the abdominal cavity appears to be characteristic.

In these larval and post-larval *Pleuragramma* the eye is proportionately smaller than in the adult fish, no doubt because the latter descend to greater depths.

Artedidraco (Pl. II, fig. 1).

Examples of *A. loennbergii*, Roule, and *A. skottsbergii*, Lönnberg, taken by the "Terra Nova" in McMurdo Sound, at a depth of 207 fathoms, on January 23rd, 1912, include nearly ripe females with eggs $2\frac{1}{2}$ to 3 mm. in diameter. Lönnberg has recorded nearly ripe females of *A. mirus*, with eggs of $2\frac{1}{2}$ mm., from South Georgia in May.

On January 28th, 1904, the "Discovery" obtained two larvae which I identify as *A. skottsbergii*, at Hut Point, Ross Island, at a depth of 3 fathoms. These are 13 mm. long, and judging by the development of the vertical fins and the size of the yolk-sac they have not been hatched very long; one of them is figured (Pl. II, fig. 1). The short tail and large yolk-sac make this larva quite unlike that of *Pleuragramma* in appearance.

GYMNODRACONIDAE.

Gymnodraco acuticeps, Bouleng. (Pl. III, fig. 4).

A post-larval fish 24 mm. long was taken by the "Discovery" on Jan. 28th, 1904, at Ross Island, at a depth of 3 fathoms. The caudal and pectoral fins are fully developed, the pelvics are rudimentary, and the dorsal and anal rays are all present but do not reach the edge of the fin. A large yolk-sac is still evident. The snout is short and blunt as compared with that of the adult fish, and the oval nostril is relatively large; the opercular spine is not yet developed.

CHAENICHTHYIDAE.

The type of *Chaenichthys rugosus*, Regan, from Kerguelen, taken between October and February, is a ripe female with eggs 3 to 4 mm. in diameter. Lönnberg has examined a ripe female of *Champsocephalus gunnari*, taken in May at South Georgia; this had eggs 4 mm. in diameter.

Pagetopsis macropterus, Bouleng. (Pl. III, figs. 1–3).

Two larvae from the "Terra Nova" collection, taken at Cape Evans, McMurdo Sound, may be referred to this species. The smaller, 14 mm. long, was captured on May 13th; the larger, 15 mm. long, on June 28th, 1911, at a depth of 20 metres. Two somewhat larger specimens, 19 and 20 mm. long, were obtained by the "Discovery" at Ross Island.

The wide mouth, cleft to below or beyond the posterior edge of the eye, at once distinguishes these larvae from those of the Nototheniidae and Bathydraconidae; another distinctive feature is the precocious development of the pelvic fins. The relatively short tail, the small number of myotomes, and the black colour of the pelvic fin membrane are characteristic of this species.

The series illustrates well the growth of the produced snout of the adult fish from the snub-nosed form of the larva.

Chionodraco kathleenae, Regan (Pl. IV, figs. 2, 3).

A larva of 21 mm. was taken by the "Terra Nova" off Cape Evans at a depth of 10 metres on October 19th, 1911. This is not quite so advanced as the young *Pagetopsis* of 19–20 mm. From these it is readily distinguished by the longer tail and the more numerous myotomes (about 60), whilst the pelvic fins are scarcely pigmented except between the spine and the first soft ray. A fish of 32 mm. from the "Discovery" collection is much more advanced, but the dorsal and anal rays are still undeveloped.

Cryodraco (Pl. IV, fig. 1).

Three specimens, 16, 17 and 21 mm. in total length, from Ross Island ("Discovery" collection) may belong to an undescribed species of this genus. The myotomes number 55 or 56, fewer than in *C. atkinsoni*, in which I count 62. The body is crossed by two dark bands, the anterior on myotomes 27 to 29, the posterior on myotomes 40 to 42; there are indications of a third band at the base of the caudal fin. The slender form, produced snout and elongate pelvic fins further distinguish these fishes from larval or post-larval *Pagetopsis* and *Chionodraco.*

The data given above with regard to the breeding and development of the Nototheniiformes may be summarized as follows:—

Of the Bovichthyidae nothing is known, and examination of the material in the Natural History Museum gives no results.

The breeding season varies considerably; approximate dates are May and September for species of *Notothenia*, July for *Trematomus hansoni* and *T. bernacchii*, November for *Pleuragramma antarcticum*, January and May for species of *Artedidraco*, May for *Champsocephalus gunnari*, etc., etc.

The eggs vary in diameter from 1 to 4 mm. when taken from ripe females preserved in spirit; the diameter would no doubt be greater if eggs freshly taken from the sea were examined. The Nototheniinae seem to have the smallest eggs, *Artedidraco* and the Chaenichthyidae the largest. In all probability the eggs are demersal throughout the group, and in some species of *Notothenia* they are known to adhere together in masses.

In some of the Nototheniinae the newly hatched larvae are about 6 mm. long, but in *Artedidraco* and the Chaenichthyidae they are probably twice as long or even more.

The newly hatched larvae have a distinct mouth, the membranous median fin extends forward above to the head and below to the yolk-sac; the anus is situated at or a little behind the posterior end of the yolk-sac, and at the edge of the fin-membrane; pectoral fins are present, but the pelvics do not appear until much later, except in the Chaenichthyidae. During growth the caudal is formed and assumes its terminal position before the dorsal and anal rays develop; of these the posterior rays appear first, at any rate in *Pleuragramma*.

Of the forms identified the larvae of the Nototheniinae differ from the rest in the small size of the yolk-sac. Of those with a large yolk-sac *Artedidraco* is distinguished from *Gymnodraco* by the short tail, whilst the Chaenichthyidae differ from both in the wide mouth and the early development of the pelvic fins.*

Except *Pleuragramma antarcticum* larval and post-larval Nototheniolds have only been taken quite near the coast. There is some evidence that the young of *Notothenia macrocephala*, a widely distributed species, may be pelagic.

II.—FISHES FROM THE TROPICAL AND SOUTH TEMPERATE ZONES.

Larval and post-larval fishes were taken, by means of plankton nets and the young fish trawl, at or near the surface in the following areas:—

(1) North of New Zealand and round the Three Kings Islands. Stations 85–142. July to September, 1911.
(2) Melbourne Harbour. Station 161. October, 1910.
(3) Temperate South Atlantic, about 200 miles from the coast of Uruguay. Station 311. April, 1913.
(4) Off Rio de Janeiro. Stations 39–40. April, 1913.
(5) Western Tropical Atlantic, south of the Equator. Stations 43–57. May, 1913.
(6) Atlantic, south of the Canaries. Stations 16–17. June, 1910.
(7) Atlantic, south of the Azores and west of the Canaries. Stations 68–69. May, 1913.

The nature of the collections made in these areas is shown by the following summary:—

New Zealand and Three Kings Islands.

Sardina neopilchardus
Prymnothonus, sp.
Myctophum coccoi
Diaphus, sp.
Lampanyctus macropterus
L. longipinnis, sp. n.
Anguilla australis
Scombresox forsteri
Scorpis violaceus
Limnichthys fasciatus
Cubiceps caeruleus
Centrolophus maoricus
Thyrsites atun
Lepidopus caudatus
Tripterygium varium
Monacanthus scaber
Diodon, sp.
Haplophryne mollis

* *Onos*, *Brosmius*, *Molva*, etc., resemble the Chaenichthyidae in the early development of the pelvic fins, in this respect differing from *Gadus* (cf. Ehrenbaum, Nordisches Plankton, Eier und Larven von Fischen, 1905–1909).

MELBOURNE HARBOUR.

Odax balteatus
Pentaroge marmorata
Platycephalus, sp.

TEMPERATE SOUTH ATLANTIC.

Stylophthalmus paradoxus
Cyclothone microdon
Myctophum benoiti
M. laternatum
Ceratias, sp.

RIO DE JANEIRO.

Sardinella pseudohispanica
Cyclothone microdon
Glyphidodon, sp.
Gobiosoma molestum
Ancylopsetta quadrocellata
Ancylopsetta, sp.
Symphurus plagusia

TROPICAL SOUTH ATLANTIC.

Stylophthalmus macrenteron, sp. n.
Cyclothone microdon
Vinciguerria lucetia
Synodus synodus
Prymnothonus, spp.
Lampanyctus maderensis
Leptocephalus muraenae unicoloris
L. acuticeps, sp. n.
L. hexastigma, sp. n.
Hemirhamphus unifasciatus
Cryptotomus ustus
Scorpaena, sp.
Bothus ocellatus

ATLANTIC, S. OF THE CANARIES.

Lampadena chavesi

ATLANTIC, S. OF THE AZORES.

Vinciguerria lucetia
Paralepis speciosus
Scombresox saurus

The majority of these were captured well out at sea, and are young stages of oceanic fishes, or oceanic larvae (*Leptocephalus*, *Bothus ocellatus*) of coast fishes. Exceptions to this are the larvae and young fishes taken in Melbourne Harbour and others captured a few miles off Rio de Janeiro (*Sardinella*, *Glyphidodon*, *Gobiosoma*, *Ancylopsetta*, *Symphurus*); also some of the New Zealand species were taken near the coast and may never be oceanic.

Of some importance in its bearings on the geographical distribution of coast-fishes is the capture of young *Hemirhamphus unifasciatus* and *Cryptotomus ustus*, Brazilian species, far out in the Atlantic.

Of greater interest is the case of *Limnichthys fasciatus*, known previously as a little fish of the rock-pools of New South Wales and Lord Howe Island; now its range is extended to New Zealand, and its occurrence in localities so wide apart is explained by the capture of the young fish at or near the surface between the Three Kings Islands and New Zealand.

ISOSPONDYLI.

Clupeidae.

Sardinella pseudohispanica, Poey. (Pl. V, fig. 2).

Typical Clupeoid larvae, 7 to 8 mm. long, with the anus far back, anal fin undeveloped, dorsal fin posterior, and caudal rayed and terminal. There are stellate chromatophores on the head, below the heart, and above and below the gut; they are most distinct on the dorsal border of the hinder two-thirds of the gut. Vertebrae 46.

The number of vertebrae and the resemblance to the larval Pilchard (*Sardina pilchardus*) lead me to identify these larvae as *Sardinella pseudohispanica*, which is the Western Atlantic representative of the Mediterranean Allache (*Sardinella aurita*, Cuv. and Val.); the genera *Sardina* and *Sardinella* are very closely related.

Stations 39, 40. Six miles off the mouth of Rio de Janeiro Harbour. 2 metres. April 27th, 1913.

Sardina neopilchardus, Steind. (Pl. V, figs. 3, 4).

Three larval and post-larval fishes may be referred to this species. I count 16 dorsal and 16 anal rays and 52 or 53 myotomes. The smallest example, 12 mm. long, is more advanced than the 11·5 mm. larva of *Sardina pilchardus* figured by Cunningham, as the caudal fin is fully formed and terminal in position, and the anal rays are appearing. The largest, 18 mm. long, appears to differ from Cunningham's 24 mm. *S. pilchardus* chiefly in details of pigmentation, but after examination of Pilchard larvae from Plymouth, kindly lent by Dr. E. J. Allen, I am doubtful whether there are any constant differences between the larvae of the European species and its representative in the seas of Australia and New Zealand.

Station 135. Spirits Bay, near North Cape, New Zealand. 3 metres. Sept. 1st, 1911.

Stomiatidae.

Stylophthalmus macrenteron, sp. n. (Pl. V, fig. 1).

A post-larval fish, 33 mm. long, shows several resemblances to *Stylophthalmus paradoxus*, Brauer, and may therefore be described as a *Stylophthalmus*, although it is unlikely that it is congeneric with any of the species associated under that name. In all probability it belongs to the family Stomiatidae; the only other family that seems possible is the Alepocephalidae. If this be a Stomiatid it may represent a young stage of *Eustomias obscurus*, Vaillant, described from a single specimen taken near the Azores.

Form elongate; head one-fifth of the length of the fish. Snout produced and depressed; lower jaw prominent; maxillary toothed, not nearly reaching eye; interorbital region broad and flat. Myotomes about 70. Dorsal 22, placed posteriorly. Anal 40, extending forward in advance of dorsal. Protruding terminal portion of intestine very long and supported behind by a cartilaginous rod. A series of seven dark spots along the back.

Tropical Atlantic. Station 49. 18° 51′ S., 33° 40′ W. Surface. May 6th, 1913.

Stylophthalmus paradoxus, Brauer.

A larva, 6 mm. long, of the type figured on pl. V, fig. 5, of the Valdivia report.

South Atlantic. Station 311. 35° 29′ S., 50° 26′ W. 2 metres. April 22nd, 1913.

Gonostomatidae.

Cyclothone microdon, Günth. (Pl. V, fig. 5).

Several examples 6 to 8 mm. long have the fins fully developed, but the head is intermediate between that of the Gonostomatid larva figured by Holt and Byrne (Fisheries Ireland Sci. Invest. 1912, I, pl. II, fig. 5), and that of the adult fish, the maxillary not extending back beyond the eye. I count 12 dorsal and 16 anal rays and 30 myotomes.

Tropical Atlantic. Station 39. 6 miles off mouth of Rio de Janeiro Harbour. 2 metres. April 27th, 1913.

South Atlantic. Station 311. 35° 29′ S., 50° 26′ W. 2 metres. April 22nd, 1913.

Vinciguerria lucetia, Garm. (Pl. V, figs. 6, 7).

Seven examples, 8 to 10 mm. in total length, differ from the adult fish in that they are more slender and the photophores are not developed; also the mouth is smaller. A specimen of 15 mm. has the lower series of photophores developed, but the upper series is incomplete. All are from the Atlantic, taken at the surface.

Station 45. 21° S., 37° 50′ W. May 4th, 1913. Station 50. 18° S., 31° 45′ W. May 7th, 1913. Station 68. 27° 22′ N., 33° 40′ W. May 28th, 1913.

INIOMI.

Synodontidae.

Synodus synodus, Linn. (Pl. VII, fig. 4).

A larva of 14 mm. differs from those described by Max Weber (Siboga Fishes, p. 82, fig. 28) in having 13 patches of dark pigment on each side of the gut instead of 11. Probably this is a specific difference distinguishing the Atlantic *S. synodus* from the Indo-Pacific *S. varius*. I count 60 myotomes and 9 anal rays.

Station 46. 20° 30′ S., 36° 30′ W. Surface. May 4th, 1913.

Sudidae.

Prymnothonus, Richards.

The only larvae known to belong to this family are of the type described as "*Prymnothonus*" (Günther, "Challenger" Pelagic Fishes, p. 39, pl. V, 1889). These are larvae of *Paralepis* and related genera with produced snout. It has been shown above (p. 126) for the Antarctic *Notolepis coatsii* that there is an extended backward migration of the anus during the transition from the *Prymnothonus* stage to the adult fish.

A larva of 12 mm. has the snout moderately produced. There are 80 myotomes and about 20 anal rays. The anus corresponds to the twenty-eighth myotome and the origin of the anal fin to the fifty-fourth (Pl. VII, fig. 1).

Tropical Atlantic. Station 50. 18° S., 31° 45′ W. Surface. May 7th, 1913.

A second larva of 16 mm. has the snout more produced than the preceding. There are 116 vertebrae (52 + 64) and 30 or more anal rays (Pl. VII, fig. 2).

Tropical Atlantic. Station 47. 20° 30′ S., 36° 30′ W. Surface. May 4th, 1913.

In the number of anal rays these examples agree well enough with known species of *Paralepis*, and in the number of myotomes the first agrees with the Mediterranean species that I have examined. Possibly *P. borealis*, a species that I have not seen, may have the larger number of myotomes found in the second specimen.

A third "*Prymnothonus*" is probably generically distinct from these; it is a post-larval fish, 22 mm. long, evidently related to *Paralepis*, which it resembles in the structure of the head, but it has only 60 myotomes and 11 anal rays. The adipose fin is above the posterior end of the anal. Dorsal and pelvic fins are undeveloped (Pl. VII, fig. 3).

Station 85. 24 miles W.N.W. from Cape Maria van Diemen, New Zealand. 2 metres. July 24th, 1911.

Paralepis speciosus, Bellotti.

Omosudis elongatus, Brauer, Valdivia Tiefsee Fische, p. 140, fig. 68 (1906).

This species is represented in the British Museum collection by two examples of 65 and 75 mm. from Messina. Bellotti's specimens were 75 and 90 mm., Brauer's from 8 to 30 mm., the larger full grown. There is therefore reason to suppose that this is a small species, and that it assumes the adult form at an early age.

A larva of 8 mm. that I refer, with some doubt, to this species has the fin-rays not yet developed, but the form of the head is already as in the adult fish. The patches of pigment on each side of the gut number only five, instead of eight, but this may be a larval character.

Station 69. 29° 10′ N., 33° 36′ W. Surface. May 29th, 1913.

This species was described from the Mediterranean (Bellotti, Atti. Soc. Ital. XX, 1877, fasc. 1, p. 2, fig.), and has been recorded by Brauer from the Gulf of Guinea and the Indian Ocean.

Myctophidae.

Larval and post-larval stages of *Myctophum* and related genera were taken to the north of New Zealand and in the Atlantic. The species of this group are so numerous and have such a wide range that the definite assignment of larvae to their species is very difficult. This difficulty is increased by the fact that the head, owing to the relatively smaller size of the eye and mouth and the greater length of the snout, has a physiognomy quite unlike that of the adult fish. However, by counting the myotomes and fin-rays and taking into consideration the position of the fins, the size of the mouth, etc., it is possible to make determinations which may, in some cases, approximate to the truth.

The general character of the development has already been described in dealing with *Myctophum antarcticum*.

Myctophum benoiti, Cocco (Pl. VI, figs. 1, 2).

Several examples, from 4 to 7 mm. in total length, may belong to this species. They have much in common with the larvae described and figured by Holt and Byrne (Fisheries Ireland Sci. Invest. 1910, VI, p. 29, pl. I, fig. 8), from the Irish Atlantic slope under the name " Scopelid larva, R 2," but seem to be specifically distinct. They are distinguished by their rather deep form, conical snout, strong teeth, and by the distribution of the stellate pigment spots ; four large ones are present on each side, respectively at the origin of the dorsal and anal fins, below the adipose fin and above the end of the anal fin ; usually there is a fifth on the side between the two last-named. There is also a spot on the back behind the head and a mid-ventral series of small spots from the end of the lower jaw to the origin of the anal fin. I count 12 or 13 dorsal and 17 or 18 anal rays and 37 myotomes.

South Atlantic. Station 311. 35° 29′ S., 50° 26′ W. 2 metres. April 22nd, 1913.

Myctophum laternatum, Garm. (Pl. VI, fig. 7).

A specimen 8 mm. long is probably of this species. It is moderately elongate ; the snout is short and the mouth is small, the maxillary extending to below the middle of the eye. The anal fin has 14 rays and commences below the posterior part of the dorsal, which has 11. The myotomes number 35.

South Atlantic. Station 311. 35° 29′ S., 50° 26′ W. 2 metres. April 22nd, 1913.

Myctophum coccoi, Cocco.

An example 20 mm. long has the characters of the adult fish, except that the eye is relatively smaller, its diameter being less than the length of the snout.

Station 86. Off Three Kings Islands. 3 metres. July 25th, 1911.

Diaphus sp. (Pl. VI, figs. 3, 4).

Form rather deep ; snout obtuse and mouth oblique. Length 4 to 5 mm. Dorsal and anal fins each with about 14 rays ; about 35 myotomes. The distribution of the pigment is shown in the figures.

Station 135. Spirits Bay, near North Cape, New Zealand. 3 metres. September 1st, 1911.

Lampadena chavesi, Collett (Pl. VI, fig. 8).

Four specimens, 10 to 12 mm. long, may belong to this species. I count 12–13 dorsal, 13–14 anal, and 15 pectoral rays and 38 myotomes. The fins are placed as in the adult fish. The maxillary extends to below the middle of the eye. On each side there is a photophore in front of the eye, another at the base of the pectoral fin, and a third above the base of the pelvic fin. Two examples have 2 mid-dorsal stellate blackish spots behind the adipose fin and a mid-ventral series of 3 or 4 linear spots behind the anal fin.

Station 17. South of the Canaries. 26° 17′ N., 20° 54′ W. 10 metres. June 30th, 1910.

Lampanyctus maderensis, Lowe (Pl. VI, fig. 6).

An example of 9 mm. shows the supraorbital ridge ending in an antrorse spine; the cleft of the mouth extends to below the posterior edge of the eye. The myotomes number 36 and the fins are as in the adult fishes figured by Goode and Bean, and Brauer. There is a bar of pigment at the base of the caudal fin. In specimens of 5 mm. the spine is not developed, the mouth is smaller, and the adipose fin is longer.

Station 50. Tropical Atlantic. 18° S., 31° 45′ N. Surface. May 7th, 1913.

Lampanyctus macropterus, Brauer (Pl. VI, fig. 5).

A specimen of 10 mm. may belong to this species; it is very similar to the example of *L. crocodilus* of the same size figured by Holt and Byrne (Fisheries Ireland Sci. Invest., 1910, VI, pl. 1, fig. 3). There are 12 dorsal and 20 anal rays and 40 myotomes. There is a black spot at the base of the caudal fin, another above the anal papilla, and some smaller ones on the lower part of the head.

Station 135. Spirits Bay, near North Cape, New Zealand. 3 metres. September 1st, 1911.

Lampanyctus longipinnis, sp. n. (Pl. VI, fig. 9).

Dorsal 22. Anal 25. Myotomes 38. Evidently related to *L. procerus*, Brauer, differing in the more numerous dorsal and anal rays.

A young fish of 15 mm.

Station 113 (N.E. of Three Kings Islands). 33° 12′ S., 171° 05′ E. 3 metres. August 9th, 1911.

APODES.

Following the plan adopted by workers on this group, I use the name *Leptocephalus* as a generic term for larval Eels, and give new specific names to those that cannot be identified.

Leptocephalus acuticeps, sp. n. (Pl. VII, fig. 5).

Very similar to *L. oxycephalus*, Pappenh. (Deutsche Südpolar Exped. XV, Zool. VII,

p. 190, pl. IX, figs. 3, 5), from the Indian Ocean, but with fewer myotomes, 207 (174 + 33) instead of 220–230 (180–190 + 40). Form elongate; head small; snout rather produced and acute. Teeth in 1 + 6 pairs in the upper jaw and 1 + 5 in the lower. Gut with a swelling (liver) at about the thirtieth myomere. A series of dots along the axis and along the dorsal border of the gut; a group of similar dots at the end of the tail. Dorsal and anal fins rayless; a caudal fin.

Total length 47 mm.

Tropical Atlantic. Station 45. 21° S., 37° 50′ W. Surface. May 4th, 1913.

Anguillidae.

Anguilla australis, Richards.

An elver of 50 mm.

Station 129. Off Three Kings Islands. Surface. August 26th, 1911.

Muraenidae.

Leptocephalus muraenae unicoloris (Pl. VII, fig. 7).

A specimen of 60 mm. has the general characters of *L. euryurus* and *L. similis* of Lea (Michael Sars Exped. III, 1, No. 7), and of the larva of *Muraena helena* (Schmidt, Medd. Komm. Havunders. Fiskeri. IV, 2, 1913, p. 5, pl. I, fig. 3). The myotomes number 138 (64 + 74), and as this is nearly the number of vertebrae (136) counted in *Muraena unicolor*, De la Roche, this Leptocephalid may be referred to that species, which is represented in the British Museum collection by specimens from Algiers, Madeira, the Azores and St. Helena, but does not as yet appear to have been recorded from Brazil.

The snout is blunt and the lower edge of the mandible is somewhat convex; there are 7 or 8 teeth on each side in both jaws. The vertical fins are rayed and the caudal is much reduced. The pigment is in the form of small dots; some on the anterior dorsal fold and one at the base of each dorsal and anal ray; a line of dots along the dorsal surface of the gut, and anteriorly some below it.

Tropical Atlantic. Station 46. 20° 30′ S., 36° 30′ W. Surface. May 4th, 1913.

Ophichthyidae.

Leptocephalus hexastigma, sp. n. (Pl. VII, fig. 6).

Myotomes 164 (72 + 92). Head small; snout acute and produced. Upper jaw with 10 pairs of teeth, the three following the anterior pair strong and spaced, the rest closer together and decreasing. Lower jaw with 9 pairs of teeth, the anterior pair followed on each side by 5 strong and spaced teeth and 3 small posterior teeth. Dorsal rays commence in advance of anus, anal rays a little behind it. Gut with 6 pigmented swellings, the third largest, the last 3 small: these correspond respectively to myotomes 15, 22–23, 29–30, 47, 57 and 67–68. Total length 60 mm.

Tropical Atlantic. Station 50. 18° S., 31° 45′ W. Surface. May 7th, 1913.

The resemblances to the *Ophichthys* larvae described and figured by Schmidt (Medd. Komm. Havunders. Fiskeri, IV, 2, 1913) make it probable that this is a member of the family Ophichthyidae.

SYNENTOGNATHI.

Scombresocidae.

Scombresox saurus, Walb.

Post-larval fishes, 10 and 18 mm. in total length, are strongly pigmented. The snout is short and the lower jaw is prominent, but not produced. The fins are fully developed; the smaller specimen has the fold in front of the anal fin still persistent.

Station 69. South of the Azores. 29° 10′ N., 33° 36′ W. Surface. May 29th, 1913.

Scombresox forsteri, Cuv. and Val.

Post-larval examples of this species are similar to those of its Atlantic representative.

Station 89. Off Three Kings Islands. Surface. July 25th, 1911.

Hemirhamphidae.

Hemirhamphus unifasciatus, Ranzani.

Dorsal 13–14. Anal 14–15. Myotomes about 50. Lower jaw not produced. Total length 10 mm.

Station 53. Tropical Atlantic. 5° S., 27° 15′ W. 2 metres. May 12th, 1913.

PERCOMORPHI.

Scorpididae.

Scorpis violaceus, Haast.

A young fish of 38 mm.

Station 129. Off Three Kings Islands. Surface. August 26th, 1911.

Pomacentridae.

Glyphidodon, sp. (Pl. VIII, fig. 5).

Dorsal XII–XIII, 10–11. Anal II, 10–11. Vertebrae 26 (11 + 15). The specimen measures 5 mm. in total length.

Station 39. Six miles off the mouth of Rio de Janeiro Harbour. 2 metres. April 27th, 1913

SCARIDAE.

Cryptotomus ustus, Cuv. and Val. (Pl. VIII, fig. 6).

Dorsal IX, 10. Anal 12. Vertebrae 25 (9–10 + 15–16). These little fishes, 9 mm. in total length, evidently belong to the family Scaridae or to the sub-family Julidinae; the structure of the vertebral column and of the vertical fins leaves no doubt as to this. The number of fin-rays is somewhat less than in the Julidinae, except *Doratonotus megalepis*, which differs from them in its strong dorsal and anal spines, long praemaxillary pedicels, etc. After comparison with numerous species of Scaridae I am of opinion that these young fishes belong to *Cryptotomus ustus*, or to some species nearly related to it.

Station 49. Tropical Atlantic. 18° 51′ S., 33° 40′ W. Surface. May 6th, 1913.

ODACIDAE.

Odax balteatus, Cuv. and Val. (Pl. VIII, fig. 4).

In identifying a post-larval fish of 6 mm. with this species I rely on the number of vertebrae, 36 (19 + 17) and of anal and caudal rays; the anterior dorsal rays are undeveloped, and the pelvic fins have not yet appeared.

Station 161. Melbourne Harbour. 12 metres. October, 1910.

LIMNICHTHYIDAE.

Limnichthys fasciatus, Waite.

Several young fishes, 16 to 20 mm. long; some of the larger ones show the characteristic markings of the adult fish.

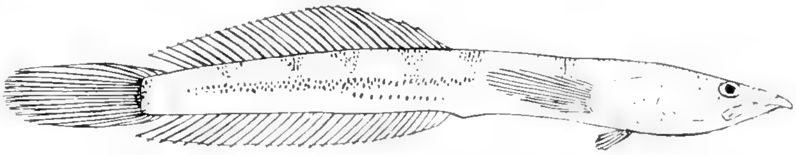

FIG. 4.—*Limnichthys fasciatus* (× 6).

This species was originally described from adult specimens in full roe, 43 mm. long. These were found in rock-pools at Lord Howe Island (Waite, Rec. Austral. Mus. V, 1904, p. 178, pl. XXIII, fig. 4), and afterwards similar examples were taken from pools near Sydney (Waite, t.c. p. 243). As Lord Howe Island is 600 miles from the coast of New South Wales, one might have inferred that the species was oceanic at some period of its life. This is proved, and its known range extended by its capture at or near the surface to the north of New Zealand, off the Three Kings Islands, and also midway between these two localities.

Station 120. 34° 26′ S., 172° 14′ E. Surface. Aug. 18th, 1911.
,, 130. Off Three Kings Islands. Surface. Aug. 27th, 1911.
,, 133. Spirits Bay, nr. North Cape, N.Z. 20 metres. Aug. 30th, 1911.
,, 135. ,, ,, 3 metres. Sept. 1st, 1911.

STROMATEIDAE.

Cubiceps caeruleus, Regan.

A young fish 20 mm. long.

Station 125. Between North Cape and Doubtless Bay, New Zealand. Surface. August 23rd, 1911.

Centrolophus maoricus, Ogilby (Pl. X, fig. 7).

A young fish 19 mm. long has the body deeper and the cross-bars stronger than the larger examples already described ("Terra Nova" Fishes, p. 19).

Station 142. 34° 45′ S., 170° 45′ E. 2 metres. September 8th, 1911.

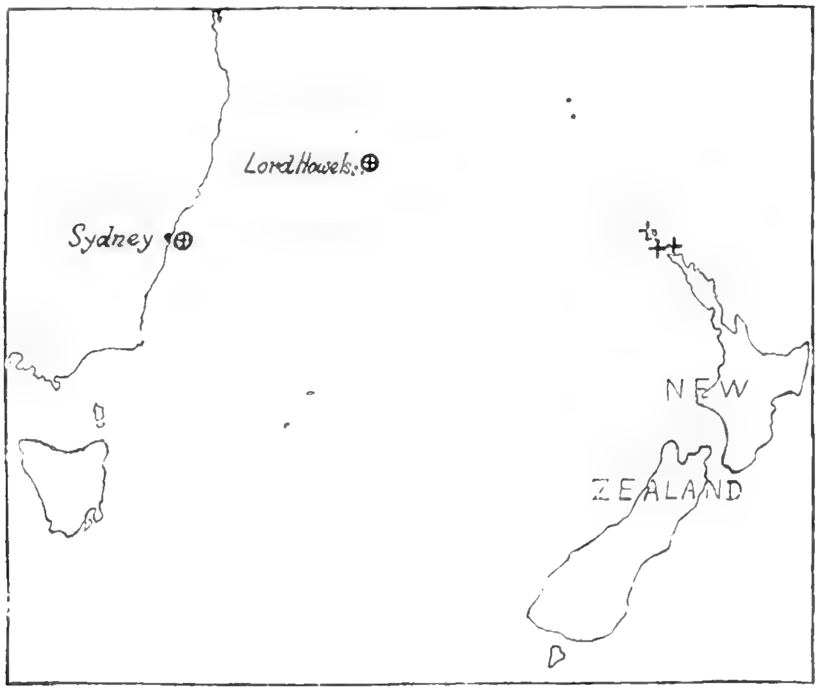

FIG. 5. Distribution of *Limnichthys fasciatus*.
⊕, Littoral, from rock-pools; +, planktonic.

GEMPYLIDAE.

Thyrsites atun, Euphras. (Pl. VIII, figs. 1–3).

Specimens 5 to 10 mm. long are very similar to those of *T. prometheus* described and figured by Günther ("Challenger" Pelagic Fishes, p. 7, pl. I, figs. C, D). There are about 35 vertebrae and 18 to 20 dorsal spines.

Station 133. Spirits Bay, near North Cape, New Zealand. 20 metres. Augus 30th, 1911.

TRICHIURIDAE.

Lepidopus caudatus, Euphras. (Pl. VIII, fig. 7).

A specimen of 11 mm. is distinguished from the preceding by the more elongate form and the numerous vertebrae (about 100). The pelvic fins are represented by a pair of serrated spines.

Station 135. Spirits Bay, near North Cape, New Zealand. 3 metres. September 1st, 1911.

GOBIIDAE.

Gobiosoma molestum, Girard.

A post-larval fish of 5 mm. has the form of the adult. The number of fin-rays dorsal VII, 13; anal 11—point to this species.

Station 39. Six miles off the mouth of Rio de Janeiro Harbour. 2 metres. April 27th, 1913.

CLINIDAE.

Tripterygium varium, Forst. (Pl. IX, figs. 1, 2).

Numerous larval and post-larval examples, 6 to 14 mm. in total length. One of 6 mm. is figured (Pl. IX, fig. 1); only the caudal fin has traces of the permanent rays. At 9 or 10 mm. the caudal is fully formed and terminal and the anal and third dorsal have their full complement of rays, but there is no trace of the first and second dorsals nor of the pelvics in these, nor in the larger examples of 13 or 14 mm. (Pl. IX, fig. 2). The absence of these fins made it difficult to determine these fishes, but after preparing the skeleton of one of the larger specimens I was led to place them in the Clinidae, the form of the skull and the arrangement of the elements at the base of the pectoral fin being especially characteristic. The number of vertebrae, about 45, and of fin-rays, 12–13 dorsal, 25–27 anal, 14 principal caudal and not less than 14 or 15 pectoral, lead to the determination of the species as *Tripterygium varium*.

Spirits Bay, near North Cape, New Zealand.

Station 133. 20 metres. August 30th, 1911.

" 135. 3 metres. September 1st, 1911.

" 136. Surface. September 2nd, 1911.

SCLEROPAREI.

SCORPAENIDAE.

Scorpaena, sp. (Pl. X, fig. 6).

Fin-rays.—Dorsal XI, I 9; Anal III 5; Pectoral 18. Vertebrae 24 (10 + 14).

The specimen is 10 mm. long; the head is armed with serrated spines, two praeorbital, four praeopercular, one at the angle longest; the interorbital ridges are continued back to a pair of strong occipital spines; the infraorbital ridges are serrated. The lower part of the pectoral fin is pigmented.

Station 53. Tropical Atlantic. 5° S., 27° 15′ W. Surface. May 12th, 1913.

Pentaroge marmorata, Cuv. and Val. (Pl. X, fig. 5).

Larvae 6 to 7 mm. long may be referred to this species, with which they agree in the number of vertebrae (28), pectoral (10) and caudal (14) rays. At this stage the pectoral rays are simple and elongate, the pelvic fins are rudimentary, and the dorsal and anal are rayless. The head is armed with paired occipital, otic and supraorbital spines; the praeoperculum has two strong spines alternating with two smaller ones.

Station 161. Melbourne Harbour. 12 metres. Young fish trawl. October, 1910.

Platycephalidae.

Platycephalus sp. (Pl. X, fig. 4).

Numerous specimens, 5 to 7 mm. long, evidently pertain to this genus. I count 27 vertebrae and 18 pectoral rays. In all the dorsal and anal are rayless; in the larger ones the end of the notochord is upturned and the hypurals and caudal rays are evident; at 7 mm. rudimentary pelvic fins are present. The snout is depressed and rounded and the mouth is wide. There is a double spine on each side of the occiput, and there are two strong praeopercular spines and a smaller one below.

Station 161. Melbourne Harbour. 12 metres. Young fish trawl. October, 1910.

HETEROSOMATA.

Bothidae.

Paralichthinae.

Ancylopsetta quadrocellata, Gill (Pl. IX, fig. 3).

A specimen of 5 mm. has the general characters of the post-larval fish described and figured by Kyle as *Ancylopsetta* sp. (Danish Oceanographical Exped. Flat-fishes, p. 143.) The head is similarly armed, the anterior dorsal rays are produced, etc. Notable differences from Kyle's specimen are that the body is deeper and the fin-rays are fewer. I count 73 dorsal rays, the anterior 13 somewhat spaced and at least the first 8 of these produced; the anal rays number 60, and the vertebrae 34 or 35 (9–10 + 25).

A second example of less than 3 mm. shows the characteristic pigmentation and the prominent abdomen, but the fins are rayless and the end of the notochord is not turned upwards.

Station 39. Six miles off the mouth of Rio de Janeiro Harbour. 2 metres. April 27th, 1913.

Ancylopsetta sp. (Pl. IX, fig. 4).

Two larvae, each 4 mm. long, may be provisionally referred to this genus. They agree with the preceding in the armature of the head and the number of vertebrae, but are not so deep, and lack the spots on the body. The fins are membranous except an anterior dorsal of 7 prolonged rays.

Station 39. Six miles off the mouth of Rio de Janeiro Harbour. 2 metres. April 27th, 1913.

Bothinae (*Platophrinae*).

Bothus ocellatus, Agass.

A specimen of 26 mm. is still externally symmetrical and is extremely similar to the example of *B. podas* figured by Kyle (t.c. p. 98, fig. 16). I count 86 dorsal and 59 anal rays and 38 (10 + 28) vertebrae.

Station 53. Tropical Atlantic. 5° S., 27° 15′ W. 2 metres. May 12th, 1913.

Cynoglossidae.

Symphurus plagusia, Bl. Schn. (Pl. IX, figs. 5, 6).

Dorsal 90–95; Anal 70–75; Caudal 10; Vertebrae 49 (9 + 40).

Two examples of 6 to 7 mm. are rather similar to *S. lactea* of this size described and figured by Kyle (t.c. p. 132, pl. iv, figs. 41–42), but the abdominal appendix is lacking, and the distribution of the pigment is somewhat different. A specimen of 11 mm. has already metamorphosed, showing that the change takes place at a smaller size than in the European species.

Stations 39, 40. Six miles off the mouth of Rio de Janeiro Harbour. 2 metres. April 27th, 1913.

PLECTOGNATHI.

Balistidae.

Monacanthus scaber, Forst. (Pl. X, fig. 3).

A post-larval specimen 5 mm. long. The head is large; the external bones are spinate. The posterior dorsal and anal rays are not fully formed, but the total number exceeds 30. The considerable length of the tail posterior to the permanent caudal fin is worth notice.

Station 133. Spirits Bay, near North Cape, New Zealand. 20 metres. August 30th, 1911.

Diodontidae.

Diodon sp.

A young fish, 5 mm. long.

Station 92. 24 miles S. by W. from Three Kings Islands. Surface. July 27th, 1911.

PEDICULATI.

Ceratiidae.

Ceratias sp. (Pl. X, fig. 1).

Two examples, 6 mm. in length, are in many respects similar to the adult fish. There are 4 dorsal, 4 anal, and 9 caudal rays; an interorbital papilla represents the illicium. The mouth is nearly vertical and there are pointed teeth in the jaws.

Station 311. South Atlantic. 35° 29′ S., 50° 26′ W. 2 metres. April 22nd, 1913.

ACERATIIDAE.

Haplophryne mollis, Brauer (Pl. X, fig. 2).

A specimen of 10 mm. is very similar in outline to the one figured by Brauer (Valdivia Tiefsee Fische, pl. XVI, fig. 10); but this outline is that of the loose skin in which the fish is enclosed, and that of the body of the fish is quite different. The dorsal and anal rays are long, but only their tips project, and a rudiment of the illicium is present, but is hidden under the skin.

Station 127. Off Three Kings Islands. Surface. August 25th, 1911.

III.—NOTES AND CONCLUSIONS.

1. PELAGIC LARVAE IN RELATION TO THE DISTRIBUTION OF SPECIES.

The larval, post-larval, and young fishes of the "Terra Nova" collection were all taken at or near the surface. The majority of those captured far from land, whether in the Antarctic (*Notolepis coatsii*), Subantarctic (*Myctophum antarcticum*), South Temperate or Tropical Zones (cf. p. 134) belong to oceanic species, either pelagic or bathypelagic. On the other hand, most of those taken near the coast are young stages of coast fishes which, when adult, may either swim near the surface (e.g., Clupeidae) or live at the bottom (e.g., Heterosomata). This is in agreement with the fact that the same species of coast fishes rarely inhabits areas separated by a wide expanse of sea; for example, the majority of the Brazilian species are not found on the West African coast. It may be inferred that the distribution of a benthic species along a coast may be helped by a pelagic larval phase, but that unless this be prolonged it will not serve to establish the species in places separated from its original habitat by a wide sea.

Bothus ocellatus (p. 147), one of the Flat-fishes, is a good example of a benthic fish with a prolonged pelagic larval phase. The "Terra Nova" example, more than an inch long, is still transparent and symmetrical; it was taken in the Atlantic in 5° S., 27° 15′ W., quite 300 miles from the American coast. Jordan and Evermann give the habitat of this species as from "Long Island to Rio Janeiro, on sandy shores"; but a specimen in the British Museum collection proves that it also occurs at Ascension, about 1,000 miles from Brazil. There can be little doubt that it has reached this island owing to the long duration of its life as a pelagic larva.

The Eels, Apodes (p. 140, Pl. VII, figs. 5–7) are benthic fishes with pelagic larvae that attain a considerable size and age and may migrate for long distances; but the majority of the Atlantic species of this group are not common to the eastern and western coasts.

There is considerable evidence that some coast fishes with a wide geographical range do not have a particularly long larval life, but that the young fishes may be oceanic.

Of the species dealt with in this report three may be selected to illustrate this.

(1) *Notothenia macrocephala* (p. 130), a species of the shallow water benthos; this is known from the Magellan and New Zealand districts and from Kerguelen: off the last-named the "Challenger" obtained young fishes, 40 mm. long, swimming at or near the surface.

(2) *Hemirhamphus unifasciatus* (p. 142) ranges from Florida to Rio de Janeiro, and belongs to a genus of herbivorous fishes that swim at the surface near the coast. The capture of a young fish, 10 mm. long, far out in the Atlantic, is of interest, as *H. picarti*, Cuv. and Val., from Algeria is believed to be the same species.

(3) *Limnichthys fasciatus* (p. 143). Previously recorded from rock-pools near Sydney and at Lord Howe Island; the pelagic young of this little fish were taken by the "Terra Nova" to the north of New Zealand, near the Three Kings Islands, and midway between these localities.

Further examples are *Scorpaena* (p. 145) and *Cryptotomus ustus* (p. 143).

It may be regarded as nearly certain that when a species of coast fishes occurs in areas separated from each other by wide expanses of the ocean, it has a pelagic phase in its life history of sufficient duration to enable it to travel or to be carried from one such area to another. In some fishes (*Bothus*, Apodes) this pelagic stage ends when the larva acquires the structure and habits of the adult fish, but in other cases it seems that the young fishes, essentially similar to the adults in structure, may differ from them in habits and swim across the ocean.

2. THE RECAPITULATION THEORY.

It is well known that the truth of the theory that ontogeny repeats phylogeny is shown by almost every Teleostean fish in the development of its caudal fin, which is at first ventral and then becomes terminal.

Two rather puzzling developmental features, the migration forwards of the dorsal fin in the Clupeidae and the migration backwards of the anus in *Notolepis*, *Paralepis*, etc., may possibly be explained by the same theory.

In the Clupeidae, and the closely-related Elopidae and Albulidae, which are the most generalised living Teleosts, the dorsal fin is completely formed on the posterior part of the back and then travels forward to its permanent position. The earliest fishes that can be regarded as ancestral to the Clupeoids are the palaeozoic Palaeoniscidae: in this family the dorsal fin was placed posteriorly, usually above the anal. Next come the Semionotidae, which are a big step nearer the Teleosteans, and then the Pholidophoridae, which may be regarded as the immediate ancestors of the Clupeoids; in both these mesozoic families, and especially in the Semionotidae, the dorsal fin is placed well backward and in a number of the genera is at least partly opposed to the anal. It seems possible, therefore, that the backward position of the dorsal fin of larval Clupeoids may be an ancestral feature.

In *Notolepis* (p. 125, Pl. I, figs. 4, 5), *Paralepis* (cf. *Prymnothonus*, p. 137, Pl. VII, figs. 1–3), etc., the larva has a short gut with the anus not far behind the head; as the fish grows the gut becomes relatively longer, and the anus travels backward until it reaches its final position a short distance in front of the anal fin. In a paper on the classification of the Iniomi (Ann. Mag. N. H. (8) VII. 1911, pp. 120–133) I have pointed out that the long-bodied and long-snouted *Paralepis* is closely related to, but more specialized than, *Chlorophthalmus*, a short-snouted fish of normal piscine form, but with the anus nearer to the head than to the anal fin. It is not impossible that the anterior position of the anus in the larval *Paralepis* may be due to the evolution of this genus from a *Chlorophthalmus*.

3. DEVELOPMENT OF THE FINS.

The pectoral fins, which are principally concerned with balancing, are usually present in the youngest larvae, and the permanent fin-rays appear at a very early stage. As a rule the caudal, used for propulsion, is the next fin to develop. The hypurals and fin-rays make their appearance below the notochord, and then by flexion of the latter are brought into a terminal position. Afterwards the dorsal and anal rays develop in the embryonic fin-fold and the pelvic fins grow out. There are many deviations from and exceptions to the general course of development of the fins outlined above.

The dorsal and anal fins usually originate in their final position, but in the Clupeidae, and the related Albulidae and Elopidae, they develop more posteriorly and the dorsal especially migrates forwards for a considerable distance after it has been formed (cf. Pl. V, figs. 2–4). In these families the dorsal fin develops earlier than the anal, but in the Iniomi the reverse is the case (e.g., *Synodus synodus*, p. 137, Pl. VII, fig. 4; *Prymnothonus*, p. 137, Pl. VII, figs. 1–3). Sometimes the formation of the dorsal fin, or the anterior part of it, is so delayed that the embryonic fin-fold disappears first; this may often happen with the spinous dorsal fin of acanthopterous fishes (e.g., *Odax balteatus*, p. 143, Pl. VIII, fig. 4; *Tripterygium varium*, p. 145, Pl. IX, figs. 1, 2).

Notable exceptions to the general rule that the anterior or spinous portion of the dorsal fin develops later than the posterior or soft-rayed portion are the Trichiuroids and some Paralichthinae. In the former (e.g., *Thyrsites atun*, p. 144, Pl. VIII, figs. 1–3) the early formation of the spinous dorsal may be for purposes of defence, and one may well believe that it would be effective in warding off the attacks of the predaceous young of such fishes as *Pomatomus saltator* (cf. Agassiz and Whitman, Mem. Mus. Comp. Zool. XIV, No. 1, 1885, p. 16).

In some Flat-fishes of the sub-family Paralichthinae (e.g., *Ancylopsetta*, p. 146, Pl. IX, figs. 3, 4) the anterior dorsal rays are formed at a very early stage and grow out into filaments which may be used as feelers, perhaps to find food at night. When the pelvic fins develop precociously they also may take the form of spines (e.g., *Thyrsites*) or of long filaments (e.g., *Trachypterus*); but in other cases they grow out into large fins with the rays fully connected by membrane (e.g., *Pagetopsis macropterus*, p. 132, Pl. III, figs. 1–3); presumably such fins would be used to help the pectorals in balancing and to prevent the fish from sinking.

It seems that in most fishes the fins develop in the same order and that the development of one or more fins out of their turn, precociously, may be for purposes either of flotation, balance, defence, or perhaps nocturnal feeding.

4. CHARACTERISTIC FEATURES OF PELAGIC LARVAE.

Absence of accessory organs of respiration and of adhesive organs.—Larval structures that occur in more than one group of fresh-water fishes are external gills and adhesive organs; the latter enable them to remain in the place selected by the parents until the yolk is absorbed, and external gills are advantageous when the water is limited in quantity or deficient in oxygen; that these structures are not found in pelagic marine larvae is not surprising.

Invisibility.—All pelagic larvae are transparent, and in some groups the larval stage is prolonged until a considerable size is reached; these large larvae remain transparent owing to the strong compression of their bodies and the looseness of their tissues, and the change into the less compressed and more compact young fish is accompanied by a shrinkage. This type of development is characteristic of the Apodes (p. 140, Pl. VII, figs. 5–7), but it occurs also in the Elopidae and Albulidae.

Buoyancy and balance.—It has been suggested that the dorsal sinus of the Myctophidae (pp. 127, 138, Pl. VI) may serve as a float, and it seems likely that the large pelvic fins of the larval Chaenichthyidae, especially *Pagetopsis* (p. 132, Pl. III, figs. 1–3), may be spread to prevent the fish sinking,

Generally the vertical fin acts as a keel, and balance is maintained by movements of the pectorals; possibly the protrusion of the terminal part of the gut in many larvae may be connected with balance; in those described as *Stylophthalmus* the protruded portion may be quite long, but it is difficult to understand why this feature should be so exaggerated as it is in *Stylophthalmus macrenteron* (p. 136, Pl. V, fig. 1). The terminal part of the gut, with its basal support, forms a long appendage; this would, presumably, keep the fish steady, and make it difficult for it to turn over on its back, but would retard its progress if it attempted to swim; in fact, one may suppose that the chief effect of flexions of the tail would be to rotate the fish, the anal appendage serving as a fulcrum.

Sense organs.—Certain fin-rays may be formed precociously and grow out into long filaments; these may be used as feelers, perhaps to find food at night. In all larvae the auditory, optic and olfactory organs appear to be well developed, but it is difficult to assign any reason for the stalked eyes of some early larvae (Stomiatidae, especially *Stylophthalmus*), unless it be conceded that they may enable the larva to see in all directions and help it to maintain a balance, and, as it is so small and not yet an active swimmer, are not likely to be injured or to impede its progress.

Defence.—Many pelagic larvae have the bones of the head, and especially the praeoperculum, armed with strong spines, no doubt defensive. This is well exemplified by *Thyrsites* (p. 144, Pl. VIII, figs. 1–3), *Platycephalus* (p. 146, Pl. X, fig. 4) and *Ancylopsetta* (p. 146, Pl. IX, figs. 3, 4). The precocious development, probably for defensive purposes, of the spinous dorsal and pelvic fins in *Thyrsites* has already been referred to.

5. SYSTEMATIC IMPORTANCE OF LARVAL CHARACTERS.

Except in a few groups, of which the Apodes are the most notable example, there are no features that characterize pelagic larval fishes as belonging to one order or another, and it is not easy to determine their systematic position unless they are sufficiently advanced towards the structure of the adult fish. In all cases the number of myotomes and of fin-rays, if these be developed, are of the greatest help: with these as a guide one may, by a patient process of trials and eliminations, determine specifically some most puzzling examples, as, for instance, the post-larval *Odax balteatus*, described and figured above (p. 143, Pl. VIII, fig. 4). Although it does not appear that the diagnostic characters of the different orders are likely to be strongly reinforced by larval features, yet the study of a series of larval and young fishes, such as those collected by the "Terra Nova," confirms and in no degree modifies ideas as to the relationship of the Teleostean orders and families derived from the study of the morphology of the adult fish.

The pigmented patches on the gut of the Sudidae and Synodontidae (Pl. VII, figs. 1, 2, 4), the armature of the head in the Platycephalidae (Pl. X, fig. 4) and Triglidae, are examples of similar larval characters in related families. The development of the anal fin before the dorsal in the Iniomi, the migration of the dorsal in the Clupeidae, Albulidae, etc., may be cited as examples of developmental features common to a series of related families.

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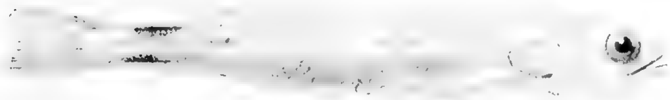
PLATE I.

	Length of Specimen.	Locality.
FIG. 1. *Myctophum antarcticum*, Günth. (p. 127) . .	11 mm.	S. of New Zealand, Station 252.
FIG. 2. ,, ,, . . .	15 mm.	,, ,,
FIG. 3. ,, ,, . . .	18 mm.	,, ,,
FIG. 4.—*Notolepis coatsii*, Dollo (p. 125) . . .	50 mm.	Weddell Sea.
FIG. 5. ,, ,, . . .	70 mm.	Antarctic, Station 269.
FIG. 6.—*Paraliparis terrae-novae*, sp. n. (p. 129) . .	35 mm.	McMurdo Sound, Station 332.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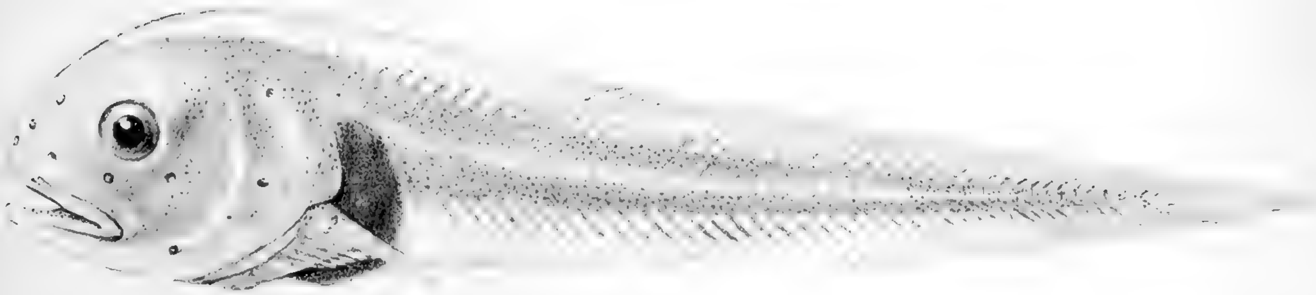
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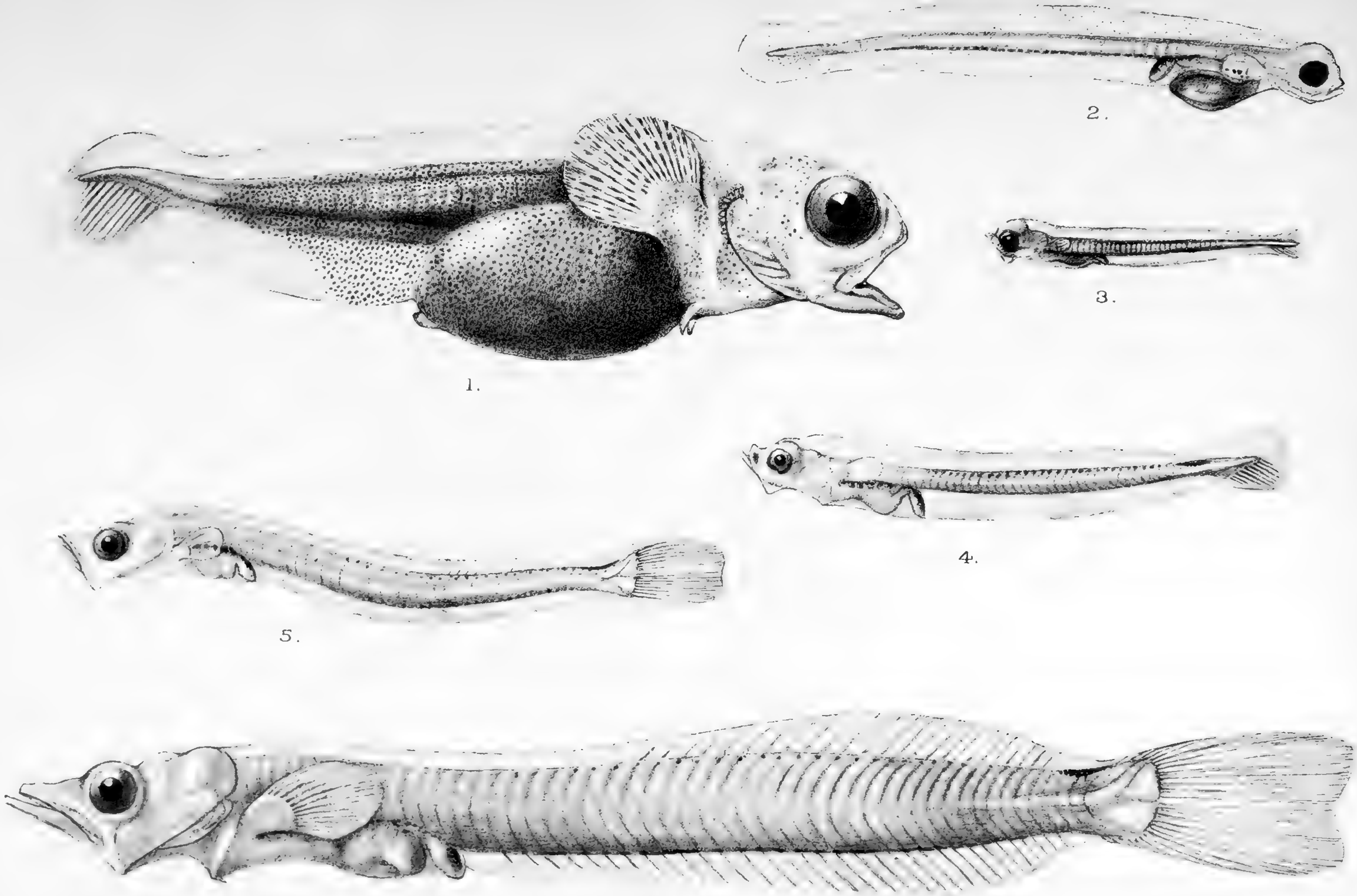
Iniomi and Paraliparis.

PLATE II.

	Length of Specimen.	Locality.
FIG. 1.—*Artedidraco skottsbergii*, Loennb. (p. 132)	13 mm.	Ross Island.
FIG. 2. *Notothenia*, sp. (p. 130)	6 mm.	Falklands.
FIG. 3. *Pleuragramma antarcticum*, Bouleng. (p. 131) . .	6 mm.	Ross Island.
FIG. 4. ,, ,, . . .	11·5 mm.	,,
FIG. 5. ,, ,, ...	13·5 mm.	,,
FIG. 6. ,, ,, ...	25 mm.	,,



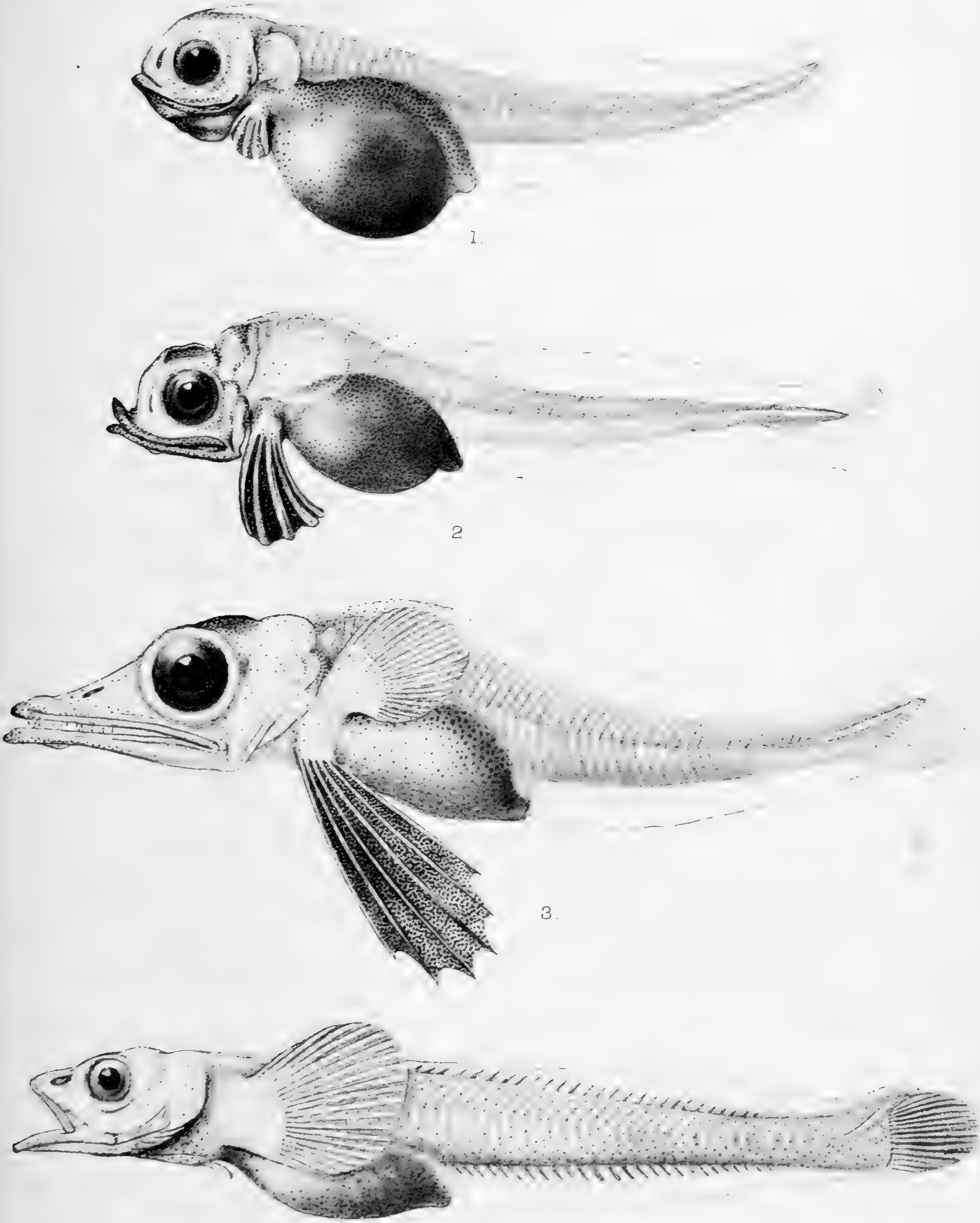
Larval Fishes, Pl. II.

J. M. Woodward del. et lith., Huth imp.

Nototheniidae.

PLATE III.

		Length of Specimen.	Locality.
Fig. 1.	*Pagetopsis macropterus*, Bouleng. (p. 132) . . .	14 mm.	McMurdo Sound.
Fig. 2.	,, ,, . . .	15 mm.	,,
Fig. 3.	,, ,, . .	19 mm.	Ross Island.
Fig. 4.	*Gymnodraco acuticeps*, Bouleng. (p. 132) .	24 mm.	,,



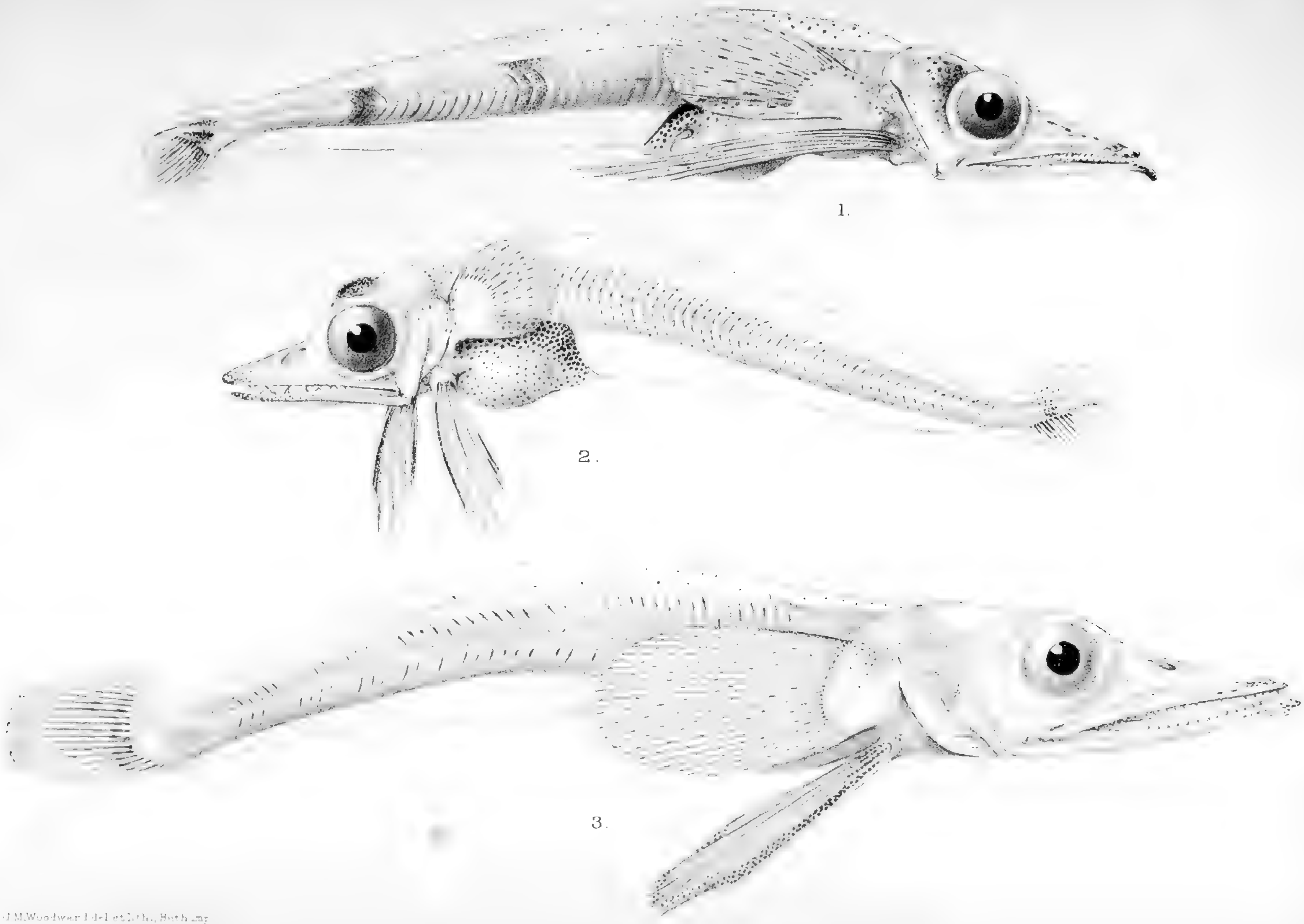
1. 2. 3. 4

G. M. Woodward del. et lith.

Pagetopsis and Gymnodraco

PLATE IV.

	Length of Specimen.	Locality.
Fig. 1.—*Cryodraco* sp. (p. 133)	21 mm.	Ross Island.
Fig. 2.—*Chionodraco kathleenae*, Regan (p. 133)	21 mm.	,,
Fig. 3. ,, ,, ...	32 mm.	,,



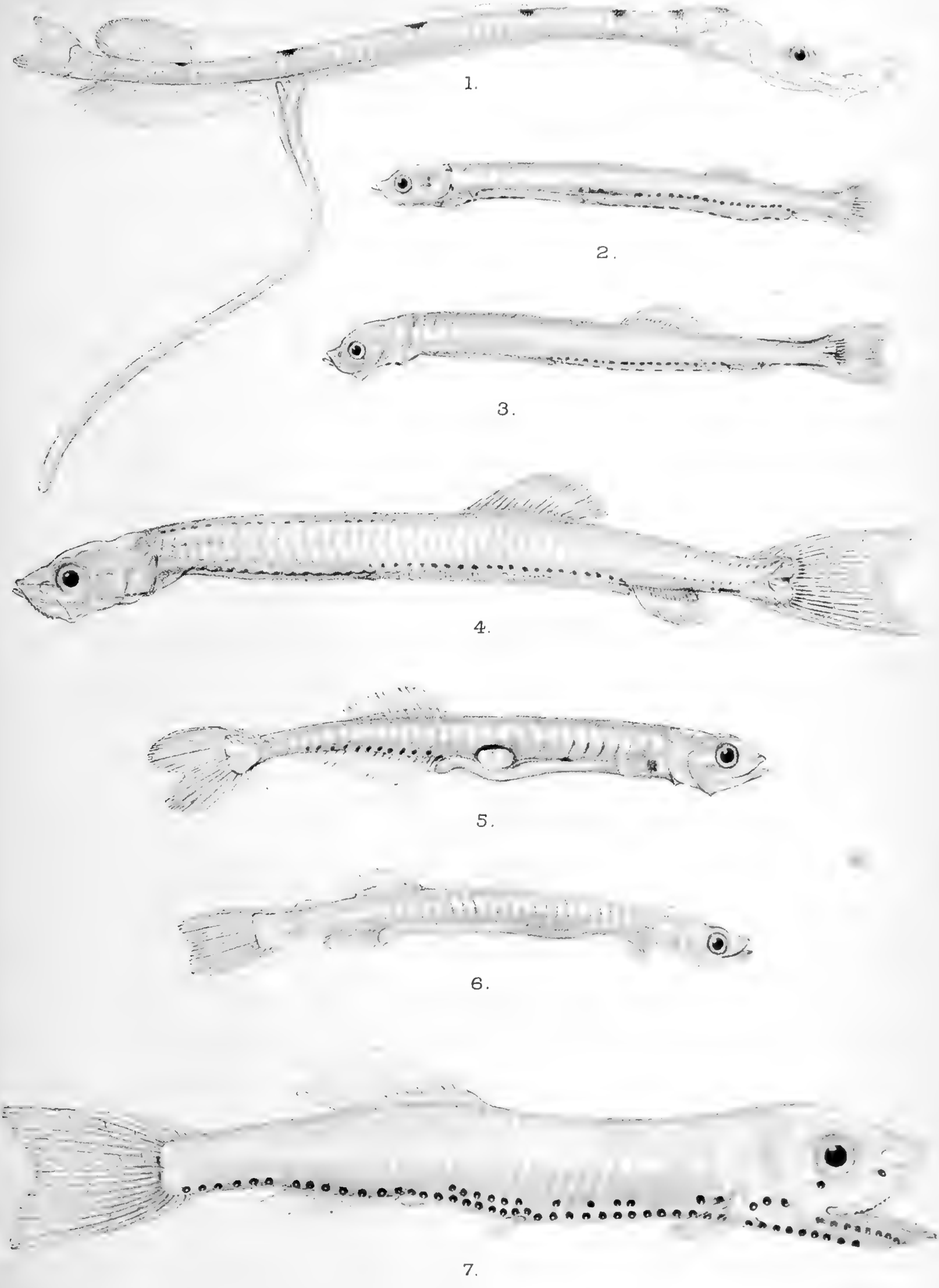
Larval Fishes, Pl. IV.

J. M. Woodward del. et lith., Huth imp.

Chaenichthyidae

PLATE V.

		Length of Specimen.	Locality.
Fig. 1.—*Stylophthalmus macrenteron*, sp. n. (p. 136)	. .	33 mm.	Atlantic, Station 49.
Fig. 2.—*Sardinella pseudohispanica*, Poey (p. 136)	. .	7 mm.	Rio de Janeiro, Station 39.
Fig. 3.—*Sardina neopilchardus*, Steind. (p. 136)	. . .	12 mm.	New Zealand, Station 135.
Fig. 4. ,, ,,	. . .	18 mm.	,, ,,
Fig. 5.—*Cyclothone microdon*, Günth. (p. 137)	. . .	8 mm.	Atlantic, Station 39.
Fig. 6.—*Vinciguerria lucetia*, Garm. (p. 137)	. . .	9 mm.	Atlantic, Station 45.
Fig. 7. ,, ,,	. . .	15 mm.	,, ,,

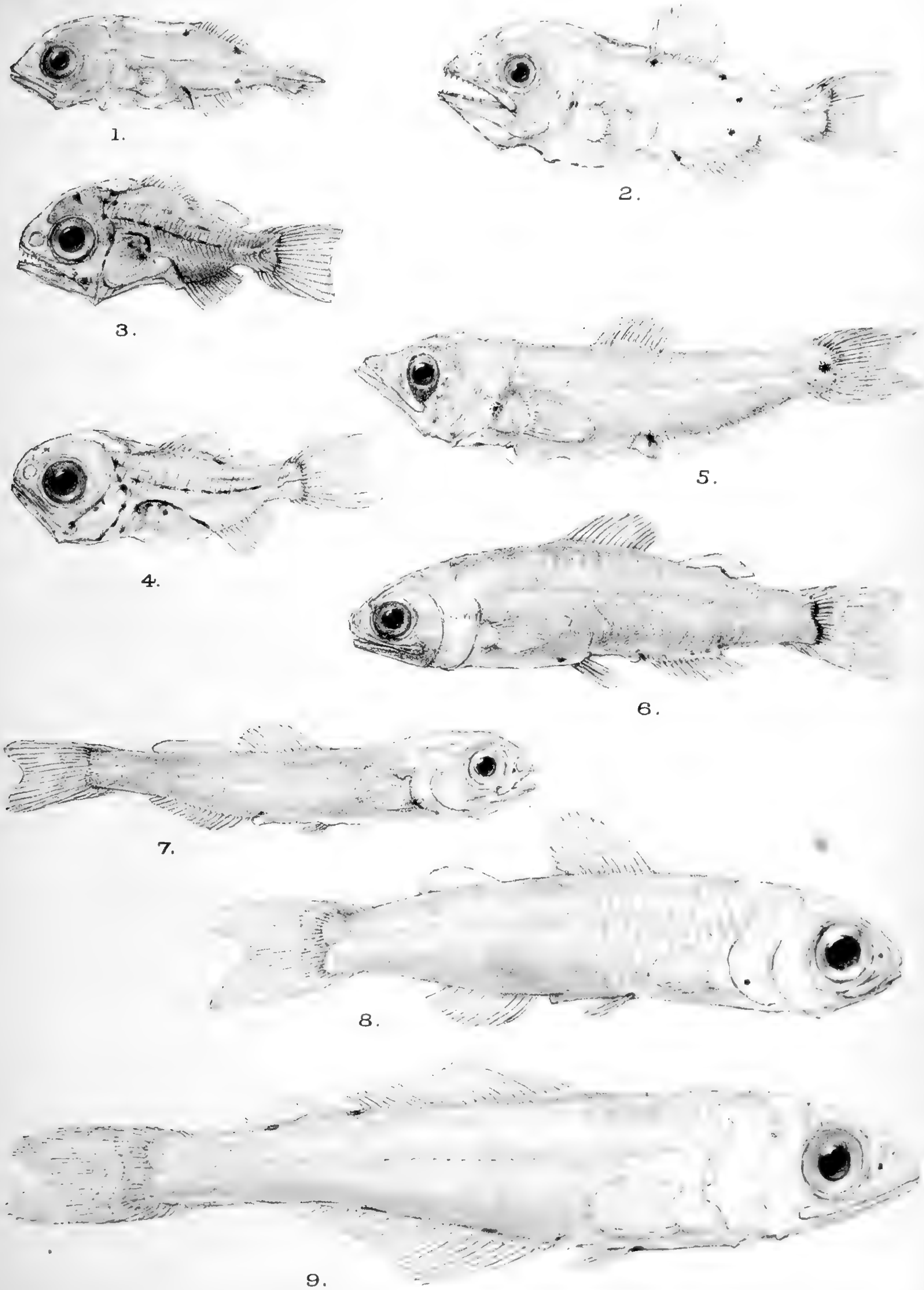


G M Woodward del et lith. Huth imp.

Isospondyli.

PLATE VI.

	Length of Specimen.	Locality.
Fig. 1.—*Myctophum benoiti*, Cocco (p. 139)	4 mm.	Atlantic, Station 311.
Fig. 2. ,, ,,	7 mm.	,, ,,
Fig. 3.—*Diaphus* sp. (p. 139)	4 mm.	New Zealand, Station 135.
Fig. 4. ,,	5 mm.	,, ,,
Fig. 5. *Lampanyctus macropterus*, Brauer (p. 140)	10 mm.	,, ,,
Fig. 6. *Lampanyctus maderensis*, Lowe. (p. 140)	9 mm.	Atlantic, Station 50.
Fig. 7.—*Myctophum laternatum*, Garm. (p. 139)	8 mm.	,, Station 311.
Fig. 8.—*Lampadena chavesi*, Collett (p. 140)	11 mm.	,, Station 17.
Fig. 9. *Lampanyctus longipinnis*, sp. n. (p. 140)	15 mm.	New Zealand, Station 113.



G. M. Woodward del. et lith. Huth imp.

Myctophidae.

PLATE VII.

	Length of Specimen.	Locality.
Fig. 1.—*Prymnothonus* sp. (p. 138)	12 mm.	Atlantic, Station 50.
Fig. 2. ,, sp. (p. 138)	16 mm.	,, Station 47.
Fig. 3. ,, sp. (p. 138)	22 mm.	New Zealand, Station 85.
Fig. 4.—*Synodus synodus*, Linn. (p. 137)	14 mm.	Atlantic, Station 46.
Fig. 5.—*Leptocephalus acuticeps*, sp. n. (p. 140)	47 mm.	,, Station 45.
Fig. 6. ,, *hexastigma*, sp. n. (p. 141)	60 mm.	,, Station 50.
Fig. 7. ,, *muraenae unicoloris* (p. 141)	60 mm.	,, Station 46.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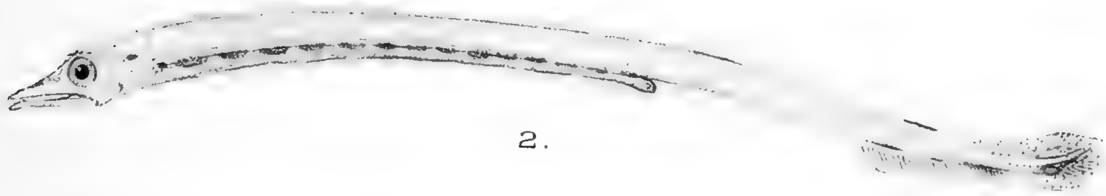
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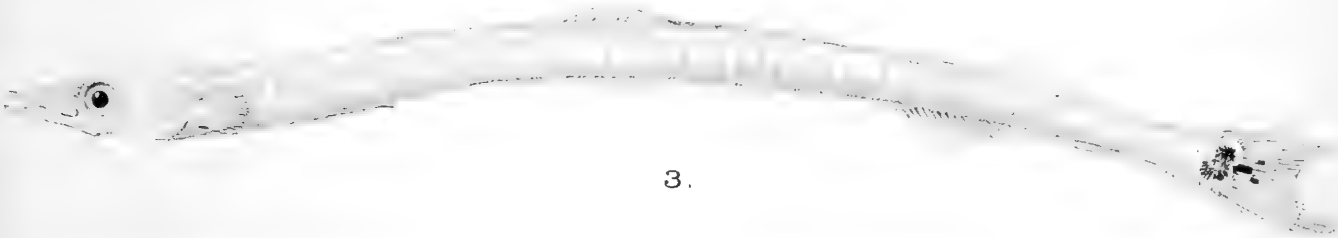
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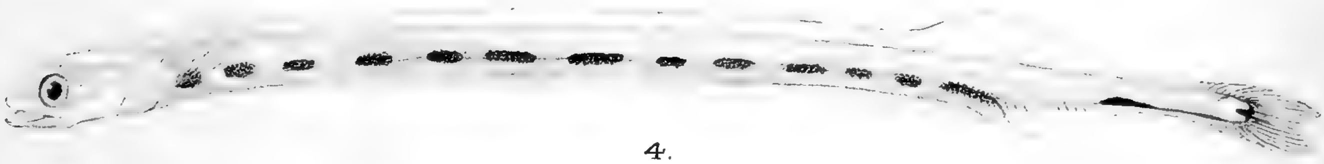
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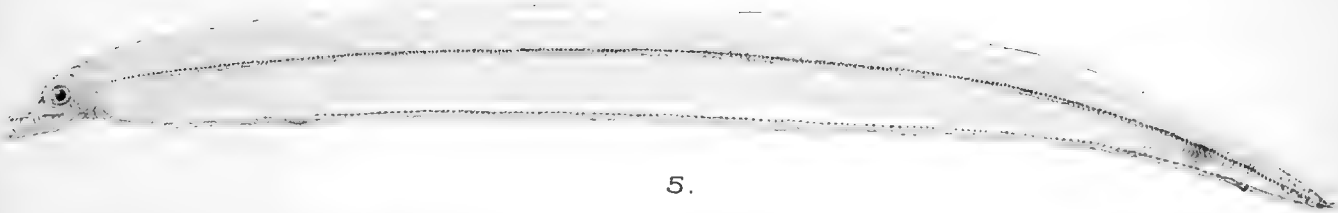
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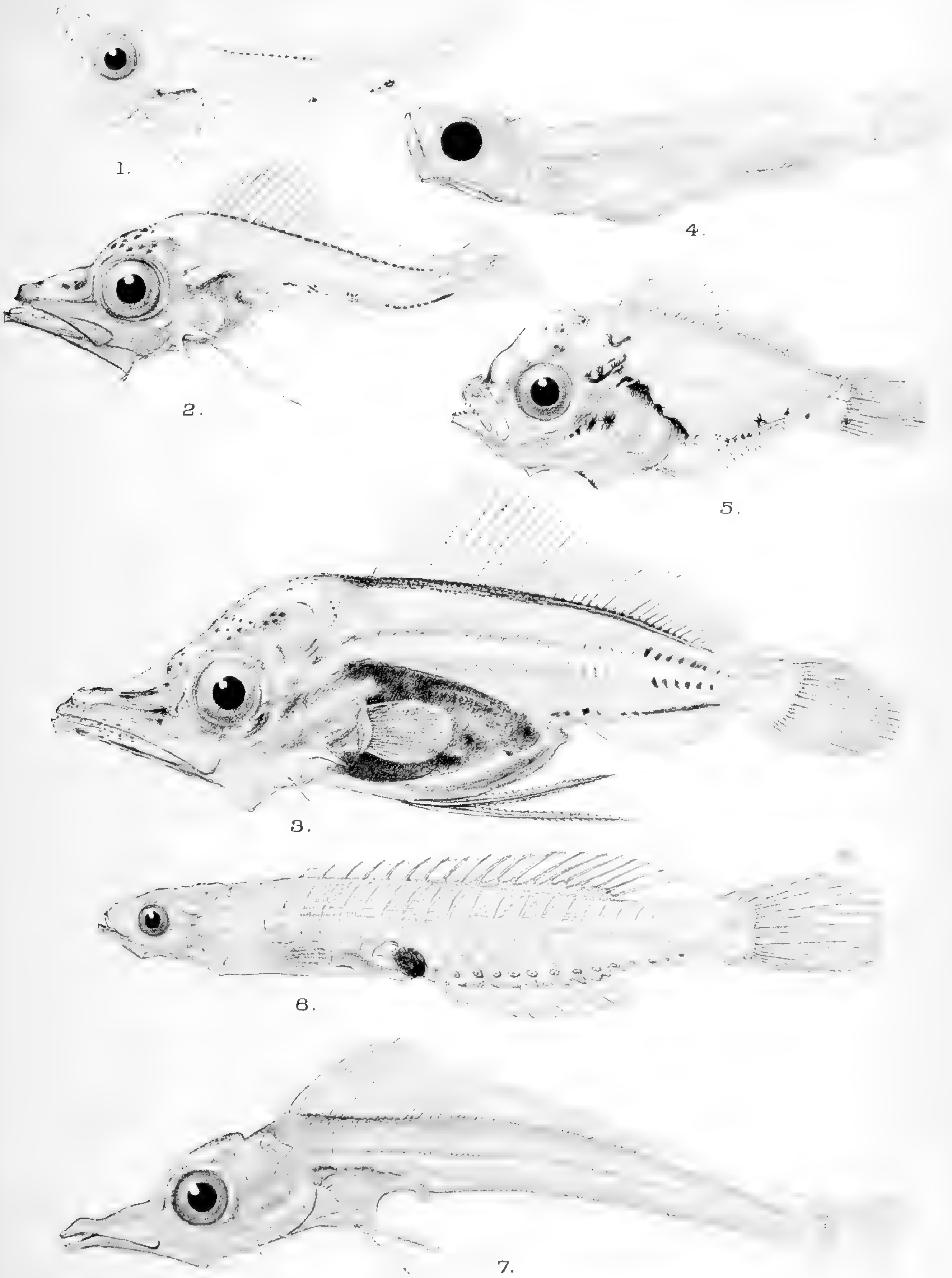
Iniomi and Apodes

PLATE VIII.

	Length of Specimen.	Locality.
Fig. 1.—*Thyrsites atun*, Euphras. (p. 144)	5 mm.	New Zealand, Station 133.
Fig. 2. ,, ,,	6 mm.	,, ,,
Fig. 3. ,, ,,	10 mm.	,, ,,
Fig. 4.—*Odax balteatus*, Cuv. and Val. (p. 143)	6 mm.	Melbourne, Station 161.
Fig. 5.—*Glyphidodon*, sp. (p. 142)	5 mm.	Rio de Janeiro, Station 39.
Fig. 6.—*Cryptotomus ustus*, Cuv. and Val. (p. 143)	9 mm.	Atlantic, Station 49.
Fig. 7.—*Lepidopus caudatus*, Euphras. (p. 144)	11 mm.	New Zealand, Station 135.

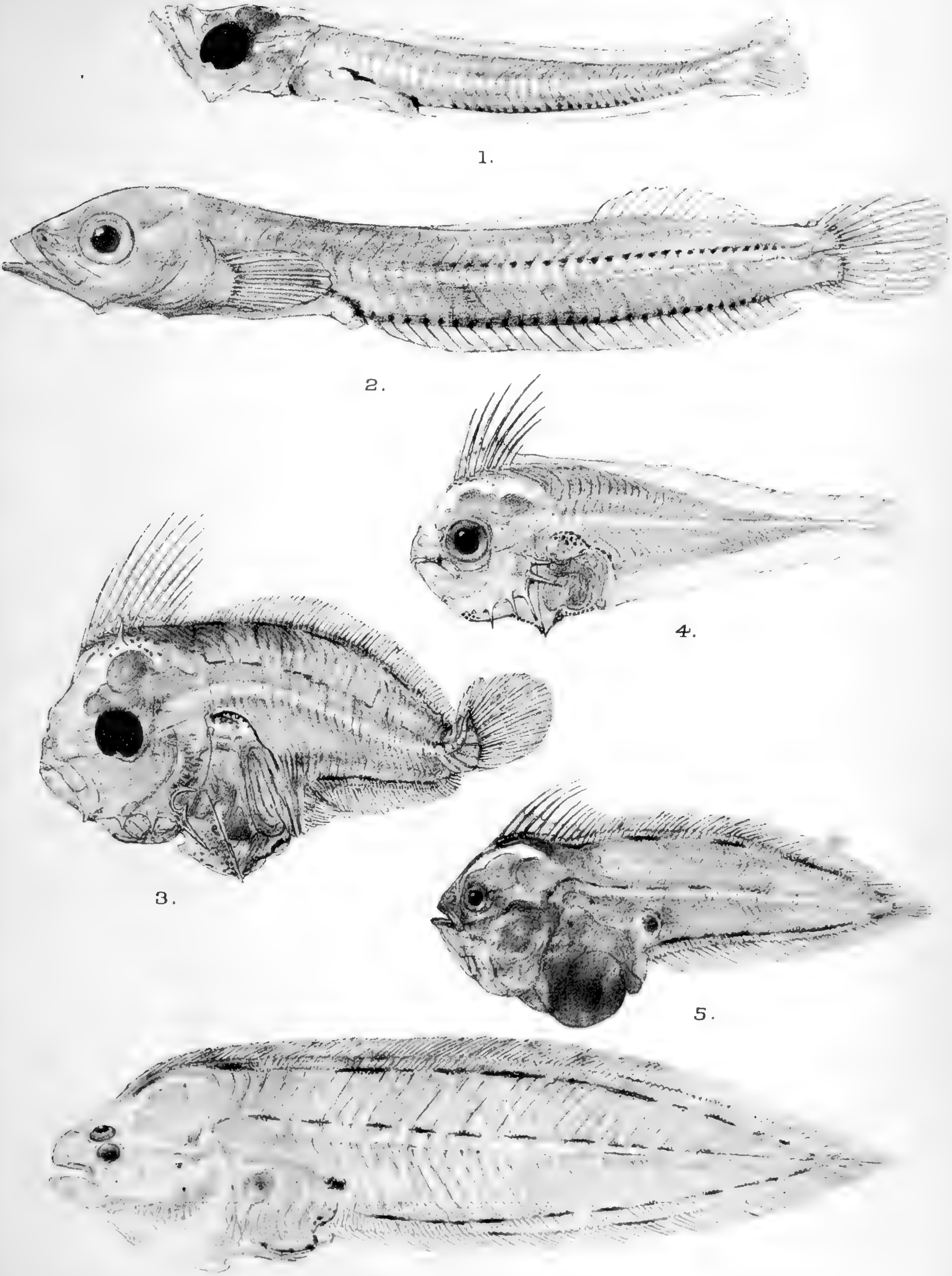


G. M. Woodward del. et lith. Huth imp.

Trichiuroidea and Percoidea.

PLATE IX.

	Length of Specimen.	Locality.
Fig. 1.—*Tripterygium varium*, Forst. (p. 145) . . .	6 mm.	New Zealand, Station 135.
Fig. 2. ,, ,, . . .	13 mm.	,, ,,
Fig. 3.—*Ancylopsetta quadrocellata*, Gill. (p. 146) . . .	5 mm.	Rio de Janeiro, Station 39.
Fig. 4. ,, sp. (p. 146)	4 mm.	,, ,,
Fig. 5.—*Symphurus plagusia*, Bl. Schn. (p. 147) . . .	7 mm.	,, ,,
Fig. 6. ,, ,, . . .	11 mm.	,, ,,



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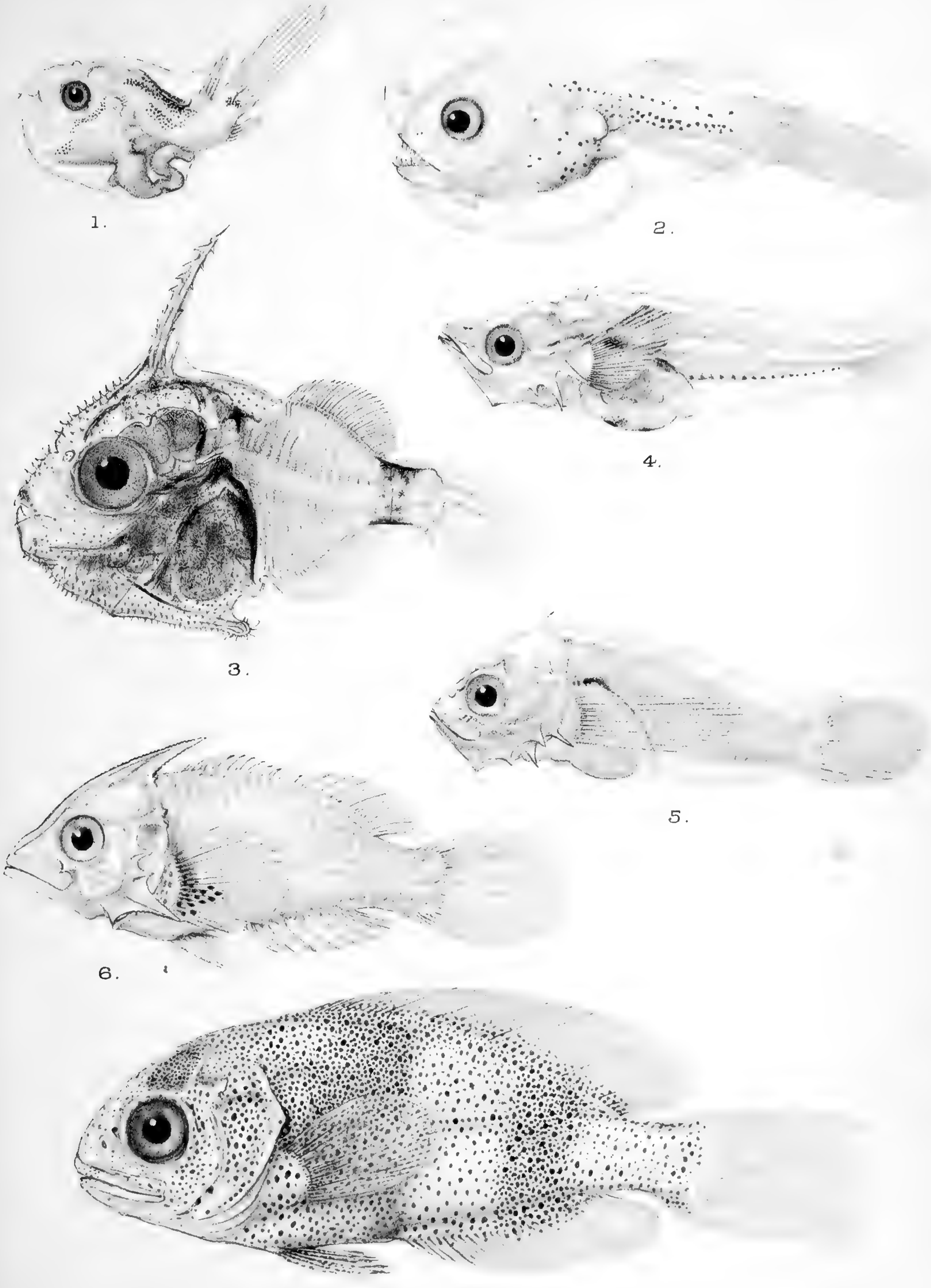
Tripterygium and Heterosomata.

PLATE X.

	Length of Specimen.	Locality.
Fig. 1.—*Ceratias* sp. (p. 147)	6 mm.	Atlantic, Station 311.
Fig. 2. *Haplophryne mollis*, Brauer (p. 148)	10 mm.	New Zealand, Station 127.
Fig. 3. *Monacanthus scaber*, Forst. (p. 147)	5 mm.	,, Station 133.
Fig. 4.—*Platycephalus* sp. (p. 146)	7 mm.	Melbourne, Station 161.
Fig. 5.—*Pentaroge marmorata*, Cuv. and Val. (p. 145)	7 mm.	,, ,,
Fig. 6. *Scorpaena* sp. (p. 145)	10 mm.	Atlantic, Station 53.
Fig. 7. *Centrolophus maoricus*, Ogilb. (p. 144)	19 mm.	New Zealand, Station 142.



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Pediculati, Scleroparei, Monacanthus and Centrolophus.

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